AFIN: 35-00110
Pmt #: 0199-S3N-R3
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PROPOSED WORK PLAN
SUPPLEMENTAL GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
FOR THE ENTERGY WHITE BLUFF PLANT
CLASS 3N LANDFILL
REDFIELD, ARKANSAS
PERMIT NO. 0199-S3N-R3
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REVISED
SEPTEMBER 23, 2013

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FOR THE ENTERGY WHITE BLUFF PLANT
CLASS 3N LANDFILL
REDFIELD, ARKANSAS
PERMIT NO. 0199-S3N-R3
AFIN: 35-00110

Prepared for

Entergy White Bluff Plant
1100 White Bluff Road
Redfield, AR 72132

Prepared by

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

FTN No.R06040-0143-001

REVISED
September 23, 2013

PROFESSIONAL GEOLOGIST'S CERTIFICATION

This work plan was prepared under the direction and supervision of a qualified, State of Arkansas - registered, Professional Geologist. Ms. Dana L. Derrington, PE, PG, of FTN Associates, Ltd., was responsible for the overall preparation of the work plan.



Dana L. Derrington, PG #1944

9-23-2013
Date

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1.0 INTRODUCTION

FTN Associates Ltd. (FTN) has prepared this supplemental geotechnical and hydrogeological investigation (GHI) work plan associated with the proposed vertical expansion and upgrade to full Class 3N standards of the Entergy White Bluff Plant Class 3N Landfill in Jefferson County, Arkansas. An area map showing the location of the landfill site is included as Figure 1 (Appendix A). A site layout map of Entergy's approximately 153-acre permitted Class 3N Landfill is included as Figure 2 (Appendix A).

This work plan is based primarily upon information obtained from previous hydrogeological investigations that were conducted in association with the existing permitted Class 3N landfill by McClelland Engineers, Inc. (McClelland) in 1997 and from the groundwater monitoring program that was in place at the facility from 1991 through 1996 (CH2M Hill 1992, FTN 1993, FTN 1994, FTN 1995, and FTN 1996). The following sections describe the specific tasks that will be completed to investigate and characterize the geologic and hydrogeologic conditions of the site.

This work plan is being submitted for approval prior to beginning the field investigations, in accordance with Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 22, §22.1102(c). Section references are to APCEC Regulation No. 22 (effective April 26, 2008), and references to ASTM standards are to the latest revision thereof.

2.0 SITE CHARACTERIZATION

This section describes activities that will be completed during the site investigation to characterize site-specific geology, hydrogeology, and geotechnical conditions.

2.1 Aerial Photograph Analysis

In accordance with §22.1102(c)(1), aerial photograph analysis will be performed to determine fracture traces and fracture orientation, sedimentary features, and depositional features within and surrounding the site.

2.2 Surface Geologic Mapping

In accordance with §22.1102(c)(2), information will be compiled regarding surface stratigraphy, structural features, springs and seeps, and water wells. A review of available aerial photographs and field reconnaissance of the area within a 0.5-mile radius of the facility will be conducted. These results will be included in the summary report in addition to information obtained from a water well search using records at the Arkansas Geologic Commission, with onsite well locations and those located within a 0.5-mile radius of the facility identified on a map.

2.3 Surface Geophysical Study

In accordance with the May 6, 2013, letter from the Arkansas Department of Environmental Quality (ADEQ) (ADEQ Document Identification Number [DIN] 64374), a surface geophysical study will not be required as part of this permit modification.

2.4 Subsurface Exploration Program

Previous subsurface investigations at the site included 12 borings and 14 test pits located near or inside the permitted 153 acres. Eight of these borings (B-2, B-5, B-6, B-17, B-19, B-216, B-218, and B-217) were completed in or within 250 ft of future Cells 6 through 15 that have combined approximate acreage of 92 acres. In accordance with §22.1102(c)(4) and to

supplement findings from previous subsurface investigations, an additional 11 borings will be drilled in or within 250 ft of future Cells 6 through 15, such that the total number of borings number approximately one per 5 acres. An additional two borings/piezometers will be installed along the northwestern boundary of the landfill to aid in the determination of the direction of groundwater flow in the uppermost aquifer.

Unless poor sample recovery prevents lithologic identification, downhole geophysics will not be required as part of this permit modification per ADEQ (DIN 64374).

2.4.1 Drilling and Geotechnical Sampling

Drilling and piezometer installation will be performed by an Arkansas-licensed driller with a qualified FTN geologist or engineer on-site to document field activities. A total of 13 exploratory borings will be advanced during the investigation to augment previous investigations into the depth and areal extent of the site stratigraphy. Figure 3 (Appendix A) shows tentative boring locations, as well as the locations of proposed piezometers. Information from previous boring logs and former monitoring wells that were located within the permitted area and/or on the perimeter of the Landfill will be used to supplement the subsurface investigation.

Eight borings will be advanced a minimum of 10 ft into the saturated portion of uppermost aquifer material for the purpose of installing temporary piezometers. If the aquifer is less than 10 ft in total thickness, the bottom of the piezometer will be located at the lower boundary of the permeable unit. The remaining five borings will be advanced approximately 2 ft into the uppermost aquifer material. Because deeper borings were completed at the site in association with previous investigations and/or well installations, additional deep borings are unnecessary for this investigation. Each of the 13 exploratory borings will be advanced using hollow-stem auger drilling techniques. Based on data from previous investigations, depth to the uppermost aquifer is anticipated to occur approximately between 30 and 135 ft below ground surface (bgs), depending on topography. Table 2.1 identifies estimated depths to the target elevation of the uppermost aquifer at each proposed boring location and estimated screened intervals for each proposed piezometer. The estimated depths provided in Table 2.1 are subject to change given the variability of the unconsolidated sediments at the project location. The

qualified on-site geologist or engineer will determine the final boring depths and vertical placement of the screened interval for the piezometers based on a review of historical documents, professional judgment, and the observed lithology encountered during drilling activities.

Table 2.1. Estimated borings depths and screened intervals for proposed piezometers.

Proposed Boring/ Piezometer ID	Ground Surface Elevation[1]	Approximate Target Elevation	Depth to Target Elevation (ft bgs)	Estimated Screened Interval (ft NGVD)
FTN-PZ1	384	250	134	260-250
FTN-PZ2	378	250	128	260-250
FTN-PZ3	336	250	86	260-250
FTN-PZ4	298	250	48	260-250
FTN-PZ5	320	250	70	260-250
FTN-PZ6	282	250	32	260-250
FTN-PZ7	298	250	48	260-250
FTN-PZ8	318	250	68	260-250
FTN-B9	358	258	100	---
FTN-B10	338	258	80	---
FTN-B11	330	258	72	---
FTN-B12	312	258	52	---
FTN-B13	288	258	30	---

[1]Ground surface elevation estimated from topographic information from an aerial survey completed in 2002 by AMI Engineering and a field survey completed in 2011 by Harmon Surveying.

Soils will be sampled to the boring completion depth using a 5-ft continuous sampler and sand traps or catchers will be used to maximize recovery of granular materials. Undisturbed soil samples will be obtained at depths to be determined in the field. Soils will be classified according to the Unified Soil Classification System (USCS) and ASTM D-2488. Representative samples from each textural horizon will be collected for physical testing, as described in Section 2.6 of this work plan. Water level observations will be made during and at the completion of drilling operations. Borings that are not used for piezometers installation will be backfilled with a bentonite hole plug from the total drilled depth to ground surface.

2.4.2 Piezometer Installation

Following the advancement of the soil borings, temporary piezometers will be installed in eight of the exploratory boreholes to characterize the hydrogeological conditions across the landfill. Installation will be performed by an Arkansas licensed driller with a qualified FTN geologist or engineer on-site to document field activities. Piezometers located around the perimeter of the permitted footprint will be constructed such that they can be upgraded to facility monitoring wells upon ADEQ approval. Design and construction is based on guidance provided in *Solid Waste Disposal Facility Criteria, Technical Manual* (EPA 1993) and ASTM D 5092-04(2010)e1, *Standard Practice for Design and Installation of Groundwater Monitoring Wells*, and will be installed with the following design components, as required by §22.1103:

1. Boreholes for each piezometer will be advanced using 8⅝-inch HSAs fitted with a 9¼-inch cutter head to ensure that each borehole is a minimum of 4 inches larger than the diameter of the piezometer casing.
2. Piezometers will be constructed of 2-inch nominal inside diameter (ID) Schedule 40, flush-threaded PVC casing and screen. The bottom of the piezometer will be sealed with a 0.3 to 0.5 ft bottom cap. The solid PVC casing will extend approximately 3 ft above natural grade and will be capped with pressure-sealed locking well caps.
3. Piezometer screens will consist of 0.01-inch slot size machine-slotted pipe. Screen lengths (no more than 10 ft in length) and screened intervals will be determined by the onsite geologist or engineer.
4. A filter pack consisting of 10 to 20 grade silica sand will be placed into the annular space in a manner that avoids bridging. The filter pack will extend at least 2 ft above the screen.
5. A minimum 2-ft bentonite pellet seal will be placed in the annular space above the filter pack. If the water table is encountered below the depth of the seal, the pellets will be hydrated with potable water.
6. The remaining annular space from the top of the bentonite seal to the ground surface will be grouted with cement/bentonite grout utilizing a tremie pipe. The grout will be inspected for settlement after 24 hours and additional grout will be added, if necessary, to fill the annular space to ground surface.
7. A small vent hole will be drilled into the well cap or PVC riser to allow for equilibrium of air pressure inside and outside the casing.

8. Piezometers that are used for slug testing will be developed by surging and/or over-pumping until the water is sufficiently clear and free of sediment.
9. Piezometer identification will be clearly marked on casings and the "reference points" will be notched or marked on the PVC riser.

The temporary piezometers located within the permitted footprint, FTN-PZ4 and FTN-PZ6, will be drilled and constructed as described above with the following exceptions:

1. Piezometers will be constructed of 1-in nominal inside diameter (ID) Schedule 40, flush-threaded PVC casing and screen.
2. A bentonite pellet seal will be placed in the annular space between the filter pack and the ground surface.

Temporary fencing constructed using orange HDPE netting or similar materials will be installed around each temporary piezometer. Upon approval from the ADEQ Solid Waste Management Division (SWMD), piezometers that are upgraded to monitoring wells will be completed with 4-inch locking protective casings, protective bollards, and concrete pads. No piezometer will be altered without the written permission of SWMD per §22.1103(f).

2.4.3 Test Pits

Fourteen test pits were excavated at the site to depths ranging from about 8 to 12 ft bgs during pervious subsurface investigations at the site (Appendix B). Additional tests pits are not proposed with this investigation.

2.4.4 Survey

After completion, boring and piezometer locations and elevations will be surveyed as specified by §22.1103(g) and, where applicable, §22.426 by an Arkansas-registered surveyor. Horizontal locations will be based on the horizontal datum currently in use at the site and will be tied to the landfill property boundary (as a topographic feature). Vertical datum for the nearest ground surface and top of casing, where applicable, will be measured relative to the National Geodetic Vertical Datum of 1929 (NGVD29) or other datum currently in use at the site.

Horizontal measurements will be measured to the nearest 0.1 ft. Ground surface elevations will be reported to the nearest 0.1 ft and top of casing for each piezometer will be reported to the nearest 0.01 ft. Brass survey markers will be placed in the concrete pads of the piezometers that may be used as potential survey control markers for the landfill. The markers will be located horizontally and vertically. As requested by the SWMD (DIN 61049), a certified survey report from an Arkansas-registered surveyor will be provided with the findings from the investigation.

2.5 Hydrogeologic Investigation

The hydrogeology of the landfill site will be characterized using the piezometers that are installed during this investigation. The following information will be obtained from the hydrogeological investigation required as appropriate, by §22.1102(c)(5):

1. Water table or potentiometric surface,
2. Groundwater flow directions,
3. Hydraulic conductivities for hydraulically significant units,
4. Horizontal hydraulic gradients, and
5. Estimate of groundwater flow velocity.

2.5.1 Potentiometric Surface Determination

The potentiometric surface will be characterized by obtaining four independent site-wide measurements of depth to groundwater or potentiometric surface at each proposed piezometer location. The depths will be measured with an electronic water level meter to the nearest 0.01 ft and recorded on field data sheets. For each event, measurements at each piezometer will be completed within 24 hours or less of one another. These data will be used in conjunction with survey data to contour the potentiometric surface of the uppermost aquifer and to estimate groundwater gradient and flow direction.

2.5.2 Aquifer Testing

In accordance with the May 6, 2013, letter from ADEQ (DIN 64374), a pump test is not required as part of this permit modification. The hydraulic conductivity of the uppermost aquifer

will be determined based on slug tests conducted at five of the proposed piezometers located at the perimeter of permitted footprint. Slug test results will be evaluated in accordance with the methods presented by Bouwer and Rice (1976) and Hvorslev (1951), or other methods as appropriate. If the aquifer response is too rapid to obtain meaningful data from the slug tests and results cannot be interpreted accurately, an alternate approach(es) to determine hydraulic conductivity will be considered and discussed with SWMD personnel. Groundwater velocity of the uppermost aquifer will be estimated using hydraulic conductivities determined from these slug tests and/or results from previous investigations, the calculated hydraulic gradient, and effective porosity of the uppermost aquifer. Effective porosity will be estimated based on published values of porosity for similar aquifer materials.

The geologic units underlying the site consist of unconsolidated Quaternary deposits overlying thick (up to 3,500 ft) Tertiary sediments, of which the Jackson Group is the upper geologic unit. The Quaternary deposits consist of thin beds of silty and sandy clay that cover the crest of hills with a thickness of up to 30 ft. These deposits have been eroded from stream valleys and modified by grading of the plant site during construction.

The Jackson Group is a confining unit comprised of marine clay, marl, and limestone with the predominant lithology being clay with some sands that are of no consequence to regional aquifer systems (Hart et. al. 2008). In the vicinity of the landfill, the Jackson Group is comprised of the Redfield Formation and White Bluff Formation. The Redfield overlies the White Bluff and is composed of clay and silt, lignite, and minor amounts of sand (Geraghty and Miller 1984). The White Bluff is reportedly comprised of fossiliferous silt and clay with very fine to fine clayey sand. Depending on the location and elevation at the plant site, the Redfield Formation is between 90-150 ft thick and the White Bluff Formation is approximately 60-100 ft thick.

The Claiborne Group underlies the Jackson Group and includes the Cockfield Formation, Cook Mountain Formation, Sparta Sand, Cane River Formation, and the Carizzo Sand. Both the Cockfield Formation and the Sparta Sand are regional aquifers. The Cockfield is confined above by the Jackson Group and is reported to yield 25 gallons per minute (gpm) to wells. The Cook Mountain Formation acts as a lower confining unit to the Cockfield and an upper confining unit

to the Sparta Sand. The Sparta is used for a potable water supply and the two production wells at the Entergy plant produce water from this formation. These production wells are capable of producing 1,000 gpm.

Because the monitored unit is a sand lens contained within the substantial clays of the Jackson Group confining unit and published reports indicate that the sand units within the Jackson Group are not hydraulically connected to the underlying Cockfield or Sparta aquifers, tests to evaluate hydraulic communication between units are not proposed as part of this investigation.

2.5.3 Ambient Groundwater Chemistry

To fulfill the requirements of §22.1102(c)(5)(vii), documentation of ambient groundwater chemistry will be based on data from the former groundwater monitoring program at the site [CH2M Hill 1992, FTN 1995 (DIN 29350), FTN 1996 (DIN 3143)]. Reports that do not have an associated ADEQ DIN number are included in Appendix B. Groundwater chemistry in and around the site is generally well understood and additional sampling as part of the investigation is unnecessary.

2.6 Classification and Characterization of Soils

In accordance with §22.1102(c)(6), representative samples from each distinct textural horizon encountered in the proposed expansion areas will be classified using the Classification of Soils for Engineering Purposes (ASTM D-2487) and characterized. The final laboratory testing program will be developed based on the results of the field studies. Table 2.2 indentifies the approximate numbers and types of physical tests are proposed:

Table 2.2. Proposed geotechnical soils analyses.

§22.1102(c)(6) subpart	Subpart and/or ASTM Identification	Number of Proposed Tests
i	Atterburg Limits (ASTM D 4318-10)	16
ii	Standard Penetration Test (ASTM D 1586-08a and D 1452-09).	8
iii	Sieve analysis [ASTM D1140-00(2006) and D 422-63(2007)]	16
iv	Dry density, hydraulic conductivity/molding water content (%) relationship	(1)
v	Flex wall permeabilities on remolded soils (ASTM D 5084-10),	8
vi	Unconsolidated-undrained triaxial compression (ASTM D 2850-03a(2007),	3
vii	Standard Proctor density (ASTM D 698-07e1),	8
viii	Moisture-density relations of soils and aggregates (ASTM 1557)	---
ix	One dimensional consolidation properties of soils (ASTM D 2435/D 2435M-11)	3
x	One dimensional swell or settlement (ASTM D 4546-08),	3
xi	Moisture content of soils	16

(1)Remolded flex-wall permeameter tests will be run at remolded densities based on standard proctor test results.

In addition to the itemized tests listed above, three consolidated-drained direct shear (ASTM D 3080-04) and eight flex wall permeabilities on undisturbed soils (ASTM D 5084-10) will be performed. The Modified Proctor Test will not be run on any soils from this investigation. The Modified Proctor estimates maximum density at a lower moisture content than the Standard Proctor Test. Because lower hydraulic conductivities are obtained from clays compacted at higher moisture contents, the Standard Proctor is the appropriate test for liner construction.

2.7 Supplemental Information

Regional geology and hydrogeology will be documented through a review of available published literature, previous investigations, and reports [e.g., McClelland 1979a, McClelland 1979b, Geraghty and Miller 1984, Geraghty and Miller 1985a, Geraghty and

Miller 1985b, Holloway 1990, Ludwig 1990, CH2M Hill 1992, FTN 1995 (DIN 29350), and FTN 1996 (DIN 3143)] at the Entergy White Bluff Landfill.

3.0 FIELD DOCUMENTATION

Field observations and information pertinent to drilling and other field activities will be recorded in field logbooks with consecutively numbered pages. In addition, photographs will be taken of field operations and items of interest. A log of these photographs will be kept in the field logbook. Documentation will be sufficient to reconstruct each drilling or field event without relying on memory. Entries in the field logbooks will include the following (as applicable):

1. Location of drilling or other field activity,
2. Date and time,
3. Description of piezometer construction details,
4. Boring and piezometer identification numbers,
5. Field measurements,
6. Piezometer development procedures,
7. Weather conditions, and
8. Other pertinent field observations.

Boring logs will be prepared that include project name and number, boring number and method, site identification, coordinates, date started and completed, geologist name, drilling contractor, materials encountered, water levels measured during drilling, and physical properties test results. Piezometer construction schematics will also be prepared.

4.0 DECONTAMINATION PROCEDURES

Equipment used to drill borings and install piezometers will be cleaned as necessary to remove caked mud and dirt prior to use and between boring locations. Equipment such as wirelines/probes on water level gauges and aquifer test equipment will be hand-washed with a brush using detergent solution and rinsed with distilled water (prior to use and as needed). Decontamination activities will be documented in the field logbook.

5.0 SUMMARY REPORT

Individual studies and available geology/hydrogeology/surface water information from previous investigations and published reports will be used to update the existing hydrogeologic model for the site. The updated conceptual hydrogeologic model of the site will be summarized in a written report and certified by an Arkansas-registered Professional Geologist. Conclusions and recommended groundwater monitoring points will be included, based on the site hydrogeologic model and anticipated landfill design. Boring and piezometer construction logs derived from this and previous subsurface investigations, including well logs for the facility's production wells will be included an appendix to the report. A certified survey report including the vertical and horizontal data for the newly installed piezometers/borings will also be provided. All maps and cross sections included in the written report will be of a uniform scale and will include the following, as appropriate and as directed by §22.1102(d):

1. A geologic map of the site and the area within ½-mile of the landfill boundary,
2. Boring locations,
3. Water table or potentiometric map,
4. Isopach maps of relevant units,
5. Geologic cross sections with the following information overlain:
    a. Stratigraphy,
    b. Maximum depth of excavation for the containment structure,
    c. Water table and/or potentiometric surface from water levels,
    d. Lithologic logs of boreholes with physical properties test results,
    e. Screened intervals in piezometers, and
    f. Slug test results indicated at the appropriate screened interval.

An engineering report will be prepared by the geotechnical testing laboratory that will include results of field and laboratory tests, a summary of all laboratory test data, and a summary of the subsurface conditions. This report will be included as an appendix to the summary report.

6.0 REFERENCES

CH2M Hill, Inc. 1992. Annual Report - 1991, Groundwater Monitoring Program ,White Bluff Steam Electric Station, Arkansas Power and Light, Little Rock, Arkansas.FTN Associates, Ltd. 1995. White Bluff Plant, Groundwater Monitoring Program, 1994 Annual Report. ADEQ DIN 29350.

FTN Associates, Ltd. 1996. White Bluff Plant, Groundwater Monitoring Program, 1995 Annual Report. ADEQ DIN 3143.

Geraghty and Miller, Inc. 1984. Assessment of Surface-water and Ground-water Conditions at the Independence and White Bluff Steam Electric Stations.

Geraghty and Miller, Inc. 1985a. Assessment of Surface-water and Ground-water Conditions at the Independence and White Bluff Steam Electric Stations.

Geraghty and Miller, Inc. 1985b. Expanded Recommendations to Assess Surface-water and Ground-water Conditions at the Independence and White Bluff Steam Electric Stations

Hart, R.M., Clark, B.R., and Bolyard, S.E. 2008. Digital Surface and Thicknesses of Selected Hydrogeologic Units within the Mississippi Embayment Regional Aquifer Study (MERAS). USGS. SIR 2008-5098. 33 p.

Ludwig, A.H. 1990. A Proposed Plan for Environmental Monitoring Systems at Independence and White Bluff Steam Electric Stations for Arkansas Power and Light Company, Little Rock, Arkansas.

McClelland Engineers. 1979a. Phase I - Geotechnical Evaluation Proposed Fly Ash Disposal Areas, White Bluff Steam Electric Station, Near Redfield, Arkansas.

McClelland Engineers. 1979b. Phase II - Geotechnical Evaluation Proposed Fly Ash Disposal Areas, White Bluff Steam Electric Station, Near Redfield, Arkansas.

APPENDIX A

Figures

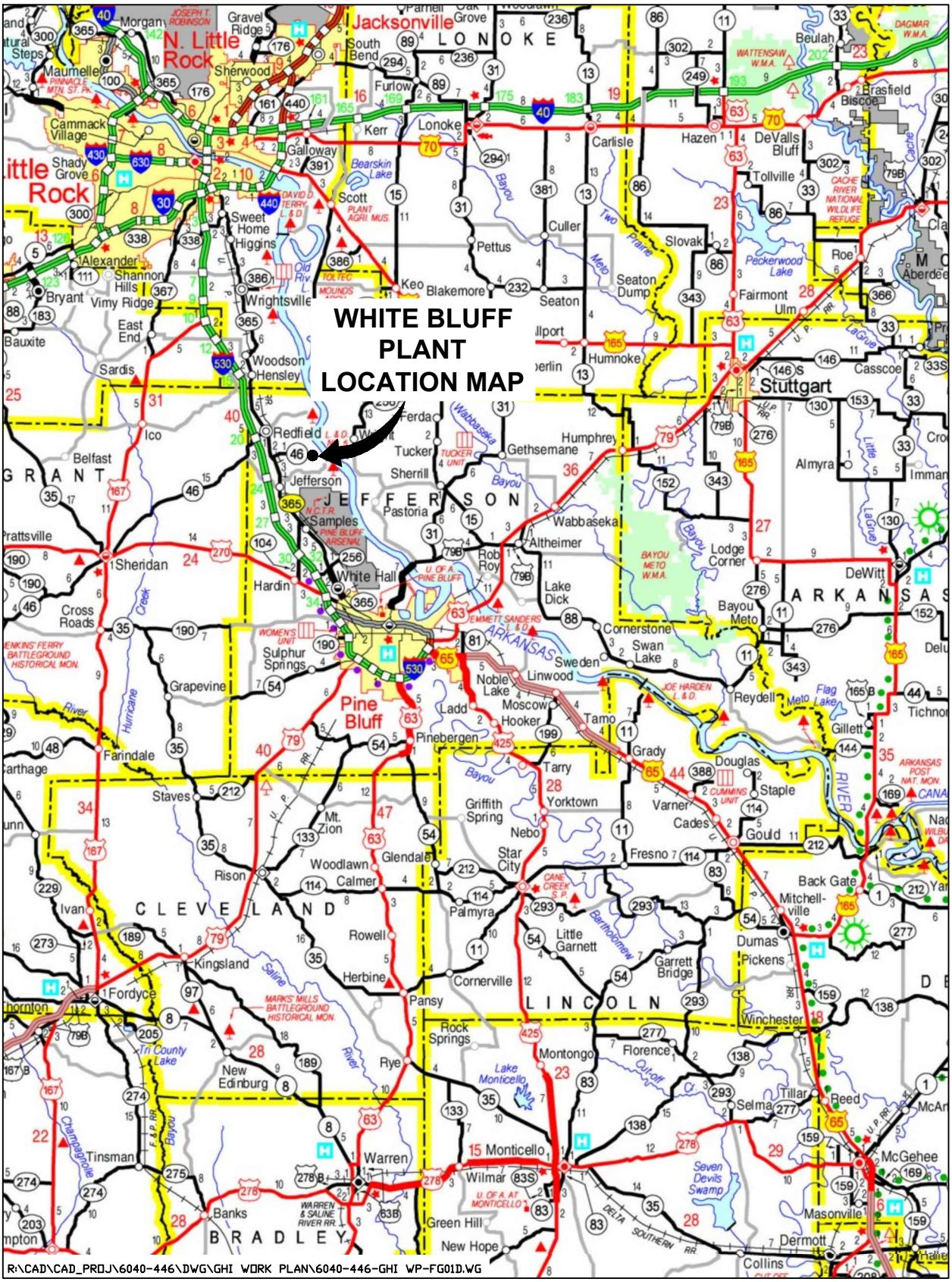


Figure 1. Site location map.

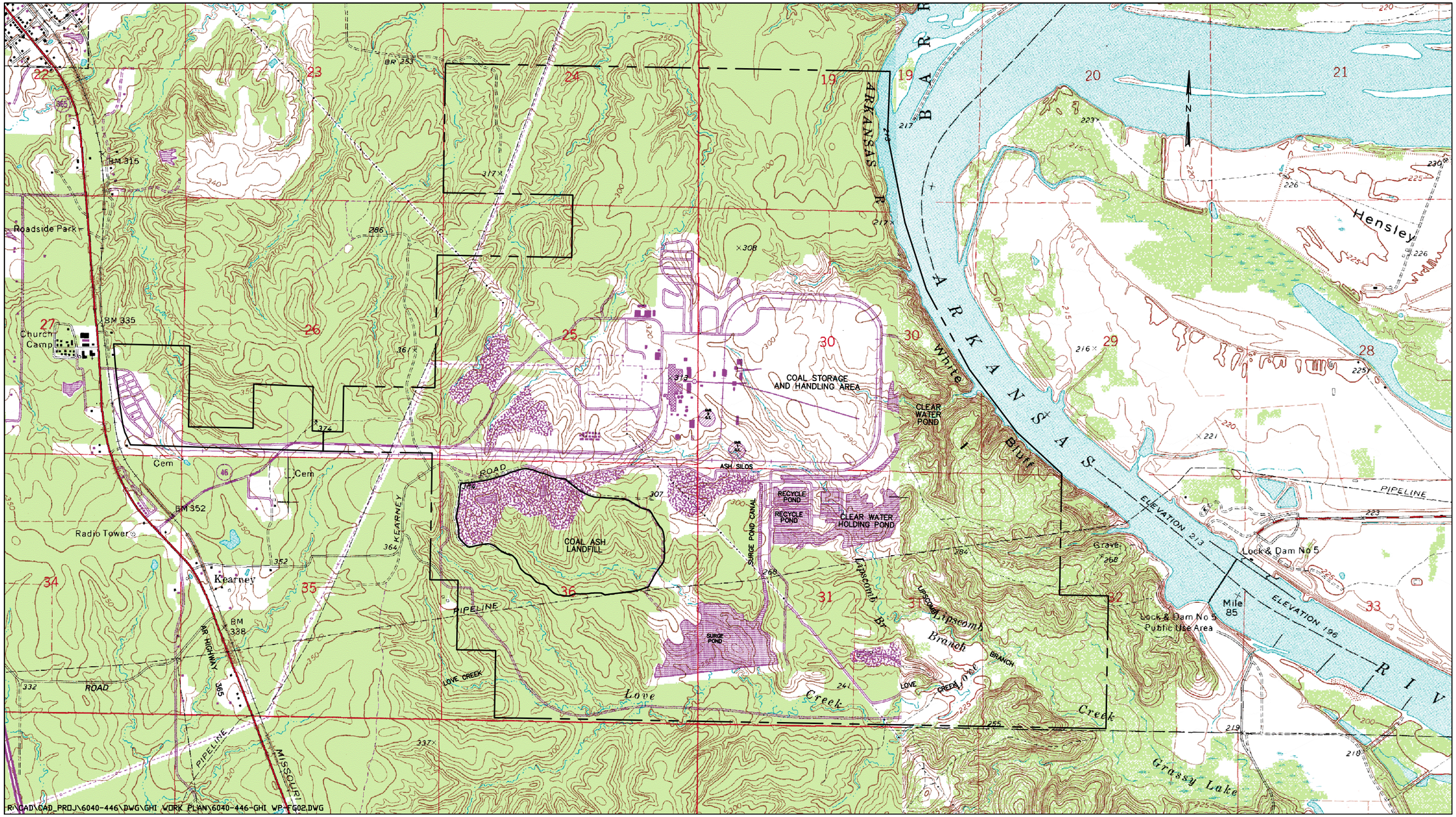


Figure 2. Site layout map.

REV	DATE	DESCRIPTION	BY	APVD
			JT	PWC
2	08/01/13	REVISED PROPOSED PIEZOMETER LOCATIONS	JT	PWC
1	07/10/13	REVISED PROPOSED PIEZOMETER LOCATIONS		

entergy resources / environmental consultants

ENTERGY WHITE BLUFF PLANT
CLASS 3N LANDFILL
SUPPLEMENTAL GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
REDFIELD, ARKANSAS

CUT SLOPE
RAILROAD TRACKS
ASPHALT ACCESS ROAD
TO PLANT
CONTRACTOR'S ENTRANCE
FTN PZ-1
FTN PZ-2
175'
415'
HV1 376.71
HV2 361.88
HV3 338.40
HV6 369.30
HV7 378.76
WET WASTE BULKING AREA
PERMITTED LANDFILL BOUNDARY
PROPOSED LIMITS OF REVISED DISPOSAL AREA
HV9 322.65
FTN PZ-8
APPROXIMATE PROPERTY LINE
EXISTING CELL 1
EXISTING CELL 2
EXISTING CELL 3
FUTURE CELL 4
FUTURE CELL 5
FUTURE CELL 6
FUTURE CELL 7
FUTURE CELL 8
FUTURE CELL 9
FUTURE CELL 10
FUTURE CELL 11
FUTURE CELL 12
FUTURE CELL 13
FUTURE CELL 14
FUTURE CELL 15
FTN B-9
FTN B-10
FTN B-11
FTN B-12
FTN B-13
FTN PZ-3
FTN PZ-4
FTN PZ-5
FTN PZ-6
FTN PZ-7
B-1 B-2 B-3 B-4 B-5 B-6 B-8 B-10 B-11 B-12 B-17 B-19 B-20 B-216 B-217 B-218
TP-1 TP-2 TP-3 TP-4 TP-5 TP-6 TP-7 TP-8 TP-9 TP-10 TP-11 TP-13
SURGE POND
EXISTING EARTHEN DIKE
HV8 300.27
HV10 316.37
HV11 327.17
PERIMETER ACCESS ROAD
0 E 500 E 1000 E 1500 E 2000 E 2500 E 3000 E 3500 E 4000 E
0 N 500 N 1000 N 1500 N 2000 N 2500 N 3000 N

N
PLANT
0 200
Scale in Feet

LEGEND

- INDEX CONTOUR (10')
- INTERMEDIATE CONTOUR (2')
- PROPOSED LIMITS OF REVISED DISPOSAL AREA
- LIMITS OF CLOSED AREA
- CELL BOUNDARIES
- ELECTRIC TRANSMISSION LINE
- EXISTING WATER LINE
- EXISTING FENCE LINE
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING SURVEY CONTROL MONUMENT AND ELEVATION
- CLOSED WASTE DISPOSAL AREA
- PROPOSED PIEZOMETER LOCATION
- PROPOSED BORING LOCATION
- TEST PIT LOCATION (Macmillan 1979)
- BORING LOCATION (Macmillan 1979)
- APPROXIMATE SURFACE DRAINAGE
- APPROXIMATE TOPOGRAPHIC DIVIDE

NOTES:

1. TOPOGRAPHIC INFORMATION IS FROM AN AERIAL SURVEY BY AMI ENGINEERING, INC. (DECEMBER 2002) AND A FIELD SURVEY BY HARMON SURVEYING (JANUARY 2011).
2. PIEZOMETER AND BORING LOCATIONS ARE APPROXIMATE. ACTUAL LOCATIONS MAY VARY DEPENDING ON FIELD CONDITIONS.

FIGURE 3 PROPOSED BORING AND PIEZOMETER LOCATIONS

DRAWN BY: JT	FILE NAME: GHI WP-FG03R3.DWG
APPROVED: PWC	PROJECT NO. 06040-143-001
SCALE: 1"=200'	DATE: 11/02/11
SHEET NO. 1 OF 1	

R:\PROJECTS\06040-143-001\CAD\DWG\GHI WORK PLAN\06040-143-001-GHI WP-FG03R3.DWG

APPENDIX B

Historical Reports

Annual Report—1991
Groundwater Monitoring Program
White Bluff Steam Electric Station
Arkansas Power & Light

Prepared For:

ARKANSAS POWER & LIGHT COMPANY
LITTLE ROCK, ARKANSAS

Prepared By:

CH2M HILL, INC.
LITTLE ROCK, ARKANSAS

April 1992
MGM33285.A0

Annual Report—1991
Groundwater Monitoring Program
White Bluff Steam Electric Station
Arkansas Power & Light

Prepared For:

ARKANSAS POWER & LIGHT COMPANY
LITTLE ROCK, ARKANSAS

Prepared By:

CH2M HILL, INC.
LITTLE ROCK, ARKANSAS

April 1992
MGM33285.A0

Executive Summary

In 1991, the White Bluff Steam Electric Station (WBSES) in Redfield, Arkansas, implemented a groundwater monitoring program. The objective of the program is to evaluate if the WBSES operations are affecting local groundwater quality. The monitoring program was described in correspondence dated September 18, 1990, from Arkansas Power and Light (AP&L) to the Arkansas Department of Pollution Control and Ecology (ADPC&E) (C. Longinotti, AP&L, to C. Bennett, ADPC&E). The ADPC&E agreed with the program description as stated in its letter of October 1, 1990 (C. Bennett, ADPC&E to C. Longinotti, AP&L).

The program uses a series of monitoring wells from which groundwater is sampled and analyzed quarterly. The first year of the program is used to identify groundwater conditions, to develop a database for long-term comparison of groundwater quality parameters, and to adjust the monitoring program so that future data will reflect the site conditions more accurately. Additional modifications to the monitoring program may be expected as data are compiled and data needs are identified.

CH2M HILL was contracted to evaluate the program and the data collected by AP&L during 1991. This document is the first annual report for the monitoring program. Results of the 1991 analyses show trends and identify data gaps for program modification. Conclusions from the 1991 program are listed below:

- No organic compounds listed in Appendix A, Attachment I, have been identified in the groundwater.
- Very few dissolved toxic metals were detected in groundwater samples, and none exceeded Primary Drinking Water Maximum Contaminant Levels (MCLs) as established by the Safe Drinking Water Act (SDWA).
- SDWA Secondary Drinking Water MCLs, which are established on aesthetic qualities, were exceeded at up to eight wells for sulfate, iron, chloride, and total dissolved solids (TDS). The presence of these parameters along with observed pH levels indicate poor quality water that is not suitable as a potable water supply.
- Upgradient water quality at Well 1 indicates that those parameters exceeding Secondary MCLs occur naturally.
- Water quality varies laterally and seasonally, and additional program monitoring will be required to evaluate background conditions effectively.
- Little or no interconnection exists between the two shallowest aquifers

This report contains recommended modifications to the groundwater monitoring program. The revised program should focus on evaluating the background distributions of the naturally occurring analytes. Not until background concentration distributions are better understood can statistical comparisons be performed. The evaluation of background will include a literature review of background concentrations in the aquifer obtained from state and federal agencies and the installation of an additional background well to monitor flow and potential contaminants in the upgradient and downgradient directions.

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Section 1

INTRODUCTION

Section 1
Introduction

In 1991, the White Bluff Steam Electric Station (WBSES) in Redfield, Arkansas, implemented a new groundwater monitoring program that replaced an offsite surface water and groundwater monitoring program. Although not required for coal combustion waste units under current Environmental Protection Agency (EPA) regulations, the program is modeled on EPA Resource Conservation and Recovery Act (RCRA) guidelines. The monitoring program was described in correspondence dated September 18, 1990, from Arkansas Power and Light (AP&L) to the Arkansas Department of Pollution Control and Ecology (ADPC&E) (C. Longinotti, AP&L, to C. Bennett, ADPC&E). The ADPC&E agreed with the program description as stated in its letter of October 1, 1990 (C. Bennett, ADPC&E to C. Longinotti, AP&L).

A series of monitoring wells have been installed to monitor the groundwater in the uppermost aquifer below the plant. The wells are sampled quarterly. In addition to the quarterly sampling, monthly data including water levels, conductivity, and pH have been collected in 1991 to evaluate baseline conditions. A report of the results of the monitoring program will be submitted to ADPC&E annually.

CH2M HILL was contracted to evaluate the program and the data collected by AP&L during 1991. This document is the first of the annual reports. It presents a description of the program, the first year's program results, and identifies planned modifications to the program so that the data collected will represent the site conditions better and the water quality will be monitored more effectively. This program will continue to evolve as more data become available.

Facility Description

WBSES is a two unit coal-fired power plant operated in Jefferson County, Arkansas, about 24 miles south of Little Rock. The facility is located near the town of Redfield and about 1.5 miles north of the Pine Bluff Arsenal. The facility is operated by AP&L, which owns about 3,400 acres, of which 1,100 acres are cleared for plant use.

Each of the two power generation units is designed to produce about 800 megawatts of electricity under full load. Power is generated through combustion of western coal from the Powder River basin in Wyoming. Coal combustion waste is transferred by pneumatics for the fly ash component and water slurry for the bottom ash/pyritic component. Some fly ash is sold as a concrete additive.

Ultimately, however, excess amounts of both ash components are disposed of with low volume waste onsite in solid waste landfills. Slurry water is recycled from surface impoundments that are dredged periodically to remove bottom ash sediments. Storm

water runoff and coal yard dust suppression water from the facility are collected in the surge pond basin and recovered for use as ash slurry water make-up and cooling tower makeup.

Cooling water is obtained from the Arkansas River and cycled through hyperbolic natural draft cooling towers. Evaporative concentration results in 5- to 8-fold increases in concentration of raw water components within the cooling water system. Dissolved mineral concentrations are maintained within cooling tower design specifications by adjusting raw water makeup and blowdown ratios. Blowdown from the cooling tower basins is discharged through an NPDES-permitted outfall to the Arkansas River.

Two production wells are located onsite. These wells are used to supply water for boiler makeup, demineralizer wash water, potable water, and sanitary waste system water for WBSES. The wells are designed to be used at a rate of up to 1,000 gallons per minute (gpm), and are pumped alternately about 90 percent of the time. The major waste handling areas and monitoring well locations are shown on Figure 1.

Site Geology and Hydrogeology

Facility Location and Geology

The site is located on a bluff overlooking the Arkansas River. The surface topography ranges in elevation from 230 to 350 ft mean sea level (msl). Before plant construction, the surface was rolling hills with some steep slopes. During construction, the plant site was graded by cutting and filling. The site is highly dissected by small creeks and branches draining primarily south and east into the Arkansas River.

The stratigraphy is characterized by a thick series of primarily unconsolidated sedimentary deposits. Table 1-1 is a stratigraphic column that summarizes the sediments underlying the WBSES. The surficial deposits consist of Quaternary terrace deposits, which in turn are underlain by a thick sequence (up to 3,500 feet) of Tertiary sediments, of which the Jackson Group and Claiborne Group are the upper geologic units.

The Quaternary terrace deposits are a thin bed of silty and sandy clay covering the crest of the hills with a thickness of up to 30 feet. The terrace deposits are not present in the stream valleys because the deposits have been eroded. Grading of the plant site during construction modified the terrace deposits at the plant site.

The Jackson Group consists of the Redfield and White Bluff formations, which are primarily silty and sandy clay beds with sand and thin lignite beds. The Redfield formation is about 90 to 150 feet thick at the facility, depending on the location and the elevation of the land surface. Geraghty and Miller report that some sandy zones at similar elevations may be interconnected; however, cross sections at the site indicate

Table 1-1
Stratigraphic Column of Geologic Formations Underlying the WBSES

System	Series	Geologic Unit		Lithology	Approximate Thickness (feet)
Quaternary	Pleistocene	Terrace deposits		Silt, sand, clay with gravel	0 to 30
Tertiary	Eocene	Jackson Group	Redfield Formation of Wilbert (1953)	Clay and silt, lignite, and minor amounts of fine sand	90 to 150
			White Bluff Formation of Dall (1898)	Very fine to fine argillaceous sand; fossiliferous silt and clay; in southeast corner of Grant County contains much more clay	60 to 100
		Claiborne Group	Cockfield Formation	Sand, fine to very fine, and Carbonaceous clay	150 to 200
			Cook Mountain Formation	Clay, carbonaceous, sandy; locally glauconitic; contains beds of sand 10-30 feet thick	150 to 200
			Sparta Sand	Sand, medium to very fine; little sandy lignitic clay. Sand occurs as much as 300 feet thick in Grant County; in Hot Springs County, in beds commonly 20-60 feet thick; and in places, 100 feet thick	400 to 500
			Cane River Formation	Clay, lignitic, sandy, and fine sand. Sand occurs commonly as beds 20-60 feet thick; in places 150 feet thick	
			Carrizo Sand	Sand, very fine to medium, and carbonaceous lignitic clay. Sand occurs commonly in beds 20-60 feet thick; in places, 150 feet thick	
		Wilcox Group		Clay, blue to tan, sandy, gray fine sand; sandy marl; contains thin sandstone stringers; white fossiliferous sandy chalk.	
		Midway Group	Porters Creek Clay	Clay, blue to black	
	Paleocene		Clayton Formation	Limestone, fractured, porous; some sand	

discontinuous sand layers. The White Bluff formation underlies the Redfield and is about 60 to 100 feet thick. The formation is reported to consist mostly of clay or sandy clay and may have less sand than the overlying Redfield formation.

The Claiborne Group underlies the Jackson Group and includes the Cockfield Formation, Cook Mountain Formation, Sparta Sand, Cane River Formation, and the Carizzo Sand. The description of the geologic units in this report will be limited to those formations from the Sparta Sand upwards. The formations below the Sparta are not used for groundwater production because of low yield or non-potable water (saline). The Cockfield Formation consists of interbedded layers of sand, silt, and clay, and is reported to be about 150 to 200 feet thick near WBSES. The Cook Mountain Formation, which is also about 150 to 200 feet thick, consists of fine-grained materials, primarily silt and clay, with small amounts of sand. The Sparta Sand underlies the Cook Mountain Formation. The top of the Sparta Sand occurs about 200 to 350 feet below msl. This formation is about 500 feet thick and is composed of massively bedded sand.

Jackson Aquifer

The Jackson Group includes two silty sand units designated as the uppermost aquifers beneath the site. The aquifers have been described as the "260-ft sand" (indicated in ft msl) and the "230-ft sand" (Geraghty and Miller). Both the 260-ft and 230-ft sand have limited areal extent because of erosion in the ravines. Neither of these aquifers produces enough water to be used for water supply; groundwater from these units discharges from seeps in ravines and hillsides and eventually discharges as surface runoff to the Arkansas River.

Holloway reported that slug tests were conducted on five piezometers in the 230-ft sand and seven piezometers in the 260-ft sand, with the following results:

•	230-ft sand	3.2×10^{-4} cm/sec
		8.3×10^{-4} cm/sec
		4.1×10^{-4} cm/sec
		4.5×10^{-4} cm/sec
		8.4×10^{-5} cm/sec
	Log Normal Average	3.3×10^{-4} cm/sec
•	260-ft sand	1.1×10^{-3} cm/sec
		1.9×10^{-4} cm/sec
		2.5×10^{-4} cm/sec
		7.4×10^{-5} cm/sec
		1.9×10^{-5} cm/sec
		6.2×10^{-5} cm/sec
		1.6×10^{-4} cm/sec
	Log Normal Average	1.3×10^{-4} cm/sec

Holloway reported that there was no apparent hydraulic connection between the two sand beds in the Jackson Group. The direction of groundwater flow in the deeper zone is generally south and southeast, and the groundwater flow in the shallow zone parallels the former ground surface. The sand beds of the Jackson are reported to be from 5 to 15 ft thick. Monitoring wells in the Jackson Group generally yield very low flow rates and can be bailed dry.

Cockfield Aquifer

The sand beds of the Cockfield Formation yield enough water to supply low-yield wells. The aquifer is reported to yield up to 25 gpm to wells. The aquifer is hydraulically confined above by the Jackson Group and below by the Cook Mountain Formation. Geraghty and Miller report that the potentiometric surface of the Cockfield aquifer was about 275 ft msl in 1968 as mapped by the US Geological Survey (USGS).

Sparta Aquifer

The Sparta is a regional aquifer that has been used for potable water supply since the early 1900s. The aquifer is semi-confined above the Cook Mountain Formation and below by the Cane River Formation. The aquifer yields up to 1,000 gpm of good quality water to high-yield wells. Pressure within the aquifer has been reduced apparently by concentrated pumping in the Pine Bluff area. Bryant, Ludwig, and Morris report a decline in water levels of over 100 ft in wells tapping the Sparta near Redfield. The potentiometric surface of the Sparta at the site is about 135 ft msl. Regional groundwater flow direction in the Sparta before development of the plant was southward towards Pine Bluff.

Two production wells at the plant produce water from the Sparta aquifer. Each well is capable of producing 1,000 gpm, and they are pumped alternately with an equivalent pumpage of about one full-time well. Pump tests conducted during installation of the production wells yielded aquifer characteristics. Transmissivity was estimated at 90,000 gallons per day per foot (gpd/ft) with a storativity coefficient of 0.03. Pumping of the production wells should create flow in the aquifer towards the plant.

Section 2

GROUNDWATER MONITORING PROGRAM

Section 2
Groundwater Monitoring Program

Objectives

The groundwater monitoring system at WBSES is made up of 22 monitoring wells and piezometers intended to provide early warning of a potential release or groundwater quality problem. A number of monitoring wells and piezometers have been installed on the site. Reasons for installation include:

- Investigate groundwater contribution to a tunnel in the coal yard
- Provide information on potentiometric surface and flow directions for both aquifers
- Measure quality of groundwater entering or leaving the site

Single and nested wells have been installed at locations shown on Figure 1. The wells were constructed from 1989 to 1990 in general accordance with EPA groundwater monitoring well installation guidelines. As agreed through negotiations between AP&L and ADPC&E, data from the monitoring wells would be evaluated and reported to ADPC&E annually. After enough data are collected, concentrations of constituents of concern in upgradient wells will be compared statistically to concentrations in downgradient wells.

Table 2-1 lists the aquifer monitored by each well. Monitoring wells intended for evaluation of groundwater quality are those screened in the 260-ft aquifer, plus Well 22, screened in the 230-ft aquifer, at the base of the surge pond dam. Well 22 is located in an area where the 260-ft aquifer is not present due to erosion. Therefore, Well 22 is screened in the uppermost aquifer at its location. Water quality data are presented in this report for only the 260-ft aquifer wells (plus Well 22). Groundwater quality data also were obtained for the other wells to evaluate baseline conditions.

Sampling Plan

The first year monitoring program consisted of quarterly sampling and analyses of the compounds listed in Appendix A, with monthly field measurements of water level, specific conductivity, pH, and temperature. The *1991 Sampling and Analysis Plan* as prepared and implemented by AP&L is presented in Appendix A.

Table 2-1
Aquifers Monitored by Each Well

Nest (N) or Single (S)	260-ft Aquifer (Shallow)	230-ft Aquifer (Deep)
N	Well 1	Well 2
N	Well 4	Well 3
N	Well 5	Well 6
N	Well 8	Well 7
N	Well 10	Well 9
S	Well 11	
S	Well 12	
S	Well 13	
N	Well 15	Well 14
N	Well 17	Well 16
N	Well 19	Well 18
N	Well 21	Well 20
S		Well 22

Chemical Parameters

A broad group of analytical parameters was analyzed on each groundwater sample during 1991. The parameters are listed below:

• Indicator Parameters	pH conductivity total dissolved solids (TDS)
• Major Ions	calcium, dissolved magnesium, dissolved sodium, dissolved iron, dissolved chloride sulfate nitrate-nitrite fluoride
• Trace Metals	aluminum, dissolved arsenic, dissolved boron, total cadmium, dissolved chromium, dissolved mercury, dissolved molybdenum, dissolved nickel, dissolved selenium, dissolved strontium, dissolved titanium, dissolved
• Organic Compounds	volatile organic compounds semivolatile organic compounds (including pesticides)

Sampling Procedures

As stated above, the *Sampling and Analysis Plan* is attached in Appendix A and contains a detailed description of field procedures. Quarterly sampling and monthly field measurements were taken in general accordance with EPA guidelines. All field data are recorded on well survey report forms for the well being sampled.

The initial step in the purge and sample process is to obtain a water level measurement with an electronic water level tape. This measurement is recorded as depth below the top of the well casing and recorded to the nearest 0.01 ft. The purge volume is then

calculated at three times the water column volume. The wells are then purged of three casing volumes using either Teflon bailers or gas-drive pumps. Field parameters including pH, conductivity, and temperature are measured with portable instruments on samples collected following the final well volume. Laboratory samples are collected in Teflon bailers in the following order:

- Volatile organics
- Semivolatile organics
- Trace metals, field filtered
- Unpreserved analytes
- Nitrate

The samples are placed in prepared sample containers that are then stored in coolers with ice for transportation to the laboratory. AP&L uses either Chain-of-Custody forms or the well survey report forms to document sample custody.

Field Quality Assurance/Quality Control (QA/QC) measures are used to evaluate the quality of the sampling and analytical procedures. The QA/QC measures used in the Groundwater Monitoring Program include:

- Sampling and analysis procedure training
- Field instrumentation calibration and documentation
- Preparation of trip blanks, field spike samples and field blanks
- Documentation of field activities on the well survey report
- Documentation and justification on the well survey report of field sampling activities contrary to the Sampling and Analysis Plan
- Sample chain-of-custody documentation

Internal laboratory QA/QC procedures also are used to evaluate data quality in addition to the field procedures as documented in Appendix A.

Section 3

1991 MONITORING PROGRAM DATA

Section 3

Data Presentation and Evaluation

Water Levels, Hydraulic Gradients, and Flow Directions

Table 91-2 presents monthly water level measurements for all monitoring wells and piezometers. Figures 2 through 5 are quarterly potentiometric surface maps for the 260-ft aquifer. Figures 6 through 9 are potentiometric surface maps for the 230-ft aquifer.

Water Levels

Figure 10-12 shows water level hydrographs for monitoring wells on the White Bluff property. The data show temporal variations in water level of the shallow aquifer ranging from 2 to 11 ft, with the exception of Well 17. For the deep aquifer, the data show seasonal variations ranging from 2 to 12 ft, with the exception of Well 16. Temporal variations in water levels at Well Nest 16 and 17 were measured as high as 44 ft.

The potentiometric head between the upper and lower aquifers differs as much as 47 ft at Nest 5 and 6, in the northeast portion of the site. Except for isolated amomalies at Nests 14 and 15, and 20 and 21, there is at least 2 ft of head difference between the two aquifers. Data from Wells 17 and 16 indicate that the Well 16 probably is not monitoring the same formation as the shallow wells on the remainder at the site. The data also suggest that there may be some interconnection between the shallow and deeper water bearing zones at this location.

Hydraulic Gradients and Flow Direction

The potentiometric surface maps of the 260-ft aquifer (Figures 2 through 5) are very similar for all four quarterly measurements. The water levels in Wells 1 and 17 are always the highest, and Well 21 has the lowest water level. The hydraulic gradients for all four quarters result in flow directions primarily to the east and southeast. Also, some flow is indicated towards the north. This flow pattern matches the pre-development surface drainage patterns. Another feature shown on all four maps is the spreading of contours (reduction in gradient) across the coal storage area. This reduction in gradient may result from recharge to the sand bed in this area.

The potentiometric surface maps of the 230-ft aquifer (Figures 6 through 9) are similar to the overlying aquifer's potentiometric surface. The gradient generally is not as steep as the gradient of the 260-ft aquifer. The gradient of the 230-ft aquifer increases at the periphery of the facility, which indicates groundwater discharge from this aquifer at lower elevations.

The potentiometric maps of the two aquifers within the Jackson Group indicate that Wells 1, 2, 16, and 17 are hydraulically upgradient of the facility. The other wells monitor the downgradient perimeter of the facility.

Water Quality Data

Indicator Parameters

pH

Tables 91-3 and 91-4 present monthly measurements of pH and specific conductance for monitoring wells screened in the 260-ft aquifer and for Wells 22 and 2. Well 2 serves as an upgradient well for the 230-ft aquifer. Values of pH ranged from 3.35 (Well 1) to 7.75 (Well 17). Most of the pH values were less than 4.5. Process water at the facility has pH of greater than 7.0, so the low pH values do not appear to be the result of process water. The shallow sediments are reported to contain significant pyrite (iron sulfide) concretions. Oxidation of sulfide minerals produces low pH waters; therefore, these values appear to be naturally occurring.

Conductivity

Conductivity is a measure of the charged ionic species in solution. Conductivity values ranged from 68 (Well 17) to 4,560 μmhos (Well 5). The value of 68 μmhos appears to be anomolously low and is incongruent with the TDS value of 451 mg/l. Groundwater samples from Wells 1, 5, 11, 12, and 19 have the highest conductivity.

TDS

TDS values are included on Tables 91-5 through 91-8. The TDS values show broad ranges similar to conductivity because electrical conductivity is a function of the dissolved mineral content, which also is measured as dissolved solids. The TDS ranged from 194 (Well 4) to 3,490 mg/l (Well 5). Up to eight wells produced water with TDS greater than 500 mg/l. Water that contains more than 500 mg/l of TDS is not ideally suited as a potable drinking water source.

Wells 1 and 17 represent the extreme values of the indicator parameters and are hydraulically upgradient of the facility. Therefore, groundwater in the uppermost sand bed of the Jackson Group appears to show wide ranges of water quality. The variability of water quality is related to recharge rates, contact time, and mineralogy of the aquifer matrix. Areas of rapid recharge will have slightly acid water with low ionic strength (similar to rainfall). Lower recharge, slow movement, and high contact time in the presence of soluble minerals may result in higher dissolved mineral content and poorer quality.

Major Ions

Tables 91-5 through 91-8 contain the quarterly analyses for the major ions. These data show broad ranges as indicated by the TDS indicator parameter. Concentrations of most of the major ions, specifically, sulfate, chloride, iron, calcium, magnesium, and sodium are high enough to make the water nonpotable. Sulfate, chloride, and iron have Secondary Drinking Water Maximum Contaminant Levels (MCLs) as follows:

- sulfate 250 mg/l
- chloride 250 mg/l
- iron 0.3 mg/l

Up to eight wells produced water with at least one parameter in excess of the Secondary MCL. These parameters also are present in the process water at the plant site.

Nitrate is the only major ion parameter with a Primary Drinking Water MCL, which is 10 mg/l as nitrogen. One sample, from Well 5 in September, exceeded the MCL with a value of 32.7 mg/l. Facility processes do not use or generate nitrates, and no other samples from this well or other wells exceeded the nitrate MCL.

Trace Metals

Tables 91-5 through 91-8 present the trace metal data for the monitoring wells. Most of the trace metals were detected at low concentrations in soluble form in the groundwater samples. Strontium, aluminum, and titanium were the most frequently detected trace metals. These metals probably are put into solution by the low pH of the groundwater. The concentrations of these three metals is typically highest at wells with the lowest pH. Primary Drinking Water Standards exist for six of the trace metals in the program as follows:

- arsenic 0.05 mg/l
- cadmium 0.01 mg/l
- chromium 0.05 mg/l
- lead 0.05 mg/l
- mercury 0.002 mg/l
- selenium 0.01 mg/l

None of the six metals with MCLs were detected in concentrations in excess of the standards.

Organic Compounds

Tables 91-5 through 91-8 present the organic compound data for the monitoring wells. An AP&L laboratory QA/QC review invalidated the volatile and semivolatile compound analyses for the first quarter sampling event because of improper sampling techniques

and exceedance of the holding times. As shown on the tables, the organic analyses for the second, third, and fourth quarters did not detect any compounds.

Summary and Conclusions

Water levels in monitoring wells at WBSES show consistent trends across the plant site. Groundwater flow in the two sand beds of the Jackson Group generally follows the pre-development surface water flow directions. Most of the groundwater flow towards the east and southeast, eventually discharging as surface seeps, which then drain to the Arkansas River. Some flow within the shallow sand beds also flows northward.

Wide variations in water quality, primarily major ions, were observed in the Jackson aquifer. Water quality is poor and generally not suitable as a potable water supply. The quality appears to be the result of dissolution of native minerals and is characterized by low to very low pH and high dissolved mineral content. Statistical comparisons of downgradient versus upgradient (background) will not be reliable until temporal and spatial variation in background can be better defined and evaluated.

Although wide variations in the major ion concentrations were observed, no trace metals exceeded drinking water parameters. The nitrate concentration in one sample from Well 5 exceeded the MCL of 10 mg/l with a concentration of 37.2 mg/l, but nitrate concentration was below the MCL in all other samples from this well and the other wells. Nitrate is not expected to be generated by processes at the power plant.

Variations in water quality at the perimeter wells appear to be representative of background conditions. Activities at WBSES do not appear to be affecting groundwater quality at the monitoring wells.

Section 4

PLANNED PROGRAM ADJUSTMENTS

Section 4
Planned Program Adjustments

Background Water Quality

The 1991 groundwater quality data from the designated background well, Well 1, show wide ranges of inorganic parameters. These data and data from the downgradient wells show that the water quality is poor and highly variable. As part of the ongoing groundwater monitoring program, AP&L will evaluate the spatial and temporal variation in groundwater quality. Additional background data must be collected before meaningful comparisons of downgradient perimeter groundwater quality to background groundwater quality can be made.

Monitoring Well Placement

Because of its proximity to the facility, an additional background well will be placed upgradient of Well 1 to confirm the low pH groundwater conditions. Well 17 also is upgradient of the plant; however, it appears that the well may be screened in a different formation from many of the other wells, based on water chemistry. The planned well is intended to help evaluate the background pH distribution.

A well also will be installed in the deep aquifer next to the new background well. The deep well will monitor background conditions to compare to Well 22.

After the new monitoring well is installed, all plant piezometers and monitoring wells used for water level measurements will be resurveyed to verify horizontal and vertical control.

Sampling and Analysis Plan Adjustments

Sampling procedures will be modified so that specific conductivity, pH, and temperature will be measured frequently during well purging until the measured parameters have stabilized. The final stabilized readings will be reported as the steady state condition for the wells, along with the other field measurements.

Quarterly analyses will include both total and dissolved metals. Turbidity should be measured and samples for metals should not be collected until turbidity is less than 5 NTUs. If turbidity is a problem, then the wells may not be completely developed. Suspended sediment in water samples will elevate metals concentrations artificially in total analyses. Turbidity in water samples also may be reduced by using bladder pumps instead of bailers for presample purging, and by reducing pumping rates. After 1992

data are available, analyses for some of the metals that have continuously been below detection limits will be excluded from the analytical list.

QA/QC procedures should be augmented by both field sampling and laboratory audits by independent parties. Laboratory procedures should be revised to reduce detection limits on the volatile organic compounds. Detection limits should be equal to or less than Primary Drinking Water MCLs.

Because no volatile or semivolatile organic compounds have been detected for the four quarters of 1991, the analysis of these compounds will be reduced to annually.

Monthly Measurements

Specific conductivity, temperature, and pH will be measured quarterly, to coincide with the quarterly sampling. Water level measurements will continue to be conducted monthly, with all water level measurements being collected within 1 day. These data will be used to evaluate seasonal groundwater fluctuations and flow directions.

Decontamination Procedures

Sample devices that are used for more than one monitoring well, such as bailers and coated cables, should be decontaminated between wells by the following procedure:

- Wash with Alconox or similar soap
- Rinse with tap water and then Type I water
- Rinse with isopropyl alcohol
- Rinse with Type I water

Bailer ropes, if used, will be new, clean polypropylene, sealed from the supplier. Woven or braided polypropylene bailer ropes will be dedicated for each well, or discarded after use.

Electronic water level tapes will be decontaminated between wells by rinsing with Type I water, isopropyl alcohol, and then again with Type I water.

Section 5

REFERENCES

Section 5

References

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Tables and Figures

Table 1
White Bluff Steam Electric Station
Well Construction Data

Well Number	Aquifer	Ground Suface Elevation (ft)	Top of Casing Elevation (ft)	Total Depth (ft bgs)	Screen Interval (ft bgs)	Sand Pack Interval (ft bgs)	Bentonite Interval (ft bgs)
1	260	311.0	312.91	37	25–37	20–37	18–20
2	230	310.9	312.98	80	60–80	58–80	56–58
3	230	289.6	291.68	50	34–50	32–50	30–32
4	260	289.7	291.37	12	2–12	2.5–12	0.5–2.5
5	260	282.2	284.24	18	3–18	2.5–18	1.5–2.5
6	230	282.0	284.00	50	40–50	32–50	30–32
7	230	279.9	282.32	70	52–70	42–70	41–42
8	260	280.6	282.59	27	12–27	10–27	8–10
9	230	280.8	282.97	50	40–50	34–50	32–34
10	260	281.8	284.08	17	7–17	5–17	4–5
11	260	289.9	291.24	25	9–25	8–25	5–8
12	260	287.8	289.81	16	6–16	4–16	3–4
13	260	N/A	288.47	25	15–25	14–25	12–14
14	230	N/A	310.56	95	85–95	60–95	56–60
15	260	N/A	310.50	53	43–53	42–53	38–42
16	230	N/A	346.17	113	103–113	82–113	76–82
17	260	N/A	346.61	80	70–80	60–80	57–60
18	230	N/A	292.89	95	85–95	40–95	37–40
19	260	N/A	293.34	35	25–35	22–35	19–22
20	230	N/A	294.83	95	85–95	45–95	42–45
21	260	N/A	295.13	43	33–43	22–43	18–22
22	230	N/A	248.50	30	9.5–29.5	8.5–30	7–8.5
23	230	358.01	357.60	110.0	100–110 (10)		8/25/92
24	260	358.11	357.78	60.0	50–60 (10)		8/28/92
25	230	384.69	384.28	111.0	101–111 (10)		8/27/92
26	260	384.89	384.59	60.0	50–60 (10)		8/ /92

Note: All wells were grouted from top of bentonite seal to ground surface.
bgs – below ground surface
N/A – not available

Table 91–2
WHITE BLUFF STEAM ELECTRIC STATION
WATER SURFACE ELEVATIONS
FT ABOVE MEAN SEA LEVEL

SHALLOW AQUIFER

Well No.	3/20/91	4/29/91	5/17/91	6/26/91	7/26/91 7/27/91	8/23/91 8/24/91	9/26/91	10/27/91 10/28/91	11/21/91	12/14/91
1	302.48	302.64	302.61	304.25	302.86	302.81	303.63	302.71	302.51	302.21
4	286.80	287.57	287.37	284.72	284.32	284.82	284.79	283.87	287.37	287.67
5	280.41	281.14	281.59	281.64	281.44	281.24	281.24	279.99	279.74	279.54
8	278.09	278.64	278.64	278.59	277.79	277.84	278.04	277.14	277.84	277.69
10	277.58	279.28	279.28	278.63	278.18	278.18	277.66	277.28	278.87	278.88
11	285.74	285.54	285.69	285.64	283.89	284.04	284.99	284.09	285.74	N/A
12	281.97	282.46	282.66	282.66	280.06	279.41	281.31	279.36	281.28	281.01
13	279.30	279.42	278.87	278.06	275.77	275.97	277.14	275.07	276.47	277.47
15	273.95	274.19	274.10	273.09	271.60	272.00	271.80	271.00	273.00	273.50
17	311.46	315.41	N/A	309.61	307.11	309.61	309.51	294.61	297.61	298.91
19	271.34	271.64	273.09	273.11	270.94	271.54	275.92	275.54	275.74	276.24
21	268.63	268.33	267.23	268.13	268.03	267.83	267.96	257.78	268.13	267.83

DEEP AQUIFER

Well No.	3/20/91	4/29/91	5/17/91	6/26/91	7/26/91 7/27/91	8/23/91 8/24/91	9/26/91	10/27/91 10/28/91	11/21/91	12/14/91
2	271.88	271.98	272.08	271.65	270.73	270.18	270.06	269.58	270.68	270.98
3	273.11	273.08	273.28	272.88	272.23	271.38	271.68	271.28	271.39	271.48
6	240.00	237.00	234.75	234.30	234.05	233.85	234.50	234.10	N/A	233.70
7	268.32	268.77	268.77	268.27	267.92	267.72	267.92	266.92	267.12	267.52
9	268.97	269.37	269.67	269.12	268.52	267.97	268.57	268.07	268.30	268.37
14	268.26	267.06	261.61	267.23	265.56	263.16	271.89	266.21	269.76	271.16
16	311.02	320.92	324.82	325.51	316.97	317.77	324.31	281.47	297.17	310.97
18	266.29	267.09	266.84	265.99	263.64	264.29	264.47	261.44	264.49	254.99
20	259.93	260.38	260.13	267.53	257.83	257.73	263.91	256.93	258.63	258.83
22	243.73	244.30	244.00	242.20	237.90	237.90	240.05	237.25	243.83	244.20

N/A – Not Available

Table 91–3
WHITE BLUFF STEAM ELECTRIC STATION
pH (STANDARD UNIT)

WELL No.	3/20/91	4/29/91	5/17/91	6/26/91	7/26/91 7/27/91	8/23/91 8/24/91	9/26/91	10/27/91 10/28/91	11/21/91	12/14/91
1	3.45	3.48	3.35	3.64	N/A	3.70	3.76	3.72	4.30	4.20
2	5.90	5.35	5.33	6.45	N/A	4.80	6.37	4.94	5.09	6.80
4	4.47	4.70	4.48	4.55	N/A	4.00	4.74	4.11	5.07	4.20
5	3.47	3.53	3.64	4.13	N/A	3.64	3.84	3.89	3.78	3.85
8	4.16	4.77	4.30	4.42	N/A	3.73	4.76	4.17	5.43	3.80
10	4.30	4.50	5.30	4.60	N/A	4.30	5.00	4.24	4.17	4.40
11	4.29	4.15	4.15	4.52	N/A	4.00	4.60	3.89	5.03	N/A
12	3.44	3.75	3.51	3.85	N/A	3.50	4.18	3.44	4.48	3.44
13	3.51	4.06	4.30	4.38	N/A	4.05	3.75	3.56	5.65	3.80
15	5.79	6.72	6.48	5.82	N/A	5.80	6.19	5.82	6.05	6.05
17	5.30	6.67	6.77	6.86	N/A	6.10	7.54	6.89	6.97	6.30
19	4.31	4.96	4.10	5.11	N/A	4.10	4.22	3.62	5.30	3.74
21	3.88	3.90	3.49	4.23	N/A	3.70	3.94	3.90	4.18	3.63
22	4.36	4.50	3.91	4.82	N/A	4.04	4.66	4.00	4.40	3.81

N/A – Not Available

Table 91–4
WHITE BLUFF STEAM ELECTRIC STATION
SPECIFIC CONDUCTIVITY (uMHOS)

WELL No.	3/20/91	4/29/91	5/17/91	6/26/91	7/26/91 7/27/91	8/23/91 8/24/91	9/26/91	10/27/91 10/28/91	11/21/91	12/14/91
1	3080	2560	2880	2890	N/A	3000	3320	1795	3018	1310
2	1225	1050	1490	1355	N/A	1380	1230	1412	1304	2300
4	188	157	218	174	N/A	244	210	278	217	212
5	4290	3600	3850	3999	N/A	4026	3350	4560	4150	4100
8	500	440	410	370	N/A	465	386	495	424	483
10	500	543	753	395	N/A	530	481	587	550	616
11	1200	1200	1250	1030	N/A	1340	1110	1464	1500	N/A
12	1100	1130	1370	1200	N/A	1481	1200	2240	1300	1360
13	330	450	350	340	N/A	384	450	417	435	440
15	622	733	621	535	N/A	596	676	730	655	810
17	68	235	271	300	N/A	369	338	389	467	444
19	1480	1725	1943	1745	N/A	1575	1600	1622	1208	1675
21	788	1318	1505	1126	N/A	1203	1361	1329	800	1433
22	278	340	293	276	N/A	229	234	294	240	405

N/A – Not Available

Table 91-5
WHITE BLUFF STEAM ELECTRIC STATION
QUARTERLY ANALYSES
MARCH 20, 1991

WELL No.	PARAMETERS (mg/L)											
	TDS	NO3	SO4	Cl	B	F	Ni	Ca	Mg	Na	Fe	Sr
Well 1	2870	NA	471.0	710.9	0.20 U	0.65	NA	292.0	112.4	258.4	25.050	5.05
Well 2	1318	NA	332.0	123.8	0.20 U	0.20 U	NA	93.8	35.8	84.8	0.120	3.95
Well 4	217	NA	70.5	21.4	0.20 U	0.20 U	NA	5.9	2.4	17.7	0.170	0.12
Well 5	336	NA	382.0	891.7	0.20 U	0.68	NA	322.0	150.8	371.6	0.070	5.61
Well 8	399	NA	196.7	45.8	0.20 U	0.20 U	NA	26.1	10.1	42.8	0.240	0.39
Well 10	434	NA	179.9	37.8	0.20 U	0.20 U	NA	20.1	9.7	59.3	0.140	0.43
Well 11	1043	NA	663.9	40.0	0.20 U	0.62	NA	42.0	32.8	161.6	0.430	0.98
Well 12	413	NA	877.7	53.3	0.20 U	0.20 U	NA	57.2	20.7	18.4	0.340	0.23
Well 13	320	NA	72.5	58.9	0.37	0.21	NA	227.0	5.9	19.6	0.780	0.35
Well 15	682	NA	393.0	24.8	0.20 U	0.20 U	NA	73.6	22.9	47.1	0.040	1.91
Well 17	451	NA	387.6	9.6	0.20 U	0.20 U	NA	20.7	4.8	30.5	3.290	0.52
Well 19	1502	NA	334.3	40.0	0.33	0.83	NA	179.0	59.8	79.1	3.490	3.46
Well 21	1282	NA	75.9	37.6	0.20 U	0.68	NA	126.0	49.3	73.1	1.010	2.44
Well 22	278	NA	115.5	19.3	0.20 U	0.23	NA	15.2	5.2	19.1	0.930	0.33
Field Blank	1.00 U	NA	37.5	1.0 U	0.20 U	0.20 U	NA	1.0 U	1.0 U	1.0 U	0.010 U	0.01 U
Trip Blank	1.00 U	NA	20.0	1.0 U	0.20 U	0.20 U	NA	1.0	1.0 U	1.0 U	0.010 U	0.01 U

WELL No.	PARAMETERS (mg/L)										
	Al	Ti	Mo	As	Se	Cr	Cd	Hg	Pb	BNA	VOA
Well 1	30.00	0.278	0.005 U	0.005 U	0.002 U	0.005 U	0.004	0.0005 U	0.001 U	**	**
Well 2	0.02	0.129	0.007	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 4	0.22	0.020	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 5	4.80	0.070	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 8	1.08	0.045	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 10	0.38	0.032	0.005 U	0.005 U	0.002	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 11	3.20	0.091	0.005 U	0.005 U	0.002 U	0.005 U	0.001	0.0005 U	0.001 U	**	**
Well 12	0.68	0.060	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 13	4.50	0.063	0.005 U	0.005 U	0.002 U	0.005 U	0.002	0.0005 U	0.001 U	**	**
Well 15	0.02	0.081	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 17	0.27	0.160	0.005 U	0.005 U	0.002 U	0.008	0.001	0.0005 U	0.002	**	**
Well 19	4.00	0.158	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Well 21	7.80	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001	0.0005	0.001 U	**	**
Well 22	0.90	0.040	0.005 U	0.005 U	0.002 U	0.005	0.001 U	0.0005 U	0.001 U	**	**
Field Blank	0.03	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**
Trip Blank	0.01 U	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	**	**

Note:
U – Below method detection limit
** – Sampling and analytical procedures not reliable for this sampling event
NA – Not analyzed
ND – None detected

Table 91-6
WHITE BLUFF STEAM ELECTRIC STATION
QUARTERLY ANALYSES
JUNE 26, 1991

WELL No.	PARAMETERS (mg/L)										
	TDS	NO3	SO4	Cl	B	F	Ni	Ca	Mg	Na	Fe
Well 1	2514	0.10 U	798.0	172.6	0.20 U	0.71	0.190	392.6	109.0	255.0	24.970
Well 2	1258	0.10 U	546.0	41.0	0.30	0.20 U	0.019	221.4	42.0	78.7	6.090
Well 4	192	0.20	30.5	19.2	0.20 U	0.20 U	0.023	5.7	2.5	16.0	0.910
Well 5	3152	0.50	795.0	85.2	0.20 U	0.73	0.140	436.4	166.0	372.0	0.120
Well 8	375	0.10 U	140.0	47.8	0.20 U	0.20 U	0.041	20.4	9.3	39.3	3.930
Well 10	450	0.10 U	10.5	40.4	0.20 U	0.20 U	0.023	20.0	9.2	66.4	0.110
Well 11	993	0.19	417.0	34.6	0.20	0.80	0.084	55.3	33.0	156.0	0.340
Well 12	1115	0.10 U	691.0	48.4	0.20 U	0.53	0.120	114.2	43.0	102.6	4.380
Well 13	357	0.10 U	65.0	56.0	0.40	0.25	0.085	18.5	7.6	19.6	7.500
Well 15	645	0.14	286.5	21.4	0.20 U	0.20 U	0.020	64.4	23.0	46.2	7.870
Well 17	242	0.10 U	190.6	0.2 U	0.20 U	0.20 U	0.005	21.6	6.1	35.4	0.008
Well 19	1479	0.10 U	325.0	38.0	0.39	0.76	0.058	237.0	64.0	77.5	24.940
Well 21	1312	0.10 U	349.0	54.0	0.20	0.68	0.095	179.9	53.3	70.9	15.520
Well 22	257	0.10 U	103.5	18.2	0.20 U	0.20 U	0.021	17.2	6.6	18.8	2.970
Field Blank	1.00 U	0.10 U	5.0 U	0.2 U	0.20 U	0.20 U	0.005 U	1.0 U	1.0 U	1.0 U	0.002
Trip Blank	1.00 U	0.10 U	5.0 U	0.2 U	0.20 U	0.20 U	0.005 U	1.0 U	1.0 U	1.0 U	0.001

WELL No.	PARAMETERS (mg/L)											
	Sr	Al	Ti	Mo	As	Se	Cr	Cd	Hg	Pb	BNA	VOA
Well 1	5.10	0.01 U	NA	0.006	0.005 U	0.002 U	0.005 U	0.002	0.0005 U	0.001 U	ND	ND
Well 2	3.49	0.20	NA	0.005	0.005 U	0.002 U	0.005 U	0.001	0.0005 U	0.001 U	ND	ND
Well 4	0.12	0.22	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 5	6.20	0.01 U	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 8	0.37	0.25	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 10	0.43	0.23	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 11	0.91	0.13	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 12	1.60	0.01 U	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 13	0.47	0.01 U	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.002	0.0005 U	0.001 U	ND	ND
Well 15	1.41	0.07	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 17	0.64	0.04	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 19	3.75	0.20	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 21	2.60	0.01 U	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 22	0.42	0.18	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Field Blank	0.01	0.06	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Trip Blank	0.01	0.11	NA	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND

Note:
U – Below method detection limit
NA – Not analyzed
ND – None detected

Table 91-7
WHITE BLUFF STEAM ELECTRIC STATION
QUARTERLY ANALYSES
SEPTEMBER 25, 1991

WELL No.	PARAMETERS (mg/L)										
	TDS	NO3	SO4	Cl	B	F	Ni	Ca	Mg	Na	Fe
Well 1	2731	8.13	710.5	56.0	0.20 U	0.60	0.235	257.0	110.4	262.0	25.250
Well 2	1213	0.50 U	574.8	50.4	0.29	0.20 U	0.005 U	159.0	47.7	68.1	15.840
Well 4	217	0.50 U	40.9	16.9	0.20 U	0.20 U	0.011	9.5	3.0	12.0	2.130
Well 5	3378	37.20	942.0	13.8	0.20 U	0.87	0.110	342.0	174.4	386.0	0.140
Well 8	389	0.50 U	96.1	57.1	0.20 U	0.20 U	0.260	21.3	8.9	32.1	44.100
Well 10	496	0.50 U	180.6	44.3	0.20 U	0.02 U	0.010	22.3	10.4	65.4	0.460
Well 11	1087	0.50 U	548.0	42.0	0.24	0.63	0.060	54.0	37.8	153.0	0.970
Well 12	1046	0.50 U	446.0	61.4	0.20 U	0.69	0.034	81.0	39.2	85.5	4.500
Well 13	350	1.94	55.2	68.8	0.49	0.30	0.055	15.3	7.2	14.9	6.550
Well 15	629	0.50 U	294.0	33.9	0.20 U	0.20 U	0.005 U	59.1	22.2	44.6	8.380
Well 17	552	0.50 U	28.7	0.2 U	0.20	0.20 U	0.005 U	21.8	4.6	27.3	1.820
Well 19	1467	0.50 U	541.5	64.9	0.43	0.62	0.005 U	181.5	56.8	82.3	23.310
Well 21	1273	0.71	540.5	45.1	0.31	0.67	0.086	137.5	50.0	75.3	16.000
Well 22	238	4.92	43.0	18.4	0.20 U	0.20 U	0.007	11.6	4.2	13.1	2.450
Field Blank	6	0.50 U	5.0 U	0.2 U	0.20 U	0.20 U	0.005 U	1.0 U	1.0 U	1.0 U	0.010 U
Trip Blank	5	0.50 U	5.0 U	0.2 U	0.20 U	0.20 U	0.005 U	1.0 U	1.0 U	1.0 U	0.010 U

WELL No.	PARAMETERS (mg/L)											
	Sr	Al	Ti	Mo	As	Se	Cr	Cd	Hg	Pb	BNA	VOA
Well 1	5.43	0.20	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 2	3.53	0.60	0.030	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 4	0.22	0.20	0.049	0.008	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 5	6.62	0.50	0.025 U	0.012	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 8	0.39	0.30	0.048	0.006	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 10	0.48	0.2	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 11	1.04	0.30	0.176	0.013	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 12	1.44	0.30	0.025 U	0.015	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 13	0.48	0.30	0.025 U	0.010	0.007	0.007	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 15	1.44	0.01 U	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 17	0.59	0.30	0.162	0.005 U	0.005 U	0.002 U	0.008	0.001	0.0005 U	0.002	ND	ND
Well 19	3.60	0.30	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 21	2.72	0.10	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Well 22	0.32	0.10	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Field Blank	0.01 U	0.01 U	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND
Trip Blank	0.01 U	0.01 U	0.025 U	0.005 U	0.005 U	0.002 U	0.005 U	0.001 U	0.0005 U	0.001 U	ND	ND

Note:
U – Below method detection limit
NA – Not analyzed
ND – None detected

29350

WHITE BLUFF PLANT
GROUNDWATER MONITORING PROGRAM
1994 ANNUAL REPORT

Prepared for:

Arkansas Power and Light Company

a subsidiary of

Entergy Corporation

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27 March 1995

EXECUTIVE SUMMARY

This report presents the results of the fourth year groundwater monitoring program at the White Bluff Plant at Redfield, Arkansas. By agreement with the Arkansas Department of Pollution Control and Ecology (ADPCE), the White Bluff Plant collects data from a shallow monitoring well network, evaluates these data, and reports the results annually to the agency. The White Bluff Plant also reports the results of sampling wells that are completed in a deeper aquifer beneath the site. The plant's monitoring network currently consists of 26 wells that were installed to measure the quality of groundwater beneath the site and to determine if the plant's operations are affecting local groundwater quality. These wells are sampled on an annual basis.

FTN Associates, Ltd. (FTN) was contracted to evaluate the groundwater data collected by AP&L in 1994. Major conclusions from this evaluation are consistent with the 1993 findings and are as follows:

1) Target zones for the White Bluff groundwater monitoring program are found in the Jackson Group. Regionally, the Jackson Group is not considered to be an important aquifer because it is not very productive and groundwater quality is poor. Water quality often exceeds secondary maximum concentration limits (SMCLs) that were established by EPA based on aesthetic qualities, not human health criteria. As expected for lithologies in the Jackson Group, values for TDS, chloride, and sulfate were higher than SMCLs in several White Bluff wells, including wells that monitor background conditions.
2) Analytical results of the analysis of field parameters, major ions, and trace metals were within the range of values observed in previous years.
3) Organic compounds that were monitored are not present in groundwater beneath the site.

4) Statistical differences in TDS, sulfate, sodium, and chloride suggest that the plant may be affecting groundwater quality at some locations; however, these effects are within the range of background water quality reported for the Jackson Group.

5) The migration of groundwater from areas beneath the plant site to Jackson Group wells within 1 mile of the plant site or to wells completed in the Cockfield and Sparta aquifers is unlikely. The plant site is within a hydrologically isolated system that is bounded by streams and thick, low permeability subsurface materials, and domestic wells are likely located hydraulically upgradient.

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1.0 INTRODUCTION

The White Bluff plant at Redfield, Arkansas, implemented a new groundwater monitoring program in 1991. Although not required for coal combustion waste units under current Environmental Protection Agency (EPA) regulations, the program is modeled on EPA Resource Conservation and Recovery Act (RCRA) guidelines. The monitoring program was described in correspondence dated 18 September 1990 from Arkansas Power and Light (AP&L) to the Arkansas Department of Pollution Control and Ecology (ADPCE) (C. Longinotti, AP&L to C. Bennett, ADPCE). The ADPCE agreed with the program description as stated in its letter of 1 October 1990 (C. Bennett, ADPCE to C. Longinotti, AP&L). Since 1991, AP&L has adjusted the program with ADPCE's concurrence to improve evaluation and interpretation of program data. The purpose of the current groundwater program is to monitor the affects of the plant's operations on local groundwater quality.

FTN Associates, Ltd. (FTN) was contracted to evaluate the data collected at the White Bluff plant in 1994. This document is the fourth annual report. By agreement between AP&L and ADPCE, only data from wells screened in the Shallow, or uppermost aquifer are evaluated and reported annually to the Department. White Bluff's internal monitoring of wells screened in the Deep aquifer, however, showed statistical differences between background wells and some downgradient monitoring wells; therefore, beginning in 1994, AP&L's annual reports have addressed these data as well. Section 2.0 presents a description of the facility's groundwater monitoring program. The results of the fourth year program are in Section 3.0. Planned changes in the groundwater monitoring program are discussed in Section 4.0, and Section 5.0 provides references.

2.0 GROUNDWATER MONITORING PROGRAM

This section provides the background and regulatory basis for the White Bluff Plant's groundwater monitoring program, presents improvements made to the program in 1994, and describes both the groundwater monitoring network and the sampling and analysis plan (SAP) for the facility.

2.1 Facility Description

The White Bluff Plant is a two-unit coal-fired power plant operated in Jefferson County, Arkansas, about 24 miles south of Little Rock. The facility is located near the town of Redfield and is about 1.5 miles north of the Pine Bluff Arsenal. The facility is operated by AP&L, which owns about 3,400 acres, of which 1,100 acres are cleared for plant use.

Each of the two power generation units is designed to produce about 800 megawatts of electricity under full load. Power is generated through combustion of western coal from the Powder River basin in Wyoming. Coal combustion waste is transferred by pneumatics for the fly ash component and by water slurry for the bottom ash/pyritic component. Some fly ash is sold as a concrete additive.

Ultimately, however, excess amounts of both ash components are disposed of with low volume waste onsite in solid waste landfills. Slurry water is recycled from surface impoundments that are dredged periodically to remove bottom ash sediments. Storm water runoff and coal yard dust suppression water from the facility are collected in the surge pond basin and recovered for use as ash slurry water makeup and cooling tower makeup.

Cooling water is obtained from the Arkansas River and is cycled through hyperbolic natural draft cooling towers. Evaporative concentration results in 5- to 8-fold increases in concentration of raw water components within the cooling water system. Dissolved mineral concentrations are maintained within cooling tower design specifications by

adjusting raw water makeup and blowdown ratios. Blowdown from the cooling tower basins is discharged through an NPDES-permitted outfall to the Arkansas River.

2.2 Program Background

In 1983, AP&L initiated an assessment of groundwater conditions at the plant to evaluate the potential effects of plant operations on groundwater resources beneath the facility (Geraghty & Miller, 1984). This study was based entirely on the interpretation of engineering, soils, and environmental data compiled from the files of ADPCE, contractors, and state and federal agencies. Twelve monitoring wells were installed in 1989 to monitor groundwater conditions beneath the coal yard. An evaluation of onsite migration of contaminants from external sources and the risks associated with offsite migration of potential contaminants, if any, produced at the plant was completed by Ludwig (1990).

The current groundwater monitoring program is an outgrowth of a circumstance that developed in 1989. ADPCE was concerned that operations at the White Bluff facility were adversely affecting the shallow aquifer and residential wells to the south. Consequently, ADPCE requested revisions in the scope of the original surface water and well water monitoring program at the White Bluff Plant. As a result, a new, formal groundwater monitoring program was established by agreement between AP&L and ADPCE in 1991.

Based on suggestions made by CH2M Hill, Inc. and ADPCE at the end of the 1991 monitoring program, several changes were made to the groundwater monitoring program in 1992 to generate more reliable data and to enhance the interpretation of these data. Among these improvements were the installation of additional monitoring wells, installation of dedicated bladder pumps, and performance of field and laboratory audits.

2.3 1994 Program Improvements

Additional changes were made at the end of the 1993 monitoring program based on a review of program data and the results of field and laboratory audits. The White Bluff

Plant adjusted the 1994 program by reducing the parameter list and the frequency of sampling. The White Bluff Plant currently monitors groundwater on an annual basis. The parameter list includes the major constituents that are indicative of groundwater quality beneath the site and some metals. ADPCE agreed with these changes in their letter dated 12 July 1994.

White Bluff also elected to continue the independent audit program that was initiated in 1992 and that resulted in several modifications to the program. The ESI System Chemistry Laboratory's (System Chemistry) field and laboratory quality assurance/quality control (QA/QC) procedures were evaluated during 4Q94. Results and recommendations from these audits were used to document adherence to the *Sampling and Analysis Plan* (Appendix A) and to support the reliability and validity of the data.

2.4 Groundwater Monitoring Network

Figure 2.1 shows the location of facility monitoring wells. These monitoring wells are designated as Shallow aquifer (screened in the "260-ft Aquifer") wells and Deep aquifer (or "230-ft Aquifer") wells. Monitoring wells are sampled on an annual basis by staff from System Chemistry in Little Rock, Arkansas.

The current monitoring well network consists of 26 monitoring wells and piezometers (Table 2.1) that were installed onsite between 1989 and 1992. Monitoring Wells 1 through 12 were installed in 1989 to monitor groundwater quality beneath the coal yard. Monitoring Wells 13 through 22 were installed in 1990 to expand the monitoring network and provide long-term data for the evaluation of water quality beneath the plant site. White Bluff further expanded the monitoring network in 1992 with the installation of monitoring Wells 23 through 26 to establish background groundwater quality conditions west (upgradient) of the plant. Well 25 was removed from the water quality program during 1993 because it would not yield a representative sample of groundwater due to well construction problems. Table 2.2 identifies nested wells and the aquifer monitored by each well.

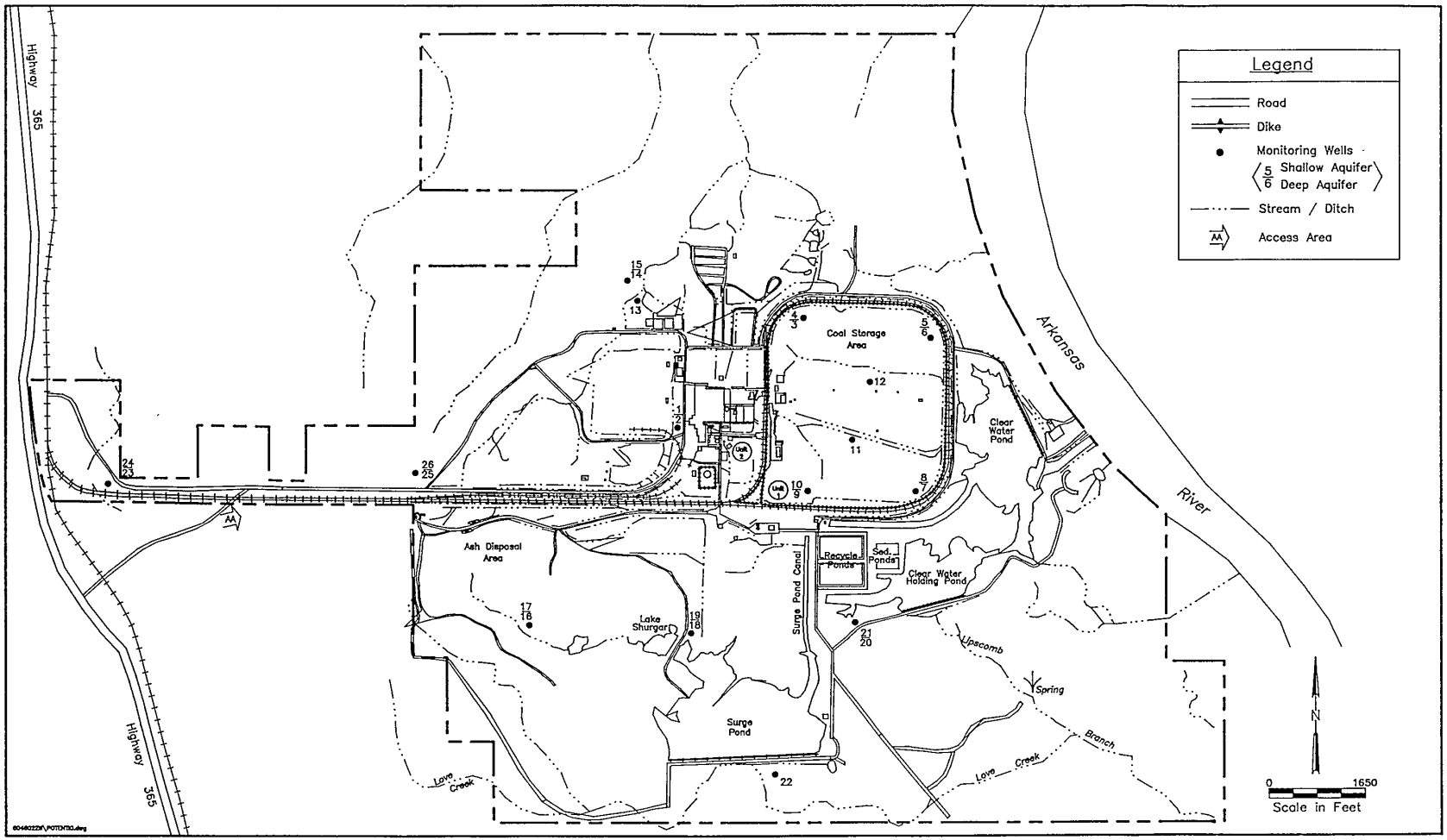


Figure 2.1. Location of White Bluff Plant monitoring wells.

Table 2.1. White Bluff Plant well construction data.

Well Number	Well Installation Date	Aquifer	Ground Surface Elevation (ft)	Top of Casing Elevation (ft)	Total Depth (ft bgs)[b]	Screen Interval (ft bgs)[b,c]	Sand Pack Interval (ft bgs)[b]	Bentonite[d] Interval (ft bgs)[b]
1	11/7/89	Shallow	311	312.91	37	25-37	20-37	18-20
2	11/6/89	Deep	310.9	312.98	80	60-80	58-80	56-58
3	11/10/89	Deep	289.6	291.68	50	34-50	32-50	30-32
4	11/10/89	Shallow	289.7	291.37	12	2-12	2.5-12	0.5-2.5
5	11/14/89	Shallow	282.2	284.24	18	3-18	2.5-18	1.5-2.5
6	11/13/89	Deep	282	284	50	40-50	32-50	30-32
7	11/9/89	Deep	279.9	282.32	70	52-70	42-70	41-42
8	11/9/89	Shallow	280.6	282.59	27	12-27	10-27	8-10
9	11/8/89	Deep	280.8	282.97	50	40-50	34-50	32-34
10	11/8/89	Shallow	281.8	284.08	17	7-17	5-17	4-5
11	11/14/89	Shallow	289.9	291.24	25	9-25	8-25	5-8
12	11/14/89	Shallow	287.8	289.81	16	6-16	4-16	3-4
13	10/30/90	Shallow	NA[a]	288.47	25	15-25	14-25	12-14
14	11/5/90	Deep	NA[a]	310/56	95	85-95	60-95	56-60
15	11/5/90	Shallow	NA[a]	310.5	53	43-53	42-53	38-42

Note: [a] NA - Data Not Available
[b] bgs - below ground surface
[c] All wells were constructed of 2-inch Sch 40 PVC
[d] All wells were grouted from top of bentonite seal to ground surface.

Table 2.1. Continued.

Well Number	Well Installation Date	Aquifer	Ground Surface Elevation (ft)	Top of Casing Elevation (ft)	Total Depth (ft bgs)[b]	Screen Interval (ft bgs)[b,c]	Sand Pack Interval (ft bgs)[b]	Bentonite[d] Interval (ft bgs)[b]
16	11/7/90	Deep	NA[a]	346.17	113	103-113	82-113	76-82
17	11/7/90	Shallow	NA[a]	346.61	80	70-80	60-80	57-60
18	10/31/90	Deep	NA[a]	292.89	95	85-95	40-95	37-40
19	10/31/90	Shallow	NA[a]	293.34	35	25-35	22-35	19-22
20	11/2/90	Deep	NA[a]	294.83	95	85-95	45-95	42-45
21	11/2/90	Shallow	NA[a]	295.13	43	33-43	22-43	18-22
22	10/31/90	Deep	NA[a]	248.5	30	9.5-29.5	8.5-30	7-8.5
23	8/25/92	Deep	358.01	357.6	114	104.5-114.5	97.5-114.5	78-97.8
24	8/28/92	Shallow	358.11	357.78	60	48.9-58.9	44-58.9	38-44
25	8/27/92	Deep	384.69	384.28	111	99.9-109.9	93-111	60-93
26	8/26/92	Shallow	384.89	384.59	60	49.9-59.9	44-60	38-44

Note: [a] NA - Data Not Available
[b] bgs - below ground surface
[c] All wells were constructed of 2-inch Sch 40 PVC
[d] All wells were grouted from top of bentonite seal to ground surface.

Table 2.2. Aquifers monitored by each well.

Nest (N) or Single (S)	Shallow Aquifer	Deep Aquifer
N	Well 1	Well 2
N	Well 4	Well 3
N	Well 5	Well 6
N	Well 8	Well 7
N	Well 10	Well 9
S	Well 11	
S	Well 12	
S	Well 13	
N	Well 15	Well 14
N	Well 17	Well 16
N	Well 19	Well 18
N	Well 21	Well 20
S		Well 22
N	Well 24	Well 23
N	Well 26	Well 25

2.5 Sampling and Analysis Plan

The fourth year groundwater monitoring program consisted of annual measurement of water levels in wells and annual sampling, analysis, and evaluation of the following parameters:

- Field parameters (i.e. pH, conductivity, turbidity, and groundwater temperature),
- Total Dissolved Solids (TDS),
- Sulfate,
- Chloride,
- Sodium,
- Boron,
- Strontium,

- Lead,
- Nickel, and
- Volatile Organic Compounds (VOCs) and semivolatile organic compounds.

All field sampling activities were conducted in accordance with EPA guidelines. System Chemistry used analytical methods that conform to 40 CFR Part 136.3 and SW-846. System Chemistry also used internal QA/QC procedures to evaluate data quality. Appendix A presents the *Sampling and Analysis Plan* that AP&L prepared and implemented.

3.0 DATA PRESENTATION AND EVALUATION

This section presents findings from the 1994 annual groundwater monitoring program at the White Bluff Plant. Section 3.1 addresses site geology and hydrogeology. System Chemistry staff sampled monitoring wells on 22 and 23 February 1994. Sections 3.2 and 3.3 present the resulting water level and groundwater water quality data. Results of data evaluation are discussed in Section 3.4, and Section 3.5 provides a summary and the conclusions of this evaluation. Data quality was evaluated by reviewing duplicate data, QA/QC sample results, comparisons to previous data, and independent field and laboratory audits.

3.1 Site Geology and Hydrogeology

Appendix B includes background information on local and site geology and hydrogeologic characteristics. This appendix repeats the information that has been presented in previous annual reports and is included to facilitate the reader's review of this document.

3.2 Water Level Data

Static water level measurements were made to determine the volume of water to remove during purging and to contour the potentiometric surface of each aquifer. This section describes well hydrographs for the period of record and addresses hydraulic gradient and subsurface flow direction.

3.2.1 Water Level Measurement and Well Hydrographs

Water level elevations that were measured on 22 February 1994 are shown on well hydrographs in Appendix C. During the 1994 sampling event, depth to water was approximately 3 to 37 feet in the Shallow aquifer and 15 to 78 feet in the Deep aquifer. Based on well hydrographs for the period of record, temporal variations in both the Shallow and Deep aquifers range from approximately 0.5 to 3 feet, except in nested

Wells 17 and 16 where larger water level fluctuations have been observed. Well hydrographs also show the potentiometric head difference between the Shallow and Deep aquifers differ by approximately 3 to 40 feet, except at nested Wells 15 and 14, where the difference is negligible. As discussed in the 1992 and 1993 Annual Reports, well construction accounts for similar water levels in Wells 15 and 14; however, there is still no explanation for the observations at Wells 17 and 16.

Due to the change in water level measurement frequency (i.e. once per year), future annual reporting of groundwater monitoring results will determine whether annual water level readings fall within the range of water level fluctuations anticipated for each aquifer. This determination will be made by comparing water level elevations to period of record data (i.e. 1991 through 1994) shown on well hydrographs, and excursions will be noted.

3.2.2 Hydraulic Gradient and Flow Direction

Figures 3.1 and 3.2 are potentiometric surface maps for the Shallow and Deep aquifers. As shown on these maps, groundwater generally flows from west to east across the site at gradients of 0.004 to 0.02 ft/ft, discharging to the Arkansas River and its tributaries. Groundwater hydrology beneath the site is further discussed in Section 3.4.

3.3 Groundwater Quality Data

This section addresses the analytical results of sampling of the shallow and deep monitoring wells. Appendix D presents the raw laboratory data. Appendix E lists period of record data collected from monitoring wells and facility sources at the White Bluff Plant from 1991 through 1994. Appendix F presents summary statistics for each monitoring well.

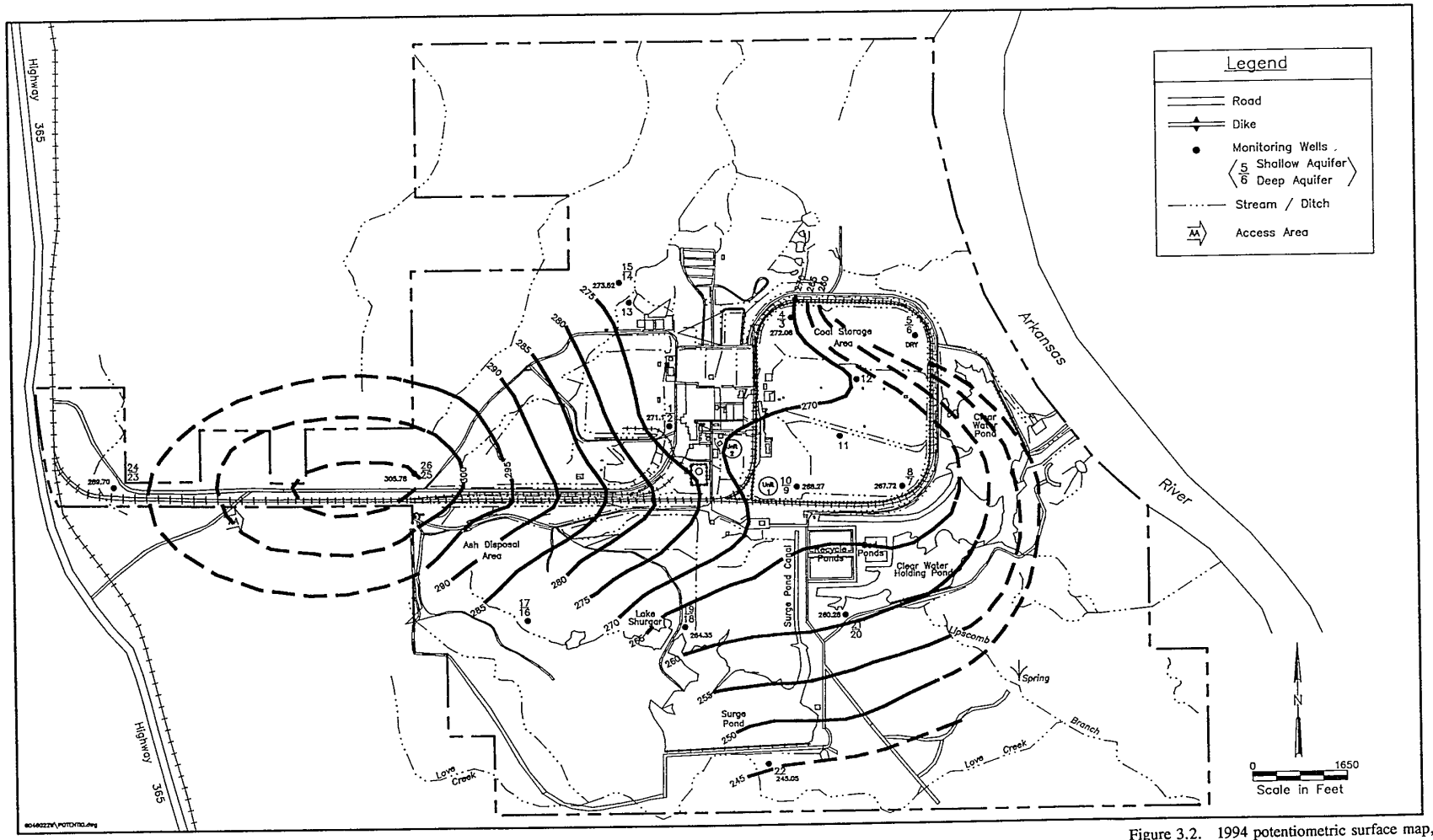


Figure 3.2. 1994 potentiometric surface map, Deep aquifer, White Bluff Plant (22 February 1994).

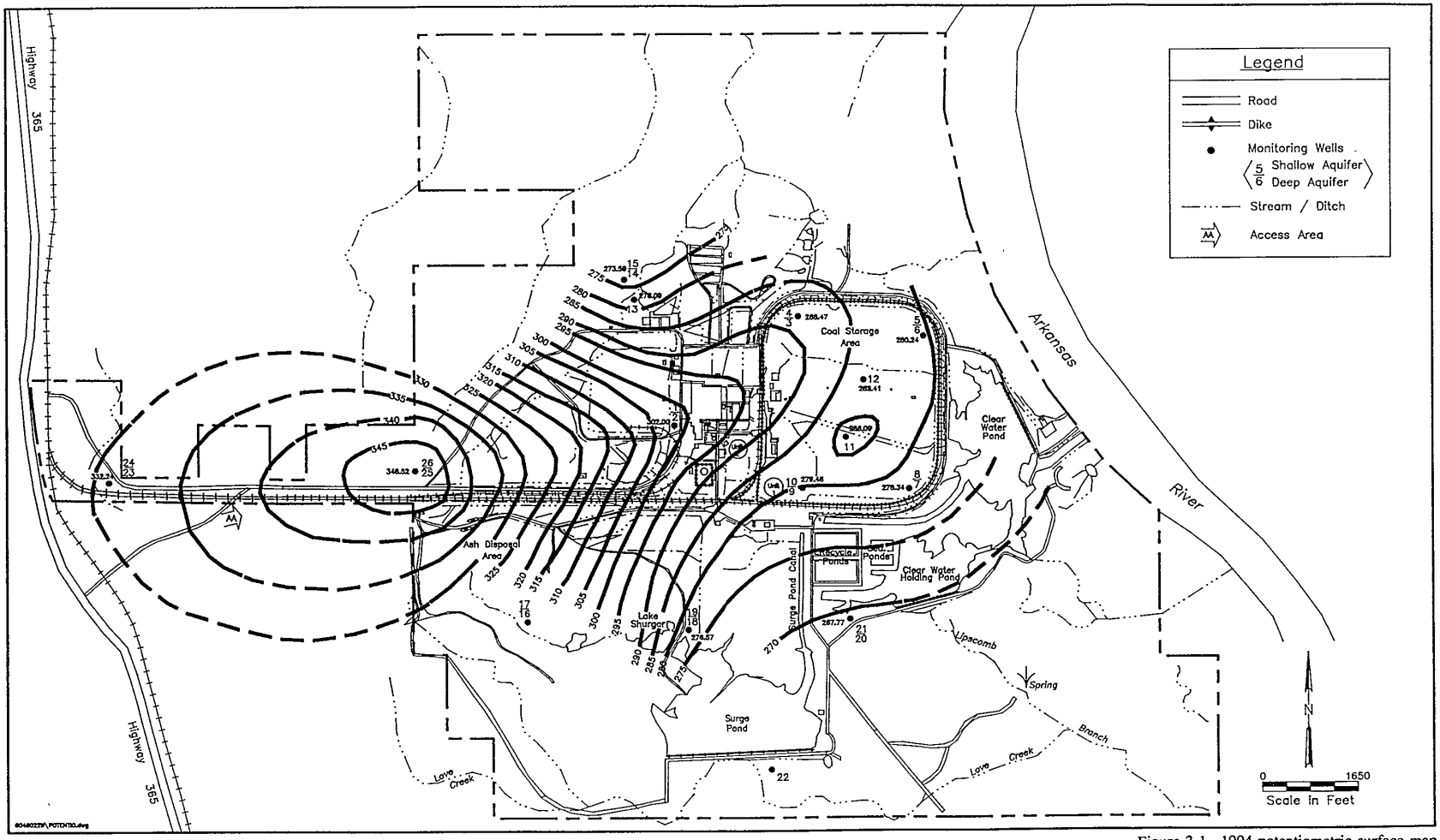


Figure 3.1. 1994 potentiometric surface map, Shallow aquifer, White Bluff Plant (22 February 1994).

3.3.1 Shallow Monitoring Wells

Table 3.1 presents 1994 summary statistics for the constituents of interest. The results of field parameter, major ion, and metals analyses follow:

1) The range of pH values was 3.7 to 8.9 su with a mean of 4.8 su.
2) The range of conductivity in these wells was 145 to 4,410 μmhos with a mean value of 1,442 μmhos. Conductivity values are consistent with TDS data described in Section 3.3.1 (5).
3) The range of measured groundwater temperatures was 12.0 to 19.5°C with a mean groundwater temperature of 15.9°C.
4) Turbidity levels were generally greater than 100 NTU in Wells 4, 10, and 11.
5) TDS ranged from 119 to 2,748 mg/L with a mean of 978 mg/L. TDS levels exceeded 2,000 mg/L in samples from Wells 1, 5, and 24 (background well); exceeded 1,000 mg/L in samples from Wells 11, and 19; exceeded the Safe Drinking Water Act's secondary maximum contaminant level (SMCL) of 500 mg/L in samples from Wells 10, 12, 15, and 21; and were less than 500 mg/L in Wells 4, 8, 13, 17, and 26.
6) Sulfate concentrations ranged from 11.6 to 1,400 mg/L with a mean of 568 mg/L. Sulfate levels were the highest in Wells 1(1,400 mg/L), 5 (1,267 mg/L), and 19 (1,146 mg/L); sulfate levels also exceeded the 250 mg/L SMCL in Wells 10 (387 mg/L), 11 (620 mg/L), 12 (593 mg/L), 15 (322 mg/L), 21 (661 mg/L), and background Well 24 (1,227 mg/L).
7) Chloride levels ranged from 6.6 to 802 mg/L with a mean of 134 mg/L. Chloride concentrations were measured above the SMCL of 250 mg/L in samples from Wells 1 (604 mg/L) and 5 (802 mg/L).

Table 3.1. 1994 summary statistics for the field parameters, major ions (mg/L), and trace metals (mg/L) in samples from the shallow and deep wells at the White Bluff Plant.

Parameter	SHALLOW AQUIFER					DEEP AQUIFER				
	N cases	Min	Max	Mean	Std Dev	N cases	Min	Max	Mean	Std Dev
pH (su)	14	3.7	8.9	4.8	1.4	10	3.6	7.9	5.4	1.2
Conductivity (μmhos)	14	145	4,410	1,442	1,506	10	153	1,905	981	657
Turbidity (NTU)	14	0.25	210	59	73	10	0.5	86.8	27.2	27.1
Temp (°C)	14	12.0	19.5	15.9	2.5	10	14.0	18.8	16.7	1.4
TDS	14	119	2,748	978	858	10	100	1,369	611	459
Sulfate	14	12	1,400	568	506	10	50	1,025	405	324
Chloride	14	6.6	802	134	245	10	3	178	43	53
Sodium	14	15.7	321	84.8	87.8	10	8.0	81.0	41.9	26.3
Boron	14	<0.2	0.91	0.32	0.22	10	0.20	0.61	0.25	0.13
Strontium	14	0.11	5.81	1.57	1.83	10	0.05	3.54	1.45	1.30
Lead	14	<0.001	0.003	0.001	0.001	10	<0.001	0.005	0.001	0.001
Nickel	14	<0.005	0.083	0.024	0.028	10	<0.005	0.083	0.015	0.024

8) Sodium levels ranged from 15.7 to 321 mg/L with a mean of 84.8 mg/L. Sodium levels greater than the mean were found in Wells 1 (217 mg/L), 5 (321 mg/L), 11 (150 mg/L), and 12 (93 mg/L).

9) Boron levels ranged from less than detection (<0.2) to 0.91 mg/L.

10) Strontium was detected in all shallow wells during 1994 in concentrations ranging from 0.11 to 5.81 mg/L with a mean of 1.6 mg/L. The highest strontium values were found in Wells 1 (4.9 mg/L) and 5 (5.8 mg/L).

11) Lead was not found in 13 of 14 shallow wells during 1994. Lead was found in the sample from Well 4 at a concentration of 0.003 mg/L.

12) Nickel concentrations ranged from less than detection (<0.005 mg/L) to 0.083 mg/L in remaining shallow wells with a mean value of 0.029 mg/L.

13) Neither volatile organic compounds (VOCs) nor the semi-volatile (BNA) compounds were found when measured during 1994.

3.3.2 Deep Monitoring Wells

Table 3.1 also presents summary statistics for the field parameters, major ions, and trace metals, the results of which follow:

1) The range of pH values was 3.6 to 7.9 su with a mean of 5.4 su.
2) The range of conductivity in these wells was 153 to 1,905 μmhos with a mean of 981 μmhos. Conductivity values are consistent with TDS data described in Section 3.3.2 (5).
3) The range of measured groundwater temperatures was 14 to 18.8°C with a mean groundwater temperature of 16.7°C.
4) Turbidity levels did not exceed 100 NTU in the Deep wells.
5) TDS ranged from 100 to 1,369 mg/L with a mean of 611 mg/L. TDS levels exceeded 1,000 mg/L in samples from Wells 18 and 20; and exceeded the 500 mg/L SMCL in samples from Wells 2, 9, and 14.
6) Sulfate concentrations ranged from 50.4 to 1,025 mg/L with a mean of 405 mg/L. The highest sulfate levels were observed in Wells 2 (674 mg/L), 18 (790 mg/L), and 20 (1,025 mg/L). Sulfate concentrations exceeded the 250 mg/L SMCL in Wells 7 (262 mg/L), 9 (432 mg/L), 14 (290 mg/L), and background Well 23 (290 mg/L).
7) Chloride values did not exceed 250 mg/L SMCL. The highest values were found in Wells 2 (178 mg/L) and 9 (82 mg/L).
8) Sodium values ranged from 8.0 to 81.0 mg/L with a mean of 41.9 mg/L. Sodium levels greater than the mean were found in Wells 2 (66.2 mg/L), 9 (55.7), 18 (71.39 mg/L), and 20 (81.0 mg/L).
9) Boron levels ranged from 0.2 to 0.61 mg/L with a mean of 0.25 mg/L.

10) Strontium was detected at levels ranging from 0.05 to 3.5 mg/L with a mean value of 1.5 mg/L. The highest strontium values were found in Wells 2 (3.4 mg/L), 9 (2.4 mg/L), and 18 (3.5 mg/L).

11) Lead was found at a concentration of 0.005 mg/L in the sample from Well 3 and at the detection limit (0.001 mg/L) in the sample from Well 16.

12) Nickel was found in concentrations ranging from 0.007 to 0.083 in 5 out of 10 wells during 1994.

13) Neither VOCs nor the BNA compounds were found when measured during 1994.

3.3.3 Data Trends

Appendix G presents time series graphs for selected parameters measured in the shallow and deep monitoring wells. Because of the variability of some data shown on these graphs, trends are difficult to identify. The data suggests seasonal trends in sulfate in samples from Well 5 and a possible increasing trend in sulfate in Well 20. A long-term decreasing trend in TDS, pH, strontium, and sodium in samples from the North and South recycle ponds is also apparent.

3.3.4 ANOVA and Post-ANOVA Comparisons

A one-way analysis of variance (ANOVA) was used to test for significant differences between means of TDS, sulfate, chloride, sodium, strontium, and pH among wells at the White Bluff Plant. The analysis followed the procedures in *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* (EPA, 1989). Separate analyses were conducted for the shallow and deep wells. These analyses were conducted using background Wells 24 and 23 and 26. Appendix H presents the results of these comparisons. Although the potentiometric surface maps support the supposition that Wells 1 and 2 are upgradient monitoring wells, it was assumed for the purpose of this comparison that these wells were potentially affected by mounding of water beneath the Cooling Towers.

A significance level ($P \leq 0.05$) was used for the initial analysis. If a difference among wells was significant at the $P \leq 0.05$ level, a post-ANOVA multiple comparison procedure (Scheffé test) was used to determine if individual wells downgradient of background wells were significantly different from the mean of the background well(s). Because an experiment-wise error of $P < 0.05$ is required by EPA (1989), a mean value for a well was determined to be significantly different from the mean value of the background wells if the Scheffé test was significant at $P \leq 0.01$.

Significant differences among well means were found for TDS, sulfate, chloride, sodium, strontium, and pH. The post-ANOVA comparison for the shallow wells found downgradient wells to be significantly different from the background Wells 24 and 26 for the respective constituents, as follows:

1) TDS was significantly higher in Wells 1 and 5 and significantly lower in remaining shallow wells except Well 19, where no statistical difference was found.
2) Sulfate was significantly lower in Wells 4, 8, 10, 13, 15, and 17.
3) Chloride was significantly higher in Wells 1 and 5.
4) Sodium was significantly higher in Wells 1, 5, and 11.
5) Strontium was significantly higher in Well 5 and lower in remaining shallow wells except Wells 1, 19, and 21 where no statistical difference was found.
6) The pH was significantly lower in downgradient shallow wells, except Well 8, where no statistical differences were found.

The post-ANOVA comparison for the deep wells found downgradient wells to be significantly different from background Well 23 for the respective constituents, as follows:

1) TDS was significantly higher in Wells 2, 18, and 20 and lower in Wells 3, 7, 16, and 22.

2) Sulfate was significantly higher in Wells 18 and 20.

3) Chloride was significantly lower in Wells 3, 16, and 22.

4) Sodium was significantly lower in deep wells except in Wells 2, 9,18, and 20, where no significant difference was found.

5) Strontium was significantly lower in Wells 3, 7, 16, and 22.

6) The pH was significantly lower in the deep wells.

3.4 Discussion of Results

This section presents a discussion of groundwater flow beneath the plant and the quality of groundwater entering and leaving the site.

3.4.1 Groundwater Flow Beneath the White Bluff Plant

Potentiometric surface maps drawn for the Shallow and Deep aquifers show that monitoring Wells 24 and 23, 26, and 1 and 2 are located hydraulically upgradient of the facility and serve as background wells. As shown on these maps (Figures 3.1 and 3.2), groundwater generally flows east beneath the site towards the Arkansas River and its tributaries. The hydraulic gradient averages 0.004 to 0.02 ft/ft in the Shallow aquifer and 0.004 to 0.007 ft/ft in the Deep aquifers. Groundwater flow patterns are stable with little change in the configuration of the potentiometric surface through time. The difference in total head in the Shallow and Deep aquifers was approximately 80 feet and 50 feet, respectively, during 1994.

3.4.2 Groundwater Quality

Groundwater quality monitored by the plant's wells is poor and generally not suited as a potable water supply. During 1994, analytical results were within the range of values observed in previous years, except for some anomalous low values in background Well 23. Figures 3.3 and 3.4 show the distribution of TDS in shallow and deep groundwater at the White Bluff Plant. Figures 3.5 and 3.6 likewise show the distribution of sulfate. TDS and sulfate concentrations exceeded secondary drinking water MCLS in samples

collected from some wells, including background monitoring wells. Water quality varies beneath the site; however, this is expected given the size of the area being monitored (approximately 3 mi^2), and the low permeability and heterogeneity of subsurface materials.

Statistically significant effects are suggested when the mean value of a constituent is significantly higher (and/or lower for pH) in a downgradient well than the mean value of that constituent in the background well (EPA, 1989). The post-ANOVA comparison for the White Bluff wells consequently suggests the following:

1) Statistically significant differences in TDS, sodium, and chloride suggest plant activities may have affected the Shallow aquifer near the Cooling Towers (Well 1) and beneath the Coal Storage Yard (near Well 5).
2) Statistically significant differences in TDS and sulfate suggest plant activities may have affected the Deep aquifer near the Cooling Towers (Well 2), near Lake Shurgar (Well 18, north of Surge Pond), and in the vicinity south of the Recycle Ponds (Well 20).
3) Although statistical differences in pH suggest plant activities may have affected groundwater beneath the site, pH is probably not a good indicator. The pH measurements of groundwater samples were low (i.e., approximately 4-5 su) whereas the pH of potential sources of contamination (i.e. 6 to 8 su in Cooling Towers and Surge Pond and 6 to 9 su in Recycle Ponds) were within or slightly above the expected range for natural groundwaters (6-8 su); therefore, one would expect to find higher pH values in groundwater samples from potentially affected areas than were observed. Values for pH were actually within background levels expected for lithologies in the Jackson Group.

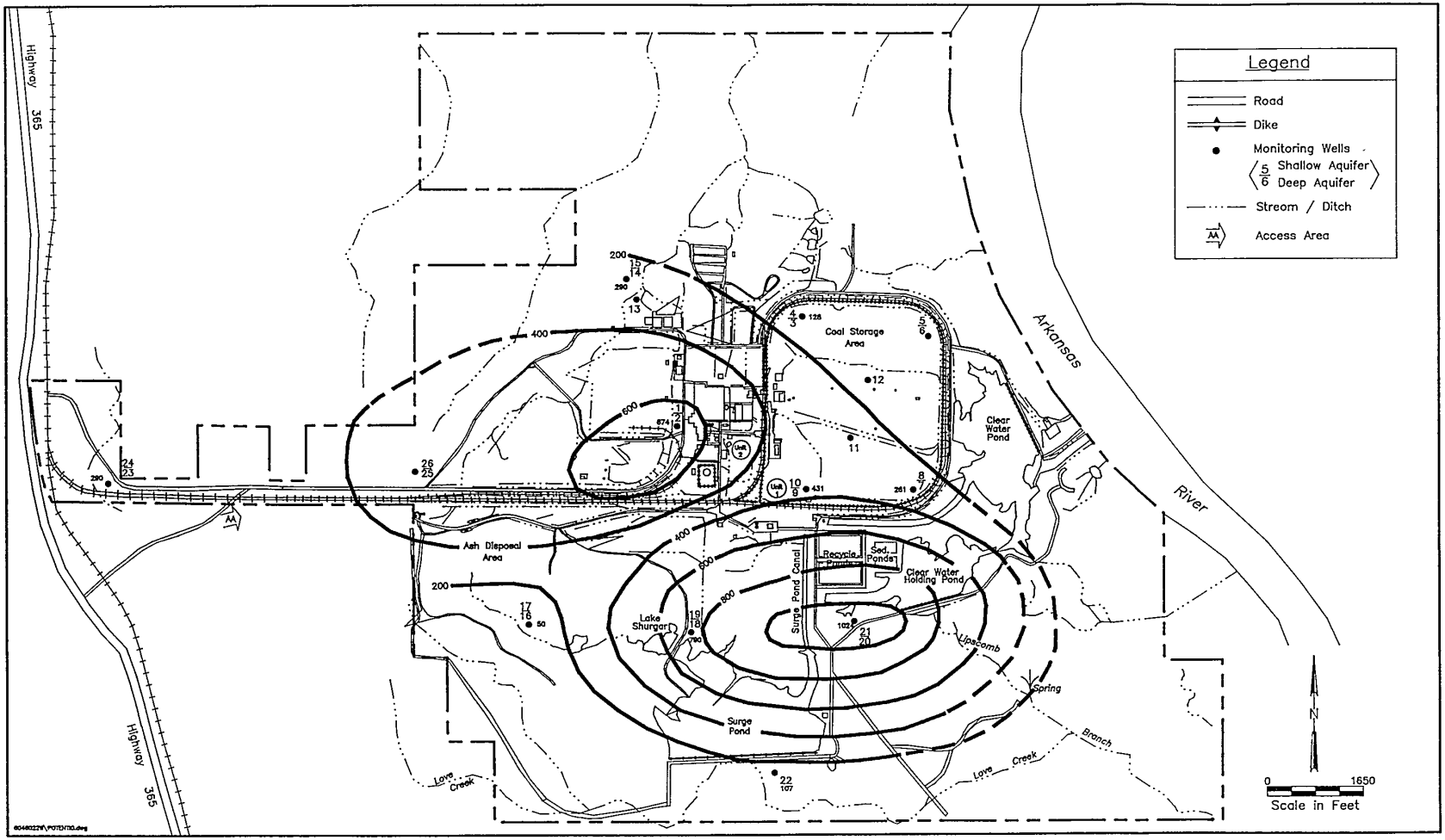


Figure 3.6. 1994 sulfate isopleths (mg/L), Deep aquifer, White Bluff Plant.

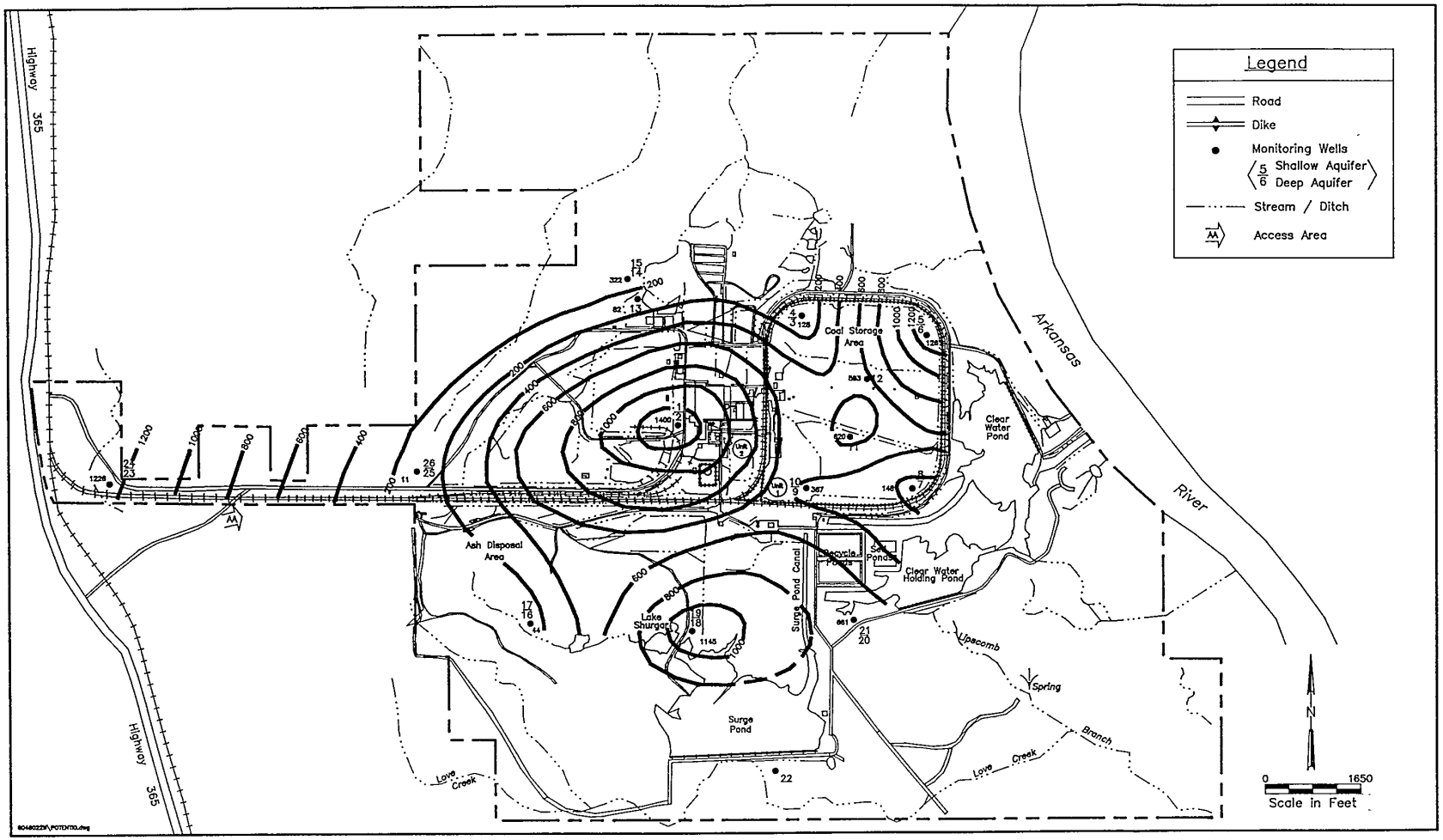


Figure 3.5. 1994 sulfate isopleths (mg/L), Shallow aquifer, White Bluff Plant.

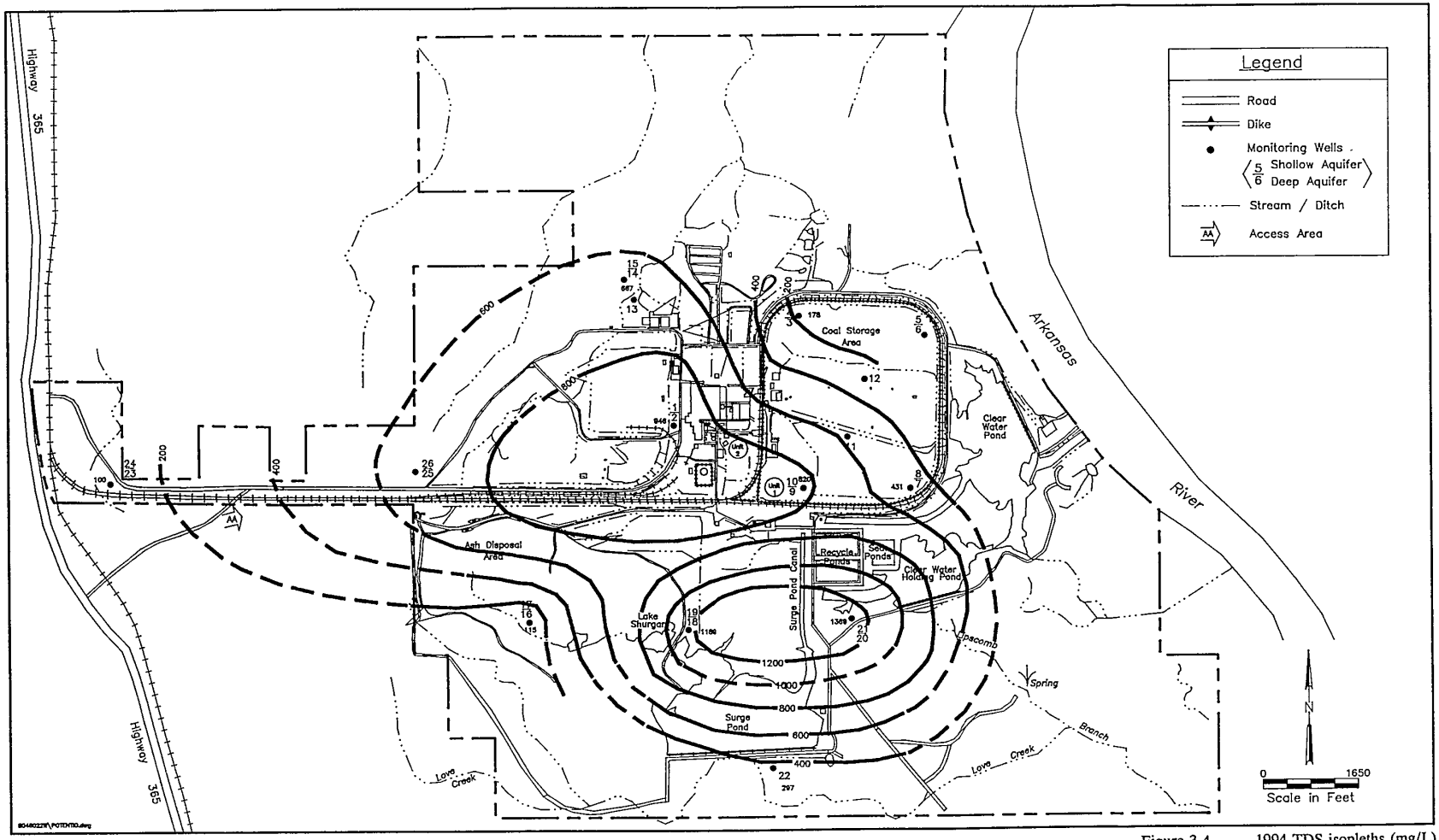


Figure 3.4. 1994 TDS isopleths (mg/L), Deep aquifer, White Bluff Plant.

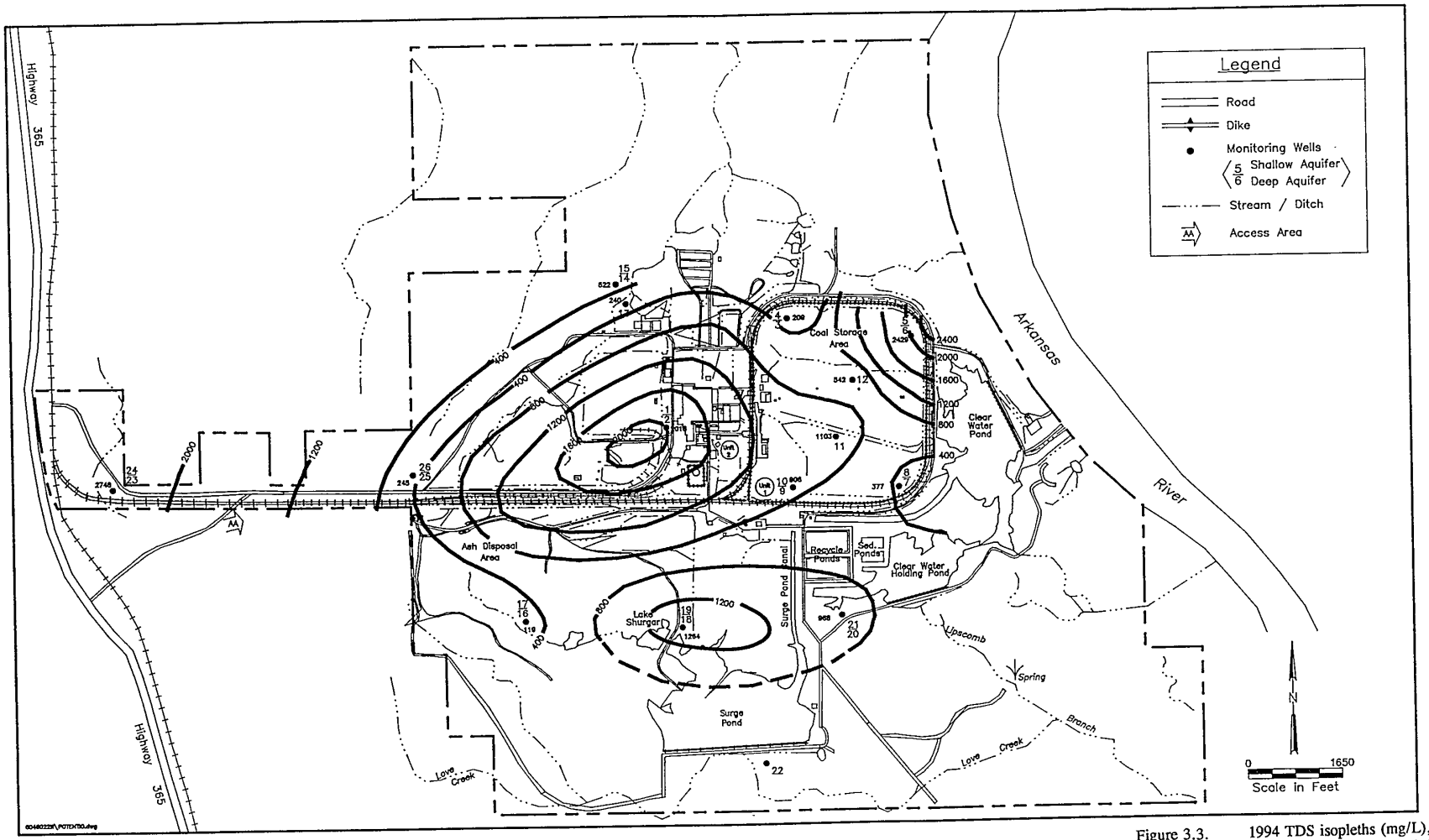


Figure 3.3. 1994 TDS isopleths (mg/L), Shallow aquifer, White Bluff Plant.

To assess potential risks associated with degradation of offsite groundwater quality from plant activities, if any, the White Bluff Plant identified existing groundwater users in the vicinity of the plant in 1993. Appendix B presents the results of this survey.

As discussed in the 1993 Annual Report, the migration of poor quality groundwater beneath the plant to domestic wells that were identified in the survey is highly improbable based on the following:

1) The Jackson Group is approximately 200 feet thick beneath the White Bluff Plant; therefore, poor groundwater quality water is unlikely to affect the quality of groundwater in domestic or industrial wells completed in the underlying Cockfield or Sparta aquifers.
2) Groundwater beneath the plant site is also within a hydrologically isolated system (Ludwig, 1990) because the site is bounded by the Arkansas River and streams that receive groundwater flows that subsequently discharge to the Arkansas River.
3) If any of the wells identified during the survey were completed in the Jackson Group, they would be located on the surface water divide between the Love Creek watershed to the north and the Carver Mill Creek watershed to the south.

Furthermore, degradation of offsite groundwater is unlikely because of the following reasons:

1) The Jackson Group is not an important aquifer because the water quality from the Jackson is poor (Terry et al., 1986). The Jackson is considered to be a non-water bearing unit that confines deeper and more productive aquifers (Petersen et al., 1985). According to Terry et al. (1986), dissolved solids in the Jackson range from 78 to 5,330 mg/L and average about 852 mg/L. Average specific conductance is about 839 μmhos and values range from 35 to 5,490 μmhos. Hardness ranges from 4 to 2,620 mg/L and

averages about 379 mg/L, indicating that water from the Jackson is generally hard. Although the Jackson does furnish small amounts of water to domestic wells in the region, where large quantities of good quality water are needed in the outcrop area of the Jackson Group, it is usually necessary to drill deeper into the Cockfield Formation or the Sparta Sand. Sources of dissolved ions in the Jackson may include clay and lignitic material within the group and recharge from the overlying quaternary deposits. Groundwater from quaternary deposits may have concentrations of iron, chloride, sulfate, and TDS that can exceed allowable limits (Kilpatrick and Ludwig, 1988).

2) Groundwater quality beneath the plant site is within the range of natural variability for the Jackson Group. Table 3.2 is a comparison of Jackson groundwater quality in the region to groundwater quality in monitoring wells on the plant site. Regional data was supplied by the USGS for 68 wells that were sampled between 1949 and 1966. The maximum levels of TDS, sulfate, chloride, and sodium are lower than the maximum concentrations of these constituents measured in regional Jackson groundwater. This table also shows background concentrations relatively high when compared to data from other wells at the site.

3.5 Summary and Conclusions

The following summary and conclusions were based on a review of the 1994 data from the White Bluff Plant monitoring wells and are similar to conclusions found in previous Annual Reports.

1) The potentiometric surface maps drawn for the Shallow and Deep aquifers beneath the site support the supposition that monitoring Wells 24 and 23, 26, and 1 and 2 are located hydraulically upgradient of the facility and should serve as background monitoring wells.

Table 3.2. Comparison of groundwater quality in the Jackson Group.

Parameter[1]	Jackson Group					
	Regional[2]		White Bluff 1994		White Bluff Background[3]	
	Min	Max	Min	Max	Min	Max
pH (su)	3.3	8	3.6	8.9	5.8	8.9
TDS (mg/L)	83	5,330	100	2,748	100	2,748
Sulfate (mg/L)	1.4	2,400	12	1,400	12	1,227
Chloride (mg/L)	1.8	850	3	802	3	71
Sodium (mg/L)	2.2	450	8	321	8	36

[1]Concentrations in mg/L unless otherwise noted.
[2]Data for 68 wells sampled between 1949 - 1966 was provided by the USGS.
[3] Range of values for monitoring Wells 23, 24 and 26

2) Statistical differences in TDS, sulfate, sodium, and chloride suggests the plant may be affecting groundwater quality near the Cooling Towers, beneath the Coal Storage Yard, in the vicinity south of the Recycle Ponds, and possibly near Lake Shurgar; however, these effects are within the range of background water quality reported for the Jackson Group.

3) As expected for lithologies in the Jackson Group, groundwater quality is poor and generally not suited as a potable water supply. TDS was higher than the 500 mg/L SMCL in 9 shallow wells (including background wells) and 5 deep wells. Sulfate was higher than the 250 mg/L SMCL in 9 shallow wells (including a background well) and 7 deep wells (including background wells), and chloride was higher than the 250 mg/L SMCL in 2 shallow wells.

4) Organic compounds that were monitored are not present in groundwater beneath the facility.

5) Nickel and lead are not present in significant concentrations in groundwater beneath the site, that is, they did not exceed MCLs.

6) Based on a literature review and a review of data from the Jackson Group wells at the site, water quality beneath the site that would include any effects from plant activities is within the range of background water quality.

7) The migration of groundwater from areas beneath the site to Jackson wells within 1 mile of the plant site or to wells completed in the Cockfield and Sparta aquifers is unlikely because the plant site is within a hydrologically isolated system that is bounded by streams and thick, low permeability subsurface materials, and domestic wells are likely located hydraulically upgradient.

8) FTN's audits of Entergy's groundwater monitoring operations have resulted in the following conclusions:

   a) Field and laboratory personnel associated with the operations are well trained and knowledgeable of the tasks (sampling and analytical) that they perform,

b) The field equipment and laboratory instrumentation that is utilized is in good working order and well maintained,

c) System Chemistry personnel follow appropriate sampling and analytical protocols during the groundwater operations in the field and laboratory and these protocols are documented,

d) Sampling activities (including field analyses and field QA/QC) are well organized, completed according to applicable guidance from EPA and Standard Methods, and are carefully documented, and

e) Analytical protocols and laboratory QA/QC are based on EPA accepted methodologies.

Based on the above conclusions and regional/historical groundwater data, the data generated by the System Chemistry groundwater monitoring operations/ program are considered to be representative of groundwater quality at the White Bluff Plant.

4.0 PLANNED 1995 PROGRAM ADJUSTMENTS

AP&L plans to continue annual groundwater monitoring at its White Bluff Plant. Based on a review of the 1994 groundwater monitoring program data, AP&L does not anticipate significant program changes in 1995. However, AP&L proposes to remove organic compound analysis from the program because the volatile and semivolatile compounds that were monitored have not been found in groundwater beneath the facility in 4 years of sampling. In addition, statistical trend analysis will be evaluated for use in detecting and quantifying changes in groundwater quality that might indicate decline or improvement in water quality conditions beneath the White Bluff Plant.

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APPENDIX A

Sampling and Analysis Plan

INDEPENDENCE AND WHITE BLUFF STEAM ELECTRIC STATIONS
GROUNDWATER MONITORING PROGRAMS
1993 SAMPLE AND ANALYSIS PLAN

1.0 INTRODUCTION

This Sample and Analysis Plan will govern activities associated with the groundwater monitoring programs for the White Bluff and Independence Steam Electric Stations. Elements of this S&A plan include procedures and techniques for sample collection, sample chain-of-custody control and field and laboratory quality assurance/ quality control procedures.

2.0 SAMPLE COLLECTION PROCEDURES

2.1 SAMPLING AND ANALYSIS PERSONNEL

Entergy power plant and Entergy Services. Inc. (ESI) System Chemistry personnel will determine water levels and acquire groundwater samples from monitoring wells installed at White Bluff and Independence Steam Electric Stations.

Field and laboratory analyses will be conducted by Entergy power plant and/or System Chemistry personnel. Contract laboratories may be utilized for some analytical parameters.

It is recognized that the quality of analytical data derived from any environmental monitoring is heavily dependent upon the expertise of the involved personnel. Therefore, all personnel involved in the acquisition and analysis of samples associated with the groundwater monitoring projects shall be trained for the task to which they are assigned and be thoroughly familiar with the elements of this S&A Plan.

2.2 SAMPLING FREQUENCY

Frequency of sampling for chemical characterization of groundwater is to be quarterly. Piezometric readings and gross water quality field analyses (pH, specific conductivity, and temperature) will be performed quarterly. If analytical results for a sample acquired from a given well indicates significant changes, the affected well(s) will be re-sampled as soon as practicable in order to verify the data.

2.3 SAMPLING METHODOLOGY

Major activities that will occur during a groundwater sampling event are summarized as follows:

- Schedule sampling date with power plant staff
- Assembly and preparation of equipment and supplies
- Groundwater field measurements and sampling
- Sample preservation and transport
- Field data/chain-of-custody record archiving
- Sample analysis
- QA\QC and sample analytical data evaluation
- Data archiving (QA\QC and sample analytical results)
- Comparison of upgradient/downgradient well data
- Report generation

2.3.1 Scheduling of Sampling Date

Efforts will be made to have quarterly well sampling events occur on approximately the same date during each quarter. However, power plant /System Chemistry activities and/or weather conditions may occasionally necessitate slight deviations from this schedule.

2.3.2 Assembly and Preparation of Equipment and Supplies

2.3.2.1 Field Instrumentation and Sampling Apparatus

Prior to each sampling event, all required equipment will be inventoried and verified to perform to manufacturer's specifications. Any test equipment requiring repair that cannot be performed by the operator should be removed from service and alternate equipment substituted. Defective equipment should be repaired or replaced as soon as possible.

2.3.2.2 Equipment Decontamination

Prior to each sampling event all apparatus and equipment that will contact or contain the sample will be thoroughly cleaned before use unless purchased "EPA clean". EPA cleaning protocols will be used where practicable with the following materials:

- All sample containers except volatile organic compounds; and sample bailer and bailer cable initial cleaning.
- Sample containers for volatile organic chemicals
- Electronic water level indicators should be rinsed with Type I distilled water before use and between wells.

- Membrane filters for trace metal sample filtration will be purchased as disposable preassembled units. Tygon tubing for the peristaltic pump will be cleaned using EPA general cleaning procedure with the omission of the hexane rinse and packaged in individual plastic bags.
- Garden sprayers used for field cleaning apparatus should be emptied and refilled with fresh demineralized water immediately before a sampling event. Note: these sprayers are to be filled with de mineralized water only.

2.3.2.3 Sample Container Kit and Field Notebook Preparation

As a part of each sample trip preparation, a sample log sheet will be generated that will assign each location a discrete laboratory sample identification number. The sample identification number consists of a five-digit number. The first two digits from the left correspond to the sample year and the remaining three digits are arranged 001-999 in consecutive order. Therefore, 93001 would correspond to the first sample acquired during 1993. The sample log sheet is archived in the System Chemistry sample groundwater log book.

The sample log sheet is then used to generate a container label packet for each sample location. These labels will bear the following information:

1. Site name.
2. Location name.
3. Container fill order
4. Laboratory sample I.D. number
5. Analytes to be measured
6. Date sampled
7. Collection time
8. Sample team
9. Sample holding time
10. Sample expiration date
11. Remarks-- preservatives, storage temperature, or special consideration in collection

A copy of the site map for the facility being sampled will be obtained and a sampling strategy determined. Once the well sampling sequence is finalized, the map will be marked to correlate the sample location to the ice chest that will contain the corresponding sample container kit. A copy of the sample log sheet, site map, field date sheets and field instrument calibration sheets are then assembled into a notebook that will accompany each sampling team into the field and will be archived as a permanent record upon returning to the laboratory.

The required sample preservatives will be added to the cleaned sample

containers and the containers will be grouped into the appropriate type and number for each sample location. Each sample container in the group will be labeled and the cap verified to be tightly sealed. Sample bottles containing nitric acid as a preservative shall be sealed in a plastic bag. This is done as a precaution against breakage and to ensure isolation of any acid vapor from the other sample containers. 2.5 -liter amber glass jugs for containing semi-volatile organic samples should be placed in either a bubble-pak ziplock bag, covered with bubble-pak plastic or placed inside protective plastic webbing as protection against breakage. Volatile organic sample containers should be placed in a bubble-pak pouch as a precaution against breakage. All the containers within each sample location group will then be placed in a plastic bag marked with the sample location on the outside and will be placed into the appropriate ice chest as determined by the sampling sequence. The outside of each ice chest will be marked so as to identify the groups contained within.

2.3.3 GROUNDWATER SAMPLING

2.3.3.1 Well Evacuation/Sample Collection Equipment

Monitoring well will be evacuated utilizing either fluorocarbon resin (Teflon) bailers attached to polypropylene rope or bladder pumps with Teflon-lined discharge lines. Bailer and rope assembly will be thoroughly rinsed before beginning sampling and between well with Type I demineralized water and housed in a PVC tube for transport between wells and for storage. Groundwater samples will be collected using teflon bailer and cable assembles dedicated to the individual well. Sample collection assemblies will be stored in situ suspended in the well casing between sampling events.

2.3.3.2 Well Head Security

All monitoring wells should be protected by installation of a locked steel overcap that is anchored into the concrete apron surrounding the casing. Access to the lock key shall be restricted only to personnel directly involved in the monitoring project in order to protect the integrity of the monitoring point. The security cap will remain locked in place between sampling events.

2.3.3.3 Field Testing Instrumentation Calibration

All field testing equipment will be calibrated at the first well head in the following manner:

- pH meters will be calibrated to commercially prepared buffers at the pH 4.00, 7.00, and 10.00 S.U. levels.

- Conductivity meters will be calibrated the 75, 200, 720, and 2000 uohm activity levels with commercially available conductivity standards.

- Turbidity meters will be calibrated to 0.1, 1.0, 10.0 and 100.0 NTU Formazin turbidity standards.

- Temperature readout of meters will have been verified against NIST-traceable thermometers prior to use.

- "Electric tape" water level measurement devices will be verified to be in working order.

All field instrumentation calibration data will be recorded on the calibration log forms contained in the field data notebook.

2.3.3.4 Well Evacuation and Sampling Methodology

Prior to opening the well casing cover all debris is removed from the vicinity of the well. A new clean plastic trash bag will be placed over the well casing and secured to the top with duct tape so that only the interior of the casing is visible. This will prevent the contamination of equipment that inadvertently contacts the outside of the casing.

Applicable data (date, time, etc.) will be entered on the well survey report form for the well being sampled.

The well casing cap will be removed and any odors emanating from the casing interior will be noted on the well survey report form. Every person handling sampling equipment will don a clean pair of disposable latex (or similar) gloves.

2.3.3.5 Water Level Measurement

Depth below ground-level to the top of the water column is determined by lowering the electric tape probe until the annunciator and/or indicator light illuminates. Depth is determined by comparing relative positions of gradations on the tape to the survey benchmark on the top rim of the well casing. This reading is recorded on the well survey report form to the nearest 0.01 feet. The electric tape is withdrawn from the casing and the probe examined for any evidence of low-density organic compounds (floaters) and their presence noted on the well survey report form.

2.3.3.6 Well Bore Evacuation

In order to ensure collection of a representative groundwater sample, "stagnant" water will be removed from the well bore. This will be accomplished by removing three well water column volumes of water from the well casing in high yield aquifers or by bailing until dry in wells in low yield formations (Note: do not allow recharge water to cascade in well.) The quantity of water required to be purged from the well will be calculated according to the formula on the well survey report form. When using bladder pumps to purge the well casing the discharge rate of the pump should be determined and time on/time off noted in order to verify removal of the required water volume. If warranted, water purged from the wells will be collected and transported to the facility waste water processing system.

2.3.3.7 Sample Extraction

When extracting the sample by bailer, it will be lowered gently to minimize splashing and retrieved from the water surface slowly to minimize surface agitation or vacuum formation in the water column. The first bailer volume removed for sampling shall be analyzed for pH, specific conductivity, temperature and turbidity. These values will be recorded on the well survey report form. Subsequent bailer volumes will be utilized for laboratory analysis. Sample containers will be filled in the following order(if applicable):

- Volatile organics (VOA)
- Semi-volatile organics
- Trace metals
- Unpreserved (including total alkalinity)
- Nitrate

Sample containers will be filled completely full to minimize headspace so as to preclude volatilization of organic compounds.

Sample containers will be tightly sealed, replaced in any protective overwrap, replaced in plastic kit bag and returned to ice chest. Upon filling all kits within an ice chest, ice (in bags) will be placed on top of samples and maintained until transported to the System Chemistry laboratory where they will be

stored at < 4.C.

3.0 SAMPLE CHAIN-OF CUSTODY

3.1 SAMPLE CONTAINER SEALS

Since the samples will remain in ESI System Chemistry's custody from acquisition until analysis, the use of security seals is deemed unnecessary.

3.2 FIELD LOGBOOK

A field logbook containing the well survey report forms for the well to be sampled will be an integral part of the required sampling supplies.

3.3 SAMPLE CHAIN-OF CUSTODY

If samples are retained in ESI custody from acquisition through analysis, the well survey report will suffice as a chain-of-custody document. However, if a sample is submitted to an independent analytical laboratory for analysis, a sample chain -of-custody record will be required from that laboratory. All well survey reports and contract laboratory sample chain-of-custody forms will be archived as permanent records.

3.4 ANALYSIS NOTEBOOKS

All phases of sample preparation and analysis, including extractions and digestions, will be documented in analysis notebooks for each analytical parameter and archived as permanent records.

4.0 GROUNDWATER SAMPLE ANALYSIS

4.1 ANALYTICAL PROCEDURES

All procedures for the analysis of groundwater samples obtained in support of this project shall conform to the United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, SW-846 , Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Vols. IA, IB, IC, AND II, Third Edition, Rev.1, December 1987 or equivalent as specified by 40CFR part 136. Specific analytical parameters, SW-846/40 CFR Part 136 procedure reference numbers and PQL's are designated in Attachment I .

5.0 FIELD AND LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Project analytical data validation shall begin with the initial phases of preparation, follow throughout every phase of a sampling event and will consist of the following:

- Sampling and analysis procedure training
- Field instrumentation operational status verification
- Preparation of trip blanks. field spike samples and field blanks
- Field instrumentation calibration documentation
- Documentation of field activities on the well survey report
- Documentation and justification on the well survey report of field sampling activities contrary to the S&A plan.
- Sample chain-of custody documentation
- Audit of independent analytical laboratory QA/QC, analytical, and sample handling/storage procedures if necessary

5.1.1 SAMPLING AND ANALYSIS PROCEDURE TRAINING

Personnel involved in the sample acquisition and/or sample analysis phase of this project shall review all components of the S&A Plan and receive "hands on" training on the task for which they are responsible.

5.1.2 PREPARATION OF TRIP BLANKS, FIELD SPIKES AND FIELD BLANKS

It should be required to prepare trip blank , field spike and field blank samples for every sampling event. These samples are prepared as follows:

5.1.2.1 Trip Blank

Prepared by adding laboratory Type I deionized water to a kit of cleaned sample containers with all preservatives added. These containers will be placed in their respective ice chests upon departure to the plant site and shall accompany the other samples through all phases of sample storage, preparation and analysis. This provides a check on container cleaning, sample storage and sample processing techniques.

5.1.2.2 Field Spikes

Prepared by adding, to half capacity, commercially (or EPA) prepared multi-element inorganic check standards to a kit of clean sample

bottles containing all required preservatives. Sample containers will be placed in ice chests and upon arrival at a previously selected well head will be filled to capacity during sample collection at that location. Wells selected for the spike sample will be rotated quarterly until all wells have been included. The cycle will then be repeated. Field spikes will accompany the other samples throughout all phases of sample storage, preparation and analysis.

5.1.2.3 Field Blanks

Prepared by adding Type I deionized water that is transported from the ESI System Chemistry Laboratory to the plant site into a kit of cleaned sample bottles containing all required preservatives at a preselected well head. Sample bottles are transported to the site in their respective ice chests, filled and then returned to the ice chests and shall accompany the other samples through all phases of sample storage, preparation, and analysis.

5.1.3 DOCUMENTATION OF FIELD INSTRUMENTATION CALIBRATION

Field instrumentation calibrations will be performed at the first well head prior to being used during a sampling event. Calibrations will be performed according to manufacturer's specifications and the results will be recorded on the instrument calibration log sheet. These logs will be archived as permanent records.

5.1.4 DOCUMENTATION OF FIELD ACTIVITIES

All field activities and measurements will be recorded in the appropriate space on the well survey report. These reports will be archived as permanent records.

5.1.5 DOCUMENTATION AND JUSTIFICATION OF ACTIVITIES CONTRARY TO THE PROJECT S&A PLAN

Any deviation from the S&A Plan during a sample event shall be documented in the comments section of the well survey report form. This documentation will include justification for the deviation. Unusual circumstances should also be noted on the well survey report (e.g., plant maintenance activities that could influence field readings and/or analytical results.

5.1.6 SAMPLE CHAIN-OF-CUSTODY DOCUMENTATION

Sample chain-of-custody documentation will be required for sample analysis by independent analytical laboratories and will be archived as a permanent record.

5.1.7 AUDIT OF INDEPENDENT ANALYTICAL LABORATORIES

If independent analytical laboratories are utilized for the analysis of samples from this project, periodic audits will be conducted. Scope of these audits should include sample chain-of-custody integrity; procedures for sample storage, preparation and analysis; and laboratory QA/QC procedures. Results of these audits will be compiled as a report and archived as a permanent record.

5.2 SYSTEM CHEMISTRY WATER QUALITY LABORATORY QA/QC PROCEDURES

The analytical laboratory portion of the QA/QC for the groundwater monitoring project shall consist of the following individual components:

- Utilization of EPA-approved procedures
- Analytical procedure training
- Laboratory instrumentation's maintenance/calibration procedures
- Verification of sample extraction/concentration procedures
- Utilization of multiple point calibration curves
- Utilization of surrogate compounds and internal standards in the analysis of organic compounds
- Utilization of BFB and DFTPP GC/MS tuning
- Maintenance of an organic analysis extraction log
- Analysis of intralaboratory (accuracy) standards
- Analysis of duplicate (precision) samples
- Analyses of matrix spikes
- Computerized statistical inorganic QA/QC data comparison utilizing +/- two sigma warning limits and +/- three sigma control limits
- "Blind" analysis of commercially prepared inorganic quality control standards quarterly

5.2.1 UTILIZATION OF EPA APPROVED PROCEDURES

EPA SW-846 analytical methods or equivalent as approved under 40 CFR Part 136 shall be used for all analyses performed in support of this groundwater monitoring project.

5.2.2 ANALYTICAL PROCEDURE TRAINING

All personnel involved in the analysis of samples acquired in support of this project shall be thoroughly trained for the task to which they are assigned.

5.2.3 VERIFICATION OF SAMPLE EXTRACTION/CONCENTRATION PROCEDURES

All extraction/concentration procedures, distillations and digestions shall be verified to provide sufficient analyte recovery through the utilization of field spikes, surrogates, and matrix spike samples.

5.2.4 STANDARD CALIBRATION CURVES

A minimum of four calibration points will be utilized for all calibration curves. New calibration curves will be generated for each sample batch. Reagent blank corrections shall be made where applicable. All calibration curves shall be archived as permanent records.

5.2.5 USE OF SURROGATE AND INTERNAL STANDARDS

Surrogate and internal standards shall be utilized for all GC/MS determinations.

5.2.6 USE OF EPA GC/MS TUNING CRITERIA

GC/MS system shall be tuned to BFB and DFTPP acceptance criteria for the analysis of volatile and semi-volatile organic compounds, respectively.

5.2.7 USE OF GC/MS SYSTEM PERFORMANCE CHECK STANDARDS

GC/MS system will be evaluated using the system performance check standards prior to the analysis of each sample batch.

5.2.8 ORGANIC CHEMICAL ANALYSIS EXTRACTION LOG

A log shall be maintained of samples extracted for semi-volatile organic compound determinations. Sample status will be tracked using laboratory sample log numbers.

5.2.9 ANALYSIS OF INTRALABORATORY ACCURACY QUALITY CONTROL STANDARDS

Intralaboratory accuracy standards shall be prepared using standard reference materials as solutes. Analytes will be prepared as combined standards in synthetic matrices if feasible. Otherwise, the material will be dissolved in Type I reagent water as individual standards. Accuracy standards shall be analyzed after every eighth sample or every time analyses are performed if batch size is less than eight.

5.2.10 ANALYSIS OF DUPLICATE PRECISION SAMPLES

Every eighth sample collected in a sampling event shall be a duplicate and shall serve as a precision check for all aspects of sample storage, preparation and analysis.

5.2.11 ANALYSIS OF MATRIX SPIKES

Matrix spikes shall be prepared by diluting accuracy standards in a 1:1 ratio with duplicate standards. These analyses shall provide information of matrix effects on analyte recovery.

5.1.12 STATISTICAL TRACKING OF QA DATA

Inorganic accuracy, precision ad matrix spike quality control data will be statistically evaluated at the +/- two sigma warning and +/- three sigma control limits utilizing computer software.

5.1.13 ANALYSIS OF COMMERCIALLY PREPARED QUALITY CONTROL STANDARDS

Commercially (or EPA) prepared inorganic wastewater/drinking water quality control check standards shall be analyzed once per quarter on a "single blind" basis when available.

6.0 DATA EVALUATION AND REPORTING

6.1.1 Reporting of Low and Zero Concentration Values

Detection limits for analytical parameters monitored by this project are specified in Attachment I. These limits will be consistently applied to analytical data generated between sample locations as well as between sampling intervals.

6.1.2 Statistical Analysis of Data

Statistical evaluation methods will be applied to the analytical data derived from these programs upon acquisition of an adequate data population.

6.1.3 Report Frequency

1993 annual reports for these programs will be generated during the first quarter of 1994 and delivered to the appropriate people upon completion.

7.0 PLANNED 1993 PROGRAM ADJUSTMENTS

Prior to 1993, water level adjustments were made on a monthly basis. However, in 1993 water level measurements shall be performed once per calendar quarter at both ISES and WBSES during a twenty-four hour period, and preferably during an eight hour span at each plant.

Groundwater samples shall not be filtered for metals analysis at either plant site unless the turbidity exceeds 100 NTU. (The third and fourth quarter samples shall not be filtered for all parameters,except TDS, unless the turbidity exceeds 100 NTU.

Mercury analyis of groundwater samples from ISES shall be discontinued and cadmium, selenium, and arsenic analysis of groundwater samples from WBSES shall be discontined because analysis of these metals have historically been at or below the detection limits set for these parameters.

ENTERGY SERVICES, INC., SYSTEM CHEMISTRY
ANALYTICAL PROCEDURES REFERENCE LIST
1993 INDEPENDENCE AND WHITE BLUFF SES GROUNDWATER MONITORING PROGRAMS

PARAMETER	PROCEDURE NUMBER	40 CFR PART 136/SW-846 TEST METHODS FOR EVALUATING SOLID WASTES REFERENCE METHODS	PQL (mg/L)
COLORIMETRIC/GRAVIMETRIC/TITRATION (Unfiltered sample except TDS)			
BORON	212.3	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.20
CHLORIDE	407.A	STD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER	1.0
FLUORIDE	340.2	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.20
NITRATE-NITRITE (SCREEN)	4500D	STD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER	0.50
SULFATE	600/4-79-020	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	5.0
TOTAL DISSOLVED SOLIDS	160.1	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	1.0
TRACE METAL PROCEDURES		(TOTAL METALS, unless turbidity exceeds 100 NTU)	
ALUMINUM	7020	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.10
IRON	7380	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.1
MOLYBDENUM	7481	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.025
TITANIUM	283.2	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.025
ARSENIC	7060	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.005
CADMIUM	7131	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.001
CALCIUM	7140	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	1.0
CHROMIUM	7191	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.005
LEAD	7421	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.001
MAGNESIUM	7450	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	1.0
MERCURY	7470	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.0005
NICKEL	249.2	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.005
SELENIUM	7740	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.005
STRONTIUM	I-1800-85	USGS-- METHODS FOR DET. OF INORG. SUBST. IN WATER AND FLU. SED.	0.01
SODIUM	7770	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	1.0

SYSTEM CHEMISTRY

MISSING DATA FOR 1991-92 SAMPLES - GROUNDWATER PROGRAM

SAMPLE	EXPLAIN.	CODE
92066 PRODUCTION WELL D COLLECTED - 3/19/92	OUT OF SERVICE AND/OR NO IN-LINE SAMPLING PORT	0S
92227 WELL D-503 METALS (TOTAL) COLLECTED - 9/23/92	SAMPLE BOTTLE LOST OR BROKEN	LS
92251 WELL D-508 METALS (TOTAL) COLLECTED - 9/23/92	SAMPLE BOTTLE LOST OR BROKEN	LS
91102 PRODUCTION WELL D COLLECTED - 3/19/91	OUT OF SERVICE	0S
91097 PRODUCTION WELL A COLLECTED - 3/19/91	OUT OF SERVICE	0S

APPENDIX B

Site Geology and Hydrogeology

APPENDIX B
SITE GEOLOGY AND HYDROGEOLOGY

The purpose of this appendix is to provide background information on local and site geology and hydrogeologic characteristics. This section also repeats information that has been presented in previous annual reports and is included to facilitate the reader's review of the current annual report.

B.1 Site Geology

The White Bluff plant is located on a bluff overlooking the Arkansas River. The surface topography ranges in elevation from 230 to 375 feet National Geodetic Vertical Datum (1929) (NGVD). Before plant construction the surface was rolling hills with some steep slopes. During construction, the plant site was graded by cutting and filling. The site is highly dissected by small creeks and branches that drain primarily south and east to the Arkansas River.

The geologic units underlying the plant consist of unconsolidated Quaternary deposits overlying thick (up to 3,500 feet) Tertiary sediments, of which the Jackson Group is the upper geologic unit. Table B.1 is a stratigraphic column that summarizes the sedimentary units beneath the White Bluff plant.

The Quaternary terrace deposits consist of thin beds of silty and sandy clay that cover the crest of hills with a thickness of up to 30 feet. These deposits have been eroded from the stream valleys and modified by grading of the plant site during construction.

The Jackson Group consists of the Redfield and White Bluff Formations, which consist primarily silty and sandy clay beds with sand and thin lignite beds. Depending on the location and elevation at the plant site, the Redfield Formation is between 90 to 150 feet thick. The White Bluff Formation is about 60 to 100 feet thick. The formation is reported to consist mostly of clay or sandy clay and may have more sand than the overlying Redfield Formation.

Table B.1. Stratigraphic column of geologic formations underlying the White Bluff plant.

System	Series	Geologic Unit		Lithology	Approximate Thickness (Feet)
Quaternary	Pleistocene	Terrace deposits		Silt, sand, clay with gravel	0 to 30
Tertiary	Eocene	Jackson Group	Redfield Formation of Wilbert (1953)	Clay and silt, lignite, and minor amounts of fine sand	90 to 150
			White Bluff Formation of Dall (1898)	Very fine to fine argillaceous sand; fossiliferous silt and clay; in southeast corner of Grant County contains much more clay	60 to 100
		Claiborne Group	Cockfield Formation	Sand, fine to very fine, and Carbonaceous clay	150 to 200
			Cook Mountain Formation	Clay, carbonaceous, sandy; locally glauconitic; contains beds of sand 10-30 feet thick	150 to 200
			Sparta Sand	Sand, medium to very fine; little sandy lignitic clay. Sand occurs as much as 300 feet thick in Grant County; in Hot Springs County, in beds commonly 20-60 feet thick; and in places, 100-feet thick	400 to 500
			Cane River Formation	Clay, lignitic, sandy, and fine sand. Sand occurs commonly in beds 20-60 feet thick; in places, 150 feet thick	150
			Carrizo Sand	Sand, very fine to medium, and carbonaceous lignitic clay. Sand occurs commonly in beds 20-60 feet thick; in places, 150 feet thick	150

Modified from Geraghty and Miller (1984)

The Claiborne Group underlies the Jackson Group and includes the Cockfield Formation, Cook Mountain Formation, Sparta Sand, Cane River Formation, and the Carizzo Sand. Table B.1 provides a brief description of these geologic units. These formations are not included in the groundwater monitoring program. Both the Cockfield Formation and Sparta Sand, however, are regional aquifers. The Cockfield aquifer, which is confined above by the Jackson Group and below by the Cook Mountain Formation, is reported to yield up to 25 gpm to wells. The Sparta aquifer has been used for potable water supply since the early 1900s. Two production wells at the plant produce water from the Sparta aquifer. The groundwater is used for boiler make-up by demineralization, potable water, and sanitary waste system water. Each well is capable of producing 1,000 gpm, and they are pumped alternately with an equivalent pumpage of about one full-time well.

B.2 Target Zones in the Jackson Group

Geraghty and Miller (1984) used the logs of soil borings that were prepared as part of the plant construction program to describe site subsurface geology to a depth of about 60 feet. They identified two silty sandy units in the Jackson Group as target zones and referred to these zones as the "260-foot sand" and the "230-foot sand." These sand units are reported to be 5 to 15 feet thick and are identified by the approximate elevation at which they occur in the section. These sand units were thought to be uppermost aquifers beneath the site, and subsequent groundwater monitoring reports refer to a "260-foot Aquifer" and a "230-foot Aquifer." The 260-foot sand was expected to be the principal conduit for potential contaminants because of its area of occurrence and proximity to the land surface. This annual report largely drops these references and refers to "shallow" and "deep" aquifers instead. An explanation for this change in designation follows.

Figure B.1 shows the relative position of the sand zones on a cross section prepared by Geraghty and Miller (1984). The section is drawn north-south through the plant site near Wells 1 and 2. This cross section clearly shows the existence of two layers of sand; however, the shallowest sand layer is at an elevation of 280 feet national geodetic vertical

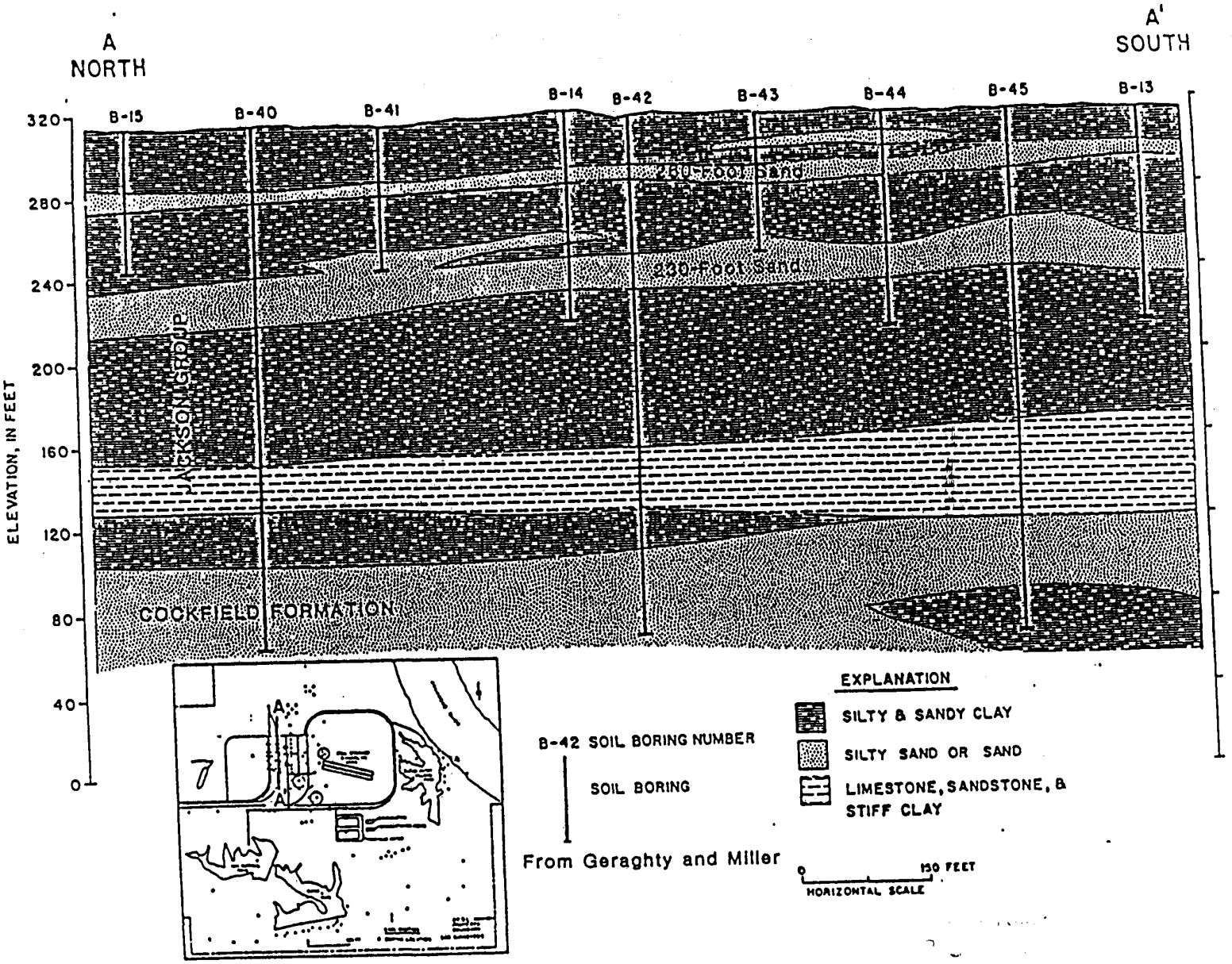


Figure B.1. Geologic cross section beneath the White Bluff plant showing relative positions of the 260-ft and 230-ft sands.

datum (NGVD) and the next unit below that is between 230 and 260 feet (NGVD); that is, there are no distinct "260-foot" and "230-foot" sand layers shown on this section. Furthermore, subsequent drilling for the installation of monitoring wells indicate the presence of sand units between 260 feet (NGVD) and approximately 320 feet (NGVD), but a well defined sand unit at an elevation of 230 feet (NGVD) does not occur, except at the location of Well 22.

Based on the boring logs and well construction data for the plant's monitoring wells, the first two saturated zones that were encountered during drilling were screened for the purpose of groundwater monitoring with lesser importance given to the actual elevation of the saturated zone. For example, monitoring wells screened in the "260-foot aquifer" have screen midpoint elevations from 257 to 281 feet (NGVD). Descriptions of this aquifer include:

- "medium, dense, silty fine sand with lignite partings,"
- "stiff, dark gray, fine sandy clay with light gray fine sandy silt partings,"
- "stiff clay with fine sand partings and pockets," and
- "dense, gray, clayey [or] silty sand."

The "260-foot sand" extends laterally from the plant site but varies in thickness and character and outcrops along the hillsides north, east, and south of the plant area. The sand tends to thin in the direction of the Ash Disposal Area and extends only a short distance downgradient of the plant site.

The "230-foot aquifer" is described as "alternating seams and layers of gray clay and fine gray sand with traces of lignite" at most of the well sites. The screen midpoint elevations of these wells range from 199 to 248 feet (NGVD). The only "sand" layer shown on the boring logs for this aquifer is a 5-foot sand that occurs at an elevation of 234 feet (NGVD) in Well 22. The three wells closest to Well 22 were completed at elevations well below 230 feet (NGVD) without encountering the sand unit observed at Well 22; therefore, this sand unit does not appear to be laterally extensive.

Because the plant's wells monitor the two uppermost saturated zones beneath the site and the "260-foot" and "230-foot" sands are discontinuous, or these sands are not well defined with respect to their approximate elevation, the target zones are referred to as the "shallow" and "deep" aquifers. Neither the shallow nor the deep aquifers produces enough water for use as a water supply, and groundwater from these units discharges from seeps in ravines and hillsides and eventually discharges as surface runoff to the Arkansas River.

B.3 Groundwater Users

To address potential risks associated with degradation of offsite groundwater quality from plant activities, if any, existing groundwater users in the vicinity of the plant were identified in 1993. The survey involved collection of information from various sources and field verification. User data was obtained from a search of well installation records maintained by the Arkansas Geological Commission and later field verified. Table B.2 lists groundwater users within a mile radius of the facility, provides some well information, and indicates if the well is used for domestic water supply or other purpose. The table also indicates observations that were made during field verification. As shown on Figure B.2, there are 6 domestic wells located 0.7 to 0.8 mile south of the property boundary on the downgradient side of the plant. Well construction data concerning depth of completion for these wells were not found; therefore, it can not be determined if these wells were completed in the Jackson Group or deeper aquifers.

Table B.2. Groundwater users located in the vicinity of the White Bluff plant.

Map Identifier	Location	Owner	Distance from site Feet (Miles)	Well Depth	Well Type	Production Rate (GPM)
1a	T3S, R11W, S25	Brown & Root	Inside Property	636.2'	Monitoring	1000
2a	T3S, R11W, S27	Odis Perry	8648 (1.6)	60'	Domestic	3.33
3a	T3S, R11W, S2	George Brittian	7449 (1.4)	435'	Domestic	60
4a	T3S, R10W, S30	Holloway Construction Co.	Inside Property	443'	Domestic	12
5a	T3S, R10W, S32	Lock & Dam 5	2125 (0.4)	552'	Other	25
6b	T4S, R10W, S5	NA	3473 (0.7)	NA	Domestic	NA
7b	T4S, R10W, S5	NA	3491 (0.7)	NA	Domestic	NA
8b	T4S, R10W, S5	NA	4170 (0.8)	NA	Domestic	NA
9b	T4S, R10W, S5	NA	4277 (0.8)	NA	Domestic	NA
10b	T4S, R10W, S6	NA	4852 (0.9)	NA	Domestic	NA
11b	T3S, R10W, S34	NA	1292 (0.3)	NA	Domestic	NA
12b	T3S, R10W, S34	NA	1673 (0.3)	NA	Domestic	NA
13b	T3S, R10W, S4	Cliff Locell	4083 (0.8)	NA	Domestic	NA

a - Sources: Arkansas Geological Commission well construction logs.
b - Field Identified.
NA - Not Available

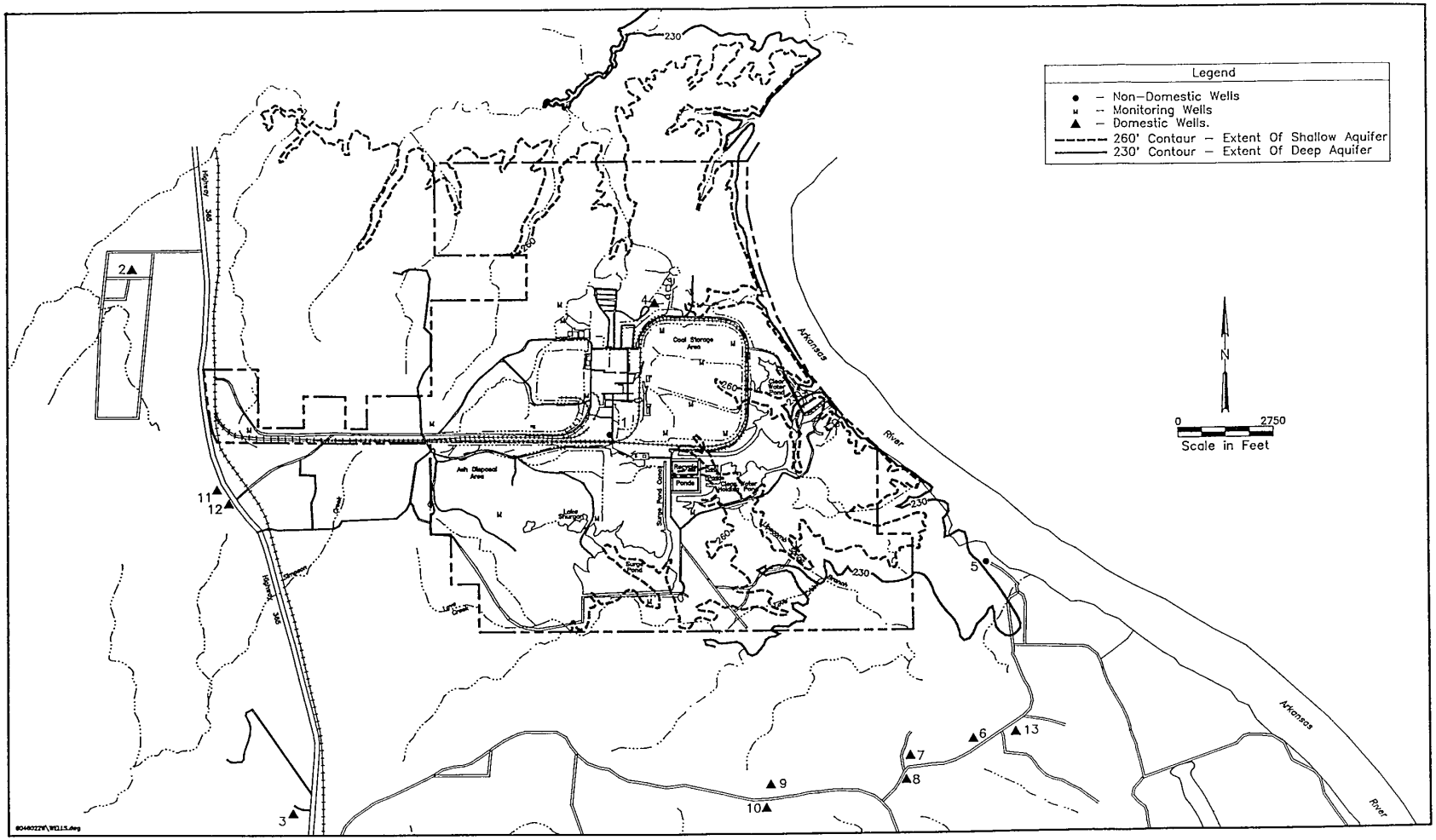
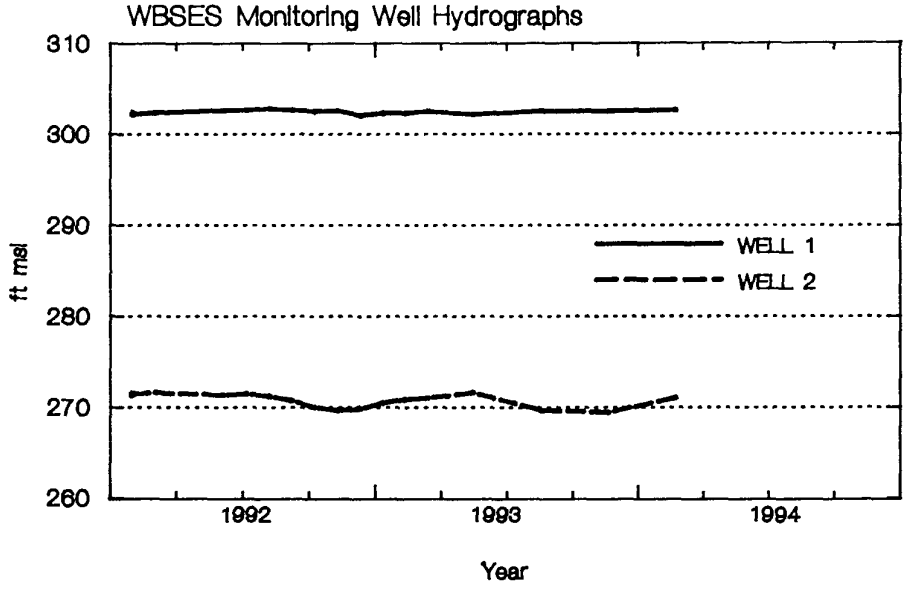
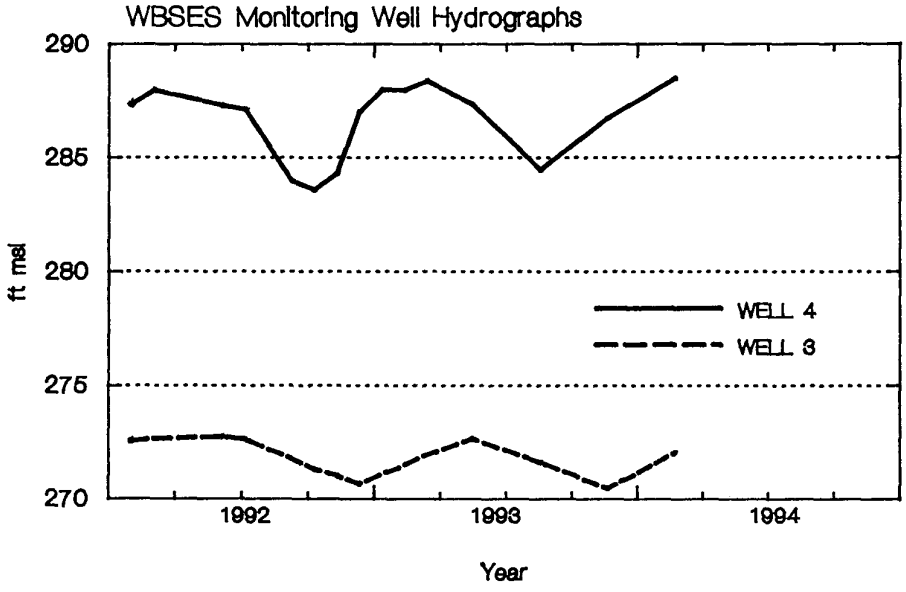


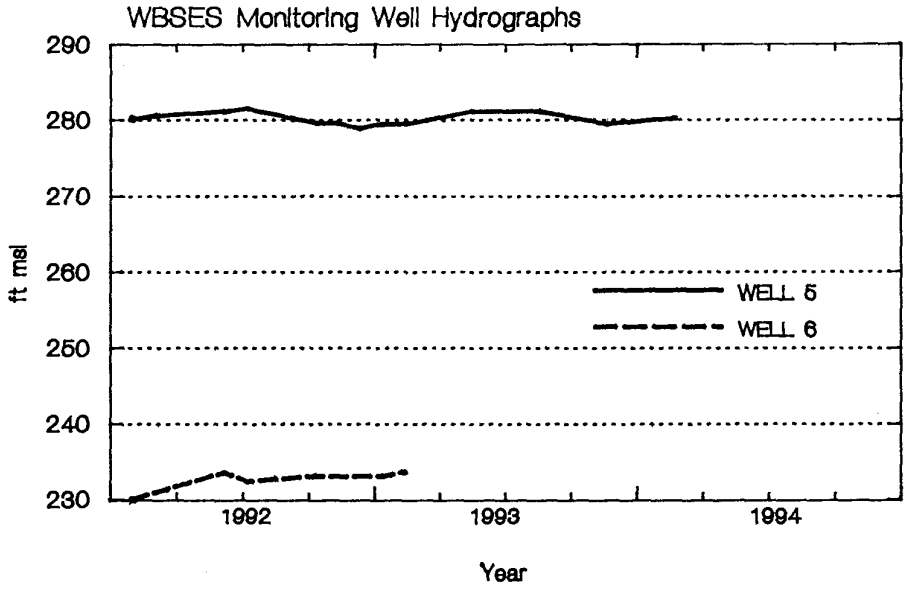
Figure B.2. Groundwater users in the vicinity of the White Bluff plant.

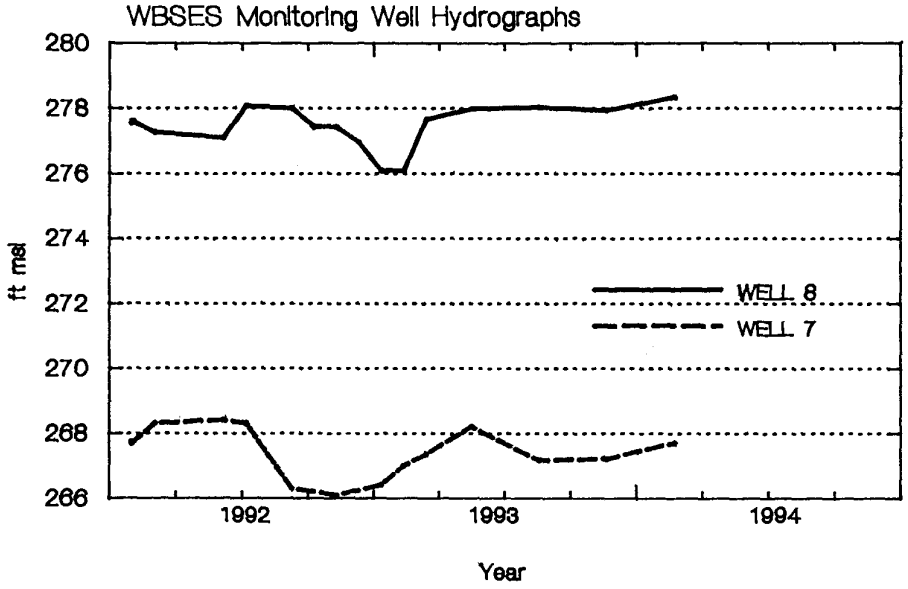
APPENDIX C

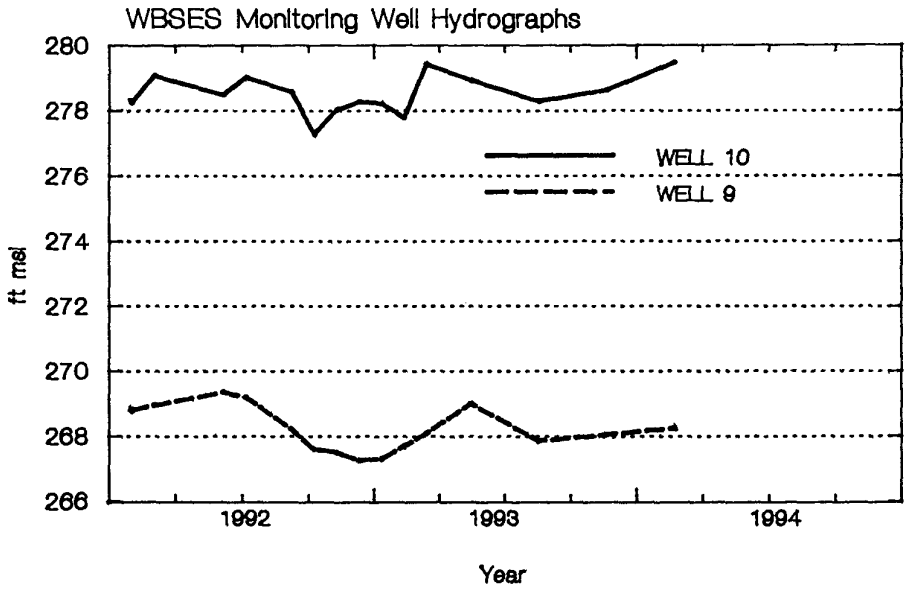
Monitoring Well Hydrographs

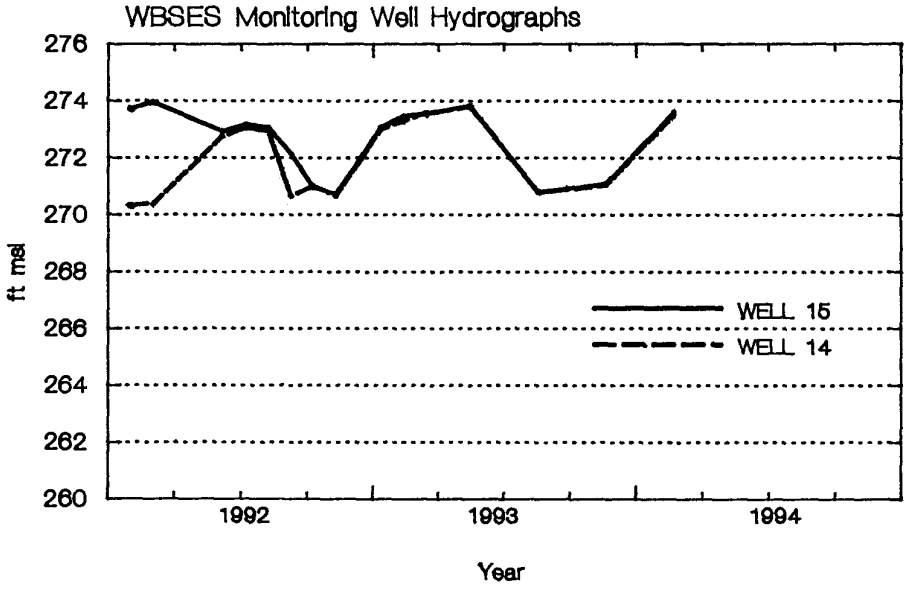

WBSES Monitoring Well Hydrographs
310
300
290
280
270
260
ft msl
1992
1993
1994
Year
WELL 1
WELL 2

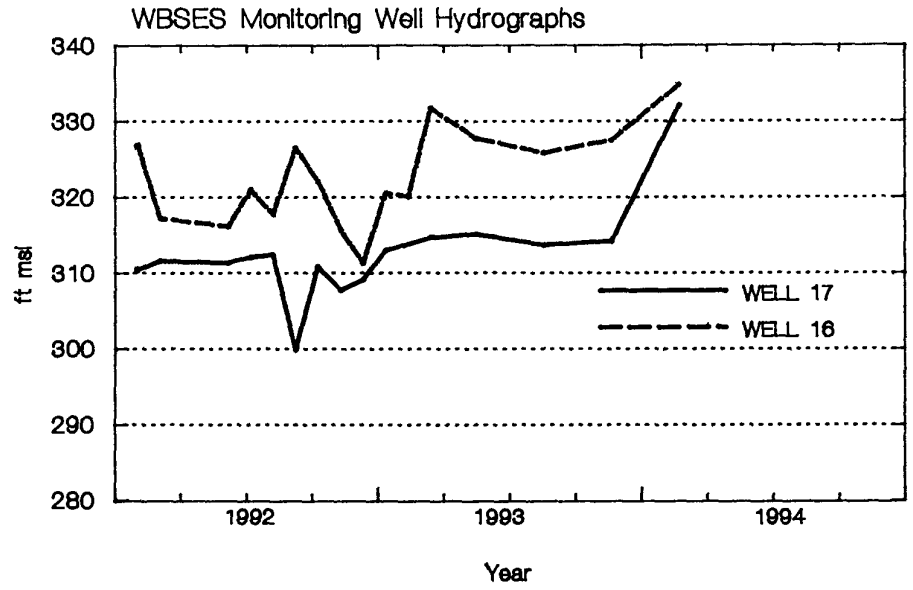

WBSES Monitoring Well Hydrographs
290
285
280
275
270
ft msl
1992
1993
1994
Year
WELL 4
WELL 3

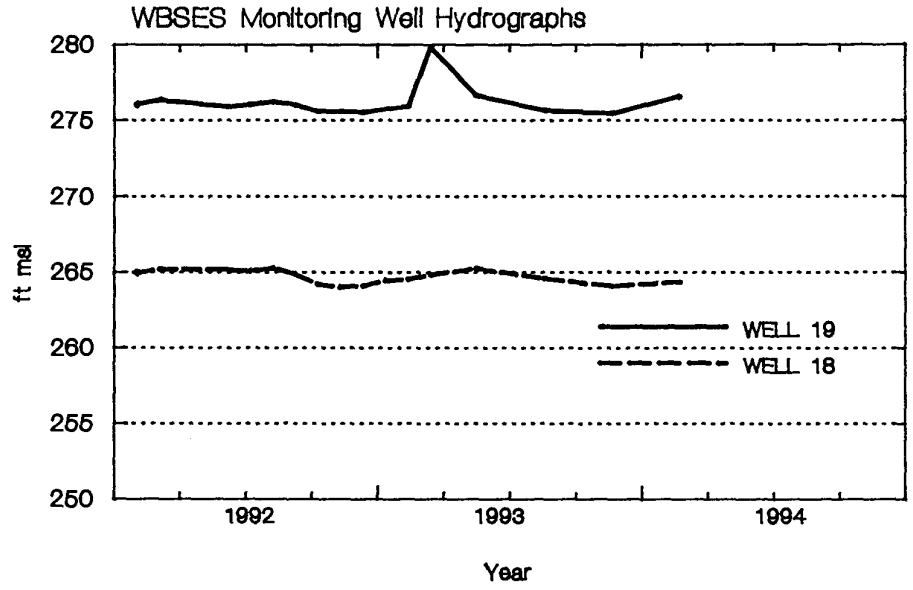

WBSES Monitoring Well Hydrographs
290
280
270
260
250
240
230
ft msl
WELL 5
WELL 6
1992
1993
1994
Year

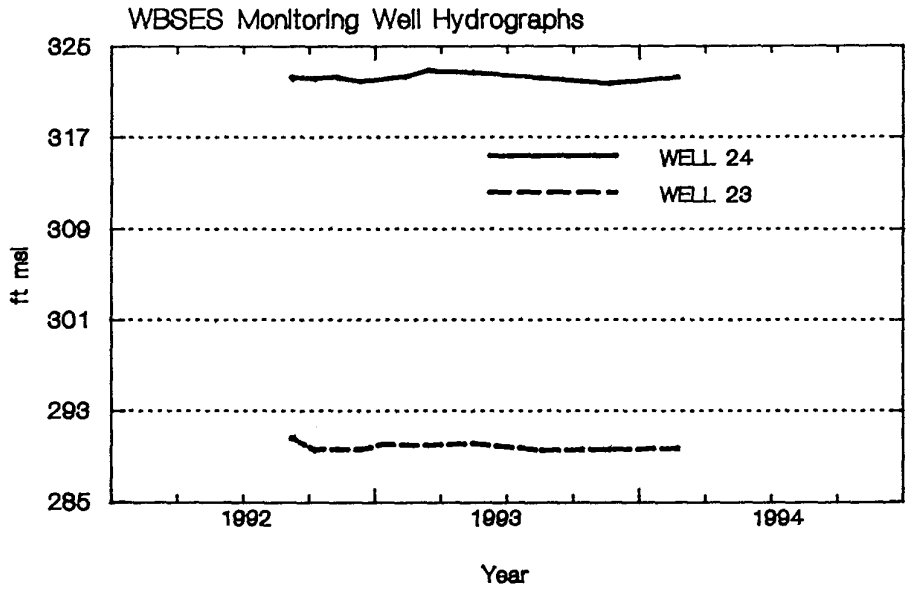

WBSES Monitoring Well Hydrographs
280
278
276
274
272
270
268
266
ft msl
WELL 8
WELL 7
1992
1993
1994
Year

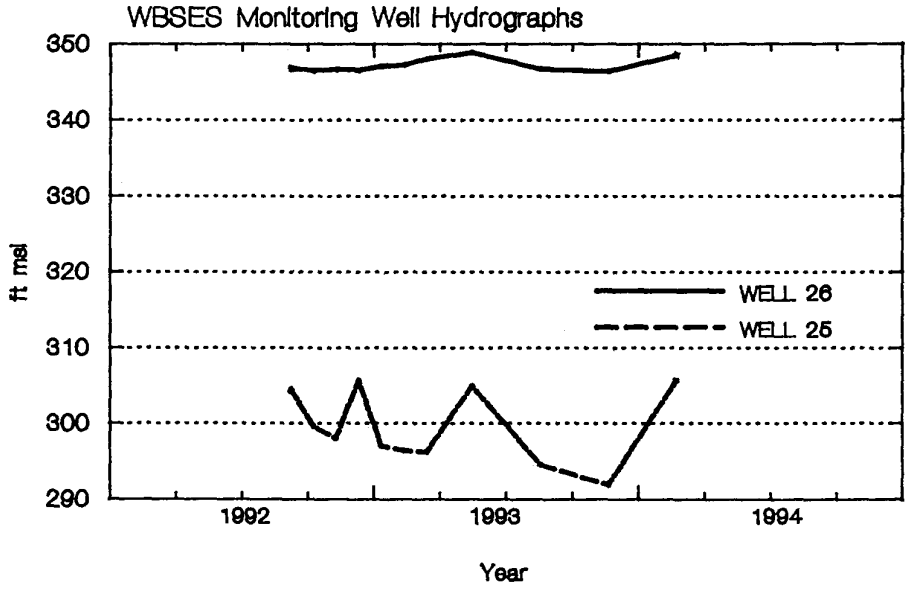

WBSES Monitoring Well Hydrographs
280
278
276
274
272
270
268
266
ft msl
1992
1993
1994
Year
WELL 10
WELL 9

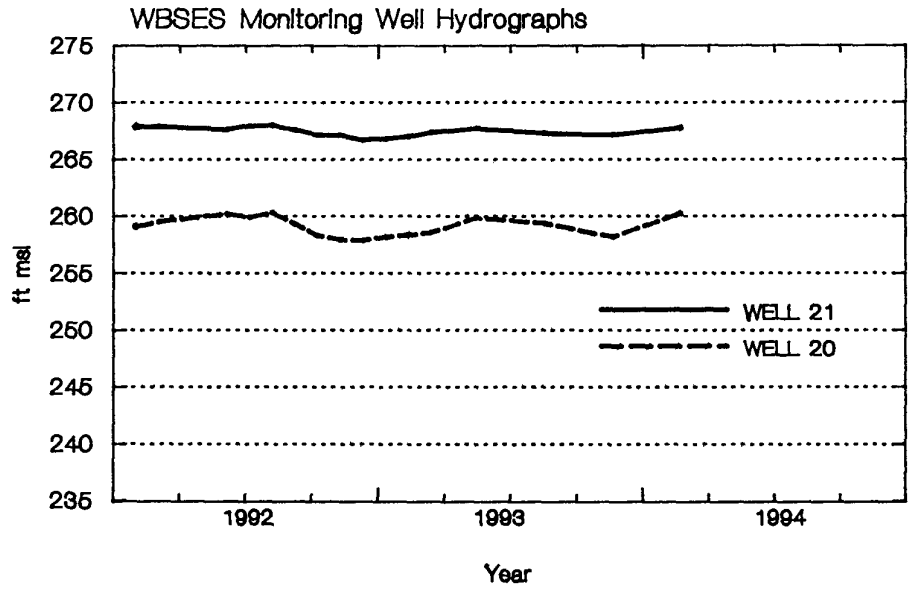

WBSES Monitoring Well Hydrographs
276
274
272
270
268
266
264
262
260
ft msl
1992
1993
1994
Year
WELL 15
WELL 14


WBSES Monitoring Well Hydrographs
340
330
320
310
300
290
280
ft msl
1992
1993
1994
Year
WELL 17
WELL 16

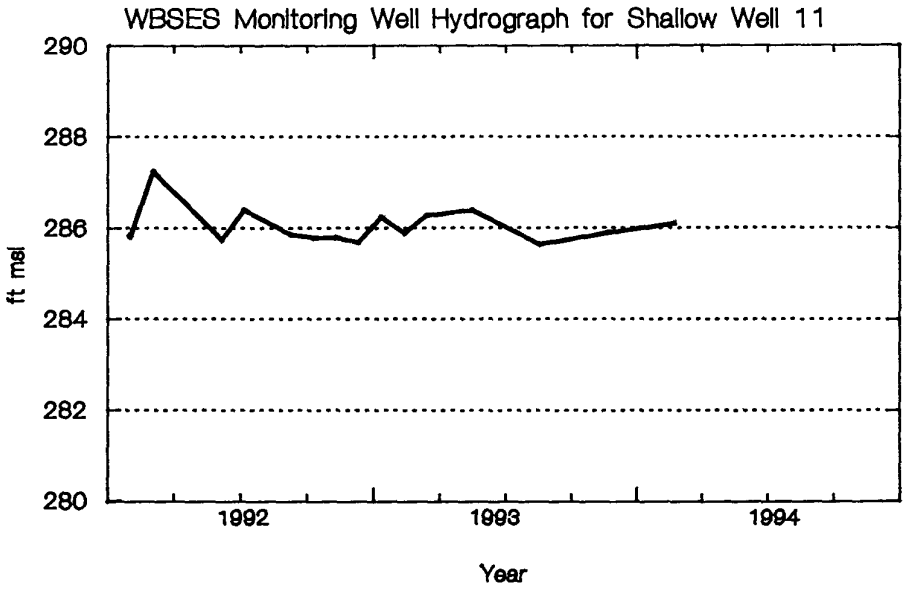

WBSES Monitoring Well Hydrographs
280
275
270
265
260
255
250
ft msl
1992
1993
1994
Year
WELL 19
WELL 18

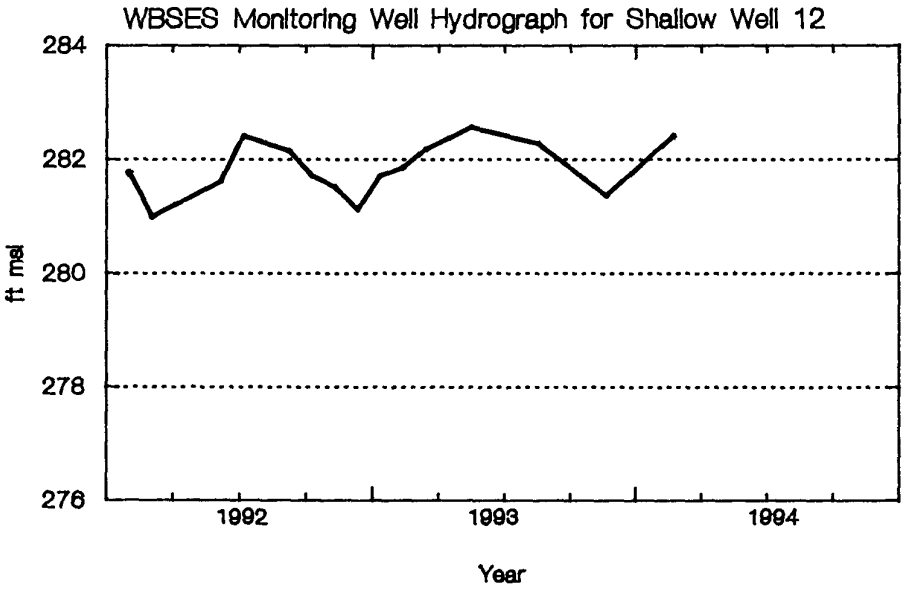

WBSES Monitoring Well Hydrographs
325
317
309
301
293
285
ft msl
WELL 24
WELL 23
1992
1993
1994
Year

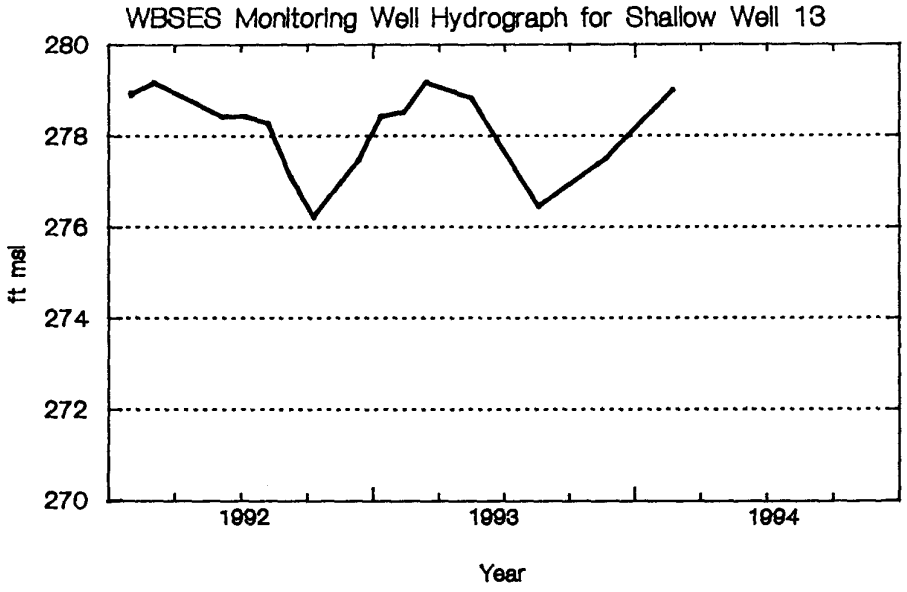

WBSES Monitoring Well Hydrographs
350
340
330
320
310
300
290
ft msl
WELL 26
WELL 25
1992
1993
1994
Year

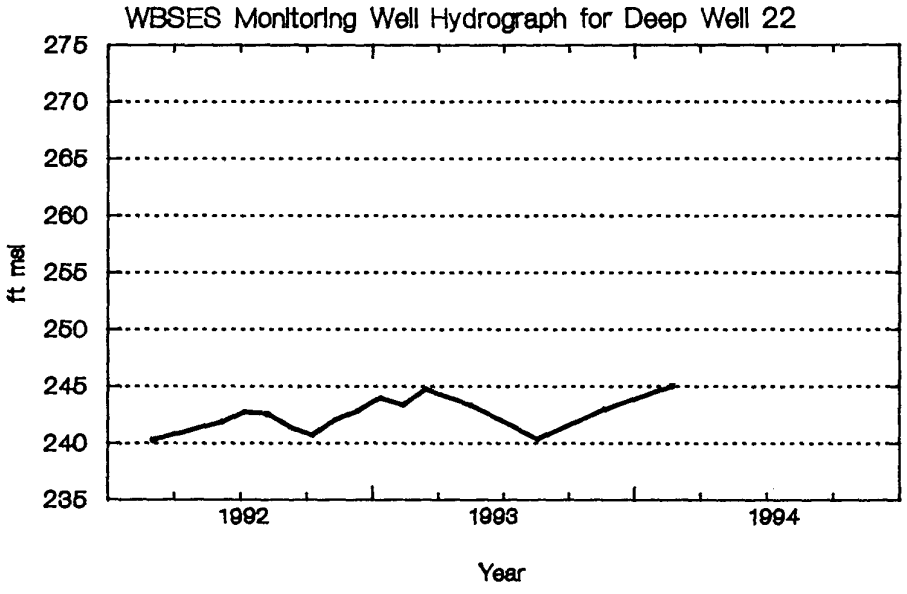


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WBSES Monitoring Well Hydrograph for Shallow Well 11
290
288
286
284
282
280
ft msl
1992
1993
1994
Year


WBSES Monitoring Well Hydrograph for Shallow Well 12
284
282
280
278
276
ft msl
1992
1993
1994
Year


WBSES Monitoring Well Hydrograph for Shallow Well 13
280
278
276
274
272
270
ft msl
1992
1993
1994
Year


WBSES Monitoring Well Hydrograph for Deep Well 22
275
270
265
260
255
250
245
240
235
ft msl
1992
1993
1994
Year

APPENDIX D

Laboratory Data

TOTALS	PLANT:	*WBSES*					SAMPLE DATE:	02/22-23/94		
				SAMPLE NUMBERS						
PARAMETERS	94051	94052	94053	94054	94055	94056	94057	94058	DUP	94059	94060	
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L	L	MATRIX SPIKE	
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L INTRA	L		
NOTED.	D G.W. - 16	D G.W. - 17	D G.W. - 18	D G.W. - 19	D G.W. - 20	D G.W. - 21	D G.W. - 22	G.W. - 23A	D G.W. - 23B	D	D	A + I	B + I
pH (SU)	5.12	5.56	5.58	4.28	3.55	3.88	3.95	7.88	7.88				
COND. (uMHO)	779	1380	1905	1520	1870	1403	417	153	153				
TURB. (NTU)	35.0	11.0	4.8	34.0	0.5	5.4	41.0	38.0	38.0				
W. TEMP. (C)	17.1	17.3	18.3	19.5	17.4	17.3	16.1	17.4	17.4				
ELEV. FT. MSL													
A. TEMP (C)	10.1	10.1	10.6	10.6	13.7	13.7	15.1	7.7	7.7				
TDS	115.0	119.0	1189.0	1264.0	1369.0	968.0	297.0	100.0	109.0	82.0	82.0	85.0	
SULFATE	50.4	44.2	790.3	1145.9	1024.7	661.0	107.9	11.6/290.1	11.6/290.1	24.5	17.3	17.3	
CHLORIDE	3.6	8.4	25.4	37.2	33.0	34.8	19.8	3.0	2.7	10.2	6.3	6.3	
BORON	< 0.20	< 0.20	0.61	0.55	0.21	0.31	< 0.20	< 0.20	< 0.20	0.97	0.53	0.53	
TOTAL ALK.	6.5	6.0	0.0	0.0	0.0	0.0	0.0	42.5	42.0	48.5	44.5	45.0	
FLUORIDE	< 0.20	< 0.20	0.61	0.77	0.82	0.62	< 0.20	< 0.20	< 0.20	1.01	0.56	0.56	
NITRATE	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	2.00	1.83	1.83	
NICKEL	0.007	0.006	< 0.005	0.008	0.083	0.039	0.010	0.011	0.010	0.019	0.013	0.012	
CALCIUM	1.7	3.7	160.8	148.9	113.8	96.9	13.9	14.3	14.2	24.5	19.2	19.4	
MAGNESIUM	< 1.0	1.7	52.2	49.0	53.7	35.0	5.1	1.6	1.6	10.3	6.1	6.2	
SODIUM	10.4	15.7	71.3	66.6	81.0	57.8	25.5	8.0	8.1	41.4	24.9	24.4	
IRON	2.37	1.03	19.90	24.65	1.85	11.52	3.78	1.01	1.02	5.30	3.34	3.32	
STRONTIUM	0.05	0.11	3.54	3.27	1.87	2.00	0.43	0.30	0.30	4.96	2.44	2.48	
ALUMINUM	1.13	1.37	2.08	3.82	25.14	8.03	2.01	1.03	2.26	4.79	3.25	3.92	
TITANIUM	0.054	0.047	0.060	0.053	0.043	0.069	0.054	0.030	0.033	0.104	0.060	0.058	
MOLYBDENUM	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.025	< 0.025	< 0.025	< 0.025	0.099	0.052	0.049	
ARSENIC													
SELENIUM													
CHROMIUM	< 0.005	0.008	0.006	0.007	0.007	0.008	0.006	0.005	0.005	0.021	0.010	0.012	
CADMIUM													
MERCURY	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0019	0.001	0.001	
LEAD	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.005	0.003	0.003	
BN/A ORG. **	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D				
VOL. ORG. **	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D				

** ANALYSES PERFORMED ANNUALLY.

TOTALS	PLANT:	WBSES										SAMPLE DATE:		02/22-23/94	
						SAMPLE NUMBERS									
PARAMETERS	94061	94062	94063	94064	94065	94066	94067	94068	DUP	94069	94070				
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L	L	MATRIX SPIKE			
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L INTRA	L				
NOTED.	D G.W. - 24	D G.W. - 26	D TRIP BLANK	D G.W. - 15	D FLD SPIK + #2	D C/T SUMP	D SURGE POND	D N RECYL POND-A	D N RECYL POND-A	D	D	A + I		B + I	
pH (SU)	5.80	8.87		5.79		6.93	6.34	6.62	6.62						
COND. (uMHO)	4270	459		737		3320	514	765	765						
TURB. (NTU)	3.50	4.50		17.0		46.4	178.6	23.8	23.8						
W. TEMP. (C)	18.4	18.1		16.0		20.0	11.0	13.0	13.0						
ELEV. FT. MSL															
A. TEMP (C)	7.6	11.6		13.1		7.5	10.0	9.0	9.0						
TDS	2748.0	245.0	< 1.0	522.0	937.0	1701.0	358.0	463.0	471.0	79.0		269.0		280.0	
SULFATE	1226.7	11.6	< 5.0	322.4	608.4	1226.7	233.5	12.7/316.3	11.8/296.1	26.2		18.6		18.6	
CHLORIDE	71.4	6.6	< 1.0	22.5	366.3	410.9	22.8	26.7	26.2	9.9		19.3		19.8	
BORON	0.63	< 0.20	< 0.20	< 0.20	< 0.20	1.18	0.53	0.74	0.78	0.98		0.87		0.87	
TOTAL ALK.	298.0	169.0	2.0	21.5	0.0	60.0	34.0	50.5	48.5	48.5		49.0		50.0	
FLUORIDE	0.34	< 0.20	< 0.20	< 0.20	0.39	1.40	0.29	0.26	0.26	1.01		0.64		0.65	
NITRATE	0.51	< 0.50	< 0.50	< 0.50	0.60	3.14	0.76	< 0.50	< 0.50	2.00		1.16		1.17	
NICKEL	< 0.005	< 0.005	< 0.005	< 0.005	0.076	0.010	< 0.005	0.010	0.010	0.020		0.013		0.015	
CALCIUM	17.7	16.9	< 1.0	50.9	110.0	285.4	47.1	97.5	96.8	25.5		62.0		62.3	
MAGNESIUM	4.7	4.5	< 1.0	17.1	40.1	41.0	7.0	5.3	5.4	10.4		7.9		7.8	
SODIUM	36.4	36.3	< 1.0	41.3	104.4	197.0	29.0	33.1	32.8	40.8		36.3		36.3	
IRON	0.21	0.24	< 0.10	9.42	12.14	1.79	3.14	0.54	0.51	5.30		2.97		2.96	
STRONTIUM	0.28	0.28	< 0.01	1.25	2.17	3.13	0.77	1.61	1.61	5.10		3.30		3.36	
ALUMINUM	0.40	1.00	< 0.10	0.59	12.68	3.35	6.00	2.80	2.87	5.04		4.13		4.32	
TITANIUM	0.047	0.045	< 0.025	< 0.025	0.107	0.062	0.041	0.113	0.108	0.097		0.106		0.100	
MOLYBDENUM	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.032	< 0.025	0.030	0.027	0.107		0.060		0.058	
ARSENIC															
SELENIUM															
CHROMIUM	0.006	0.006	< 0.005	0.006	0.048	0.010	0.010	0.023	0.023	0.02		0.021		0.021	
CADMIUM															
MERCURY	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0009	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0021		0.0011		0.0012	
LEAD	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	0.005		0.003		0.003	
BN/A ORG. **	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D						
VOL. ORG. **	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D						

** ANALYSES PERFORMED ANNUALLY.

TOTALS	PLANT:	WBSES							SAMPLE DATE:		02/22-23/94	
					SAMPLE NUMBERS							
PARAMETERS	94071	94072	94073	94074	94075	94076	94077	94078	DUP	94079	94080	
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L	L	MATRIX SPIKE
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L INTRA	L	
NOTED.	D S RCYC POND	D ARK RIVER	D G.W.- 1	D G.W.- 2	D G.W.- 3	D G.W.- 4	D G.W.- 5	D FIELD BLK-A	D FIELD BLK-B	D	D A + I	B + I
pH (SU)	8.00	6.62	3.78	5.72	5.55	4.79	4.20					
COND. (uMHO)	754	370	3560	1631	231	274	4410					
TURB. (NTU)	9.87	15.13	0.25	2.50	86.8	210.0	76.9					
W. TEMP. (C)	13.0	9.0	19.2	18.8	16.0	12.0	13.0					
ELEV. FT. MSL												
A. TEMP (C)	9.0	8.0	14.8	14.8	8.0	8.0	9.0					
TDS	452.0	195.0	2018.0	946.0	178.0	209.0	2424.0	1.0	1.0	72.0	35.0	36.0
SULFATE	271.9	116.0	1400.0	674.0	128.2	35.2	1267.1	< 5.0	< 5.0	26.2	13.2	14.8
CHLORIDE	26.7	31.9	603.9	178.2	7.4	31.2	801.9	< 1.0	< 1.0	9.9	5.4	5.4
BORON	0.78	0.23	< 0.20	0.28	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	0.98	0.52	0.50
TOTAL ALK.	56.5	44.0	0.0	19.3	11.0	0.0	0.0	0.5	0.5	49.0	25.5	25.0
FLUORIDE	0.27	< 0.20	0.67	< 0.20	< 0.20	< 0.20	0.56	< 0.20	< 0.20	0.96	0.52	0.52
NITRATE	0.56	< 0.50	0.70	< 0.50	< 0.50	0.62	1.37	< 0.50	< 0.50	2.00	1.12	0.96
NICKEL	< 0.005	< 0.005	0.010	< 0.005	< 0.005	0.010	0.008	< 0.005	< 0.005	0.020	0.009	0.009
CALCIUM	92.6	30.2	221.9	150.4	9.6	6.8	272.0	< 1.0	< 1.0	25.5	13.1	13.2
MAGNESIUM	5.5	5.7	81.1	40.6	3.2	2.9	124.2	< 1.0	< 1.0	10.4	5.5	5.3
SODIUM	30.8	24.1	217.2	66.2	16.9	28.1	321.4	< 1.0	< 1.0	40.8	21.1	21.1
IRON	0.32	0.55	25.00	21.60	3.39	7.76	1.86	< 0.10	< 0.10	5.10	2.42	2.44
STRONTIUM	1.57	0.34	4.86	3.35	0.25	0.15	5.81	< 0.01	< 0.01	5.10	2.47	2.46
ALUMINUM	2.01	0.75	26.32	0.57	2.53	10.10	8.54	< 0.10	< 0.10	5.29	2.91	2.70
TITANIUM	0.113	0.042	0.034	0.036	0.053	0.063	0.070	< 0.025	< 0.025	0.098	0.052	0.053
MOLYBDENUM	0.027	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.104	0.051	0.049
ARSENIC												
SELENIUM												
CHROMIUM	0.021	0.007	0.007	< 0.005	0.008	0.007	0.009	< 0.005	< 0.005	0.019	0.009	0.009
CADMIUM												
MERCURY	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006	< 0.0005	< 0.0005	0.0021	0.0012	0.0012
LEAD	< 0.001	< 0.001	< 0.001	< 0.001	0.005	0.003	< 0.001	< 0.001	< 0.001	0.005	0.003	0.003
BN/A ORG. **	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D			
VOL. ORG. **	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D			
** ANALYSES PERFORMED ANNUALLY.												

TOTALS	PLANT:	WBSES									SAMPLE DATE:		02/22-23/94			
						SAMPLE NUMBERS										
PARAMETERS	94081	94082	94083	94084	94085	94086	94087	94088	DUP	94089	94090	
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L	L	MATRIX SPIKE	
MG/L UNLESS	L	LOCATION	L	LOCATION	L	LOCATION	L	LOCATION	L	LOCATION	L	LOCATION	L	LOCATION	L	LOCATION	L	INTRA	L		
NOTED.	D	G.W. - 7	D	G.W. - 8	D	G.W. - 9	D	G.W. - 10	D	G.W. - 11	D	G.W. - 12	D	G.W. - 13	D	G.W. - 14A	D	G.W. - 14B	D		D	A + I	B + I
pH (SU)		5.70		4.24		5.71		4.39		4.05		3.80		3.66		5.51		5.51					
COND. (uMHO)		686		625		1306		744		174		145		480		835		835					
TURB. (NTU)		10.65		67.60		9.23		186.30		165.70		22.2		34.0		44.0		44.0					
W. TEMP. (C)		16.0		16.0		14.0		13.0		14.0		13.0		15.5		15.6		15.6					
ELEV. FT. MSL																							
A. TEMP (C)		9.0		9.0		8.0		8.0		6.0		6.0		13.1		13.1		13.1					
TDS		431.0		377.0		820.0		906.0		1103.0		542.0		240.0		667.0		674.0		67.0		346.0	360.0
SULFATE		261.5		148.4		431.5		387.0		620.5		593.2		82.3		11.6/290.1		12.4/310.3		25.3		18.9	18.9
CHLORIDE		58.4		52.0		81.7		42.6		39.1		67.3		61.4		22.8		22.5		10.3		17.3	16.8
BORON	<	0.20	<	0.20		0.22	<	0.20		0.25	<	0.20		0.91	<	0.20	<	0.20		0.99		0.37	0.36
TOTAL ALK.		0.0		0.0		25.5		0.0		0.0		0.0		0.0		24.0		23.0		48.5		35.0	36.0
FLUORIDE	<	0.20	<	0.20	<	0.20	<	0.20		0.98		0.57	<	0.20	<	0.20	<	0.20		0.99		0.59	0.58
NITRATE	<	0.50		0.51		0.78	<	0.50	<	0.50	<	0.50		0.60	<	0.50	<	0.50		2.06		1.03	1.23
NICKEL	<	0.005		0.031	<	0.005	<	0.005		0.081		0.083		0.037		0.014		0.018		0.021		0.023	0.023
CALCIUM		36.8		23.3		94.9		29.8		62.1		69.8		7.3		64.0		62.5		25.5		45.1	44.6
MAGNESIUM		11.9		10.0		28.2		13.7		38.3		31.0		4.9		19.8		19.3		10.5		16.5	16.4
SODIUM		40.6		42.8		55.7		59.9		150.5		92.8		20.0		43.6		42.5		39.6		42.5	42.4
IRON		2.68		6.70		20.25		43.05		4.09		5.48		6.16		9.84		9.74		5.07		7.93	7.72
STRONTIUM		0.86		0.38		2.40		0.67		1.24		1.33		0.30		1.43		1.38		5.06		2.22	3.20
ALUMINUM		0.84		4.91		0.25		8.54		11.40		8.35		9.34		0.46		0.67		5.01		3.50	3.16
TITANIUM		0.070		0.058		0.050		0.045		0.065	<	0.025	<	0.025	<	0.025	<	0.025		0.103		0.055	0.053
MOLYBDENUM	<	0.025	<	0.025	<	0.025	<	0.025	<	0.025	<	0.025	<	0.025	<	0.025	<	0.025		0.105		0.054	0.053
ARSENIC																							
SELENIUM																							
CHROMIUM		0.005		0.008		0.007		0.012		0.008		0.009		0.005		0.008		0.009		0.020		0.018	0.018
CADMIUM																							
MERCURY	<	0.0005	<	0.0005	<	0.0005	<	0.0005		0.0019		0.0005	<	0.0005	<	0.0005	<	0.0005		0.0022		0.0011	0.0012
LEAD	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001		0.005		0.003	0.002
BN/A ORG. **		N/D		N/D		N/D		N/D		N/D		N/D		N/D		N/D		N/D					
VOL. ORG. **		N/D		N/D		N/D		N/D		N/D		N/D		N/D		N/D		N/D					
** ANALYSES PERFORMED ANNUALLY.																							
*** SEE BN/A RESULTS.																							

APPENDIX E

Listing of Data, 1991-1994

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
AR. RIVER	93267	08/17-18/93	11		283	216.9	75.0	43.6	38.7	8.6	0.20	0.26	0.00	97	0.20	0.32
AR. RIVER	93356	11/16-17/93	12		317	94.8	30.0	21.4	38.9	5.8	< 0.2	0.23	1.12	71	0.15	0.60
AR. RIVER	94072	02/22-23/94	13		195	116.0	31.9	24.1	30.2	5.7	0.23	< 0.2	< 0.50	44	0.55	0.75
CLTWRSUMP	92002	03/12/92	5		344	105.5	74.0	55.4	42.4	8.6	0.36	0.43	< 0.00		0.14	0.24
CLTWRSUMP	92113	06/02-03/92	6		1842	416.5	435.1	231.0	218.0	36.2	1.76	0.90	8.96	62	1.19	0.21
CLTWRSUMP	92196	09/11-12/92	7		2735	627.6	96.2				2.40	1.80	1.28	63		
CLTWRSUMP	92294	12/7-8/92	8		2340	617.9	442.5	321.6	283.2	54.6	1.70	2.20	4.18	76	2.64	4.60
CLTWRSUMP	93078	3/2-3/93	9		2121	776.1	405.0	261.6	261.0	50.3	1.00	1.15	2.91	59	1.70	2.72
CLTWRSUMP	93078	3/2-3/93	9	D	2125	736.0	408.3	256.2	261.9	48.9	1.00	1.16	2.92	61	1.80	2.61
CLTWRSUMP	93175	5/17-18/93	10		2515	813.4	327.0	202.5	184.0	33.7	1.10	0.97	0.94	65	1.30	1.30
CLTWRSUMP	93263	08/17-18/93	11		2162	1485.6	486.0	332.0	296.5	63.6	0.94	1.36	0.90	88	1.20	2.00
CLTWRSUMP	93352	11/16-17/93	12		2010	1114.3	286.8	221.2	321.6	53.6	1.18	2.04	2.75	67	0.77	2.00
CLTWRSUMP	94066	02/22-23/94	13		1701	1226.7	410.9	197.0	285.4	41.0	1.18	1.40	3.14	60	1.79	3.35
NRECYCLE	92036	03/12/92	5		1113	650.0	76.0	86.0	135.9	12.7	1.38	0.84	< 0.00		0.50	0.86
NRECYCLE	92115	06/02-03/92	6		1142	399.4	128.7	92.1	190.0	13.9	2.02	0.80	5.17	31	0.33	2.04
NRECYCLE	92198	09/11-12/92	7	D	1219	500.1	239.3	91.1	151.9	14.9	2.00	0.66	0.93	14	0.19	1.86
NRECYCLE	92198	09/11-12/92	7		1200	479.2	238.9	73.4	124.5	16.8	2.00	0.68	0.93	14	0.18	1.41
NRECYCLE	92296	12/7-8/92	8		1103	459.2	79.5	95.6	192.0	11.5	1.50	0.80	0.82	35	0.44	1.50
NRECYCLE	93082	3/2-3/93	9		1090	665.0	78.0	78.5	202.0	13.4	1.00	0.60	< 0.00	21	0.50	2.18
NRECYCLE	93177	5/17-18/93	10		1740	453.7	52.5	59.9	128.0	8.7	1.20	1.26	< 0.00	35	0.20	0.70
NRECYCLE	93265	08/17-18/93	11		596	449.6	46.8	46.5	107.5	5.0	1.29	0.43	0.00	63	0.20	6.63
NRECYCLE	93354	11/16-17/93	12		606	397.3	33.6	46.0	129.2	8.9	0.55	0.78	1.03	3	0.28	1.30
NRECYCLE	94068	02/22-23/94	13		463	316.3	26.7	33.1	97.5	5.3	0.74	0.26	< 0.50	51	0.54	2.80
NRECYCLE	94068	02/22-23/94	13	D	471	296.1	26.2	32.8	96.8	5.4	0.78	0.26	< 0.50	49	0.51	2.87
SRECYCLE	92001	03/12/92	5		1181	654.7	97.8	93.8	168.6	13.9	1.39	1.33	< 0.00		0.35	0.56
SRECYCLE	92116	06/02-03/92	6		1094	388.5	121.0	88.4	192.0	14.0	1.83	1.10	5.63	58	0.19	0.27
SRECYCLE	92201	09/11-12/92	7		1066	444.4	54.5	78.0	141.2	13.6	1.60	0.78	0.40	70	0.23	2.26
SRECYCLE	92297	12/7-8/92	8		1077	453.4	77.0	94.7	189.6	11.5	1.50	0.80	1.01	36	0.31	0.90
SRECYCLE	93083	3/2-3/93	9		1005	677.0	79.8	61.2	197.0	11.4	0.70	0.49	< 0.00	35	0.20	2.26
SRECYCLE	93178	5/17-18/93	10		863	402.0	56.7	59.3	137.5	9.0	0.90	1.25	< 0.00	52	0.10	1.50
SRECYCLE	93178	5/17-18/93	10	D	858	402.0	54.6	60.4	140.5	9.0	0.90	1.30	< 0.00	52	0.20	1.40
SRECYCLE	93266	08/17-18/93	11		615	404.0	45.6	45.7	108.5	5.5	1.21	0.45	0.00	59	0.30	7.06
SRECYCLE	93355	11/16-17/93	12		644	543.4	36.0	45.1	152.0	10.8	0.62	1.25	0.97	28	0.15	1.20
SRECYCLE	94071	02/22-23/94	13		452	271.9	26.7	30.8	92.6	5.5	0.78	0.27	0.56	57	0.32	2.01
SURGEPOND	92035	03/12/92	5		499	425.0	53.0	53.9	52.1	8.7	0.79	0.32	< 0.00		< 0.1	0.15
SURGEPOND	92114	06/02-03/92	6		627	210.2	90.1	63.3	74.0	11.4	1.28	0.40	5.43	28	0.13	1.32
SURGEPOND	92197	09/11-12/92	7		563	306.4	95.5	65.1	73.4	12.1	0.90	0.49	0.69	15	0.07	0.44
SURGEPOND	92295	12/7-8/92	8		645	279.2	65.0	64.8	95.1	12.3	0.90	0.60	0.54	45	0.16	0.30
SURGEPOND	93081	3/2-3/93	9		419	261.6	33.9	39.5	68.3	9.8	0.50	0.34	0.52	39	2.50	3.08
SURGEPOND	93176	5/17-18/93	10		826	234.3	42.3	47.7	69.3	8.5	0.80	0.48	< 0.00	42	0.10	0.30
SURGEPOND	93264	08/17-18/93	11		827	240.6	61.8	55.9	80.1	10.5	0.91	0.58	0.00	40	0.10	0.60
SURGEPOND	93353	11/16-17/93	12													
SURGEPOND	93353	11/16-17/93	12		351	290.5	39.3	35.7	52.9	8.3	0.36	0.43	1.03	29	2.57	5.60
SURGEPOND	94067	02/22-23/94	13		358	233.5	22.8	29.0	47.1	7.0	0.53	0.29	0.76	34	3.14	6.00
WELL1	91035	03/20/91	1		2870	1883.0	710.9				0.20	0.65				
WELL1	91116	06/26/91	2		2514	798.0	172.6				0.20	0.71	0.00			
WELL1	91195	09/25/91	3		2731	1134.0	56.0				0.20	0.60	8.13			
WELL1	91234	11/21/91	4		2705	844.6	692.2				0.20	0.66	2.44			
WELL1	92003	03/12/92	5		2710	976.2	188.0	215.1	252.6	91.7	0.25	0.54	0.00		28.26	0.69

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL1	92082	06/02-03/92	6		2978	1245.8	335.6	218.2	222.0	90.3	0.46	0.20	7.52	0	25.41	0.00
WELL1	92161	09/11-12/92	7		2664	976.8	516.8	230.4	128.2	107.0	0.20	0.20	3.65	0	23.14	32.90
WELL1	92301	12/7-8/92	8		3085	910.4	484.3	266.8	199.8	110.0	0.20	0.80	1.01	0	29.46	36.80
WELL1	93085	02/16/93	9		3109	1133.3	469.5	223.8	255.5	106.0	0.20	0.71	0.00		24.30	32.82
WELL1	93182	05/17-05/18/	10		2751	1091.0	513.0	228.0	234.0	95.5	0.30	0.66	0.00	0	32.40	28.50
WELL1	93268	08/17-18/93	11	D	2363	996.3	504.0	225.2	256.0	94.8	0.20	0.73	0.00	0	27.20	37.00
WELL1	93268	08/17-18/93	11		2383	993.3	507.0	225.2	256.5	98.0	0.20	0.73	0.00	0	25.80	37.40
WELL1	93357	11/16-17/93	12		2587	1079.7	495.0	207.6	73.7	96.8	< 0.2	0.87	< 0.00	0	26.56	33.00
WELL1	94073	02/22-23/94	13		2018	1400.0	603.9	217.2	221.9	81.1	< 0.2	0.67	0.70	0	25.00	26.32
WELL10	91065	03/20/91	1		434	179.9	37.8				0.20	0.20				
WELL10	91126	06/26/91	2		450	10.5	40.4				0.20	0.20	0.00			
WELL10	91206	09/25/91	3		496	180.6	44.3				0.20	0.20	0.00			
WELL10	91245	11/21/91	4		501	147.6	43.0				0.20	0.20	0.00			
WELL10	92014	03/12/92	5		567	438.8	46.0	66.2	27.1	13.1	0.20	0.20	0.00		2.60	0.20
WELL10	92093	06/02-03/92	6		506	144.4	49.0	54.1	18.0	9.8	0.09	0.20	4.23	0	11.10	0.56
WELL10	92172	09/11-12/92	7		493	137.8	56.1	59.2	25.5	12.4	0.20	0.20	0.00	0	11.56	8.68
WELL10	92268	12/7-8/92	8		577	193.4	47.4	83.9	16.7	14.7	0.11	0.23	0.00	0	12.76	9.10
WELL10	92268	12/7-8/92	8	D	565	200.8	56.0	78.6	14.9	14.0	0.10	0.21	0.00	0	15.24	9.50
WELL10	93054	02/16/93	9		606	252.2	43.2	73.4	32.5	15.5	0.20	0.28	3.32	0	24.80	10.68
WELL10	93152	05/17-05/18/	10		581	242.2	43.2	66.7	28.2	13.1	0.20	0.24	0.00	0	18.60	1.50
WELL10	93281	08/17-18/93	11		465	292.3	40.5	62.3	25.7	11.8	0.20	0.22	0.00	0	8.40	1.33
WELL10	93368	11/16-17/93	12		548	82.9	41.1	59.4	30.6	12.6	< 0.2	0.21	< 0.00	0	24.60	3.50
WELL10	93368	11/16-17/93	12	D	533	101.9	41.4	60.3	30.0	13.0	< 0.2	0.23	< 0.00	0	22.88	3.30
WELL10	94084	02/22-23/94	13		906	387.0	42.6	59.9	29.8	13.7	< 0.2	< 0.2	< 0.50	0	43.05	8.54
WELL11	91042	03/20/91	1		1043	663.9	40.0				0.20	0.62				
WELL11	91128A	06/26/91	2		993	417.0	34.6				0.20	0.80	0.00			
WELL11	91207	09/25/91	3		1087	548.0	42.0				0.24	0.63	0.00			
WELL11	91246	11/21/91	4		1177	449.3	39.2				0.25	0.87	0.00			
WELL11	92015	03/12/92	5		1189	998.1	34.0				0.34	0.39	0.00			
WELL11	92094	06/02-03/92	6		1119	423.7	30.8	133.7	39.2	27.1	0.43	0.80	4.90	0	3.38	0.24
WELL11	92173	09/11-12/92	7		1124	680.5	39.2	130.9	46.4	32.4	0.20	0.20	0.00	0	7.94	14.91
WELL11	92271	12/7-8/92	8		1000	221.1	32.0	162.8	21.5	36.8	0.40	0.90	0.00	0	2.83	13.00
WELL11	93055	02/16/93	9		1000	626.9	33.0	121.2	47.0	32.7	0.20	0.82	0.00	0	1.00	5.83
WELL11	93153	05/17-05/18/	10		1132	594.9	35.7	147.5	52.7	34.5	0.30	0.94	0.00	0	0.90	8.00
WELL11	93241	08/17-18/93	11		1146	671.2	36.0	154.0	54.1	35.1	0.27	0.89	0.00	0	4.80	19.48
WELL11	93371	11/16-17/93	12		1160	889.7	37.8	144.0	58.8	41.6	0.31	1.09	1.83	0	0.98	9.10
WELL11	93371	11/16-17/93	12													
WELL11	94085	02/22-23/94	13		1103	620.5	39.1	150.5	62.1	38.3	0.25	0.98	< 0.50	0	4.09	11.40
WELL12	91043	03/20/91	1		413	877.7	53.3				0.20	0.20				
WELL12	91131	06/26/91	2		1115	691.0	48.4				0.20	0.53	0.00			
WELL12	91208A	09/25/91	3		1046	446.0	61.4				0.20	0.69	0.00			
WELL12	91247	11/21/91	4		1195	456.7	64.9				0.20	0.82	0.00			
WELL12	92016	03/12/92	5		1174	529.3	44.0	93.2	82.5	37.9	0.20	0.35	4.60		5.08	0.00
WELL12	92095	06/02-03/92	6		1031	385.4	53.0	90.5	59.8	30.3	0.22	0.60	5.15	0	6.06	0.07
WELL12	92174	09/11-12/92	7		973	578.4	70.0	83.9	62.6	33.1	0.20	0.20	0.00	0	5.18	8.49
WELL12	92272	12/7-8/92	8		1148	492.6	70.6	109.8	39.2	44.2	0.20	0.80	0.00	0	4.73	13.20
WELL12	93056	02/16/93	9		1057	845.6	67.8	84.3	84.2	39.0	0.20	0.49	0.00		3.40	8.73
WELL12	93154	05/17-05/18/	10		1005	626.8	60.6	91.2	67.4	30.8	0.20	0.57	0.00	0	2.50	7.40
WELL12	93242	08/17-18/93	11		880	528.4	63.0	91.0	68.7	32.9	0.20	0.65	0.00	0	5.20	9.69

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL12	93331	11/16-17/93	12		1165	694.2	66.9	105.5	97.2	43.8	< 0.2	0.74	6.66	0	11.74	13.60
WELL12	94086	02/22-23/94	13		542	593.2	67.3	92.8	69.8	31.0	< 0.2	0.57	< 0.50	0	5.48	8.35
WELL13	91037	03/20/91	1		320	72.5	58.9				0.37	0.21				
WELL13	91132	06/26/91	2		357	65.0	56.0				0.40	0.25	0.00			
WELL13	91211	09/25/91	3		350	55.2	68.8				0.49	0.30	1.94			
WELL13	91248	11/21/91	4		330	58.1	65.5				0.57	0.30	0.00			
WELL13	92017	03/12/92	5		323	75.0	52.8	17.6	10.5	5.7	0.82	0.20	0.00		9.40	0.00
WELL13	92096	06/02-03/92	6		330	47.1	61.7	17.5	8.6	5.5	0.89	0.20	3.47	0	23.95	0.09
WELL13	92175	09/11-12/92	7		692	40.5	120.7	21.1	8.9	6.3	0.70	0.20	0.00	0	8.05	24.65
WELL13	92273	12/7-8/92	8		319	43.8	77.2	23.5	5.6	6.3	1.20	0.30	0.00	0	5.44	4.60
WELL13	93057	02/16/93	9		336	353.9	65.1	19.2	7.9	5.5	0.60	0.29	0.00		7.00	7.83
WELL13	93155	05/17-05/18/	10		338	89.8	60.0	17.4	8.2	5.0	0.80	0.26	0.00	0	4.40	7.40
WELL13	93243	08/17-18/93	11		288	87.8	65.4	18.1	8.3	5.5	0.88	0.28	0.00	0	6.10	8.82
WELL13	93332	11/16-17/93	12		245	84.2	4.5	21.7	12.9	4.6	0.74	0.25	4.31	0	6.46	10.00
WELL13	94087	02/22-23/94	13		240	82.3	61.4	20.0	7.3	4.9	0.91	< 0.2	0.60	0	6.16	9.34
WELL14	91032	03/20/91	1		644	208.0	48.1				0.20	0.20				
WELL14	91133	06/26/91	2										0.00			
WELL14	91212	09/25/91	3		700	223.1	20.4				0.20	0.20	0.00			
WELL14	91251	11/21/91	4		674	393.9	24.1				0.20	0.20	0.50			
WELL14	92018	03/12/92	5		678	255.9	18.6	43.2	65.3	21.5	0.24	0.20	0.00		11.64	0.00
WELL14	92097	06/02-03/92	6		713	290.0	27.0	39.7	74.4	21.5	0.26	0.20	3.37	54	109.05	0.39
WELL14	92176	09/11-12/92	7		681	337.0	68.3	47.5	72.1	28.1	0.20	0.20	0.00	34	2.53	0.30
WELL14	92274	12/7-8/92	8		668	279.4	21.1	48.6	46.6	26.9	0.20	0.20	0.00	50	5.82	0.90
WELL14	93058	02/16/93	9	D	643		19.5	37.9	61.4	21.8	0.20	0.20	0.00	22	9.20	0.36
WELL14	93058	02/16/93	9		647		21.3	38.3	61.6	22.4	0.20	0.20	0.00	22	9.30	0.33
WELL14	93156	05/17-05/18/	10		705	291.7	21.0	45.2	67.8	22.3	0.20	0.20	0.00	35	6.90	0.20
WELL14	93244	08/17-18/93	11		620	426.8	21.6	42.4	64.7	22.7	0.24	0.20	0.00	32	6.30	0.21
WELL14	93333	11/16-17/93	12		506	354.6	21.3	42.7	63.8	21.5	< 0.2	< 0.2	3.45	23	1.19	0.40
WELL14	94088	02/22-23/94	13		667	290.1	22.8	43.6	64.0	19.8	< 0.2	< 0.2	< 0.50	24	9.84	0.46
WELL14	94088	02/22-23/94	13	D	674	310.3	22.5	42.5	62.5	19.3	< 0.2	< 0.2	< 0.50	23	9.74	0.67
WELL15	91031	03/20/91	1		682	393.0	24.8				0.20	0.20				
WELL15	91134	06/26/91	2		645	286.5	21.4				0.20	0.20	0.00			
WELL15	91213	09/25/91	3		629	294.0	33.9				0.20	0.20	0.00			
WELL15	91252	11/21/91	4		546	689.5	22.6				0.20	0.20	0.00			
WELL15	92021	03/12/92	5	D	624	35.8	8.6	40.7	50.1	18.1	0.20	0.20	0.67		9.10	0.19
WELL15	92021	03/12/92	5		625	36.8	8.8	41.0	50.8	18.5	0.20	0.20	0.74		9.10	0.18
WELL15	92098	06/02-03/92	6		651	235.0	31.3	37.0	46.2	17.2	0.24	0.20	3.62	33	9.41	0.28
WELL15	92098	06/02-03/92	6	D	667	238.0	30.2	39.9	51.6	18.9	0.21	0.20	3.01	32	9.76	0.20
WELL15	92177	09/11-12/92	7		634	328.0	70.3	43.2	58.3	22.9	0.20	0.20	0.00	21	8.64	0.22
WELL15	92275	12/7-8/92	8		628	226.9	14.9	45.9	37.2	23.5	0.22	0.20	0.00	36	9.32	0.40
WELL15	93061	02/16/93	9		704	392.7	21.9	40.4	74.4	26.4	0.20	0.20	1.49	40	4.50	0.45
WELL15	93157	05/17-05/18/	10		650	243.0	20.7	42.1	57.4	19.4	0.23	0.20	2.64	24	9.50	0.10
WELL15	93245	08/17-18/93	11		493	326.5	19.5	39.6	55.0	19.0	0.23	0.20	0.00	28	9.40	0.20
WELL15	93334	11/16-17/93	12		521	351.0	19.8	41.2	58.4	17.8	< 0.2	< 0.2	3.38	25	10.28	0.20
WELL15	94064	02/22-23/94	13		522	322.4	22.5	41.3	50.9	17.1	< 0.2	< 0.2	< 0.50	22	9.42	0.59
WELL16	91056	03/20/91	1		141	387.6	9.6				0.20	0.20				
WELL16	91135	06/26/91	2		83	14.0	51.2				0.20	0.20	0.00			
WELL16	91214	09/25/91	3		113	16.3	18.7				0.20	0.20	0.00			
WELL16	91253	11/21/91	4		121	54.2	20.0				0.20	0.20	0.00			

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL16	92022	03/12/92	5		113	25.0	1.0	7.9	4.9	1.2	0.20	0.20	0.00		3.80	0.66
WELL16	92101	06/02-03/92	6		111	7.1	11.5	7.9	2.6	0.4	0.20	0.20	3.68	0	0.50	0.85
WELL16	92178	09/11-12/92	7		89	10.3	14.8	8.1	2.4	0.5	0.20	0.12	0.00	7	1.24	2.29
WELL16	92178	09/11-12/92	7	D	63	8.0	11.8	8.6	2.2	0.5	0.20	0.11	0.00	7	1.06	1.91
WELL16	92276	12/7-8/92	8		108	6.8	1.0	8.7	1.6	0.6	0.20	0.20	0.00	10	2.23	3.50
WELL16	93062	02/16/93	9		100	10.0	4.2	7.8	3.0	1.0	0.20	0.20	0.00	9	4.30	1.26
WELL16	93158	05/17-05/18/	10		109	19.4	3.3	10.1	2.1	1.0	0.20	0.20	0.00	8	0.20	0.00
WELL16	93158	05/17-05/18/	10	D	111	19.4	3.3	10.1	2.3	1.0	0.20	0.20	0.00	9	0.20	0.00
WELL16	93246	08/17-18/93	11		95	12.1	3.0	7.7	1.2	1.0	0.20	0.20	0.00	9	1.10	1.56
WELL16	93335	11/16-17/93	12		115	13.0	3.0	8.2	2.3	< 1.0	< 0.2	< 0.2	4.78	8	1.02	0.90
WELL16	94051	02/22-23/94	13		115	50.4	3.6	10.4	1.7	< 1.0	< 0.2	0.20	< 0.50	7	2.37	1.13
WELL17	91055	03/20/91	1		451	387.6	9.6				0.20	0.20				
WELL17	91136	06/26/91	2		242	190.6	0.2				0.20	0.20	0.00			
WELL17	91215	09/25/91	3		552	28.7	0.2				0.20	0.20	0.00			
WELL17	91254	11/21/91	4		292	177.3	21.0				0.21	0.20	0.00			
WELL17	92023	03/12/92	5		285	44.0	1.0	39.3	27.3	6.4	0.25	0.20	0.00		1.30	0.12
WELL17	92102	06/02-03/92	6		290	23.2	18.3	43.6	29.1	6.8	0.28	0.20	4.05	173	3.25	0.07
WELL17	92181	09/11-12/92	7		280	17.1	26.6	45.4	36.8	8.5	0.30	0.77	0.00	182	6.99	9.72
WELL17	92277	12/7-8/92	8		277	11.7	3.5	46.9	28.0	8.9	0.30	0.20	0.00	176	9.44	20.70
WELL17	93063	02/16/93	9		303	30.6	6.6	39.2	36.1	8.0	0.20	0.20	0.00	187	2.10	0.96
WELL17	93161	05/17-05/18/	10		198	53.9	3.6	22.7	7.6	2.5	0.20	0.20	0.00	25	0.40	0.10
WELL17	93247	08/17-18/93	11		238	55.5	5.4	39.8	26.6	6.5	0.27	0.20	0.00	158	2.40	4.28
WELL17	93336	11/16-17/93	12		246	46.0	4.2	37.4	23.8	4.2	< 0.2	< 0.2	< 0.00	128	0.60	0.60
WELL17	94052	02/22-23/94	13		119	44.2	8.4	15.7	3.7	1.7	< 0.2	0.20	< 0.50	6	1.03	1.37
WELL18	91034	03/20/91	1		1741	1217.0	48.7				0.37	0.79				
WELL18	91137	06/26/91	2		1722	324.0	11.4				0.50	1.00	0.00			
WELL18	91216	09/25/91	3		1740	480.9	13.6				0.46	0.35	0.60			
WELL18	91255	11/21/91	4		1350	829.1	42.9				0.44	0.31	0.00			
WELL18	92024	03/12/92	5		1560	374.9	40.0	74.4	185.4	53.8	0.62	0.37	0.00		19.50	0.83
WELL18	92103	06/02-03/92	6		1695	456.5	59.9	75.1	163.0	54.8	0.68	0.40	5.18	14	25.02	0.31
WELL18	92182	09/11-12/92	7		1558	772.0	71.7	78.3	116.6	66.5	0.70	0.56	0.00	21	22.70	1.71
WELL18	92278	12/7-8/92	8		1397	722.5	57.5	87.8	167.4	58.3	0.66	0.57	0.00	37	18.49	1.10
WELL18	92278	12/7-8/92	8	D	1406	744.2	52.5	87.4	166.8	58.3	0.65	0.55	0.00	37	18.49	0.90
WELL18	93064	02/16/93	9		1515	937.9	46.8	65.1	183.5	59.6	0.35	0.61	0.00		20.60	2.22
WELL18	93162	05/17-05/18/	10		1519	827.8	45.3	74.1	156.5	52.0	0.50	0.51	0.00	3	22.20	0.80
WELL18	93248	08/17-18/93	11	D	1050	871.8	45.9	73.2	175.2	55.5	0.64	0.59	0.00	0	24.00	1.17
WELL18	93248	08/17-18/93	11		1071	844.4	45.0	72.3	172.4	54.9	0.66	0.59	0.00	0	23.80	1.11
WELL18	93337	11/16-17/93	12		1183	781.8	39.9	72.8	172.4	41.7	0.42	0.56	4.10	20	21.52	1.00
WELL18	94053	02/22-23/94	13		1189	790.3	25.4	71.3	160.8	52.2	0.61	0.61	< 0.50	0	19.90	2.08
WELL19	91033	03/20/91	1		1502	1337.0	40.0				0.33	0.83				
WELL19	91138A	06/26/91	2		1479	325.0	38.0				0.39	0.76	0.00			
WELL19	91217	09/25/91	3		1467	541.5	64.9				0.43	0.62	0.00			
WELL19	91256	11/21/91	4		1674	1248.0	43.0				0.43	0.62	0.00			
WELL19	92025	03/12/92	5		1651	328.2	36.0	73.5	187.2	58.0	0.66	0.71	0.00		27.50	0.76
WELL19	92104	06/02-03/92	6		1493	381.5	50.3	68.7	143.0	50.2	0.67	0.70	3.36	0	24.98	0.45
WELL19	92183	09/11-12/92	7		1397	755.9	98.7	68.3	82.6	56.5	0.60	0.91	0.00	0	17.74	3.44
WELL19	92281	12/7-8/92	8		1409	309.0	33.6	78.7	153.6	56.0	0.60	0.90	0.00	0	25.31	3.80
WELL19	93065	02/16/93	9		1428	905.8	37.5	63.1	166.5	56.0	0.33	0.87	0.00		22.30	3.23
WELL19	93163	05/17-05/18/	10		1537	752.5	38.1	71.4	154.0	55.0	0.50	0.71	0.00	0	28.60	1.90

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WELL19	93251	08/17-18/93	11		1058	838.3	36.3	63.2	134.4	48.5	0.60	0.83	0.00	0	17.60	2.85
WELL19	93338	11/16-17/93	12		988	652.2	36.3	63.7	185.2	32.8	0.41	0.86	< 0.00	0	26.48	8.60
WELL19	93338	11/16-17/93	12	D	998	661.7	36.3	66.7	183.6	29.5	0.36	0.86	< 0.00	0	27.56	7.00
WELL19	94054	02/22-23/94	13		1264	1145.9	37.2	66.6	148.9	49.0	0.55	0.77	< 0.50	0	24.65	3.82
WELL2	91036	03/20/91	1		1318	635.0	123.8				0.20	0.20				
WELL2	91117	06/26/91	2		1258	546.0	41.0				0.30	0.20	0.00			
WELL2	91196	09/25/91	3		1213	574.8	50.4				0.29	0.20	0.00			
WELL2	91235	11/21/91	4		1244	608.5	72.6				0.26	0.20	0.00			
WELL2	92004	03/12/92	5		1245	745.1	76.0	58.6	144.0	11.9	0.33	0.20	0.52		29.25	0.68
WELL2	92083	06/02-03/92	6		1261	622.1	66.3	48.7	86.5	29.2	0.41	0.20	4.95	50	16.80	0.25
WELL2	92162	09/11-12/92	7		1211	678.1	99.8	62.2	91.7	47.1	0.30	0.20	3.36	37	19.35	1.04
WELL2	92302	12/7-8/92	8		1208	569.0	87.7	75.0	146.4	48.9	0.40	0.20	0.00	40	23.33	0.20
WELL2	93086	02/16/93	9		1277	527.3	81.3	60.7	159.5	47.7	0.20	0.20	0.00	16	20.50	0.93
WELL2	93183	05/17-05/18/	10		1296	697.4	90.6	65.2	144.0	40.1	0.20	0.20	0.00	18	25.00	0.60
WELL2	93271	08/17-18/93	11		1250	786.7	82.5	63.0	154.5	46.0	0.33	0.20	0.00	17	21.80	0.50
WELL2	93358	11/16-17/93	12		1221	699.7	82.5	65.7	157.5	44.1	0.26	< 0.2	0.85	30	23.12	1.10
WELL2	93358	11/16-17/93	12	D	1231	604.7	81.0	66.2	154.5	45.6	0.26	< 0.2	0.86	31	23.28	1.20
WELL2	94074	02/22-23/94	13		946	674.0	178.2	66.2	150.4	40.6	0.28	< 0.2	< 0.50	19	21.60	0.57
WELL20	91054	03/20/91	1		1616	406.2	34.1				0.20	0.86				
WELL20	91141	06/26/91	2		1596	775.8	44.0				0.20	0.76	0.23			
WELL20	91218A	09/25/91	3		1585	406.0	46.0				0.26	0.77	0.00			
WELL20	91257	11/21/91	4		1548	686.0	34.4				0.20	0.72	2.45			
WELL20	92026	03/12/92	5		1627	100.7	28.0	85.3	125.3	58.5	0.30	0.86	0.50		5.90	0.37
WELL20	92105	06/02-03/92	6		1631	410.0	46.4	89.9	117.0	58.3	0.35	0.70	0.63	0	6.46	0.00
WELL20	92184	09/11-12/92	7		1562	868.1	31.8	85.7	51.2	71.5	0.40	0.83	0.00	0	3.90	23.20
WELL20	92282	12/7-8/92	8		1534	383.1	92.0	84.0	163.2	67.5	0.50	0.60	0.00	0	22.49	9.10
WELL20	93066	02/16/93	9		1418	972.0	43.8	64.5	144.5	59.0	0.20	0.80	0.00		12.10	9.35
WELL20	93164	05/17-05/18/	10		1626	874.8	78.9	88.0	126.5	59.5	0.30	0.81	0.00	0	3.30	23.60
WELL20	93252	08/17-18/93	11		1255	1382.3	33.2	82.3	30.4	58.8	0.21	0.84	0.00	0	1.60	30.55
WELL20	93341	11/16-17/93	12		1325	778.1	48.0	67.4	212.8	44.6	0.26	0.84	0.50	0	22.68	5.70
WELL20	94055	02/22-23/94	13		1369	1024.7	33.0	81.0	113.8	53.7	0.21	0.82	< 0.50	0	1.85	25.14
WELL21	91053	03/20/91	1		1282	75.9	37.6				0.20	0.68				
WELL21	91142	06/26/91	2		1312	698.4	54.0				0.20	0.68	0.00			
WELL21	91221	09/25/91	3		1273	540.5	45.1				0.31	0.67	0.71			
WELL21	91258A	11/21/91	4		1252	711.3	40.2				0.24	0.71	0.00			
WELL21	92027	03/12/92	5		1286	78.0	34.0	64.3	112.9	43.9	0.37	0.86	0.52		22.70	0.85
WELL21	92106	06/02-03/92	6		1295	415.8	52.2	64.5	108.0	41.2	0.40	0.60	3.15	0	20.54	0.00
WELL21	92185	09/11-12/92	7		1208	706.1	42.1	74.1	140.2	50.4	0.40	0.70	0.00	0	18.39	10.95
WELL21	92283	12/7-8/92	8		1207	148.7	89.0	76.6	65.0	46.6	0.40	0.60	0.00	0	17.66	6.00
WELL21	93067	02/16/93	9		1266	841.6	39.0	56.6	127.0	47.3	0.20	0.78	0.00		15.30	10.35
WELL21	93165	05/17-05/18/	10		1099	716.2	34.2	61.0	89.3	34.1	0.30	0.67	0.00	0	12.00	7.80
WELL21	93253	08/17-18/93	11		851	1081.4	34.5	61.9	110.1	41.9	0.39	0.70	0.00	0	16.40	8.30
WELL21	93342	11/16-17/93	12		1008	735.3	33.6	65.6	143.6	32.1	0.24	0.79	0.50	0	15.88	13.00
WELL21	94056	02/22-23/94	13		968	661.0	34.8	57.8	96.9	35.0	0.31	0.62	< 0.50	0	11.52	8.03
WELL22	91041	03/20/91	1		278	115.5	19.3				0.20	0.23	0.50			
WELL22	91143	06/26/91	2		257	103.5	18.2				0.20	0.20	0.00			
WELL22	91222	09/25/91	3		238	43.0	18.4				0.20	0.20	4.92			
WELL22	91261	11/21/91	4		224	182.6	18.8				0.20	0.20	0.00			
WELL22	92028	03/12/92	5	D	288	55.0	5.0	19.2	15.4	4.9	0.20	0.20	0.50		6.90	0.80

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WELL22	92028	03/12/92	5		331	50.0	5.0	18.6	15.2	4.6	0.20	0.20	0.57		6.00	0.77
WELL22	92107	06/02-03/92	6		232	41.9	32.3	14.4	9.6	2.8	0.06	0.20	4.25	0	2.88	0.26
WELL22	92186	09/11-12/92	7		211	51.9	62.1	17.3	14.5	4.1	0.20	0.20	0.00	0	3.76	1.69
WELL22	92284	12/7-8/92	8		241	32.1	15.2	18.4	11.4	4.8	0.20	0.20	0.00	0	4.61	5.30
WELL22	93068	02/16/93	9		262		20.1	19.2	15.6	4.8	0.20	0.20	0.00		3.20	1.30
WELL22	93068	02/16/93	9	D	257		20.4	19.4	15.2	4.9	0.20	0.20	0.00		3.10	1.53
WELL22	93166	05/17-05/18/	10		250	68.9	22.5	18.7	12.1	4.0	0.20	0.20	0.00	0	2.90	1.30
WELL22	93254	08/17-18/93	11		185	92.6	16.2	17.0	11.2	4.1	0.20	0.20	0.00	0	3.50	0.88
WELL22	93343	11/16-17/93	12		269	162.7	11.7	27.7	19.3	1.7	< 0.2	< 0.2	0.50	0	13.16	13.80
WELL22	93343	11/16-17/93	12													
WELL22	94057	02/22-23/94	13		297	107.9	19.8	25.5	13.9	5.1	< 0.2	0.20	< 0.50	0	3.78	2.01
WELL23	92187	09/11-12/92	7		902	299.9	143.2	75.6	94.8	34.1	0.70	0.20	0.00	200	0.60	1.39
WELL23	92285	12/7-8/92	8		860	229.6	77.0	104.5	108.0	28.5	0.70	0.20	0.00	194	0.11	0.00
WELL23	93071	02/16/93	9		837	364.0	80.5	78.8	106.4	26.7	0.40	0.20	0.00	187	0.10	0.23
WELL23	93168	05/17-05/18/	10	D	853	273.9	94.5	83.8	93.7	22.9	0.48	0.20	0.00	188	0.10	0.20
WELL23	93168	05/17-05/18/	10		856	273.9	94.5	81.3	93.9	23.1	0.49	0.20	0.00	189	0.10	0.10
WELL23	93255	08/17-18/93	11		764	326.5	105.3	70.7	110.4	30.3	0.59	0.20	0.00	216	0.10	0.37
WELL23	93344	11/16-17/93	12		572	459.1	77.4	80.4	84.6	< 1.0	0.31	< 0.2	0.50	141	0.13	1.20
WELL23	94058	02/22-23/94	13		100	290.1	3.0	8.0	14.3	1.6	< 0.2	0.20	< 0.50	43	1.01	1.03
WELL23	94058	02/22-23/94	13	D	109	290.1	2.7	8.1	14.2	1.6	< 0.2	0.20	< 0.50	42	1.02	2.26
WELL24	92188	09/11-12/92	7	D	4065	816.6	106.1	170.0	442.0	203.0	0.65	0.39	0.38	271	3.19	3.02
WELL24	92188	09/11-12/92	7		4076	854.0	120.5	171.0	478.0	227.0	0.66	0.39	0.39	228	2.92	3.26
WELL24	92286	12/7-8/92	8		3971	1806.6	105.5	196.8	602.0	222.0	0.70	0.30	0.00	233	7.78	2.30
WELL24	93072	02/16/93	9		3964	2650.5	82.5	153.4	552.0	188.8	0.70	0.32	0.00	189	7.60	3.10
WELL24	93167	05/17-05/18/	10		4210	2413.1	80.4	174.5	475.0	165.5	0.60	0.31	0.00	191	8.10	1.00
WELL24	93256	08/17-18/93	11		2524	2898.2	79.5	163.0	528.0	190.2	0.81	0.31	0.00	165	19.40	1.69
WELL24	93345	11/16-17/93	12		3507	2285.7	78.3	178.8	524.0	< 1.0	0.52	0.48	0.60	318	8.61	3.10
WELL24	94061	02/22-23/94	13		2748	1226.7	71.4	36.4	17.7	4.7	0.63	0.34	0.51	298	0.21	0.40
WELL26	92192	09/11-12/92	7		293	55.3	42.3	25.2	48.5	12.7	0.20	0.20	0.00	203	2.65	5.38
WELL26	92288	12/7-8/92	8	D	309	24.7	13.5	27.0	39.9	9.6	0.08	0.10	0.00	188	1.69	1.80
WELL26	92288	12/7-8/92	8		308	23.3	14.0	27.9	41.2	9.9	0.07	0.11	0.00	187	1.70	1.90
WELL26	93074	02/16/93	9		301	25.4	7.2	31.2	32.3	6.8	0.20	0.20	0.00	163	0.40	0.80
WELL26	93171	05/17-05/18/	10		319	13.6	6.3	44.8	11.5	1.4	0.20	0.20	2.54	160	0.80	0.30
WELL26	93257	08/17-18/93	11		219	20.2	6.0	26.1	26.4	6.3	0.20	0.20	0.00	170	0.30	0.12
WELL26	93346	11/16-17/93	12		279	12.1	6.0	23.3	31.6	< 1.0	< 0.2	< 0.2	1.02	171	0.40	0.70
WELL26	94062	02/22-23/94	13		245	11.6	6.6	36.3	16.9	4.5	< 0.2	< 0.2	< 0.50	169	0.24	1.00
WELL3	91047	03/20/91	1		232	74.2	11.2				0.20	0.20				
WELL3	91118A	06/26/91	2		215	56.0	12.0				0.20	0.20	0.00			
WELL3	91197A	09/25/91	3		247	17.0	7.8				0.20	0.20	0.00			
WELL3	91236	11/21/91	4		218	64.9	3.4				0.20	0.20	0.97			
WELL3	92005	03/12/92	5		210	256.3	12.0	15.0	10.3	3.3	0.20	0.20	0.00		5.04	0.87
WELL3	92084	06/02-03/92	6		225	34.6	16.2	15.1	8.0	3.3	0.04	0.20	3.62	12	4.25	0.31
WELL3	92163	09/11-12/92	7		204	370.0	37.5	18.0	13.1	3.7	0.20	0.20	4.42	11	3.51	2.84
WELL3	92261	12/7-8/92	8		209	33.9	7.5	21.1	11.7	4.8	0.20	0.20	0.00	12	4.18	1.40
WELL3	93087	02/16/93	9		229	151.9	9.3	15.9	10.5	3.6	0.20	0.20	0.00	9	3.00	0.75
WELL3	93184	05/17-05/18/	10		228	49.3	9.3	17.1	9.5	3.4	0.20	0.20	0.00	9	3.40	0.60
WELL3	93272	08/17-18/93	11		205	118.2	8.1	16.6	10.1	3.6	0.20	0.20	0.61	10	2.40	0.17
WELL3	93361	11/16-17/93	12		204	135.2	9.0	16.4	14.1	3.0	< 0.2	< 0.2	< 0.00	8	2.92	1.30
WELL3	94075	02/22-23/94	13		178	128.2	7.4	16.9	9.6	3.2	< 0.2	< 0.2	< 0.50	11	3.39	2.53

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL4	91046	03/20/91	1		217	70.5	21.4				0.20	0.20				
WELL4	91121	06/26/91	2		192	30.5	19.2				0.20	0.20	0.00			
WELL4	91198	09/25/91	3		217	40.9	16.9				0.20	0.20	0.00			
WELL4	91237	11/21/91	4		203	72.0	2.2				0.20	0.20	0.00			
WELL4	92006	03/12/92	5		216	104.8	32.0	18.5	6.1	2.5	0.20	0.20	0.69		1.24	0.50
WELL4	92085	06/02-03/92	6		217	61.1	29.0	17.3	6.9	3.2	0.04	0.20	6.52	0	1.33	0.70
WELL4	92164	09/11-12/92	7		238	837.1	52.0	17.7	11.5	3.6	0.20	0.20	3.99	0	3.38	4.36
WELL4	92262	12/7-8/92	8		238	28.9	19.4	22.0	7.2	3.7	0.20	0.20	1.46	0	3.08	1.50
WELL4	93088	02/16/93	9	D	233	42.4	28.5	24.1	7.4	3.1	0.20	0.20	0.57		3.80	1.73
WELL4	93088	02/16/93	9		216	38.4	28.2	26.0	8.4	3.5	0.20	0.20	0.57		3.70	1.57
WELL4	93185	05/17-05/18/	10		232	51.7	30.3	25.7	6.0	2.9	0.30	0.20	0.00	0	6.50	6.00
WELL4	93273	08/17-18/93	11		235	145.5	19.5	18.9	9.7	3.9	0.20	0.20	0.90	0	4.10	1.95
WELL4	93362	11/16-17/93	12													
WELL4	93362	11/16-17/93	12		255	106.7	20.7	21.6	16.0	3.6	< 0.2	< 0.2	1.24	0	8.32	8.80
WELL4	94076	02/22-23/94	13		209	35.2	31.2	28.1	6.8	2.9	< 0.2	< 0.2	0.62	0	7.76	10.10
WELL5	91051	03/20/91	1		336	382.0	891.7				0.20	0.68				
WELL5	91122	06/26/91	2		3152	795.0	85.2				0.20	0.73	0.50			
WELL5	91201	09/25/91	3		3378	942.0	13.8				0.20	0.87	37.20			
WELL5	91238	11/21/91	4		3490	251.3	447.0				0.20	0.67	2.46			
WELL5	92007	03/12/92	5		3056	434.2	119.8	306.6	283.8	141.2	0.22	0.20	0.00		2.07	0.12
WELL5	92086	06/02-03/92	6		3046	964.2	427.2	343.4	222.0	124.2	0.49	0.80	9.06	0	2.00	0.66
WELL5	92165	09/11-12/92	7		3321	1232.8	824.5	358.8	278.9	179.0	0.20	0.20	3.04	0	2.18	14.65
WELL5	92263	12/7-8/92	8		3332	409.0	711.7	384.0	288.4	145.0	0.40	1.10	0.00	0	3.15	13.00
WELL5	93091	02/16/93	9		3336	1053.1	798.0	324.6	301.0	147.6	0.20	0.61	0.06		1.30	8.05
WELL5	93186	05/17-05/18/	10		3216	989.6	417.0	342.0	242.0	129.0	0.20	0.20	0.92	0	1.10	6.20
WELL5	93274	08/17-18/93	11		5512	634.7	1080.0	330.5	317.0	162.0	0.20	0.75	2.93	0	0.40	10.00
WELL5	93363	11/16-17/93	12		3300	1174.7	1110.0	339.6	331.6	156.8	0.30	0.83	< 0.00	0	1.27	7.71
WELL5	94077	02/22-23/94	13		2424	1267.1	801.9	321.4	272.0	124.2	< 0.2	0.56	1.37	0	1.86	8.54
WELL6	91052	03/20/91	1		252	5.2	0.2				0.20	0.20	438.40			
WELL6	91123	06/26/91	2		143	35.0	5.8				0.20	0.20	0.00			
WELL6	91202	09/25/91	3		219	33.5	0.2				0.20	0.20	0.00			
WELL6	91241	11/21/91	4										0.00			
WELL6	92008	03/12/92	5										0.00			0.00
WELL6	92008	03/12/92	5	D									0.00			0.00
WELL6	92087	06/02-03/92	6										0.00			0.00
WELL6	92166	09/11-12/92	7													
WELL6	92264	12/7-8/92	8													
WELL6	93092	02/16/93	9													
WELL6	93187	05/17-05/18/	10													
WELL6	93275	08/17-18/93	11													
WELL6	93364	11/16-17/93	12													
WELL7	91057	03/20/91	1		553	47.0	37.0				0.20	0.20				
WELL7	91124	06/26/91	2		487	36.0	35.8				0.20	0.20	0.00			
WELL7	91203	09/25/91	3		500	173.5	38.6				0.20	0.20	0.00			
WELL7	91242	11/21/91	4		494	87.7	39.4				0.20	0.20	0.00			
WELL7	92011	03/12/92	5		494	267.6	28.0	37.7	29.5	12.1	0.12	0.20	0.00		7.14	0.42
WELL7	92088	06/02-03/92	6		520	140.0	43.1	37.6	33.4	11.8	0.17	0.20	5.43	28	6.79	0.13
WELL7	92088	06/02-03/92	6	D	505	149.0	39.9	36.6	32.5	11.5	0.16	0.20	5.49	28	6.88	0.09
WELL7	92167	09/11-12/92	7		480	183.7	89.8	40.8	41.5	13.8	0.20	0.20	3.85	30	7.10	3.53

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL7	92265	12/7-8/92	8		473	139.2	33.4	44.4	27.4	15.0	0.20	0.20	0.00	20	7.02	0.80
WELL7	93051	02/16/93	9		503	295.6	34.2	39.9	43.0	13.7	0.20	0.20	0.00	18	5.70	0.42
WELL7	93188	05/17-05/18/	10		484	190.2	34.5	40.6	35.7	12.0	0.20	0.20	0.00	17	5.40	0.30
WELL7	93188	05/17-05/18/	10	D	493	209.3	34.5	40.5	35.9	11.9	0.20	0.20	0.00	17	5.50	0.30
WELL7	93276	08/17-18/93	11		441	285.5	33.0	39.5	37.3	12.5	0.20	0.20	0.00	18	5.60	0.19
WELL7	93365	11/16-17/93	12		433	234.9	34.8	40.7	37.6	11.8	< 0.2	< 0.2	< 0.00	20	4.64	0.90
WELL7	94081	02/22-23/94	13		431	261.5	58.4	40.6	36.8	11.9	< 0.2	< 0.2	< 0.50	0	2.88	0.84
WELL8	91063	03/20/91	1		399	196.7	45.8				0.20	0.20				
WELL8	91125	06/26/91	2		375	140.0	47.8				0.20	0.20	0.00			
WELL8	91204	09/25/91	3		389	96.1	57.1				0.20	0.20	0.00			
WELL8	91243	11/21/91	4		386	319.7	56.8				0.20	0.20	0.00			
WELL8	92012	03/12/92	5		416	134.1	38.0	37.0	19.3	8.9	0.20	0.20	0.00		3.18	0.11
WELL8	92091	06/02-03/92	6		419	88.9	55.9	32.9	16.1	7.9	0.08	0.20	5.25	0	4.44	0.70
WELL8	92168	09/11-12/92	7	D	379	92.0	87.1	37.7	23.9	10.0	0.20	0.20	0.27	0	8.70	6.72
WELL8	92168	09/11-12/92	7		383	113.9	86.9	36.1	23.9	9.5	0.20	0.02	0.26	0	6.97	3.61
WELL8	92266	12/7-8/92	8		372	98.5	41.8	40.7	13.3	9.4	0.20	0.20	0.00	0	5.06	2.80
WELL8	93052	02/16/93	9		234	173.5	43.8	38.2	24.0	11.0	0.20	0.24	0.00		3.50	1.91
WELL8	93191	05/17-05/18/	10		429	229.5	48.0	41.4	20.0	9.6	0.20	0.20	0.00	0	5.00	2.20
WELL8	93277	08/17-18/93	11		343	229.7	54.3	36.8	21.1	9.2	0.20	0.20	0.00	0	4.80	1.62
WELL8	93366	11/16-17/93	12		411	206.4	50.1	41.2	23.9	8.9	< 0.2	< 0.2	< 0.00	0	7.94	5.90
WELL8	94082	02/22-23/94	13		377	148.4	52.0	42.8	23.3	10.0	< 0.2	< 0.2	0.51	0	6.70	4.91
WELL9	91064	03/20/91	1		928	657.9	245.0				0.20	0.20				
WELL9	91127	06/26/91	2		953	433.0	66.0				0.20	0.20	0.00			
WELL9	91205	09/25/91	3		997	414.3	67.9				0.20	0.20	0.00			
WELL9	91244	11/21/91	4		970	302.6	73.3				0.20	0.20	0.00			
WELL9	92013	03/12/92	5		964	692.9	60.0	53.4	90.7	31.0	0.25	0.20	0.00		22.74	0.28
WELL9	92092	06/02-03/92	6		968	375.1	74.6	55.8	86.1	29.3	0.31	0.20	7.12	27	24.55	0.03
WELL9	92171	09/11-12/92	7		950	440.7	88.0	57.1	102.7	34.0	0.20	0.18	0.50	31	15.84	0.18
WELL9	92267	12/7-8/92	8		896	327.0	75.5	64.3	64.3	34.9	0.30	0.20	0.00	35	22.52	0.40
WELL9	93053	02/16/93	9		1033	490.4	79.2	52.4	107.8	33.7	0.20	0.20	0.00	6	23.20	0.66
WELL9	93151	05/17-05/18/	10		1012	368.0	69.6	32.8	56.3	17.4	0.30	0.20	0.00	8	11.70	0.10
WELL9	93278	08/17-18/93	11		846	405.5	77.4	57.1	106.0	32.9	0.20	0.20	0.00	9	18.90	0.30
WELL9	93278	08/17-18/93	11	D	862	391.8	78.0	55.0	101.0	31.4	0.20	0.20	0.00	11	17.40	0.27
WELL9	93367	11/16-17/93	12		766	314.2	76.8	59.0	107.2	30.9	0.26	< 0.2	1.00	8	18.92	0.70
WELL9	94083	02/22-23/94	13		820	431.5	81.7	55.7	94.9	28.2	0.22	< 0.2	0.78	26	20.25	0.25

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
AR. RIVER	93267	08/17-18/93	11		0.36	0.058	0.005	0.025			0.005		0.001	0.002
AR. RIVER	93356	11/16-17/93	12		0.37	0.085	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
AR. RIVER	94072	02/22-23/94	13		0.34	0.042	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
CLTWRSUMP	92002	03/12/92	5		0.42	< 0.025	< 0.005	0.010	< 0.005	< 0.002	0.008	< 0.001	< 0.0005	< 0.001
CLTWRSUMP	92113	06/02-03/92	6		1.85	< 0.025	0.017	0.012	< 0.005	< 0.002	0.009	< 0.001	< 0.0005	0.002
CLTWRSUMP	92196	09/11-12/92	7						< 0.005	< 0.002		0.021		0.005
CLTWRSUMP	92294	12/7-8/92	8		3.20	0.301	0.019	0.031	< 0.005	< 0.002	0.020	0.002	< 0.0005	< 0.001
CLTWRSUMP	93078	3/2-3/93	9		3.41	< 0.025	0.007	< 0.025			< 0.005		< 0.0005	< 0.001
CLTWRSUMP	93078	3/2-3/93	9	D	3.37	< 0.025	0.007	< 0.025			< 0.005		< 0.0005	< 0.001
CLTWRSUMP	93175	5/17-18/93	10		2.33	< 0.025	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
CLTWRSUMP	93263	08/17-18/93	11		2.70	0.195	0.005	0.029			0.009		0.001	0.001
CLTWRSUMP	93352	11/16-17/93	12		3.89	0.177	0.020	0.045			0.010		< 0.0005	< 0.001
CLTWRSUMP	94066	02/22-23/94	13		3.13	< 0.062	0.010	< 0.032			0.010		< 0.0005	< 0.001
NRECYCLE	92036	03/12/92	5		2.17	0.179	< 0.005	0.036	< 0.005	0.012	0.022	< 0.001	< 0.0005	< 0.001
NRECYCLE	92115	06/02-03/92	6		2.28	0.044	0.015	0.048	< 0.005	< 0.002	0.026	< 0.001	< 0.0005	0.001
NRECYCLE	92198	09/11-12/92	7	D	3.84	0.076	0.005	0.020	< 0.005	< 0.002	< 0.005	< 0.001	< 0.0005	< 0.001
NRECYCLE	92198	09/11-12/92	7		3.05	0.066	< 0.005	0.026	< 0.005	< 0.002	< 0.005	< 0.001	< 0.0005	< 0.001
NRECYCLE	92296	12/7-8/92	8		2.86	0.106	< 0.005	0.053	< 0.005	< 0.002	0.029	< 0.001	< 0.0005	< 0.001
NRECYCLE	93082	3/2-3/93	9		3.51	0.110	< 0.005	0.127			< 0.005		< 0.0005	< 0.001
NRECYCLE	93177	5/17-18/93	10		2.23	< 0.025	0.006	< 0.025			< 0.005		< 0.0005	< 0.001
NRECYCLE	93265	08/17-18/93	11		2.06	0.025	0.005	0.055			0.015		0.001	0.001
NRECYCLE	93354	11/16-17/93	12		2.02	0.123	0.009	0.031			0.014		< 0.0005	< 0.001
NRECYCLE	94068	02/22-23/94	13		1.61	< 0.113	0.010	< 0.030			< 0.023		< 0.0005	< 0.001
NRECYCLE	94068	02/22-23/94	13	D	1.61	< 0.108	0.010	< 0.027			< 0.023		< 0.0005	< 0.001
SRECYCLE	92001	03/12/92	5		2.35	< 0.025	0.005	0.051	< 0.005	0.025	0.022	< 0.001	< 0.0005	< 0.001
SRECYCLE	92116	06/02-03/92	6		2.28	0.044	0.012	0.056	< 0.005	< 0.002	0.260	< 0.001	< 0.0005	< 0.001
SRECYCLE	92201	09/11-12/92	7		3.62	0.074	0.005	0.102	< 0.005	< 0.002	0.006	0.002	< 0.0005	0.036
SRECYCLE	92297	12/7-8/92	8		2.74	0.063	< 0.005	0.050	< 0.005	< 0.002	0.026	< 0.001	< 0.0005	< 0.001
SRECYCLE	93083	3/2-3/93	9		3.30	0.058	< 0.005	0.115			< 0.005		< 0.0005	< 0.001
SRECYCLE	93178	5/17-18/93	10		2.44	< 0.025	0.015	< 0.025			0.014		< 0.0005	< 0.001
SRECYCLE	93178	5/17-18/93	10	D	2.43	< 0.025	0.015	< 0.025			0.014		< 0.0005	< 0.001
SRECYCLE	93266	08/17-18/93	11		2.16	0.025	0.005	0.051			0.013		0.001	0.001
SRECYCLE	93355	11/16-17/93	12		2.14	0.123	0.011	0.032			0.013		< 0.0005	< 0.001
SRECYCLE	94071	02/22-23/94	13		1.57	0.113	< 0.005	0.027			0.021		< 0.0005	< 0.001
SURGEPOND	92035	03/12/92	5		0.74	< 0.025	0.008	0.015	< 0.005	0.004	0.023	< 0.001	< 0.0005	< 0.001
SURGEPOND	92114	06/02-03/92	6		1.06	< 0.025	0.013	0.028	< 0.005	< 0.002	0.007	< 0.001	< 0.0005	0.003
SURGEPOND	92197	09/11-12/92	7		1.68	< 0.025	< 0.005	0.043	< 0.005	< 0.002	< 0.005	0.012	< 0.0005	0.039
SURGEPOND	92295	12/7-8/92	8		1.59	0.076	< 0.005	0.032	< 0.005	< 0.002	0.018	< 0.001	< 0.0005	< 0.001
SURGEPOND	93081	3/2-3/93	9		1.12	0.043	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
SURGEPOND	93176	5/17-18/93	10		1.09	< 0.025	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
SURGEPOND	93264	08/17-18/93	11		1.34	0.074	0.005	0.044			0.010		0.001	0.001
SURGEPOND	93353	11/16-17/93	12											
SURGEPOND	93353	11/16-17/93	12		0.87	0.087	0.013	< 0.025			0.014		< 0.0005	< 0.001
SURGEPOND	94067	02/22-23/94	13		0.77	< 0.041	< 0.005	< 0.025			< 0.010		< 0.0005	< 0.001
WELL1	91035	03/20/91	1											
WELL1	91116	06/26/91	2											
WELL1	91195	09/25/91	3											
WELL1	91234	11/21/91	4											
WELL1	92003	03/12/92	5		3.91	0.025	0.113	0.010	0.005	0.002	0.012	0.001	0.001	0.002

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL1	92082	06/02-03/92	6		4.33	0.016	0.123	0.010	0.005	0.002	0.007	0.001	0.001	0.001
WELL1	92161	09/11-12/92	7		5.48	0.114	0.205	0.008	0.005	0.002	0.005	0.001	0.001	0.004
WELL1	92301	12/7-8/92	8		4.19	0.025	0.149	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL1	93085	02/16/93	9		5.79	0.039	0.057	0.025			0.005		0.001	0.001
WELL1	93182	05/17-05/18/	10		5.15	0.025	0.005	0.025			0.005		0.001	0.001
WELL1	93268	08/17-18/93	11	D	5.95	0.101	0.134	0.025			0.018		0.001	0.001
WELL1	93268	08/17-18/93	11		5.76	0.101	0.134	0.025			0.014		0.001	0.001
WELL1	93357	11/16-17/93	12		4.49	0.166	0.016	< 0.025			0.010		< 0.0005	< 0.001
WELL1	94073	02/22-23/94	13		4.86	0.034	0.010	< 0.025			0.007		< 0.0005	< 0.001
WELL10	91065	03/20/91	1											
WELL10	91126	06/26/91	2											
WELL10	91206	09/25/91	3											
WELL10	91245	11/21/91	4											
WELL10	92014	03/12/92	5		0.44	0.107	0.011	0.005	0.005	0.002	0.019	0.001	0.001	0.001
WELL10	92093	06/02-03/92	6		0.47	0.025	0.005	0.005	0.005	0.002	0.009	0.004	0.001	0.012
WELL10	92172	09/11-12/92	7		0.57	0.025	0.010	0.005	0.005	0.002	0.005	0.001	0.001	0.006
WELL10	92268	12/7-8/92	8		0.89	0.140	0.005	0.005	0.005	0.002	0.017	0.001	0.001	0.001
WELL10	92268	12/7-8/92	8	D	0.90	0.120	0.007	0.005	0.005	0.002	0.019	0.001	0.001	0.001
WELL10	93054	02/16/93	9		0.39	0.025	0.017	0.025			0.005		0.001	0.001
WELL10	93152	05/17-05/18/	10		0.66	0.025	0.013	0.025			0.005		0.001	0.001
WELL10	93281	08/17-18/93	11		0.53	0.036	0.010	0.025			0.011		0.001	0.001
WELL10	93368	11/16-17/93	12		0.64	0.040	0.018	< 0.025			0.007		< 0.0005	< 0.001
WELL10	93368	11/16-17/93	12	D	0.64	0.039	0.018	< 0.025			0.006		< 0.0005	< 0.001
WELL10	94084	02/22-23/94	13		0.67	0.045	< 0.005	< 0.025			0.012		< 0.0005	< 0.001
WELL11	91042	03/20/91	1											
WELL11	91128A	06/26/91	2											
WELL11	91207	09/25/91	3											
WELL11	91246	11/21/91	4											
WELL11	92015	03/12/92	5										0.004	
WELL11	92094	06/02-03/92	6		0.84	0.033	0.017	0.005	0.005	0.002	0.009	0.004	0.001	0.004
WELL11	92173	09/11-12/92	7		0.97	0.030	0.057	0.005	0.005	0.002	0.005	0.001	0.006	0.001
WELL11	92271	12/7-8/92	8		1.17	0.098	0.039	0.005	0.005	0.002	0.015	0.001	0.004	0.001
WELL11	93055	02/16/93	9		1.02	0.025	0.031	0.025			0.007		0.002	0.001
WELL11	93153	05/17-05/18/	10		1.12	0.025	0.056	0.025			0.005		0.002	0.001
WELL11	93241	08/17-18/93	11		1.05	0.107	0.042	0.025			0.007		0.001	0.001
WELL11	93371	11/16-17/93	12		1.19	0.079	0.072	< 0.025			0.005		0.001	< 0.001
WELL11	93371	11/16-17/93	12											
WELL11	94085	02/22-23/94	13		1.24	0.065	< 0.081	< 0.025			0.008		0.002	< 0.001
WELL12	91043	03/20/91	1											
WELL12	91131	06/26/91	2											
WELL12	91208A	09/25/91	3											
WELL12	91247	11/21/91	4											
WELL12	92016	03/12/92	5		1.39	0.155	0.156	0.005	0.005	0.002	0.020	0.001	0.001	0.001
WELL12	92095	06/02-03/92	6		1.24	0.025	0.025	0.005	0.005	0.002	0.015	0.010	0.001	0.019
WELL12	92174	09/11-12/92	7		1.26	0.025	0.079	0.005	0.005	0.002	0.006	0.003	0.001	0.001
WELL12	92272	12/7-8/92	8		1.84	0.086	0.063	0.005	0.005	0.002	0.018	0.001	0.001	0.001
WELL12	93056	02/16/93	9		1.71	0.025	0.005	0.025			0.005		0.001	0.001
WELL12	93154	05/17-05/18/	10		1.34	0.025	0.067	0.025			0.006		0.001	0.001
WELL12	93242	08/17-18/93	11		1.39	0.063	0.049	0.025			0.009		0.001	0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL12	93331	11/16-17/93	12		1.92	< 0.025	0.089	< 0.025			0.024		< 0.0005	< 0.001
WELL12	94086	02/22-23/94	13		1.33	< 0.025	0.083	< 0.025			0.009		0.001	< 0.001
WELL13	91037	03/20/91	1											
WELL13	91132	06/26/91	2											
WELL13	91211	09/25/91	3											
WELL13	91248	11/21/91	4											
WELL13	92017	03/12/92	5		0.28	0.206	0.061	0.005	0.005	0.002	0.020	0.001	0.001	0.007
WELL13	92096	06/02-03/92	6		0.39	0.045	0.151	0.005	0.008	0.002	0.011	0.007	0.001	0.010
WELL13	92175	09/11-12/92	7		0.42	0.025	0.049	0.005	0.005	0.002	0.007	0.002	0.001	0.001
WELL13	92273	12/7-8/92	8		0.44	0.085	0.022	0.005	0.005	0.002	0.015	0.003	0.001	0.001
WELL13	93057	02/16/93	9		0.41	0.051	0.028	0.025			0.006		0.001	0.001
WELL13	93155	05/17-05/18/	10		0.37	0.025	0.024	0.025			0.006		0.001	0.001
WELL13	93243	08/17-18/93	11		0.38	0.047	0.024	0.025			0.006		0.001	0.001
WELL13	93332	11/16-17/93	12		0.41	< 0.025	0.036	< 0.025			0.009		< 0.0005	< 0.001
WELL13	94087	02/22-23/94	13		0.30	< 0.025	0.037	< 0.025			0.005		< 0.0005	< 0.001
WELL14	91032	03/20/91	1											
WELL14	91133	06/26/91	2											
WELL14	91212	09/25/91	3											
WELL14	91251	11/21/91	4											
WELL14	92018	03/12/92	5		1.06	0.179	0.006	0.005	0.005	0.002	0.019	0.001		0.002
WELL14	92097	06/02-03/92	6		2.19	0.039	0.062	0.006	0.007	0.002	0.010	0.006	0.001	0.008
WELL14	92176	09/11-12/92	7		1.96	0.025	0.013	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL14	92274	12/7-8/92	8		2.02	0.093	0.005	0.009	0.005	0.002	0.014	0.001	0.001	0.001
WELL14	93058	02/16/93	9	D	1.60	0.025	0.005	0.025			0.005		0.001	0.001
WELL14	93058	02/16/93	9		1.57	0.025	0.005	0.025			0.005		0.001	0.001
WELL14	93156	05/17-05/18/	10		1.68	0.025	0.006	0.025			0.005		0.001	0.001
WELL14	93244	08/17-18/93	11		1.60	0.025	0.005	0.025			0.006		0.001	0.001
WELL14	93333	11/16-17/93	12		1.66	0.065	0.008	< 0.025			0.005		< 0.0005	< 0.001
WELL14	94088	02/22-23/94	13		1.43		0.014	< 0.025			0.008		< 0.0005	< 0.001
WELL14	94088	02/22-23/94	13	D	1.38	< 0.025	0.018	< 0.025			0.009		< 0.0005	< 0.001
WELL15	91031	03/20/91	1											
WELL15	91134	06/26/91	2											
WELL15	91213	09/25/91	3											
WELL15	91252	11/21/91	4											
WELL15	92021	03/12/92	5	D	1.18	0.025	0.005	0.005	0.005	0.002	0.018	0.001	0.001	0.001
WELL15	92021	03/12/92	5		1.21	0.025	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL15	92098	06/02-03/92	6		1.27	0.025	0.005	0.005	0.005	0.002	0.009	0.001	0.001	0.001
WELL15	92098	06/02-03/92	6	D	1.27	0.025	0.005	0.005	0.005	0.002	0.007	0.001	0.001	0.001
WELL15	92177	09/11-12/92	7		1.55	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL15	92275	12/7-8/92	8		1.54	0.025	0.005	0.005	0.005	0.002	0.015	0.001	0.001	0.001
WELL15	93061	02/16/93	9		1.86	0.025	0.005	0.025			0.005		0.001	0.001
WELL15	93157	05/17-05/18/	10		1.42	0.025	0.005	0.025			0.005		0.001	0.001
WELL15	93245	08/17-18/93	11		1.31	0.025	0.005	0.025			0.005		0.001	0.001
WELL15	93334	11/16-17/93	12		1.45	0.081	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL15	94064	02/22-23/94	13		1.25	< 0.025	< 0.005	< 0.025			< 0.006		< 0.0005	< 0.001
WELL16	91056	03/20/91	1											
WELL16	91135	06/26/91	2											
WELL16	91214	09/25/91	3											
WELL16	91253	11/21/91	4											

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL16	92022	03/12/92	5		0.10	0.062	0.005	0.005	0.005	0.002	0.018	0.001	0.001	0.010
WELL16	92101	06/02-03/92	6		0.02	0.018	0.005	0.010	0.005	0.002	0.005	0.001	0.001	0.001
WELL16	92178	09/11-12/92	7		0.06	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL16	92178	09/11-12/92	7	D	0.05	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL16	92276	12/7-8/92	8		0.01	0.213	0.005	0.005	0.005	0.002	0.015	0.001	0.001	0.001
WELL16	93062	02/16/93	9		0.11	0.025	0.005	0.025			0.005		0.001	0.001
WELL16	93158	05/17-05/18/	10		0.07	0.025	0.005	0.025			0.005		0.001	0.001
WELL16	93158	05/17-05/18/	10	D	0.06	0.025	0.005	0.025			0.005		0.001	0.001
WELL16	93246	08/17-18/93	11		0.03	0.025	0.005	0.025			0.006		0.001	0.002
WELL16	93335	11/16-17/93	12		0.07	0.071	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL16	94051	02/22-23/94	13		0.05	0.054	0.007	< 0.025			< 0.005		< 0.0005	0.001
WELL17	91055	03/20/91	1											
WELL17	91136	06/26/91	2											
WELL17	91215	09/25/91	3											
WELL17	91254	11/21/91	4											
WELL17	92023	03/12/92	5		0.63	0.040	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.003
WELL17	92102	06/02-03/92	6		0.78	0.033	0.005	0.007	0.005	0.002	0.005	0.001	0.001	0.005
WELL17	92181	09/11-12/92	7		0.87	0.025	0.013	0.010	0.005	0.002	0.010	0.002	0.001	0.001
WELL17	92277	12/7-8/92	8		1.00	0.025	0.005	0.005	0.006	0.002	0.017	0.001	0.001	0.001
WELL17	93063	02/16/93	9		1.00	0.025	0.005	0.025			0.005		0.001	0.001
WELL17	93161	05/17-05/18/	10		0.25	0.025	0.005	0.025			0.005		0.001	0.001
WELL17	93247	08/17-18/93	11		0.68	0.025	0.005	0.025			0.005		0.001	0.002
WELL17	93336	11/16-17/93	12		0.66	0.058	< 0.005	< 0.025			0.005		< 0.0005	0.002
WELL17	94052	02/22-23/94	13		0.11	0.047	0.006	< 0.025			0.008		< 0.0005	< 0.001
WELL18	91034	03/20/91	1											
WELL18	91137	06/26/91	2											
WELL18	91216	09/25/91	3											
WELL18	91255	11/21/91	4											
WELL18	92024	03/12/92	5		3.62	0.057	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.002
WELL18	92103	06/02-03/92	6		3.77	0.025	0.005	0.006	0.005	0.002	0.005	0.001	0.001	0.001
WELL18	92182	09/11-12/92	7		4.03	0.036	0.005	0.037	0.005	0.002	0.005	0.001	0.001	0.001
WELL18	92278	12/7-8/92	8		4.53	0.122	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL18	92278	12/7-8/92	8	D	4.56	0.120	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL18	93064	02/16/93	9		4.62	0.025	0.005	0.025			0.005		0.001	0.001
WELL18	93162	05/17-05/18/	10		3.94	0.025	0.005	0.025			0.005		0.001	0.001
WELL18	93248	08/17-18/93	11	D	4.24	0.080	0.005	0.025			0.005		0.001	0.001
WELL18	93248	08/17-18/93	11		4.28	0.082	0.005	0.025			0.005		0.001	0.001
WELL18	93337	11/16-17/93	12		3.97	0.094	0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL18	94053	02/22-23/94	13		3.54	0.060	< 0.005	< 0.025			0.006		< 0.0005	< 0.001
WELL19	91033	03/20/91	1											
WELL19	91138A	06/26/91	2											
WELL19	91217	09/25/91	3											
WELL19	91256	11/21/91	4											
WELL19	92025	03/12/92	5		3.79	0.063	0.006	0.005	0.005	0.002	0.020	0.001	0.001	0.002
WELL19	92104	06/02-03/92	6		3.28	0.035	0.005	0.008	0.005	0.002	0.005	0.001	0.001	0.004
WELL19	92183	09/11-12/92	7		3.15	0.025	0.028	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL19	92281	12/7-8/92	8		3.89	0.141	0.008	0.005	0.005	0.002	0.013	0.001	0.001	0.002
WELL19	93065	02/16/93	9		3.96	0.025	0.005	0.025			0.005		0.001	0.001
WELL19	93163	05/17-05/18/	10		3.70	0.030	0.005	0.025			0.005		0.001	0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL19	93251	08/17-18/93	11		3.11	0.063	0.007	0.025			0.005		0.001	0.001
WELL19	93338	11/16-17/93	12		3.27	< 0.025	0.014	< 0.025			0.008		< 0.0005	< 0.001
WELL19	93338	11/16-17/93	12	D	3.32	< 0.025	0.013	< 0.025			0.007		< 0.0005	< 0.001
WELL19	94054	02/22-23/94	13		3.27	0.053	0.008	< 0.025			0.007		< 0.0005	< 0.001
WELL2	91036	03/20/91	1											
WELL2	91117	06/26/91	2											
WELL2	91196	09/25/91	3											
WELL2	91235	11/21/91	4											
WELL2	92004	03/12/92	5		2.64	0.025	0.046	0.005	0.005	0.002	0.015	0.001	0.001	0.002
WELL2	92083	06/02-03/92	6		2.15	0.007	0.068	0.008	0.005	0.002	0.005	0.001	0.001	0.001
WELL2	92162	09/11-12/92	7		3.86	0.064	0.015	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL2	92302	12/7-8/92	8		3.07	0.025	0.005	0.005	0.005	0.002	0.015	0.001	0.001	0.001
WELL2	93086	02/16/93	9		4.00	0.025	0.021	0.025			0.005		0.001	0.001
WELL2	93183	05/17-05/18/	10		3.57	0.025	0.005	0.025			0.005		0.001	0.001
WELL2	93271	08/17-18/93	11		3.66	0.077	0.005	0.025			0.005		0.001	0.001
WELL2	93358	11/16-17/93	12		3.81	0.070	0.007	< 0.025			0.005		< 0.0005	< 0.001
WELL2	93358	11/16-17/93	12	D	3.75	0.072	0.009	< 0.025			0.005		< 0.0005	< 0.001
WELL2	94074	02/22-23/94	13		3.35	0.036	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL20	91054	03/20/91	1											
WELL20	91141	06/26/91	2											
WELL20	91218A	09/25/91	3											
WELL20	91257	11/21/91	4											
WELL20	92026	03/12/92	5		1.94	0.059	0.076	0.005	0.005	0.002	0.021	0.001	0.001	0.004
WELL20	92105	06/02-03/92	6		2.04	0.017	0.032	0.006	0.005	0.002	0.006	0.001	0.001	0.001
WELL20	92184	09/11-12/92	7		2.26	0.025	0.005	0.015	0.005	0.002	0.006	0.001	0.001	0.001
WELL20	92282	12/7-8/92	8		4.56	0.285	0.040	0.009	0.005	0.002	0.015	0.001	0.001	0.001
WELL20	93066	02/16/93	9		3.50	0.025	0.041	0.025			0.006		0.001	0.001
WELL20	93164	05/17-05/18/	10		2.26	0.025	0.005	0.025			0.005		0.001	0.001
WELL20	93252	08/17-18/93	11		2.06	0.064	0.124	0.025			0.006		0.001	0.001
WELL20	93341	11/16-17/93	12		3.85	< 0.025	0.049	0.077			< 0.005		< 0.0005	< 0.001
WELL20	94055	02/22-23/94	13		1.87	0.043	0.083	< 0.025			0.007		< 0.0005	< 0.001
WELL21	91053	03/20/91	1											
WELL21	91142	06/26/91	2											
WELL21	91221	09/25/91	3											
WELL21	91258A	11/21/91	4											
WELL21	92027	03/12/92	5		2.05	0.036	0.159	0.005	0.005	0.002	0.021	0.001	0.001	0.014
WELL21	92106	06/02-03/92	6		2.29	0.015	0.028	0.007	0.005	0.002	0.005	0.001	0.001	0.002
WELL21	92185	09/11-12/92	7		2.84	0.138	0.087	0.011	0.007	0.009	0.006	0.001	0.001	0.001
WELL21	92283	12/7-8/92	8		3.11	0.092	0.054	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL21	93067	02/16/93	9		2.93	0.025	0.048	0.025			0.005		0.001	0.001
WELL21	93165	05/17-05/18/	10		2.13	0.025	0.005	0.025			0.005		0.001	0.001
WELL21	93253	08/17-18/93	11		2.39	0.053	0.062	0.025			0.005		0.001	0.001
WELL21	93342	11/16-17/93	12		2.35	< 0.025	0.073	< 0.025			< 0.005		< 0.0005	< 0.001
WELL21	94056	02/22-23/94	13		2.00	0.069	0.039	0.025			0.008		< 0.0005	< 0.001
WELL22	91041	03/20/91	1											
WELL22	91143	06/26/91	2											
WELL22	91222	09/25/91	3											
WELL22	91261	11/21/91	4											
WELL22	92028	03/12/92	5	D	0.33	0.022	0.005	0.005	0.005	0.002	0.012	0.001	0.001	0.002

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL22	92028	03/12/92	5		0.31	0.016	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.003
WELL22	92107	06/02-03/92	6		0.24	0.025	0.066	0.007	0.005	0.002	0.011	0.009	0.001	0.019
WELL22	92186	09/11-12/92	7		0.31	0.100	0.011	0.013	0.005	0.002	0.005	0.001	0.001	0.001
WELL22	92284	12/7-8/92	8		0.67	0.088	0.008	0.005	0.005	0.002	0.014	0.001	0.001	0.001
WELL22	93068	02/16/93	9		0.45	0.025	0.009	0.025			0.005		0.001	0.001
WELL22	93068	02/16/93	9	D	0.46	0.025	0.008	0.025			0.005		0.001	0.001
WELL22	93166	05/17-05/18/	10		0.41	0.025	0.008	0.025			0.005		0.001	0.001
WELL22	93254	08/17-18/93	11		0.32	0.049	0.007	0.025			0.005		0.001	0.001
WELL22	93343	11/16-17/93	12		0.54	< 0.025	0.017	< 0.025			0.008		< 0.0005	< 0.001
WELL22	93343	11/16-17/93	12											
WELL22	94057	02/22-23/94	13		0.43	0.054	0.010	< 0.025			0.006		< 0.0005	< 0.001
WELL23	92187	09/11-12/92	7		2.52	0.069	0.010	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL23	92285	12/7-8/92	8		3.63	0.057	0.008	0.005	0.005	0.002	0.013	0.001	0.001	0.001
WELL23	93071	02/16/93	9		3.01	0.025	0.005	0.025			0.005		0.001	0.001
WELL23	93168	05/17-05/18/	10	D	3.18	0.025	0.005	0.025			0.005		0.001	0.001
WELL23	93168	05/17-05/18/	10		3.17	0.025	0.006	0.025			0.005		0.001	0.001
WELL23	93255	08/17-18/93	11		3.27	0.041	0.005	0.025			0.006		0.001	0.001
WELL23	93344	11/16-17/93	12		3.08	< 0.025	0.008	< 0.025			< 0.005		< 0.0005	< 0.001
WELL23	94058	02/22-23/94	13		0.30	0.030	0.011	< 0.025			0.005		< 0.0005	< 0.001
WELL23	94058	02/22-23/94	13	D	0.30	0.033	0.010	< 0.025			0.005		< 0.0005	< 0.001
WELL24	92188	09/11-12/92	7	D	8.04	0.025	0.152	0.009	0.005	0.002	0.005	0.001	0.001	0.001
WELL24	92188	09/11-12/92	7		8.26	0.025	0.170	0.009	0.005	0.002	0.005	0.001	0.001	0.001
WELL24	92286	12/7-8/92	8		9.88	0.025	0.088	0.005	0.005	0.002	0.006	0.001	0.001	0.001
WELL24	93072	02/16/93	9		8.79	0.031	0.048	0.025			0.005		0.001	0.001
WELL24	93167	05/17-05/18/	10		7.84	0.028	0.005	0.025			0.005		0.001	0.001
WELL24	93256	08/17-18/93	11		8.61	0.065	0.081	0.025			0.005		0.001	0.001
WELL24	93345	11/16-17/93	12		8.27	< 0.025	0.101	< 0.025			< 0.005		< 0.0005	< 0.001
WELL24	94061	02/22-23/94	13		0.28	< 0.047	< 0.005	< 0.025			0.006		< 0.0005	< 0.001
WELL26	92192	09/11-12/92	7		0.58	0.025	0.008	0.005	0.005	0.002	0.006	0.001	0.001	0.001
WELL26	92288	12/7-8/92	8	D	0.40	0.197	0.006	0.005	0.005	0.002	0.014	0.001	0.001	0.001
WELL26	92288	12/7-8/92	8		0.49	0.181	0.005	0.005	0.005	0.002	0.014	0.001	0.001	0.001
WELL26	93074	02/16/93	9		0.40	0.025	0.005	0.025			0.005		0.001	0.001
WELL26	93171	05/17-05/18/	10		0.31	0.025	0.005	0.025			0.005		0.001	0.001
WELL26	93257	08/17-18/93	11		0.38	0.030	0.005	0.025			0.005		0.001	0.002
WELL26	93346	11/16-17/93	12		0.37	< 0.025	0.008	< 0.025			0.009		< 0.0005	< 0.001
WELL26	94062	02/22-23/94	13		0.28	< 0.045	< 0.005	< 0.025			< 0.006		< 0.0005	< 0.001
WELL3	91047	03/20/91	1											
WELL3	91118A	06/26/91	2											
WELL3	91197A	09/25/91	3											
WELL3	91236	11/21/91	4											
WELL3	92005	03/12/92	5		0.24	0.025	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.010
WELL3	92084	06/02-03/92	6		0.22	0.104	0.069	0.007	0.005	0.002	0.005	0.001	0.001	0.006
WELL3	92163	09/11-12/92	7		0.31	0.236	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.018
WELL3	92261	12/7-8/92	8		0.40	0.087	0.005	0.005	0.006	0.003	0.005	0.001	0.001	0.004
WELL3	93087	02/16/93	9		0.29	0.025	0.005	0.025			0.005		0.001	0.001
WELL3	93184	05/17-05/18/	10		0.30	0.025	0.005	0.025			0.005		0.001	0.001
WELL3	93272	08/17-18/93	11		0.24	0.057	0.005	0.025			0.005		0.001	0.001
WELL3	93361	11/16-17/93	12		0.26	0.050	0.011	< 0.025			< 0.005		< 0.0005	0.002
WELL3	94075	02/22-23/94	13		0.25	0.053	< 0.005	< 0.025			0.008		< 0.0005	0.005

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL4	91046	03/20/91	1											
WELL4	91121	06/26/91	2											
WELL4	91198	09/25/91	3											
WELL4	91237	11/21/91	4											
WELL4	92006	03/12/92	5		0.14	0.025	0.010	0.005	0.005	0.002	0.019	0.001	0.001	0.003
WELL4	92085	06/02-03/92	6		0.15	0.027	0.058	0.007	0.005	0.002	0.005	0.001	0.001	0.003
WELL4	92164	09/11-12/92	7		0.23	0.107	0.013	0.005	0.005	0.002	0.005	0.001	0.001	0.013
WELL4	92262	12/7-8/92	8		0.20	0.132	0.007	0.005	0.005	0.002	0.015	0.001	0.001	0.002
WELL4	93088	02/16/93	9	D	0.22	0.025	0.018	0.025			0.005		0.001	0.001
WELL4	93088	02/16/93	9		0.23	0.025	0.017	0.025			0.005		0.001	0.001
WELL4	93185	05/17-05/18/	10		0.19	0.025	0.022	0.025			0.005		0.001	0.003
WELL4	93273	08/17-18/93	11		0.18	0.058	0.012	0.025			0.005		0.001	0.003
WELL4	93362	11/16-17/93	12											
WELL4	93362	11/16-17/93	12		0.22	0.052	0.021	< 0.025			0.011		< 0.0005	0.004
WELL4	94076	02/22-23/94	13		0.15	0.063	0.010	< 0.025			0.007		< 0.0005	0.003
WELL5	91051	03/20/91	1											
WELL5	91122	06/26/91	2											
WELL5	91201	09/25/91	3											
WELL5	91238	11/21/91	4											
WELL5	92007	03/12/92	5		5.97	0.025	0.091	0.005	0.005	0.002	0.018	0.001	0.001	0.004
WELL5	92086	06/02-03/92	6		4.61	0.024	0.081	0.005	0.005	0.002	0.005	0.001	0.001	0.011
WELL5	92165	09/11-12/92	7		8.31	0.088	0.118	0.005	0.005	0.002	0.011	0.001	0.001	0.001
WELL5	92263	12/7-8/92	8		6.23	0.025	0.083	0.005	0.005	0.002	0.021	0.001	0.001	0.001
WELL5	93091	02/16/93	9		6.86	0.029	0.033	0.025			0.006		0.001	0.001
WELL5	93186	05/17-05/18/	10		5.26	0.025	0.005	0.025			0.005		0.001	0.001
WELL5	93274	08/17-18/93	11		6.84	0.095	0.055	0.025			0.006		0.001	0.011
WELL5	93363	11/16-17/93	12		7.71	0.083	0.098	< 0.025			0.009		< 0.0005	< 0.001
WELL5	94077	02/22-23/94	13		5.81	0.070	0.008	< 0.025			0.009		0.001	< 0.001
WELL6	91052	03/20/91	1											
WELL6	91123	06/26/91	2											
WELL6	91202	09/25/91	3											
WELL6	91241	11/21/91	4											
WELL6	92008	03/12/92	5											
WELL6	92008	03/12/92	5	D										
WELL6	92087	06/02-03/92	6											
WELL6	92166	09/11-12/92	7											
WELL6	92264	12/7-8/92	8											
WELL6	93092	02/16/93	9											
WELL6	93187	05/17-05/18/	10											
WELL6	93275	08/17-18/93	11											
WELL6	93364	11/16-17/93	12											
WELL7	91057	03/20/91	1											
WELL7	91124	06/26/91	2											
WELL7	91203	09/25/91	3											
WELL7	91242	11/21/91	4											
WELL7	92011	03/12/92	5		0.86	0.025	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.003
WELL7	92088	06/02-03/92	6		0.93	0.009	0.034	0.005	0.005	0.002	0.005	0.001	0.001	0.002
WELL7	92088	06/02-03/92	6	D	0.91	0.006	0.034	0.005	0.005	0.002	0.005	0.001	0.001	0.002
WELL7	92167	09/11-12/92	7		1.04	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL7	92265	12/7-8/92	8		1.43	0.176	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL7	93051	02/16/93	9		1.08	0.025	0.005	0.025			0.005		0.001	0.001
WELL7	93188	05/17-05/18/	10		1.05	0.025	0.005	0.025			0.005		0.001	0.001
WELL7	93188	05/17-05/18/	10	D	1.04	0.025	0.005	0.025			0.005		0.001	0.001
WELL7	93276	08/17-18/93	11		0.86	0.052	0.005	0.025			0.005		0.001	0.001
WELL7	93365	11/16-17/93	12		0.93	0.050	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
WELL7	94081	02/22-23/94	13		0.86	0.070	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL8	91063	03/20/91	1											
WELL8	91125	06/26/91	2											
WELL8	91204	09/25/91	3											
WELL8	91243	11/21/91	4											
WELL8	92012	03/12/92	5		0.28	0.025	0.029	0.009	0.005	0.002	0.011	0.001	0.001	0.005
WELL8	92091	06/02-03/92	6		0.28	0.025	0.029	0.005	0.005	0.002	0.011	0.004	0.001	0.020
WELL8	92168	09/11-12/92	7	D	0.46	0.025	0.028	0.005	0.005	0.002	0.005	0.001	0.001	0.006
WELL8	92168	09/11-12/92	7		0.44	0.025	0.025	0.005	0.005	0.002	0.005	0.001	0.001	0.006
WELL8	92266	12/7-8/92	8		0.38	0.154	0.014	0.005	0.005	0.002	0.014	0.001	0.001	0.003
WELL8	93052	02/16/93	9		0.41	0.025	0.022	0.025			0.005		0.001	0.001
WELL8	93191	05/17-05/18/	10		0.43	0.025	0.005	0.025			0.005		0.001	0.001
WELL8	93277	08/17-18/93	11		0.38	0.050	0.009	0.025			0.005		0.001	0.001
WELL8	93366	11/16-17/93	12		0.38	0.053	0.040	< 0.025			0.009		< 0.0005	0.002
WELL8	94082	02/22-23/94	13		0.38	0.058	0.031	< 0.025			0.008		< 0.0005	< 0.001
WELL9	91064	03/20/91	1											
WELL9	91127	06/26/91	2											
WELL9	91205	09/25/91	3											
WELL9	91244	11/21/91	4											
WELL9	92013	03/12/92	5		1.81	0.184	0.005	0.005	0.005	0.002	0.017	0.001	0.001	0.001
WELL9	92092	06/02-03/92	6		2.45	0.025	0.005	0.005	0.005	0.002	0.007	0.001	0.001	0.005
WELL9	92171	09/11-12/92	7		2.91	0.025	0.025	0.005	0.005	0.002	0.005	0.003	0.001	0.004
WELL9	92267	12/7-8/92	8		3.01	0.128	0.005	0.005	0.005	0.002	0.013	0.001	0.001	0.001
WELL9	93053	02/16/93	9		3.01	0.025	0.005	0.025			0.005		0.001	0.001
WELL9	93151	05/17-05/18/	10		1.63	0.025	< 0.005	0.025			0.005		0.001	0.001
WELL9	93278	08/17-18/93	11		2.77	0.059	0.005	0.025			0.005		0.001	0.001
WELL9	93278	08/17-18/93	11	D	2.82	0.052	0.005	0.025			0.005		0.001	0.001
WELL9	93367	11/16-17/93	12		2.71	0.071	0.006	< 0.025			0.008		< 0.0005	< 0.001
WELL9	94083	02/22-23/94	13		2.40	0.050	< 0.005	< 0.025			0.007		< 0.0005	< 0.001

APPENDIX F

Summary Statistics by Well

Period of record summary statistics by well - White Bluff

WELL1

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	2018.000	798.000	56.000	207.600	0.200	3.910	0.001	0.005
MAXIMUM	3109.000	1883.000	710.900	266.800	0.460	5.790	0.004	0.205
MEAN	2700.385	1112.777	441.908	225.811	0.232	4.884	0.001	0.090
C.V.	0.109	0.254	0.452	0.075	0.323	0.143	0.702	0.788

WELL2

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	946.000	527.300	41.000	48.700	0.200	2.150	0.001	0.005
MAXIMUM	1318.000	786.700	178.200	75.000	0.410	4.000	0.002	0.068
MEAN	1226.769	643.362	87.131	62.811	0.289	3.346	0.001	0.020
C.V.	0.074	0.122	0.394	0.112	0.236	0.185	0.300	1.147

WELL3

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
OF CASES	13	13	13	9	13	9	9	9
NIMUM	178.000	17.000	3.380	15.000	0.040	0.220	0.001	0.005
MAXIMUM	247.000	370.000	37.500	21.100	0.200	0.400	0.018	0.069
MEAN	215.692	114.592	11.591	16.900	0.188	0.278	0.005	0.013
C.V.	0.080	0.878	0.721	0.109	0.236	0.198	1.052	1.657

WELL4

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	192.000	28.900	2.160	17.300	0.040	0.137	0.001	0.007
MAXIMUM	255.000	837.100	52.000	28.100	0.300	0.230	0.013	0.058
MEAN	221.923	124.869	24.769	21.756	0.195	0.187	0.004	0.019
C.V.	0.076	1.737	0.464	0.185	0.278	0.191	0.904	0.822

WELL5

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	336.000	251.300	13.800	306.600	0.200	4.610	0.001	0.005
MAXIMUM	5512.000	1267.100	1110.000	384.000	0.490	8.310	0.011	0.118
MEAN	3146.077	809.977	594.446	338.989	0.247	6.400	0.004	0.064
V.	0.347	0.434	0.623	0.067	0.380	0.182	1.219	0.637

WELL6

TOTAL OBSERVATIONS: 12

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	3	3	3	0	3	0	0	0
MINIMUM	143.000	5.200	0.200	.	0.200	.	.	.
MAXIMUM	252.000	35.000	5.800	.	0.200	.	.	.
MEAN	204.667	24.567	2.067	.	0.200	.	.	.
C.V.	0.273	0.683	1.564	.	0.000	.	.	.

WELL7

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	431.000	36.000	28.000	37.600	0.120	0.860	0.001	0.005
MAXIMUM	553.000	295.600	89.800	44.400	0.200	1.430	0.003	0.034
MEAN	484.077	180.185	41.543	40.200	0.192	1.004	0.001	0.008
C.V.	0.071	0.486	0.390	0.050	0.120	0.181	0.530	1.176

WELL8

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	234.000	88.900	38.000	32.900	0.080	0.280	0.001	0.005
MAXIMUM	429.000	319.700	86.900	42.800	0.200	0.440	0.020	0.040
MEAN	379.462	167.338	52.180	38.567	0.191	0.374	0.004	0.023
C.V.	0.131	0.402	0.230	0.083	0.174	0.152	1.378	0.501

WELL9

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	766.000	302.600	60.000	32.800	0.200	1.630	0.001	0.005
MAXIMUM	1033.000	692.900	245.000	64.300	0.310	3.010	0.005	0.025
MEAN	931.000	434.854	87.312	54.178	0.234	2.522	0.002	0.007
C.V.	0.084	0.276	0.549	0.161	0.190	0.201	0.879	0.905

WELL10

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	434.000	10.500	37.800	54.100	0.090	0.390	0.001	0.005
MAXIMUM	906.000	438.800	56.100	83.900	0.200	0.890	0.012	0.018
MEAN	548.462	206.892	44.205	65.011	0.185	0.584	0.003	0.010
C.V.	0.219	0.566	0.106	0.139	0.205	0.260	1.380	0.474

WELL11

TOTAL OBSERVATIONS: 15

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	14	14	14	9	14	9	9	9
MINIMUM	993.000	221.100	30.750	121.200	0.200	0.840	0.001	0.017
MAXIMUM	1189.000	998.100	42.000	162.800	0.430	1.240	0.004	0.081
MEAN	1102.357	621.036	36.514	143.178	0.279	1.088	0.001	0.052
C.V.	0.062	0.337	0.091	0.089	0.267	0.119	0.750	0.410

WELL12

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	413.000	385.400	44.000	83.900	0.200	1.240	0.001	0.005
MAXIMUM	1195.000	877.700	70.600	109.800	0.220	1.920	0.019	0.156
MEAN	980.308	595.792	60.864	93.578	0.202	1.491	0.003	0.068
C.V.	0.247	0.251	0.141	0.093	0.028	0.174	2.000	0.627

WELL13

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	240.000	40.500	4.500	17.400	0.370	0.281	0.001	0.022
MAXIMUM	692.000	353.900	120.700	23.500	1.200	0.440	0.010	0.151
MEAN	343.692	88.862	62.923	19.567	0.721	0.378	0.003	0.048
C.V.	0.322	0.916	0.389	0.111	0.324	0.143	1.272	0.849

WELL14

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	12	11	12	9	12	9	9	9
MINIMUM	506.000	208.000	18.600	38.300	0.200	1.060	0.001	0.005
MAXIMUM	713.000	426.800	68.300	48.600	0.260	2.190	0.008	0.062
MEAN	658.583	304.586	27.969	43.467	0.212	1.686	0.002	0.014
C.V.	0.083	0.223	0.533	0.076	0.102	0.201	1.226	1.336

WELL15

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	493.000	36.800	8.800	37.000	0.200	1.210	0.001	0.005
MAXIMUM	704.000	689.500	70.300	45.900	0.240	1.860	0.001	0.005
MEAN	610.000	317.331	25.568	41.300	0.209	1.429	0.001	0.005
C.V.	0.109	0.457	0.580	0.059	0.072	0.143	0.000	0.000

WELL16

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	83.000	6.800	1.000	7.700	0.200	0.010	0.001	0.005
MAXIMUM	141.000	387.600	51.200	10.400	0.200	0.110	0.010	0.007
MEAN	108.692	48.166	11.144	8.533	0.200	0.058	0.002	0.005
C.V.	0.136	2.141	1.232	0.119	0.000	0.592	1.410	0.128

WELL17

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	119.000	11.700	0.200	15.700	0.200	0.110	0.001	0.005
MAXIMUM	552.000	387.600	26.600	46.900	0.300	1.000	0.005	0.013
MEAN	290.231	85.415	8.355	36.667	0.232	0.664	0.002	0.006
C.V.	0.372	1.255	1.011	0.287	0.181	0.465	0.722	0.441

WELL18

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
)F CASES	13	13	13	9	13	9	9	9
.NIMUM	1071.000	324.000	11.400	65.100	0.350	3.540	0.001	0.005
MAXIMUM	1741.000	1217.000	71.700	87.800	0.700	4.620	0.002	0.005
MEAN	1480.000	719.931	42.162	74.578	0.536	4.033	0.001	0.005
C.V.	0.154	0.347	0.408	0.082	0.231	0.094	0.300	0.000

WELL19

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	988.000	309.000	33.600	63.100	0.330	3.110	0.001	0.005
MAXIMUM	1674.000	1337.000	98.700	78.700	0.670	3.960	0.004	0.028
MEAN	1411.308	732.369	45.376	68.578	0.500	3.491	0.002	0.010
C.V.	0.143	0.486	0.398	0.077	0.241	0.097	0.652	0.782

WELL20

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	1255.000	100.700	28.000	64.500	0.200	1.870	0.001	0.005
MAXIMUM	1631.000	1382.300	92.000	89.900	0.500	4.560	0.004	0.124
MEAN	1514.769	697.523	45.662	80.900	0.276	2.704	0.001	0.051
C.V.	0.085	0.495	0.417	0.110	0.338	0.368	0.750	0.759

WELL21

TOTAL OBSERVATIONS: 13

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	13	13	9	13	9	9	9
MINIMUM	851.000	75.900	33.630	56.600	0.200	2.000	0.001	0.005
MAXIMUM	1312.000	1081.400	89.000	76.600	0.400	3.110	0.014	0.159
MEAN	1177.462	570.017	43.873	64.711	0.305	2.454	0.003	0.062
C.V.	0.126	0.540	0.345	0.104	0.268	0.166	1.684	0.710

WELL22

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	13	12	13	9	13	9	9	9
MINIMUM	185.000	32.100	5.000	14.400	0.060	0.240	0.001	0.005
MAXIMUM	331.000	182.600	62.100	27.700	0.200	0.670	0.019	0.066
MEAN	251.923	87.717	21.510	19.644	0.189	0.409	0.003	0.016
C.V.	0.150	0.558	0.635	0.215	0.205	0.326	1.848	1.224

WELL23

TOTAL OBSERVATIONS: 7

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
OF CASES	7	7	7	7	7	7	7	7
NIMUM	100.000	229.600	3.000	8.000	0.200	0.300	0.001	0.005
MAXIMUM	902.000	459.100	143.200	104.500	0.700	3.630	0.001	0.011
MEAN	698.714	320.443	82.986	71.329	0.484	2.711	0.001	0.008
C.V.	0.409	0.231	0.510	0.419	0.398	0.411	0.000	0.313

WELL24

TOTAL OBSERVATIONS: 7

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	7	7	7	7	7	7	7	7
MINIMUM	2524.000	854.000	71.400	36.400	0.520	0.280	0.001	0.005
MAXIMUM	4210.000	2898.200	120.500	196.800	0.810	9.880	0.001	0.170
MEAN	3571.429	2019.257	88.300	153.414	0.660	7.419	0.001	0.071
C.V.	0.190	0.374	0.201	0.348	0.138	0.433	0.000	0.818

WELL25

TOTAL OBSERVATIONS: 3

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	2	2	2	2	2	2	2	2
MINIMUM	546.000	36.400	16.300	51.500	0.200	6.550	0.001	0.008
MAXIMUM	768.000	50.300	38.400	120.700	0.200	7.180	0.001	0.010
MEAN	657.000	43.350	27.350	86.100	0.200	6.865	0.001	0.009
V.	0.239	0.227	0.571	0.568	0.000	0.065	0.000	0.157

WELL26

TOTAL OBSERVATIONS: 7

	TDS	SO4	CL	NATOT	B	STTOT	PBTOT	NITOT
N OF CASES	7	7	7	7	7	7	7	7
MINIMUM	219.000	11.600	6.000	23.300	0.070	0.280	0.001	0.005
MAXIMUM	319.000	55.300	42.300	44.800	0.200	0.580	0.002	0.008
MEAN	280.571	23.071	12.629	30.686	0.181	0.401	0.001	0.006
C.V.	0.129	0.661	1.060	0.247	0.271	0.258	0.331	0.250

WELL1

THU 12/08/94 1:26:04 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	3.430	3120.000	0.200	14.500
MAXIMUM	13.000	3.970	3670.000	11.000	24.100
MEAN	7.000	3.709	3353.333	2.328	18.489
C.V.	0.556	0.040	0.056	1.508	0.137

WELL2

THU 12/08/94 1:26:07 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	5.080	720.000	0.600	14.500
MAXIMUM	13.000	6.810	1631.000	10.700	22.200
MEAN	7.000	5.831	1391.556	4.967	18.200
C.V.	0.556	0.080	0.193	0.695	0.117

WELL3

THU 12/08/94 1:26:10 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	5.100	180.000	22.700	10.100
MAXIMUM	13.000	6.120	275.000	251.000	21.600
MEAN	7.000	5.427	215.333	98.600	17.000
C.V.	0.556	0.058	0.140	0.762	0.203

WELL4

THU 12/08/94 1:26:12 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	4.130	150.000	12.000	6.600
MAXIMUM	13.000	4.790	344.000	260.000	24.400
MEAN	7.000	4.393	254.889	152.278	16.844
C.V.	0.556	0.058	0.238	0.502	0.360

WELL5

THU 12/08/94 1:26:15 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 12

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	12	8	8	8	8
MINIMUM	1.000	3.780	2800.000	32.000	7.700
MAXIMUM	13.000	4.200	4990.000	144.000	25.600
MEAN	6.833	4.048	3968.750	65.988	17.950
C.V.	0.588	0.032	0.191	0.561	0.320

WELL6

THU 12/08/94 1:26:17 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 11

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	11	0	0	0	0
MINIMUM	1.000	.	.	.	.
MAXIMUM	12.000	.	.	.	.
MEAN	6.273	.	.	.	.
C.V.	0.588	.	.	.	.

WELL7

THU 12/08/94 1:26:20 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	5.330	454.000	10.650	11.600
MAXIMUM	13.000	5.830	862.000	87.000	21.400
MEAN	7.000	5.598	585.444	34.117	17.366
C.V.	0.556	0.029	0.206	0.645	0.182

WELL8

THU 12/08/94 1:26:22 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	3.920	380.000	28.000	8.200
MAXIMUM	13.000	4.810	635.000	88.800	25.600
MEAN	7.000	4.268	514.556	56.244	17.756
C.V.	0.556	0.069	0.170	0.361	0.279

WELL9

THU 12/08/94 1:26:25 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	8
MINIMUM	1.000	5.500	958.000	9.230	8.900
MAXIMUM	13.000	6.300	2080.000	47.300	22.200
MEAN	7.000	5.818	1290.333	24.570	16.825
C.V.	0.556	0.050	0.276	0.460	0.246

WELL10

THU 12/08/94 1:26:28 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	3.940	490.000	22.000	7.800
MAXIMUM	13.000	4.830	1220.000	300.000	26.100
MEAN	7.000	4.313	737.111	173.011	17.600
C.V.	0.556	0.060	0.306	0.483	0.329

WELL11

THU 12/08/94 1:26:31 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 14

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	14	10	10	10	9
MINIMUM	1.000	3.780	174.000	108.000	7.700
MAXIMUM	13.000	4.330	1845.000	460.000	23.300
MEAN	7.429	4.108	1286.000	236.110	17.756
C.V.	0.548	0.043	0.368	0.480	0.273

WELL12

THU 12/08/94 1:26:34 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	8
MINIMUM	1.000	3.180	145.000	21.700	7.800
MAXIMUM	13.000	3.980	1789.000	104.000	24.400
MEAN	7.000	3.687	1154.222	57.167	16.838
C.V.	0.556	0.063	0.389	0.496	0.318

WELL13

THU 12/08/94 1:26:37 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	3.250	363.000	34.000	12.000
MAXIMUM	13.000	4.020	525.000	140.000	20.400
MEAN	7.000	3.678	458.111	76.889	16.033
C.V.	0.556	0.063	0.114	0.408	0.166

WELL14

THU 12/08/94 1:26:40 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	5.510	736.000	0.300	13.500
MAXIMUM	13.000	7.490	996.000	260.000	21.800
MEAN	7.000	6.249	829.000	58.250	16.600
C.V.	0.556	0.119	0.109	1.473	0.180

WELL15

THU 12/08/94 1:26:43 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	9	9	9	9
MINIMUM	1.000	5.020	701.000	0.100	13.000
MAXIMUM	13.000	6.640	850.000	20.000	21.800
MEAN	7.000	5.844	772.444	7.390	16.578
C.V.	0.556	0.078	0.068	1.193	0.161

WELL16

THU 12/08/94 1:26:46 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	5.110	52.100	0.600	13.200
MAXIMUM	13.000	5.620	779.000	50.000	22.100
MEAN	7.000	5.281	153.938	25.525	17.678
C.V.	0.556	0.035	1.641	0.698	0.148

WELL17

THU 12/08/94 1:26:48 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	5.560	175.000	0.400	13.300
MAXIMUM	13.000	7.350	1380.000	250.000	24.800
MEAN	7.000	6.599	504.375	61.313	18.288
C.V.	0.556	0.089	0.735	1.349	0.186

WELL18

THU 12/08/94 1:26:50 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	5.250	702.000	4.750	14.200
MAXIMUM	13.000	5.830	1905.000	44.000	23.100
MEAN	7.000	5.550	1590.125	19.219	18.488
C.V.	0.556	0.039	0.236	0.662	0.134

WELL19

THU 12/08/94 1:26:54 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	3.830	1087.000	2.000	14.200
MAXIMUM	13.000	4.590	1747.000	90.000	24.800
MEAN	7.000	4.223	1553.250	33.350	19.038
C.V.	0.556	0.053	0.130	1.033	0.158

WELL20

THU 12/08/94 1:26:57 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	3.310	1462.000	0.500	15.200
MAXIMUM	13.000	4.270	1875.000	10.000	21.900
MEAN	7.000	3.699	1705.250	4.400	18.275
C.V.	0.556	0.099	0.088	0.871	0.124

WELL21
THU 12/08/94 1:27:00 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	8
MINIMUM	1.000	3.700	1055.000	5.400	14.800
MAXIMUM	13.000	4.390	1570.000	74.000	22.600
MEAN	7.000	3.970	1359.500	31.525	18.763
C.V.	0.556	0.060	0.127	0.791	0.159

WELL22
THU 12/08/94 1:27:03 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 13

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	13	8	8	8	7
MINIMUM	1.000	3.720	240.000	0.300	12.800
MAXIMUM	13.000	4.300	567.000	400.000	20.500
MEAN	7.000	4.011	359.625	108.163	17.614
C.V.	0.556	0.044	0.354	1.164	0.153

WELL23
THU 12/08/94 1:27:06 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 7

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	7	7	7	7	7
MINIMUM	7.000	6.390	153.000	0.200	14.200
MAXIMUM	13.000	8.530	1240.000	38.000	21.200
MEAN	10.000	7.353	1030.000	10.000	16.957
C.V.	0.216	0.097	0.383	1.368	0.133

WELL24
THU 12/08/94 1:27:09 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 7

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	7	7	7	7	7
MINIMUM	7.000	5.800	3140.000	3.500	14.200
MAXIMUM	13.000	9.340	5480.000	26.700	24.800
MEAN	10.000	6.981	4235.714	14.229	17.757
C.V.	0.216	0.164	0.168	0.611	0.194

WELL25

THU 12/08/94 1:27:12 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 3

	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	3	2	2	2	2
MINIMUM	7.000	11.720	2240.000	16.000	15.000
MAXIMUM	9.000	12.300	3150.000	73.000	20.700
MEAN	8.000	12.010	2695.000	44.500	17.850
C.V.	0.125	0.034	0.239	0.906	0.226

WELL26

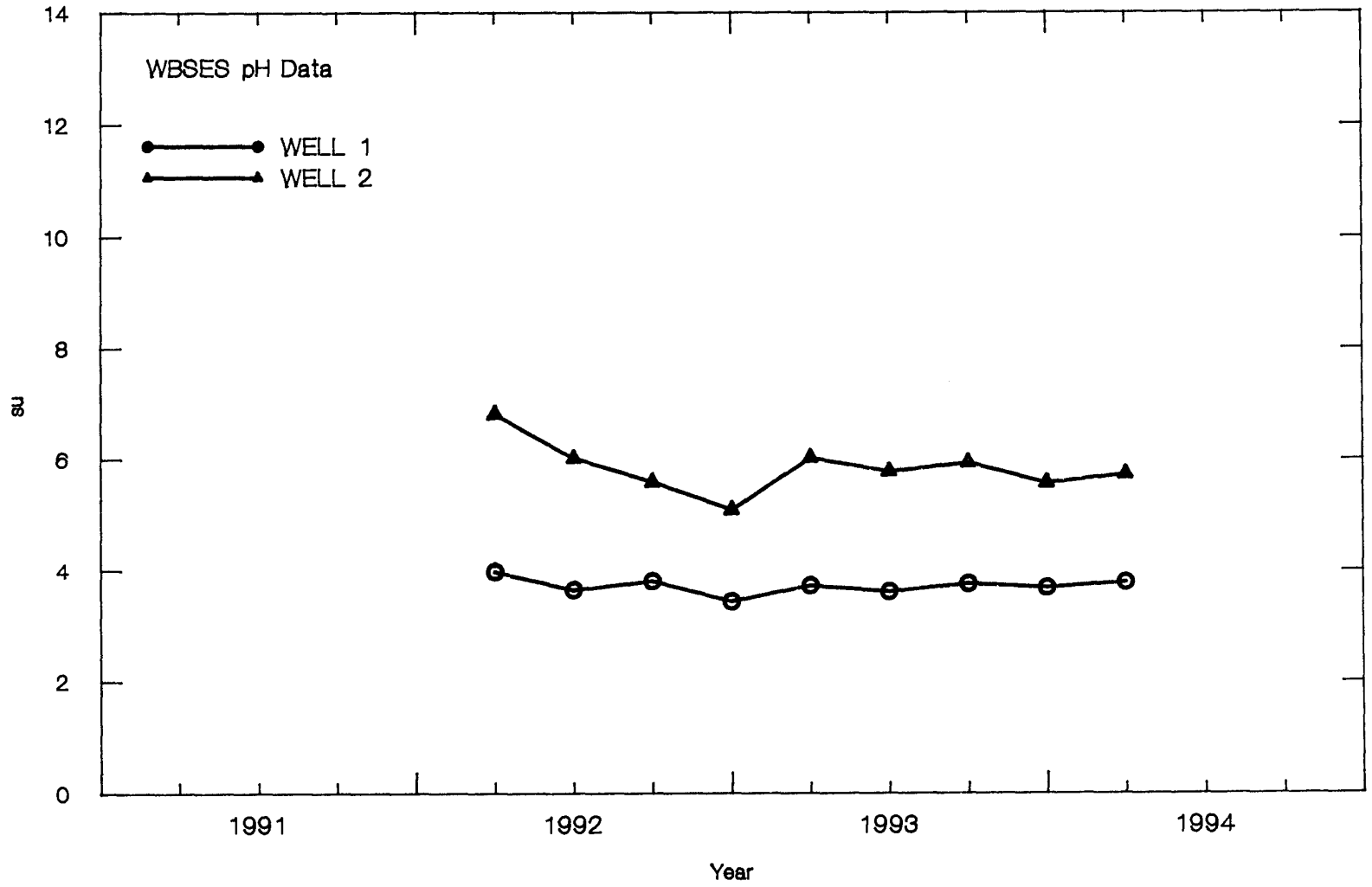
THU 12/08/94 1:27:14 PM D:\NEWDATA\WBSES\WORKING\WBFIELD.SYS
PROCESSING WELLSTAT.CMD

TOTAL OBSERVATIONS: 7

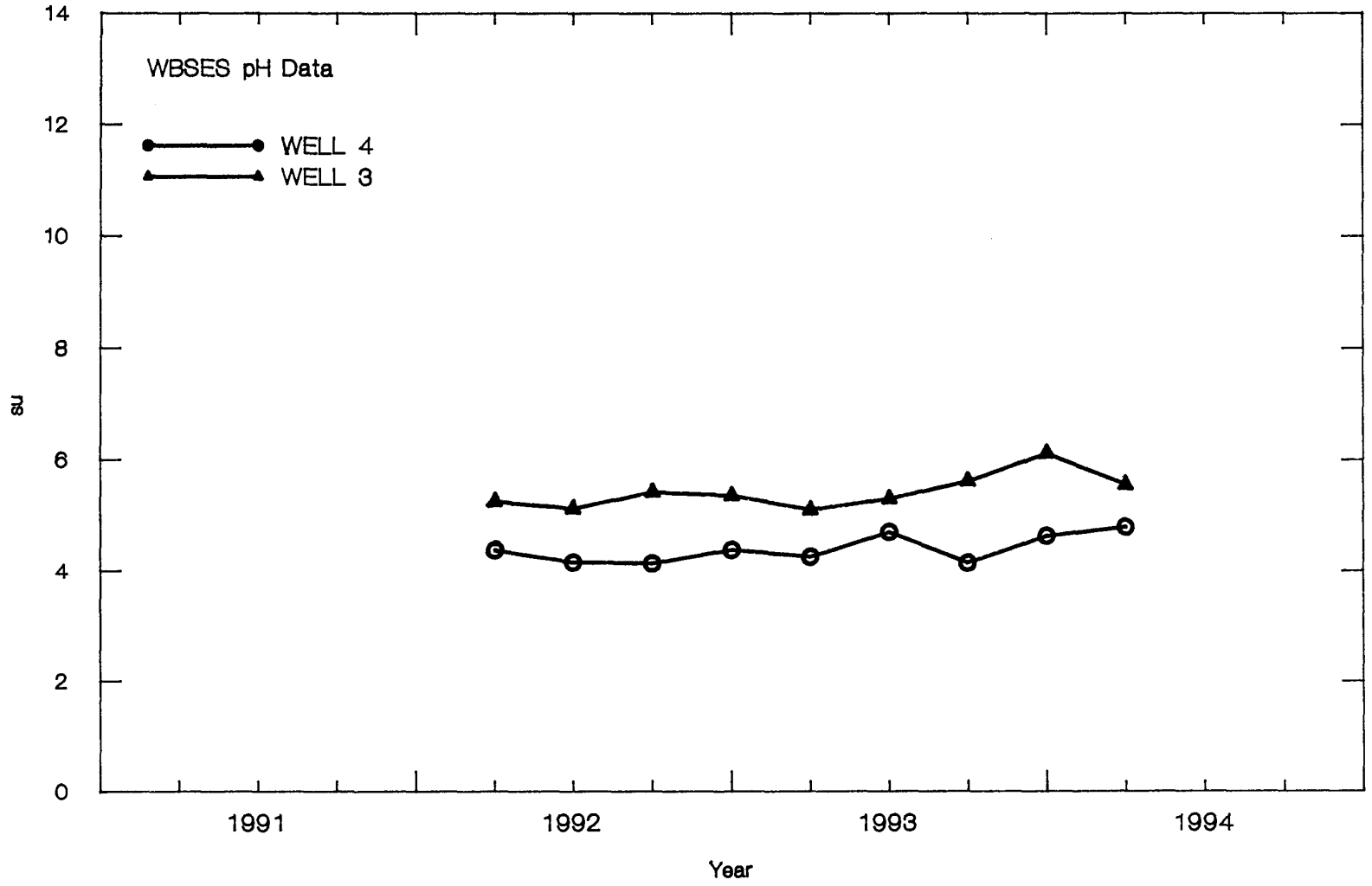
	QUARTNUM	PH	COND	TURB	H2OTEMP
N OF CASES	7	7	7	7	7
MINIMUM	7.000	6.310	260.000	1.300	13.900
MAXIMUM	13.000	9.360	670.000	57.100	21.200
MEAN	10.000	7.554	437.000	23.686	16.943
C.V.	0.216	0.150	0.282	0.896	0.149

APPENDIX G

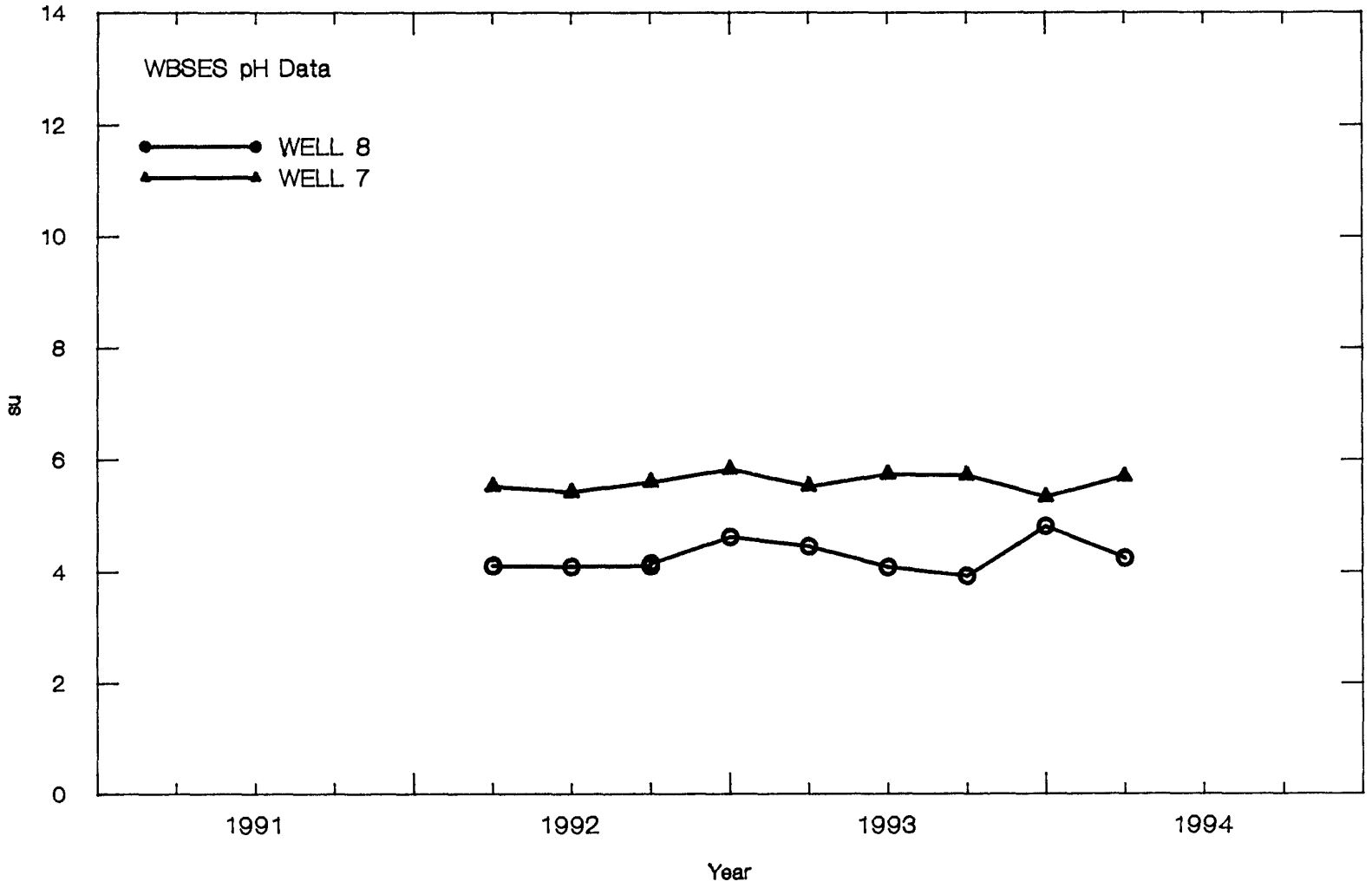
Time Series Graphs



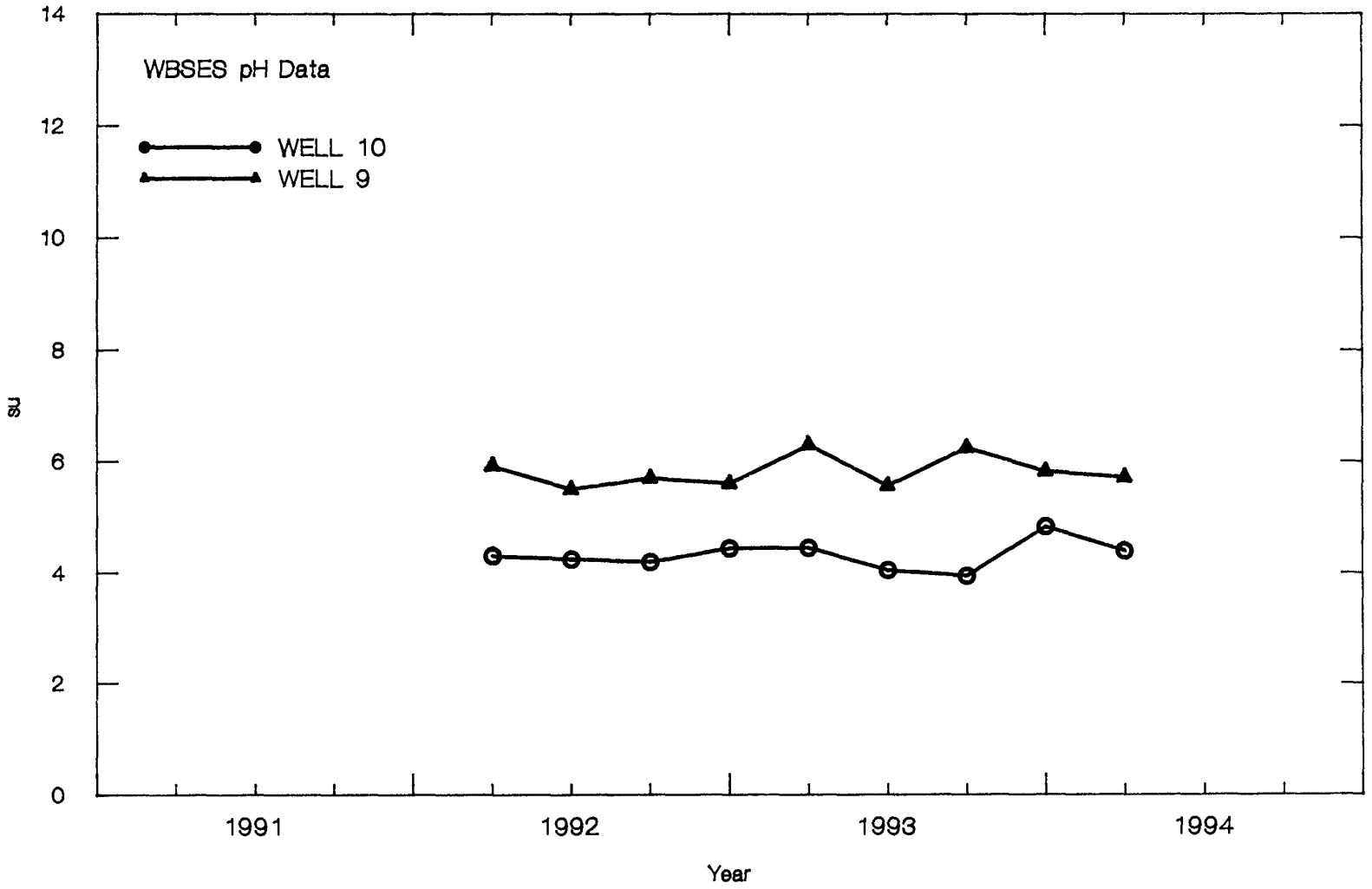
3:20 pm. 12/05/94
WBFIELD



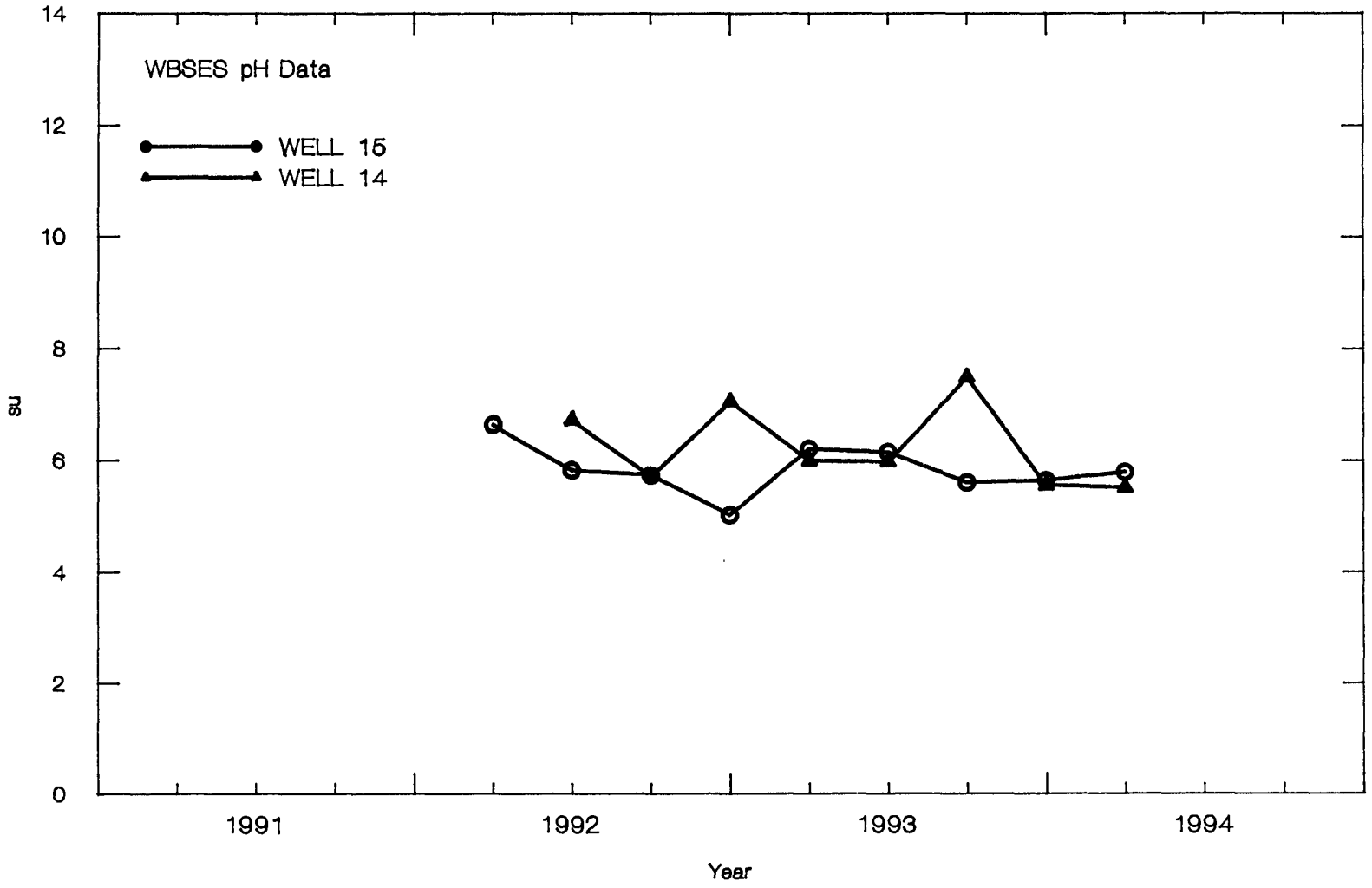
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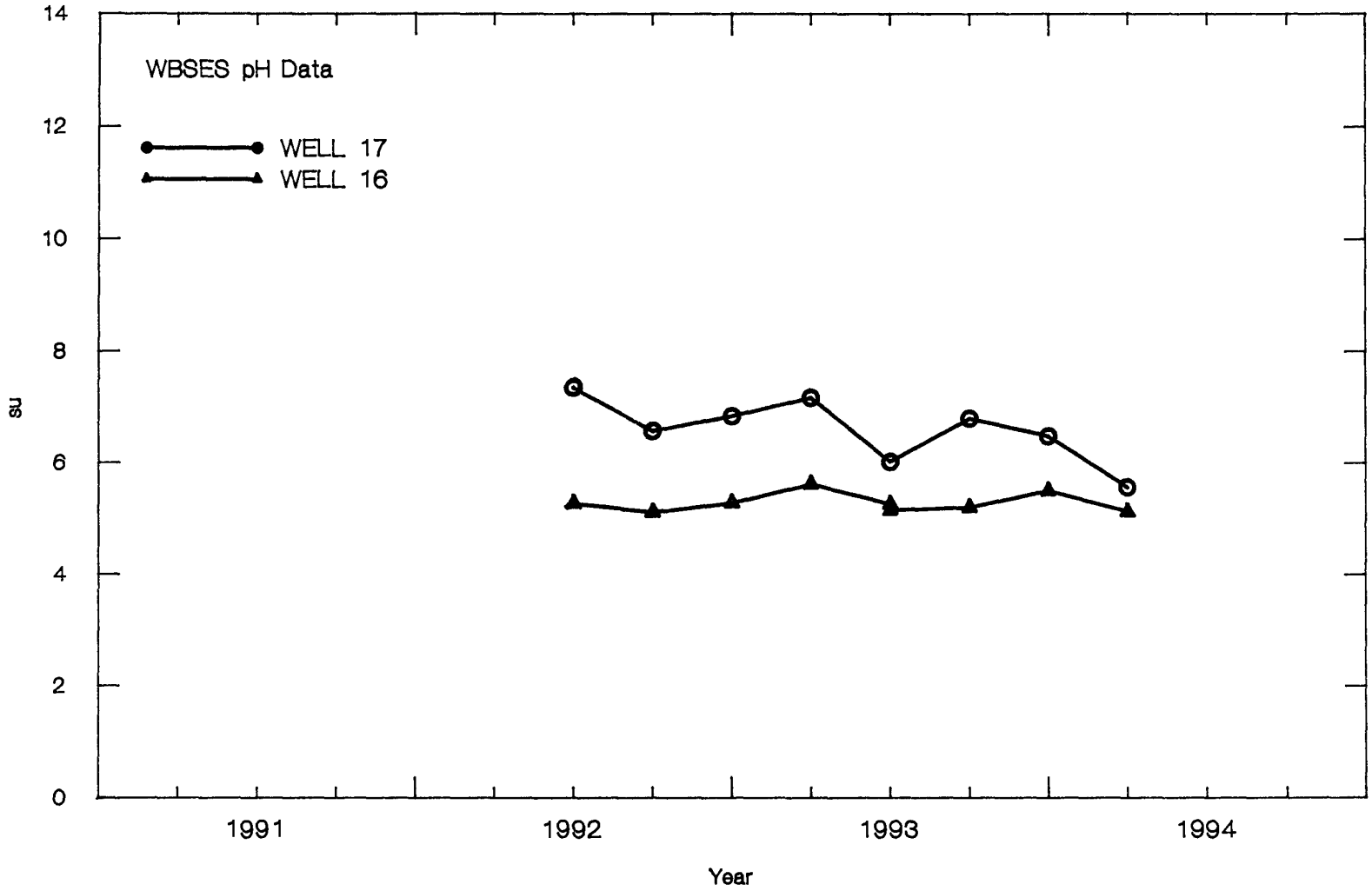
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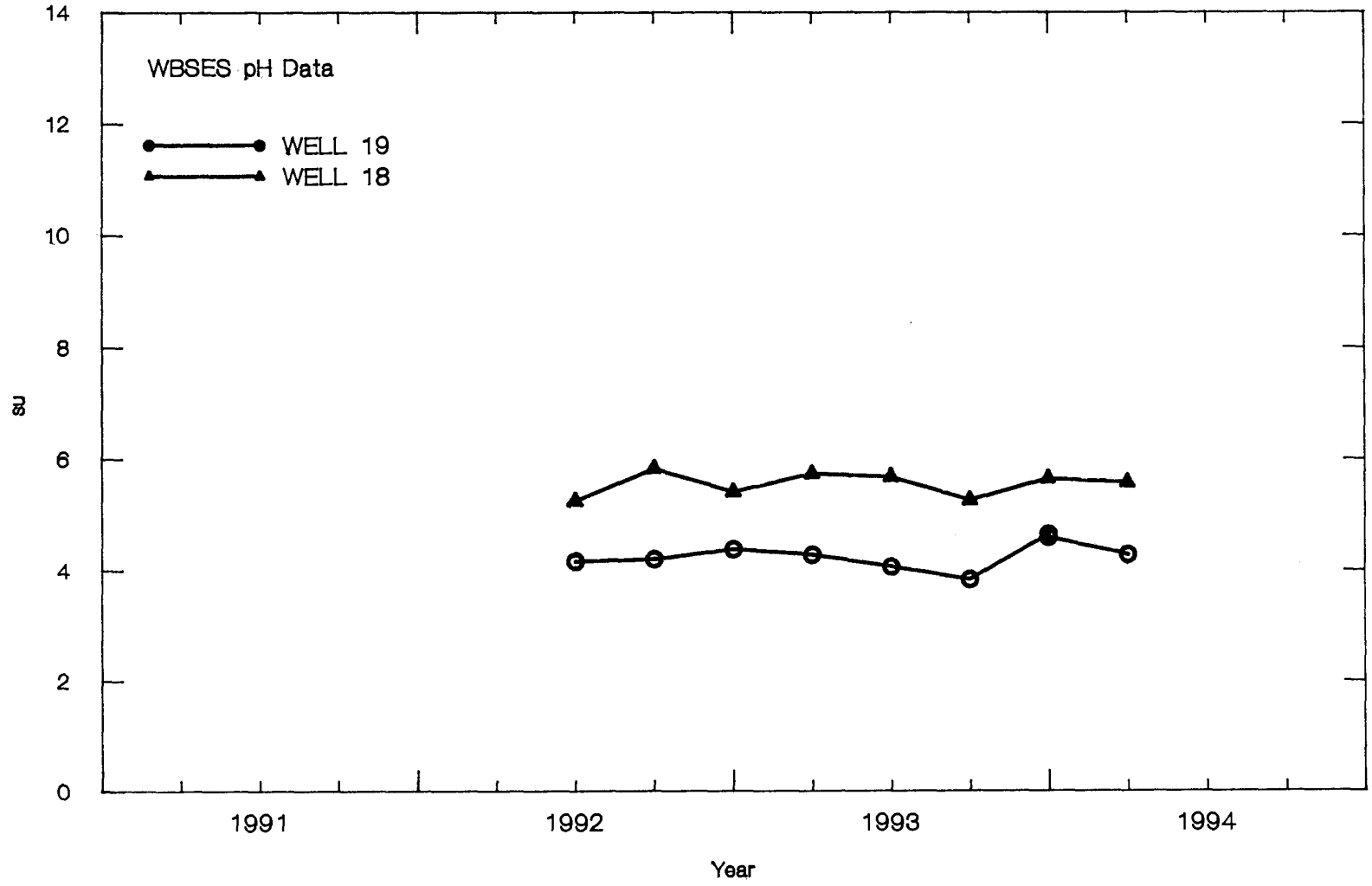
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WBFIELD



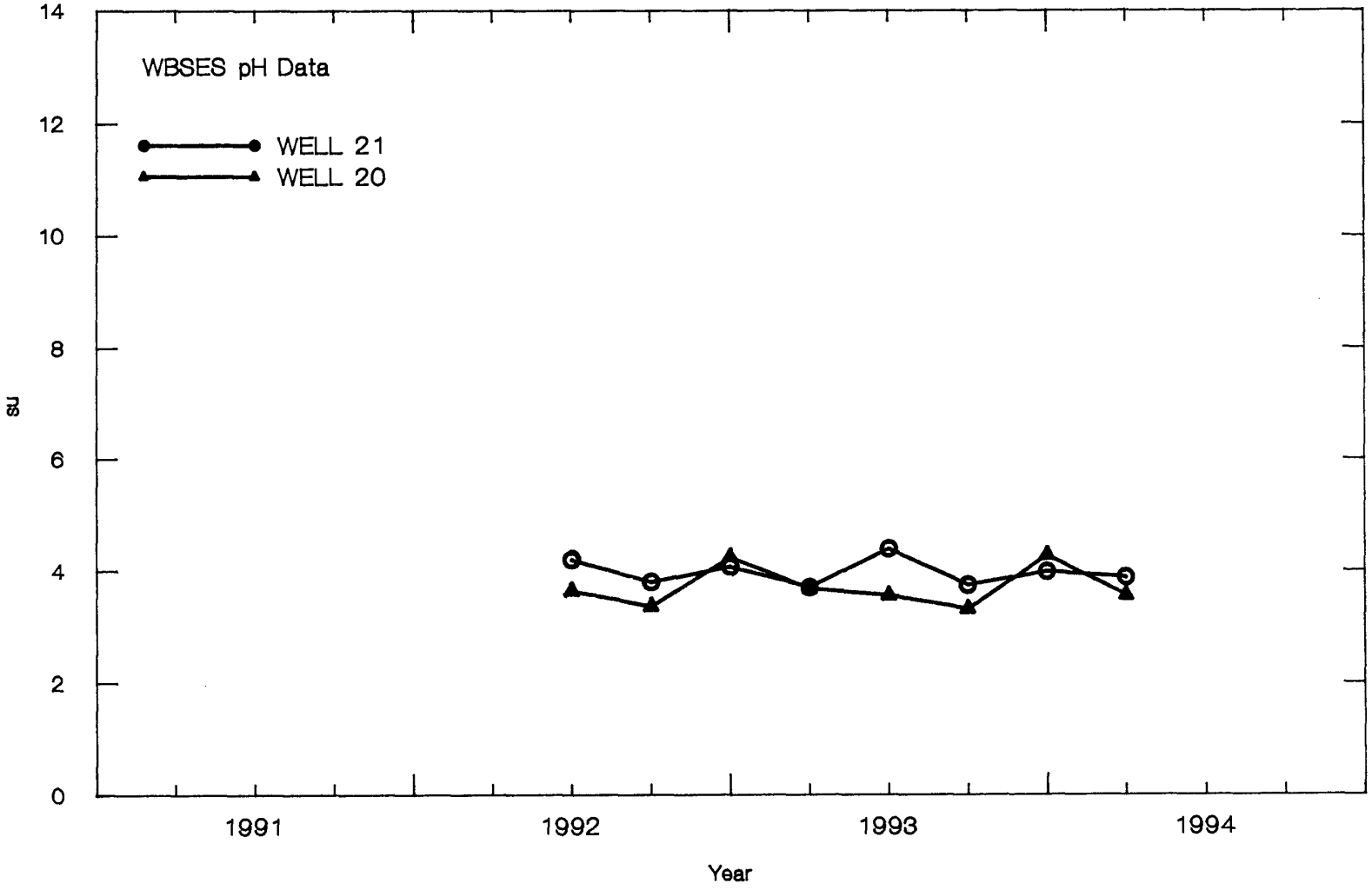
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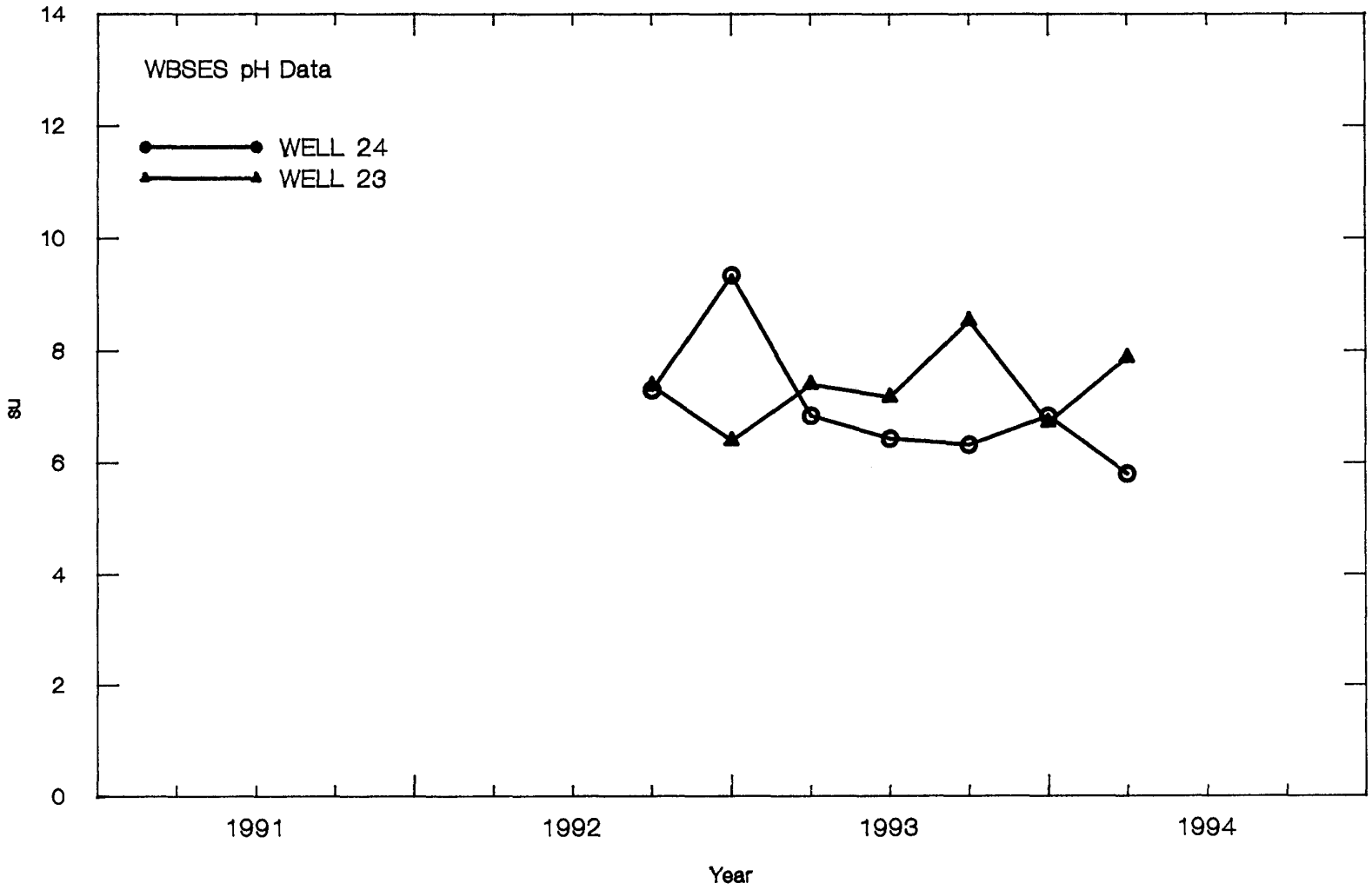
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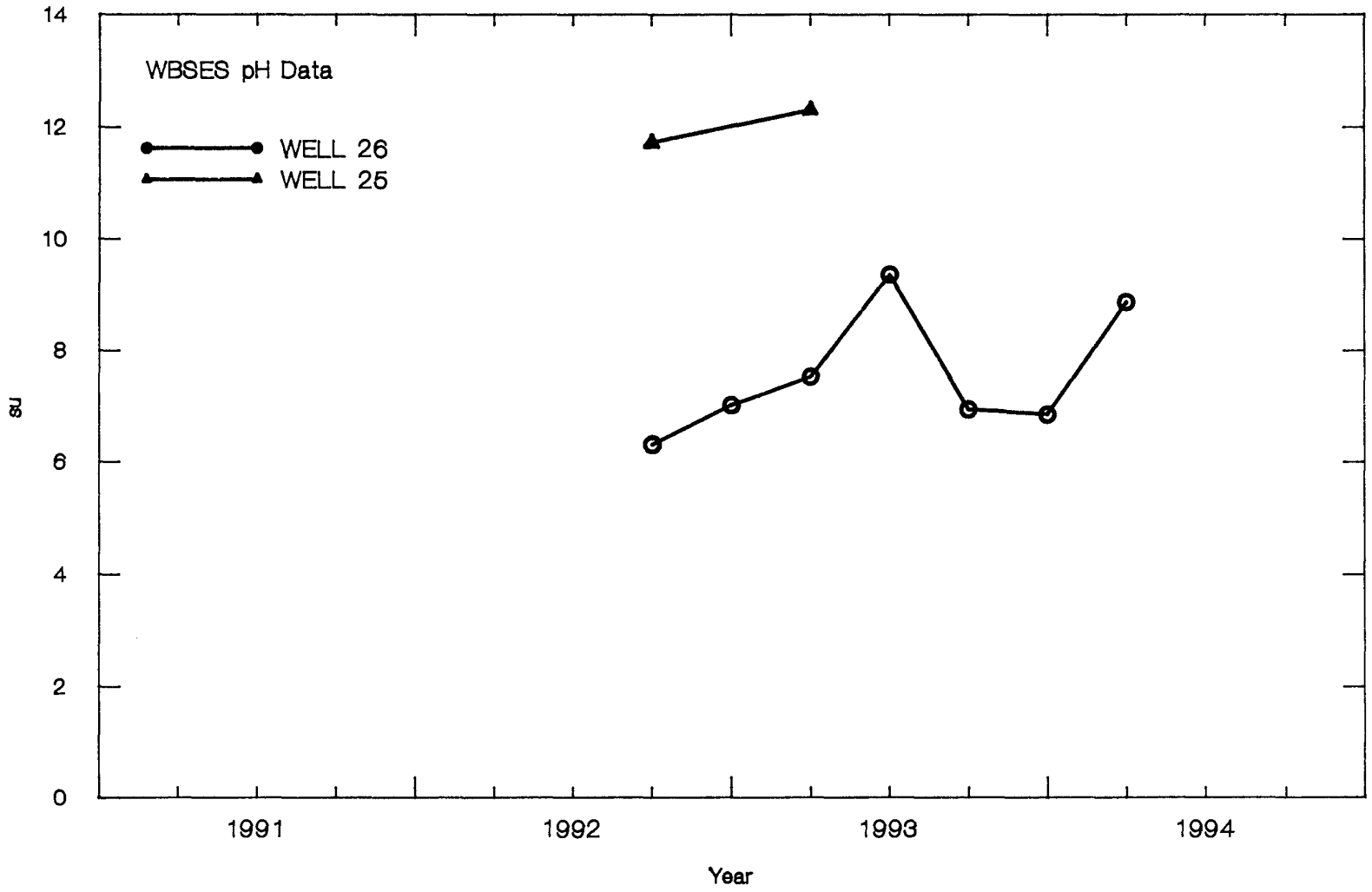
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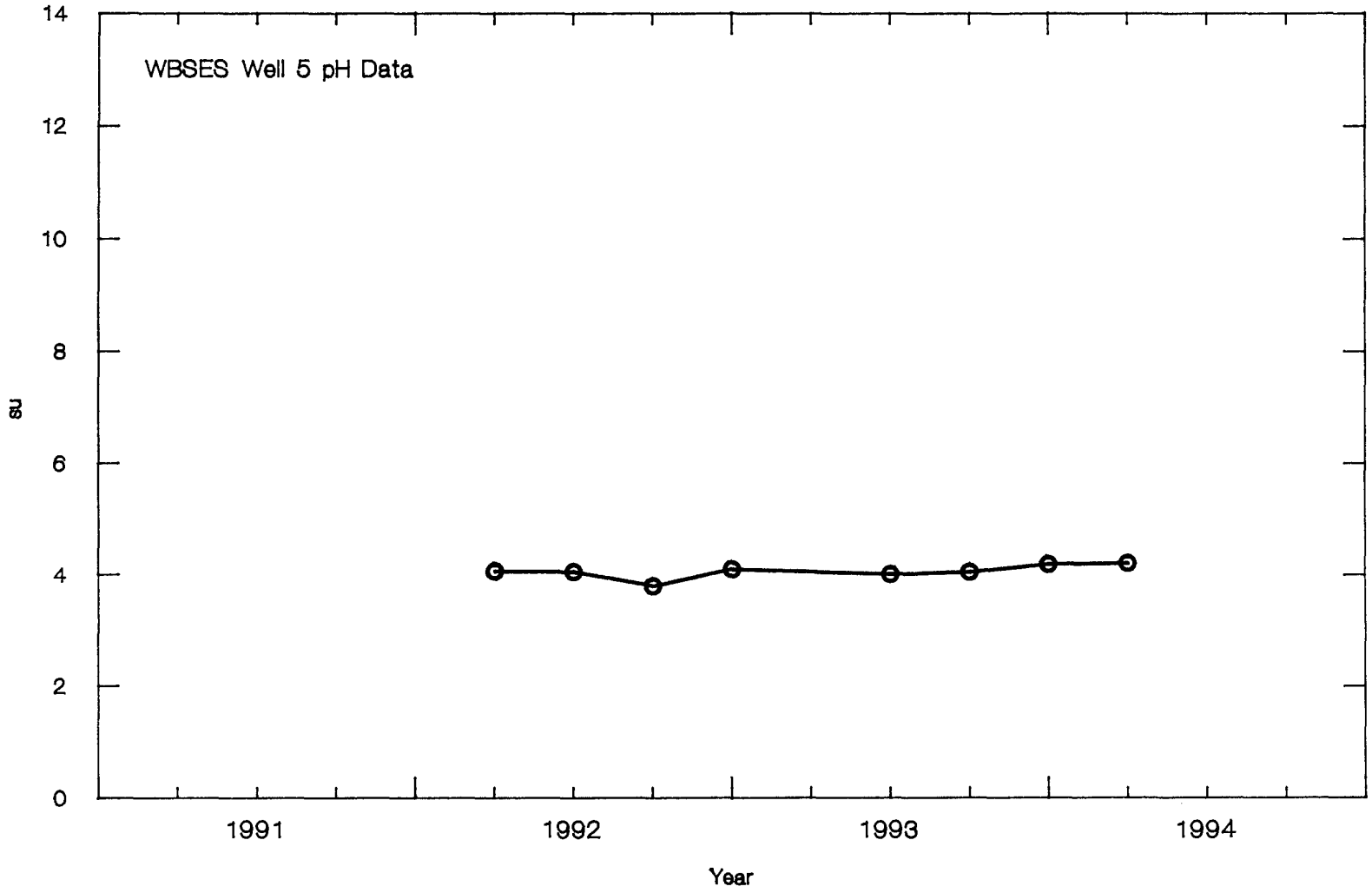
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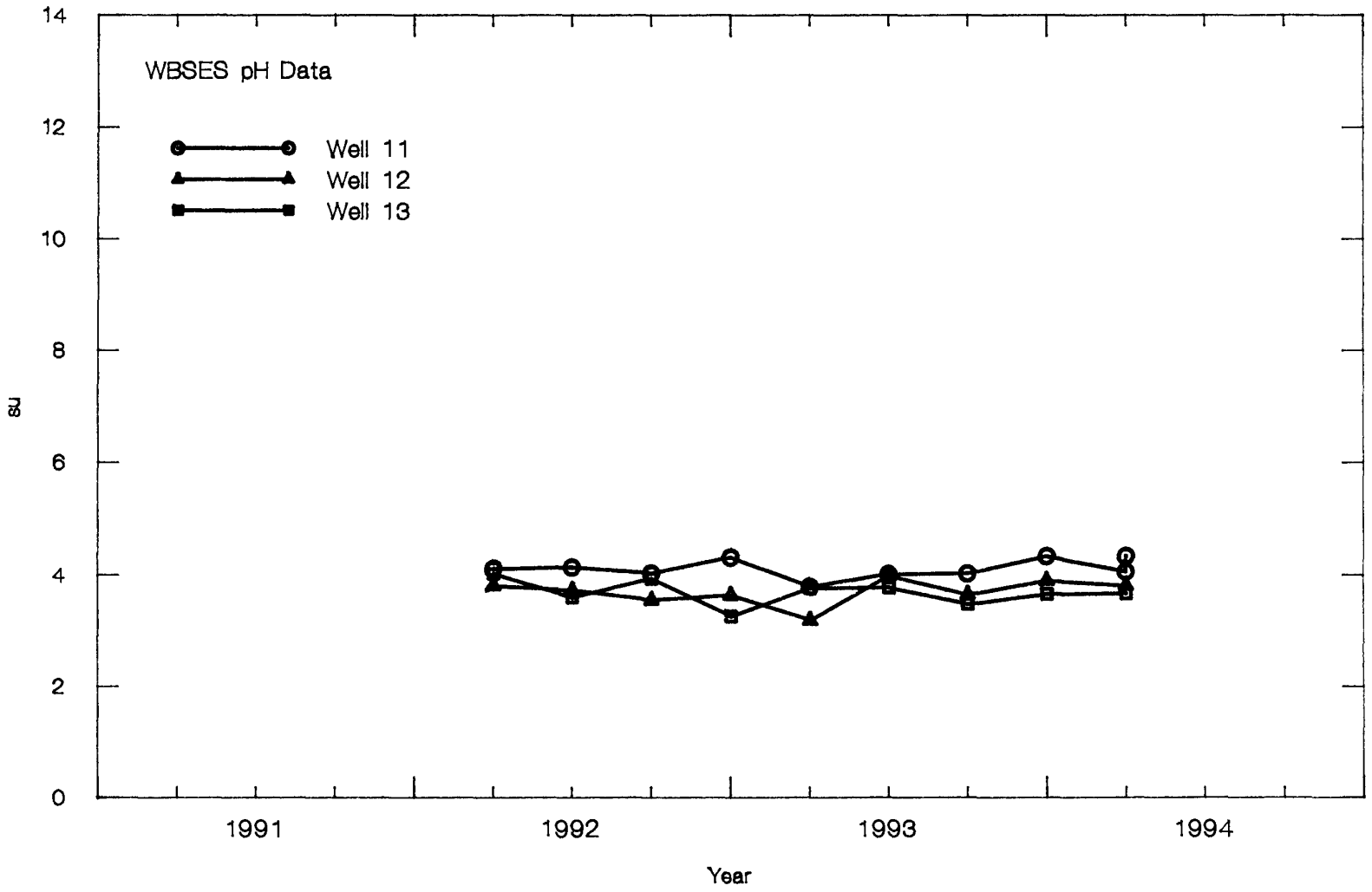


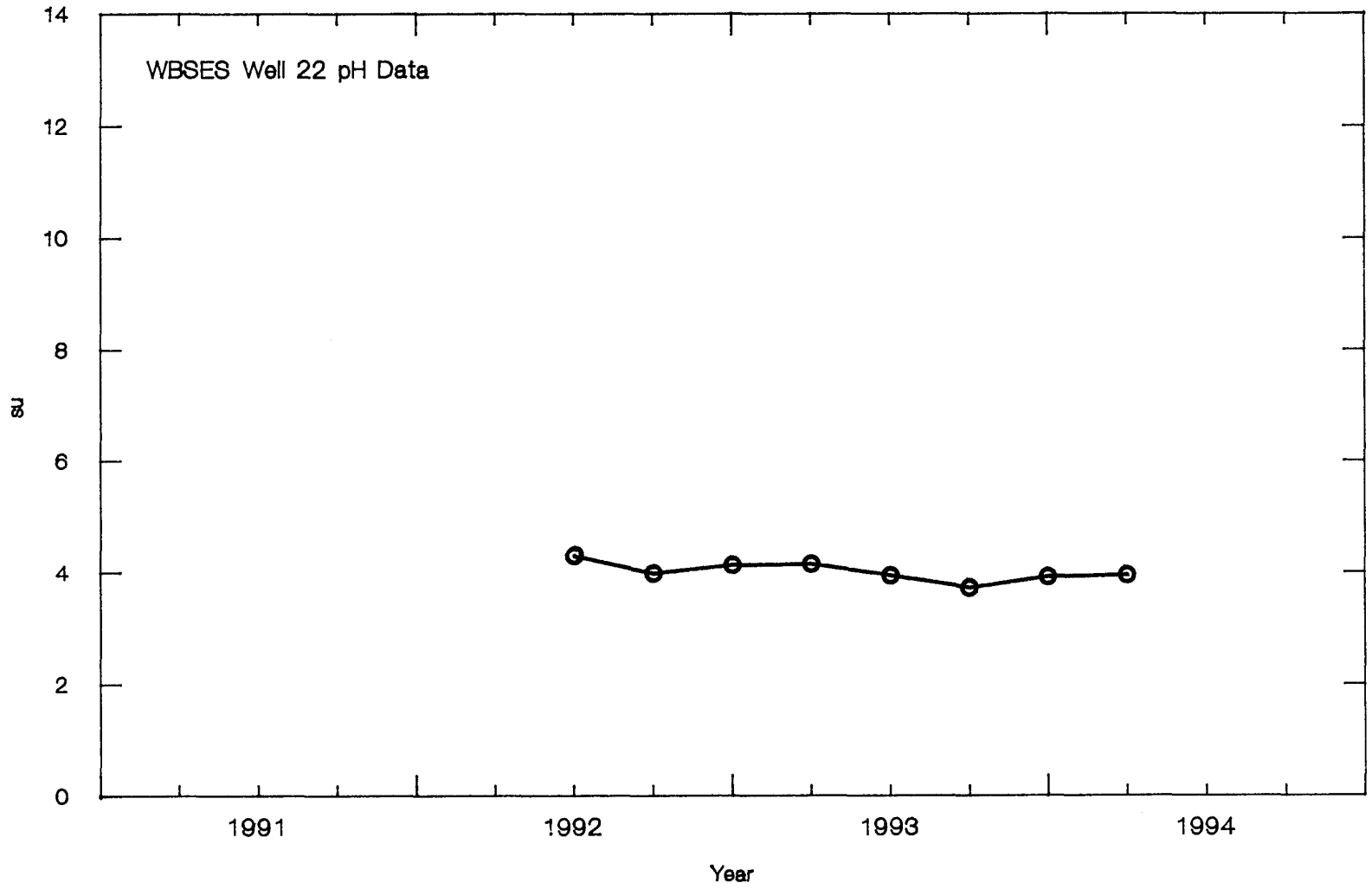
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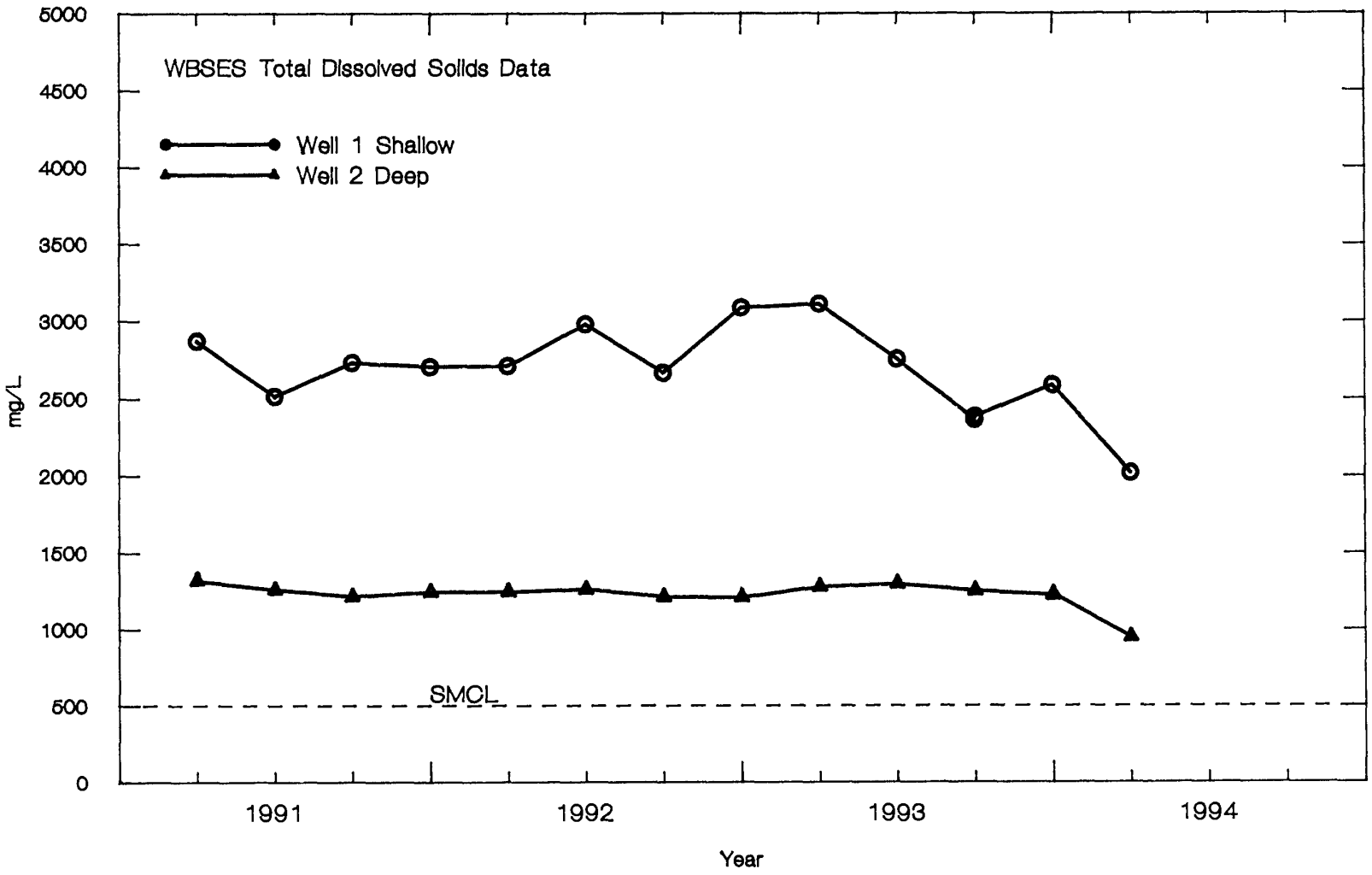


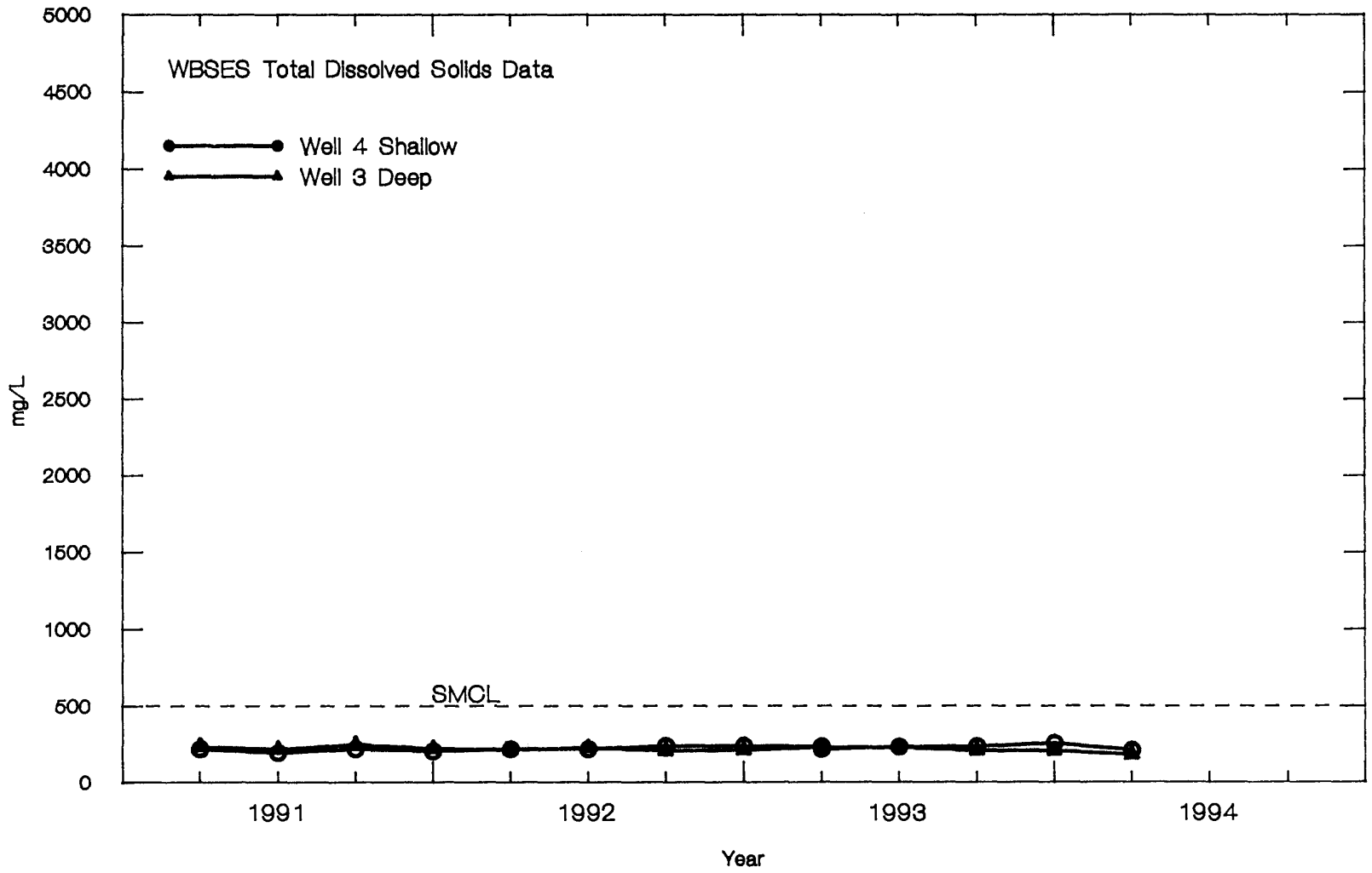
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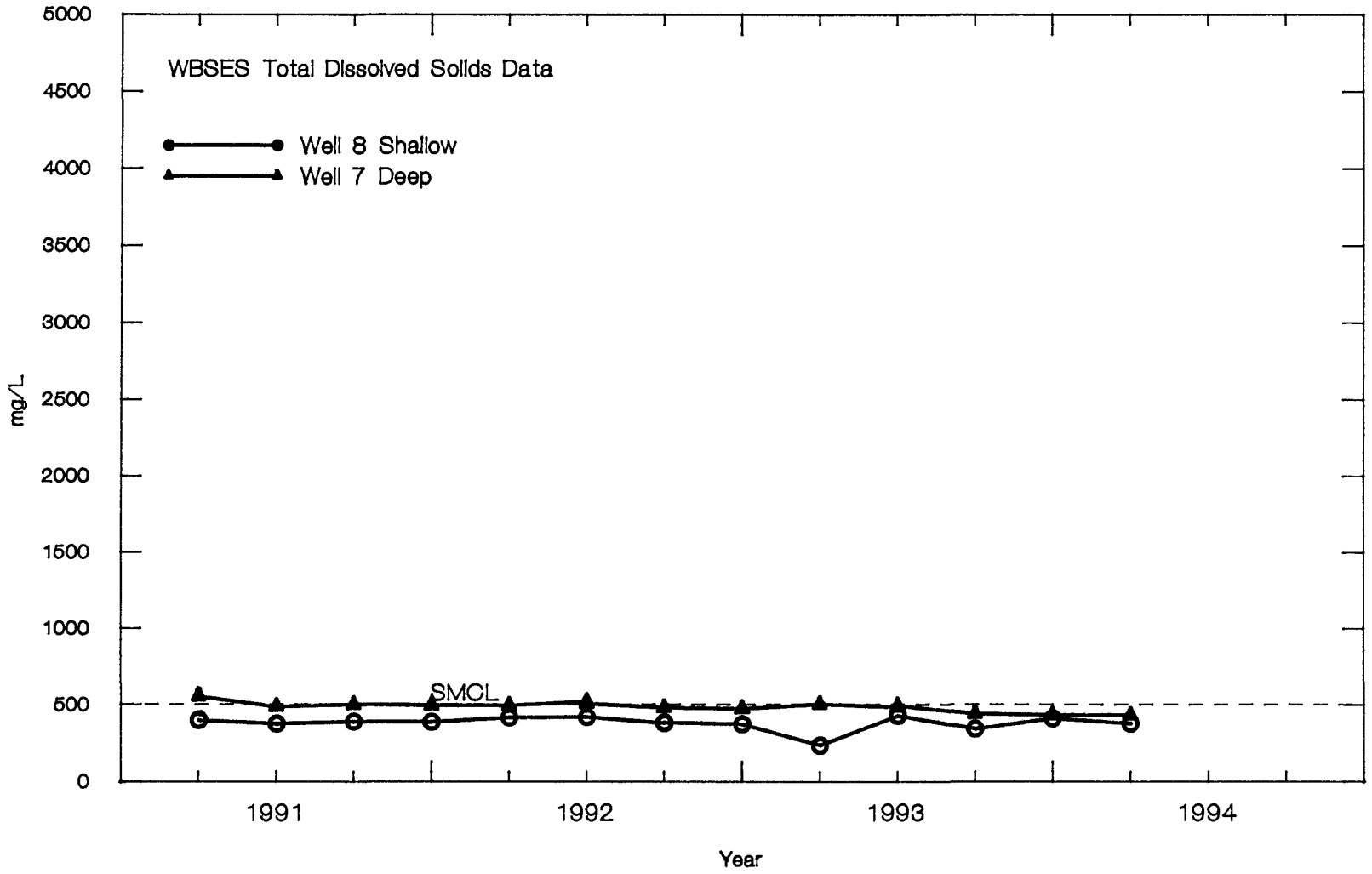

WBSES Well 5 pH Data
14
12
10
8
6
4
2
0
su
1991
1992
1993
1994
Year

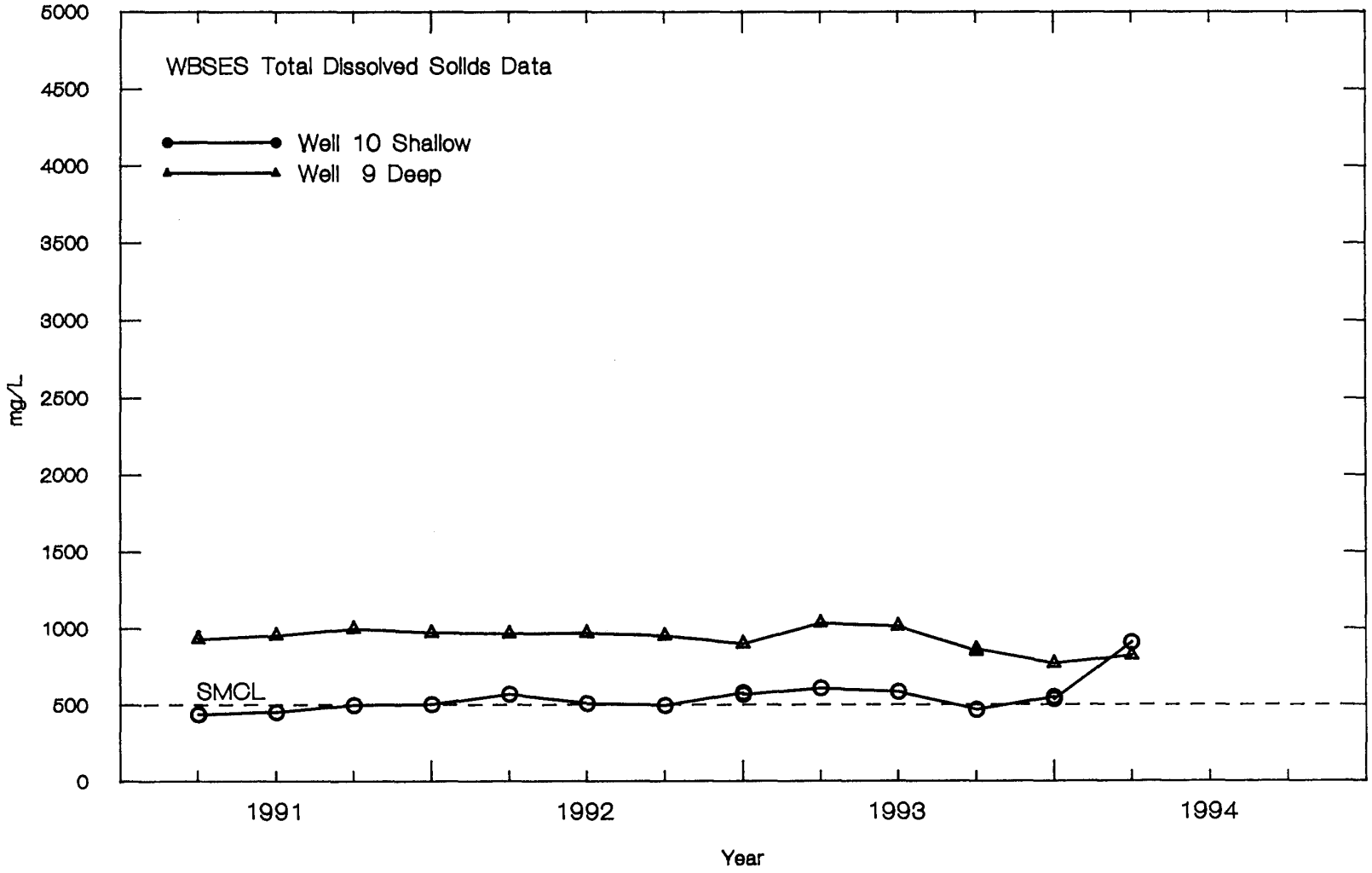

WBSES pH Data
Well 11
Well 12
Well 13
14
12
10
8
6
4
2
0
su
1991
1992
1993
1994
Year


WBSES Well 22 pH Data
14
12
10
8
6
4
2
0
pH
1991
1992
1993
1994
Year

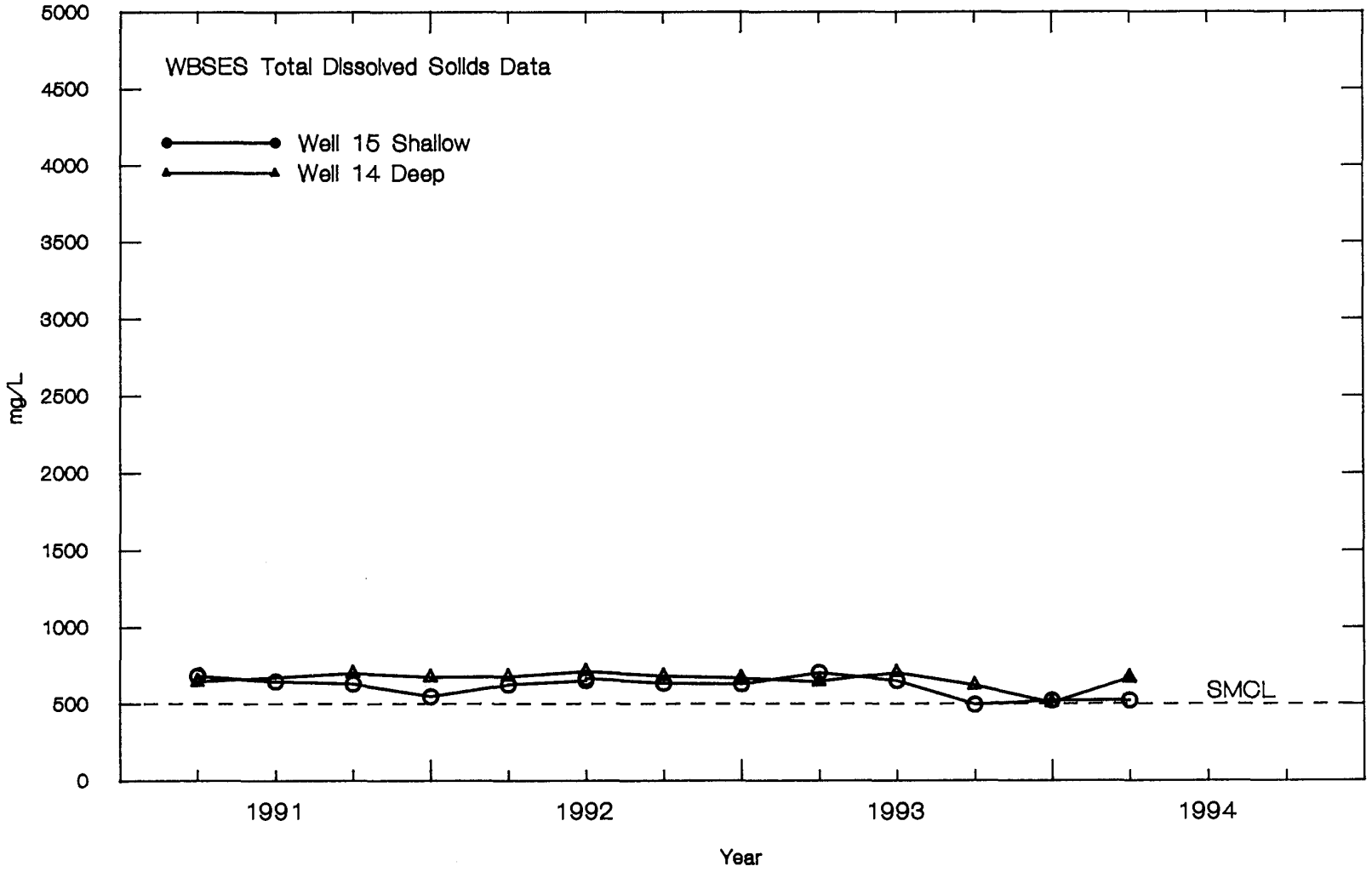

WBSES Total Dissolved Solids Data
Well 1 Shallow
Well 2 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year


WBSES Total Dissolved Solids Data
Well 4 Shallow
Well 3 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year

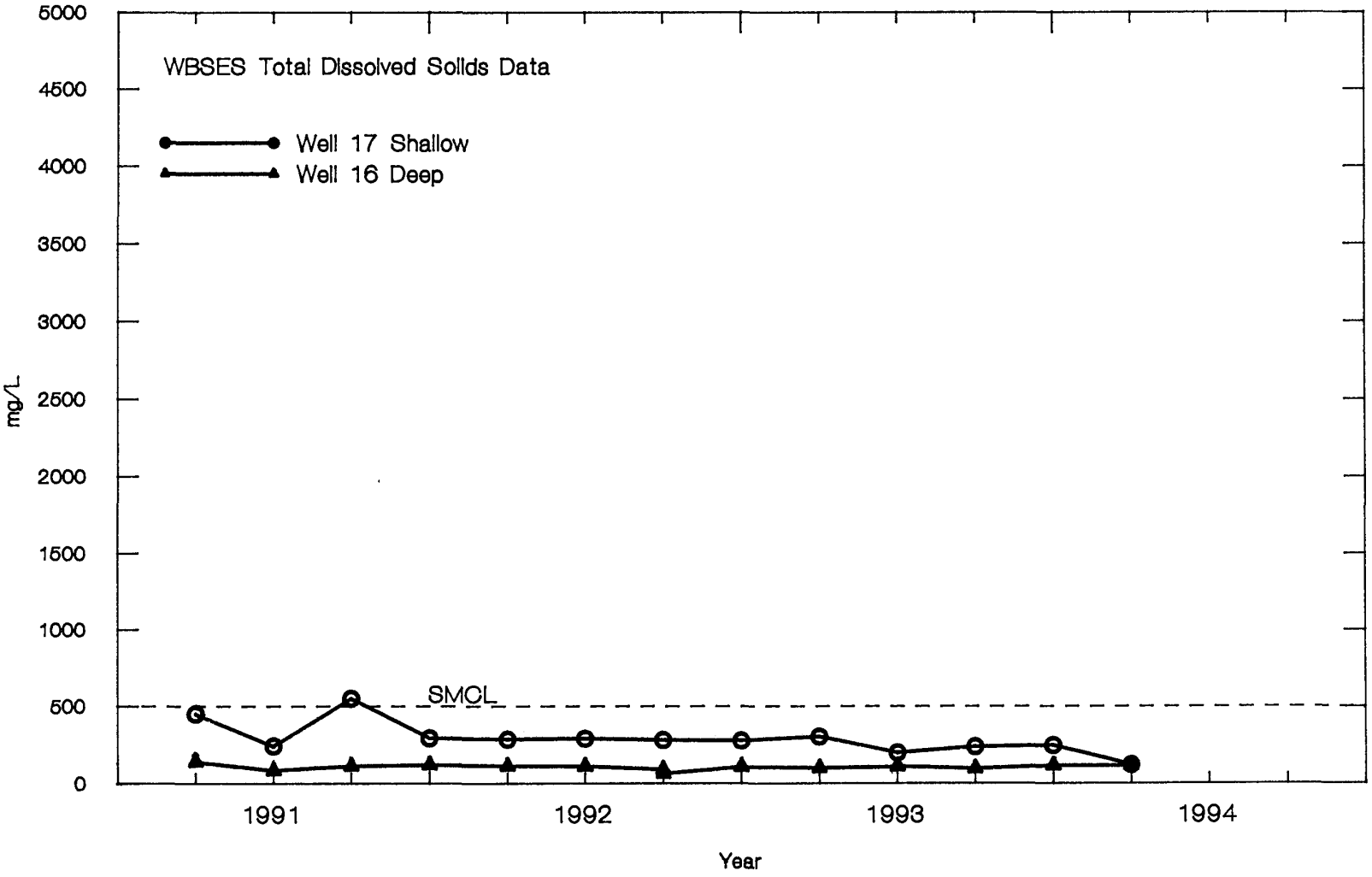

WBSES Total Dissolved Solids Data
Well 8 Shallow
Well 7 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year

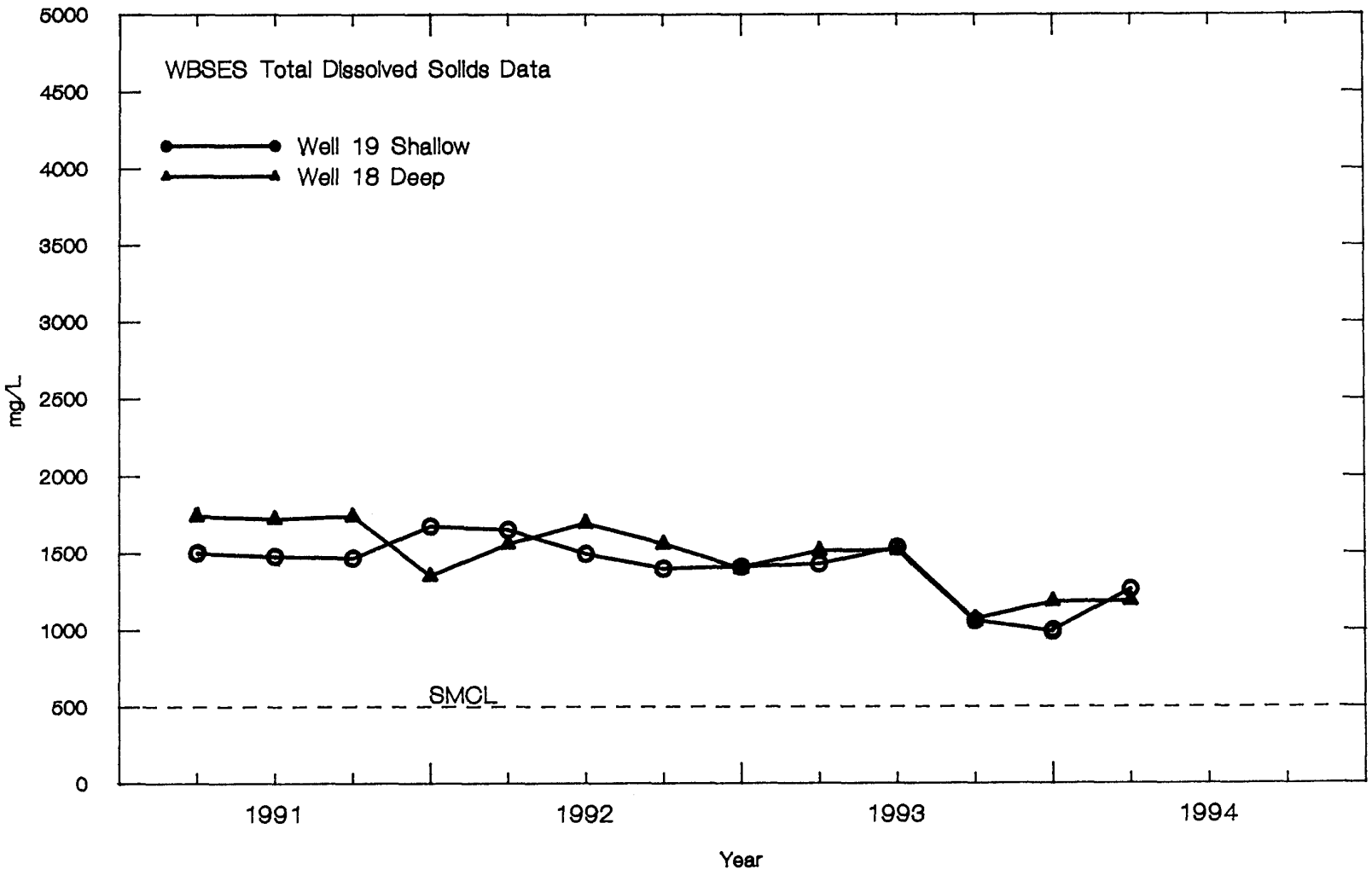


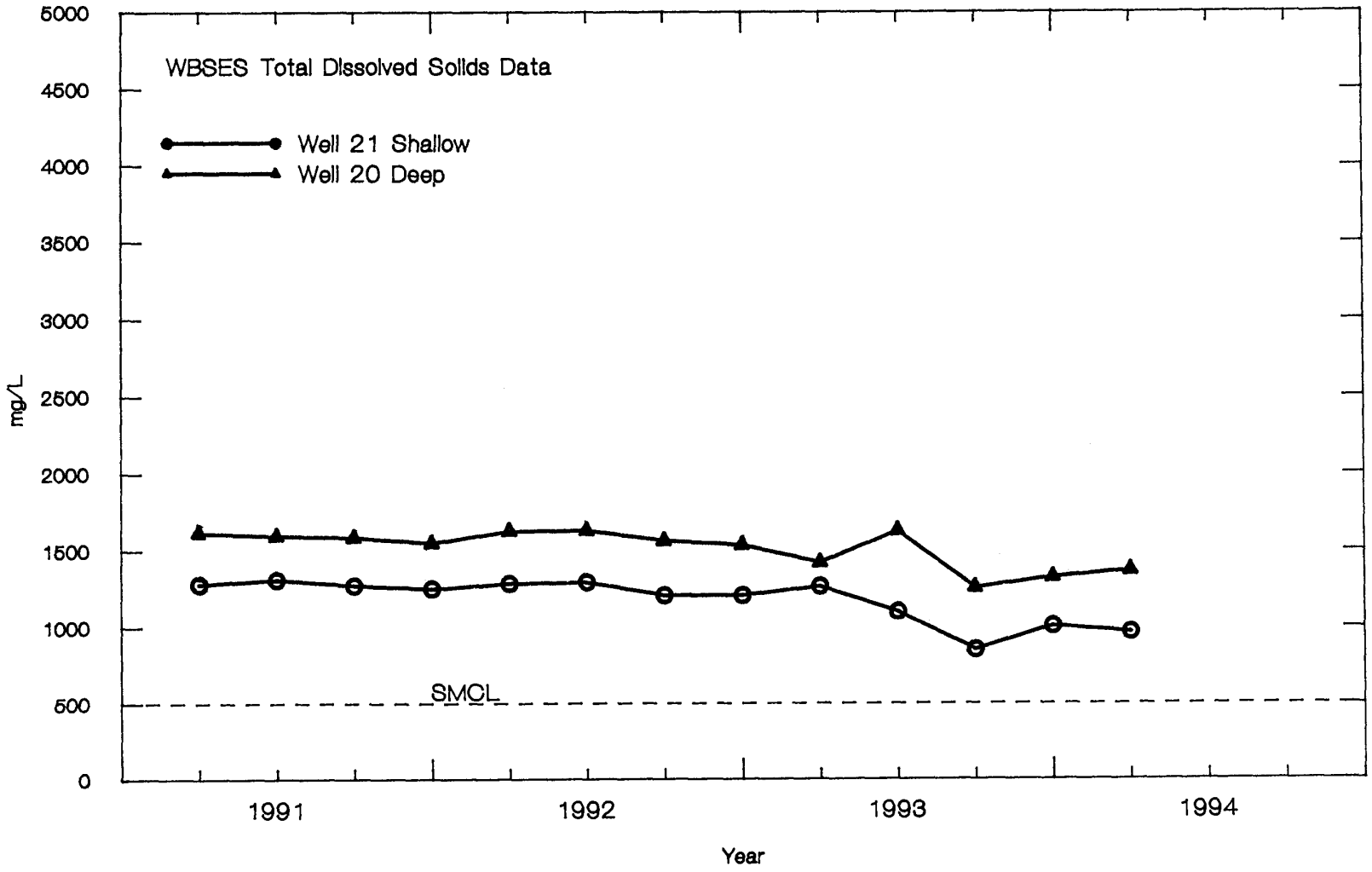
9:12 am 3/08/95
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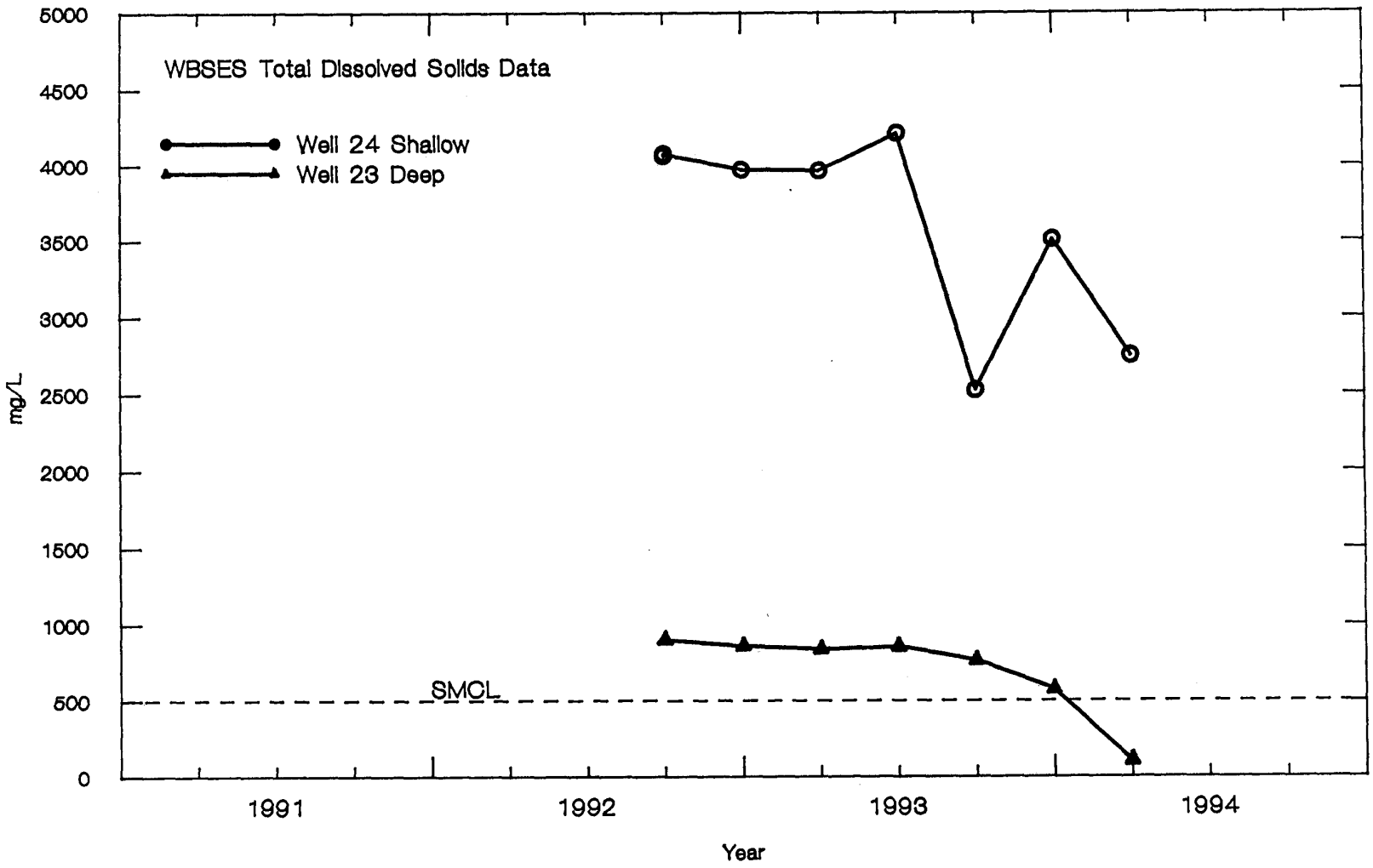


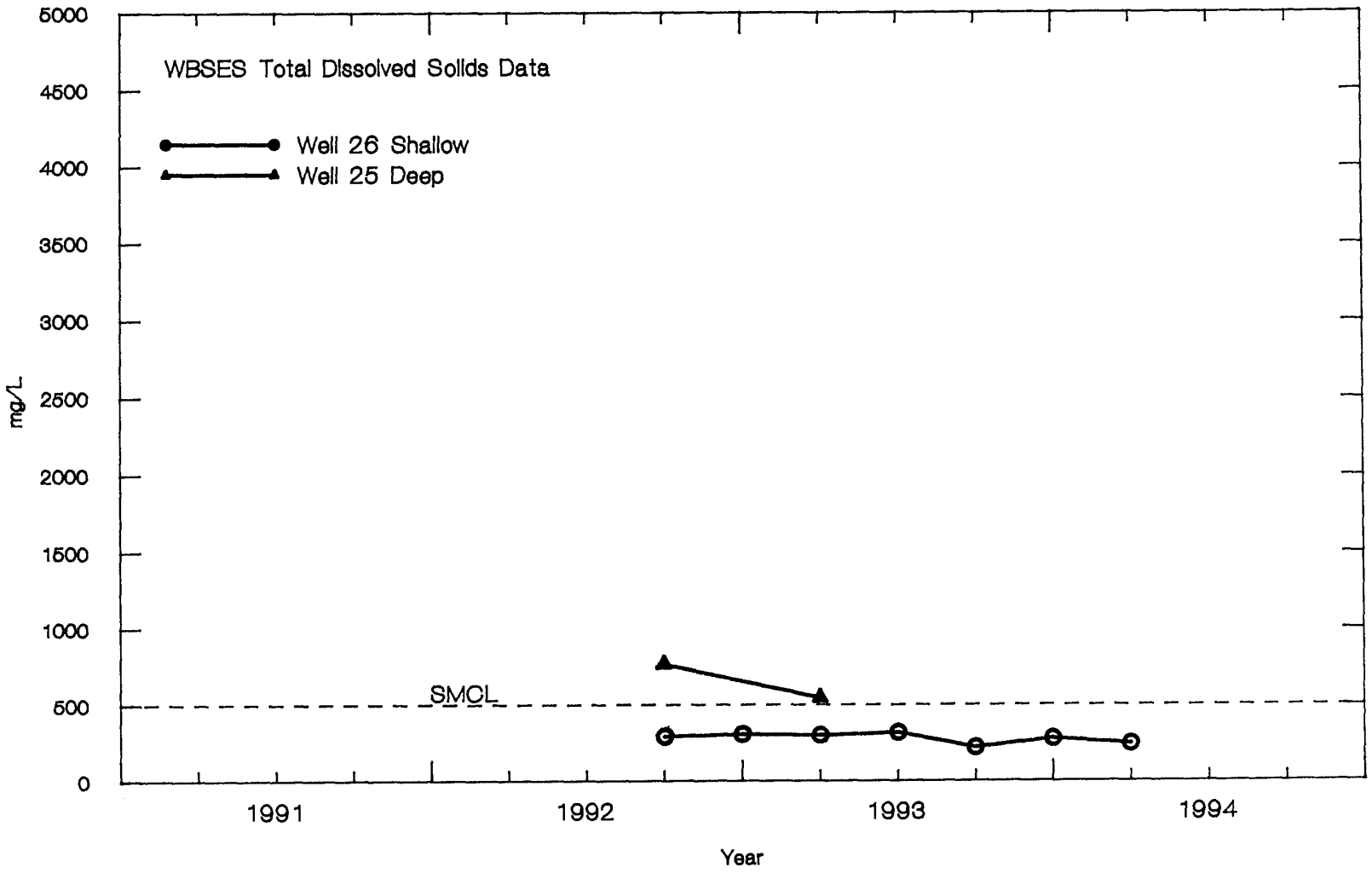
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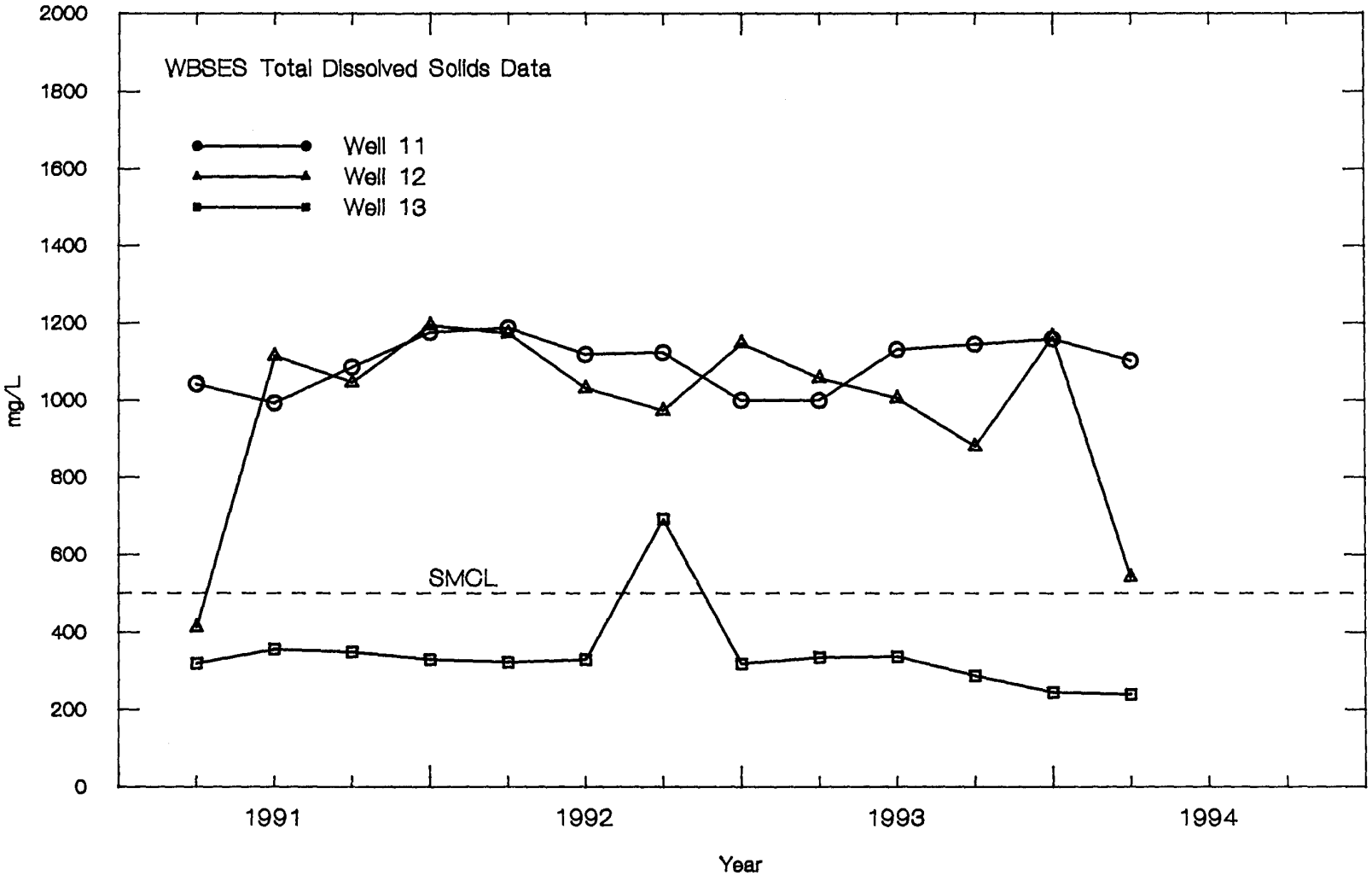

WBSES Total Dissolved Solids Data
Well 17 Shallow
Well 16 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year


WBSES Total Dissolved Solids Data
Well 19 Shallow
Well 18 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year

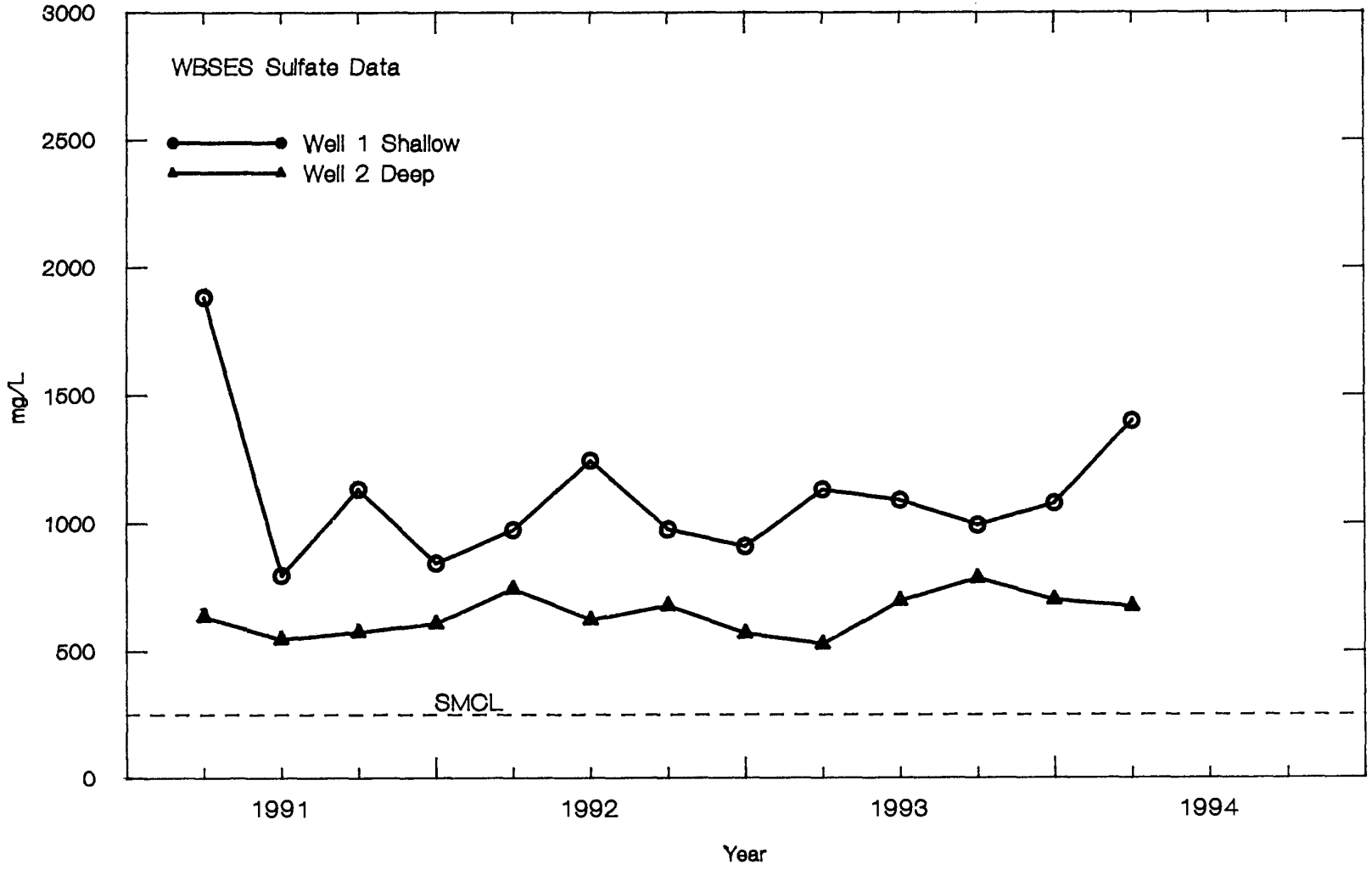

WBSES Total Dissolved Solids Data
Well 21 Shallow
Well 20 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year

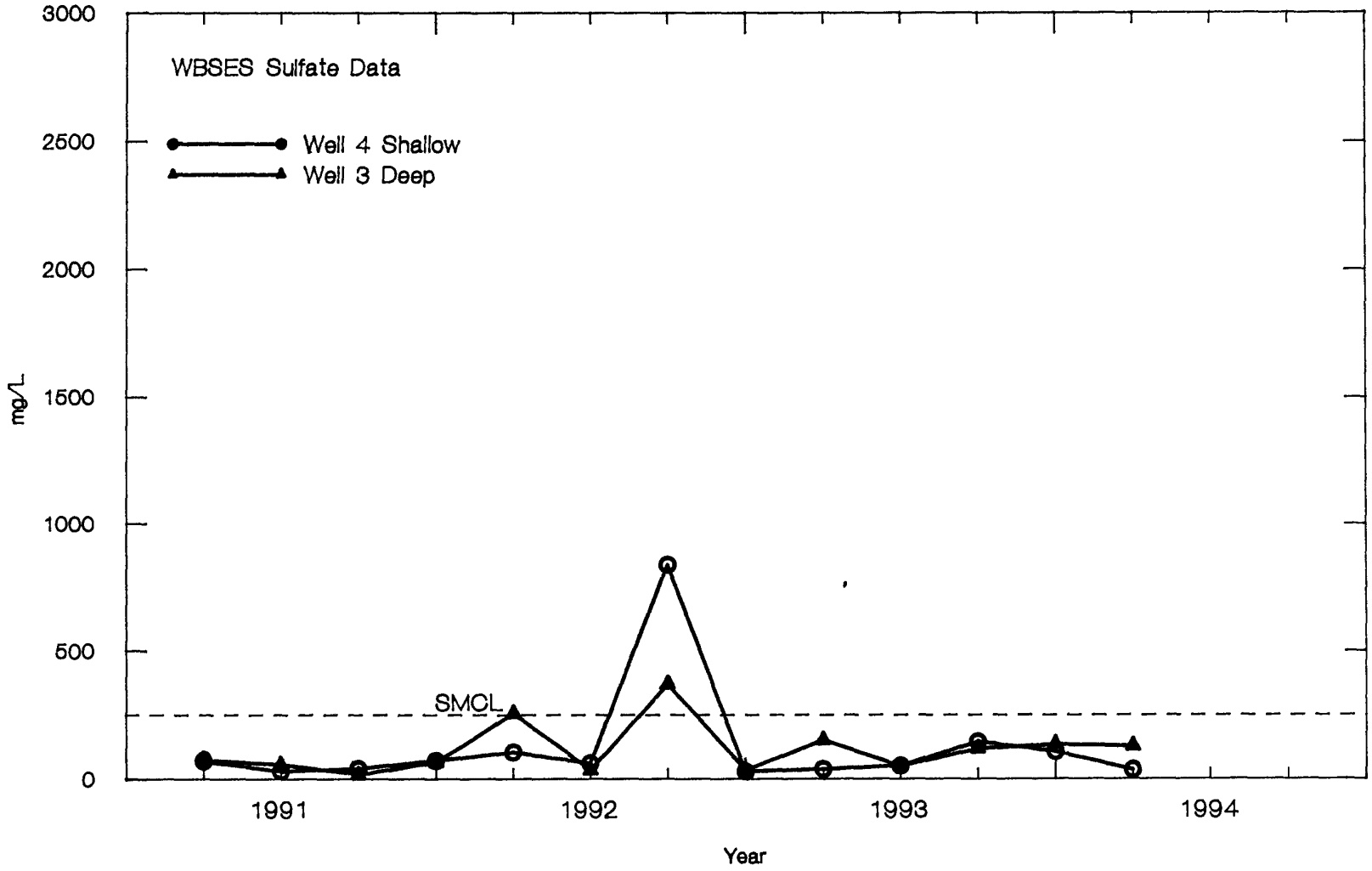

WBSES Total Dissolved Solids Data
Well 24 Shallow
Well 23 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year

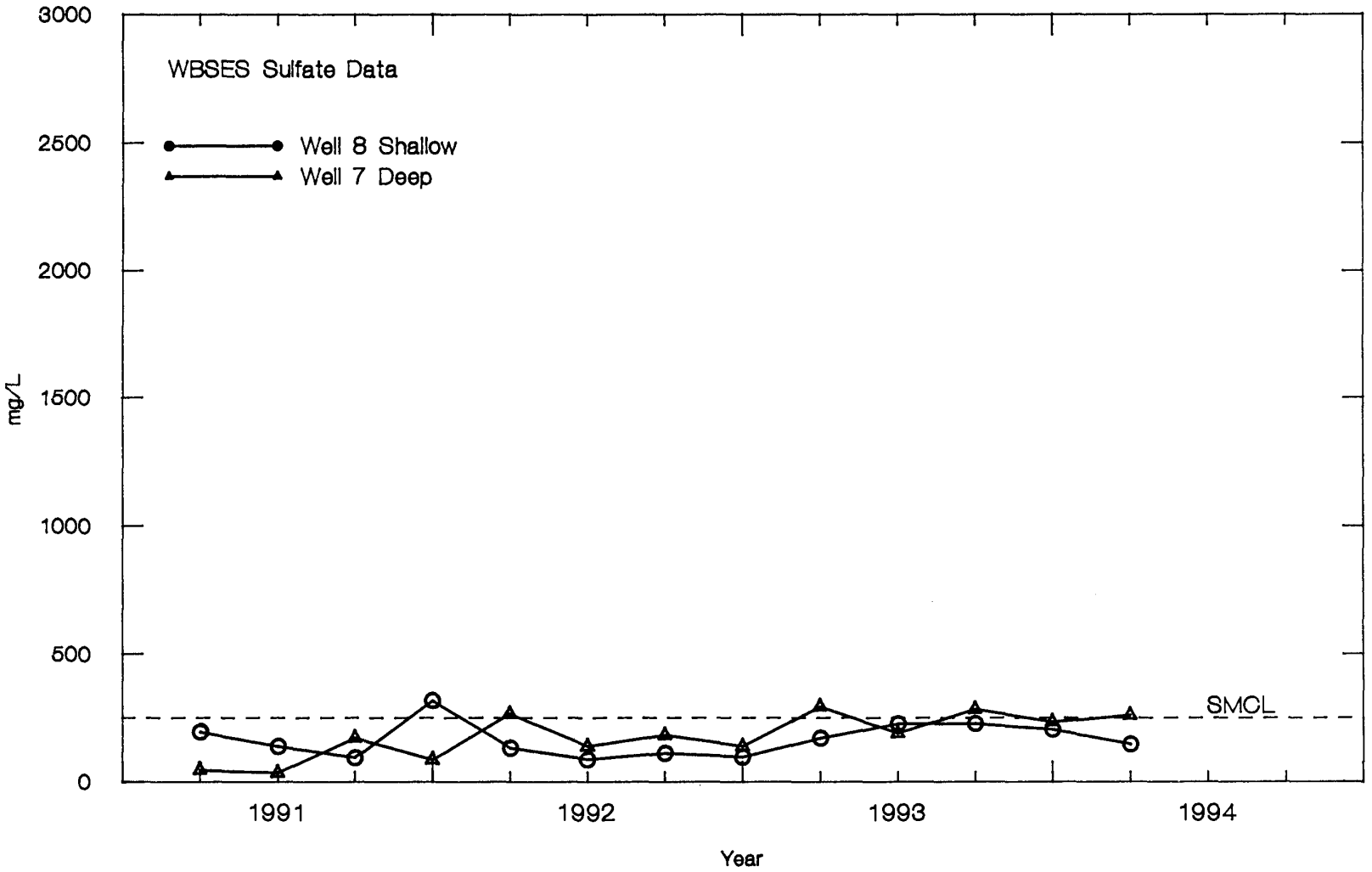

WBSES Total Dissolved Solids Data
Well 26 Shallow
Well 25 Deep
SMCL
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year



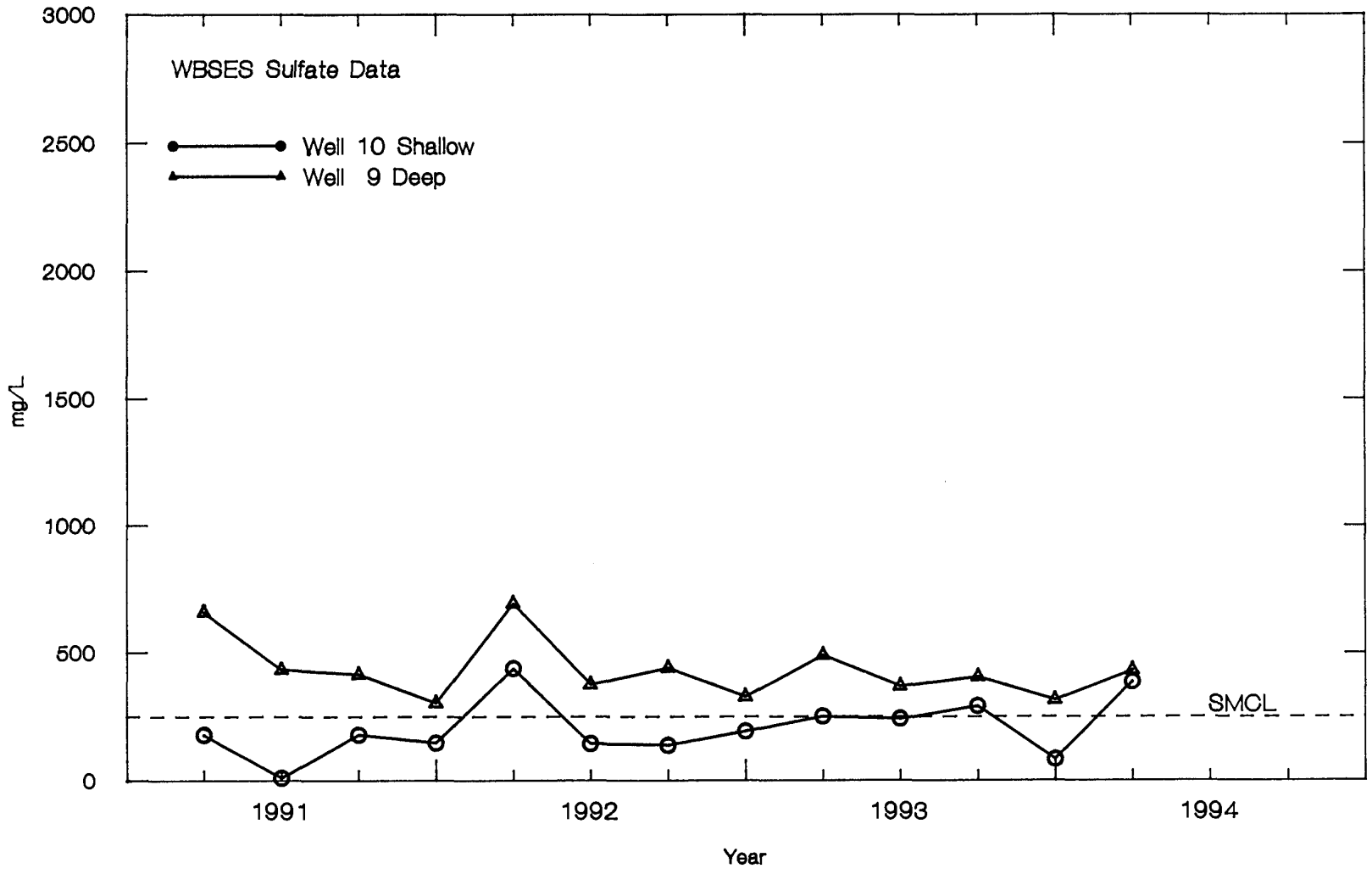
9:56 am. 3/08/95
WBLAB


WBSES Sulfate Data
Well 1 Shallow
Well 2 Deep
3000
2500
2000
1500
1000
500
0
mg/L
SMCL
1991
1992
1993
1994
Year

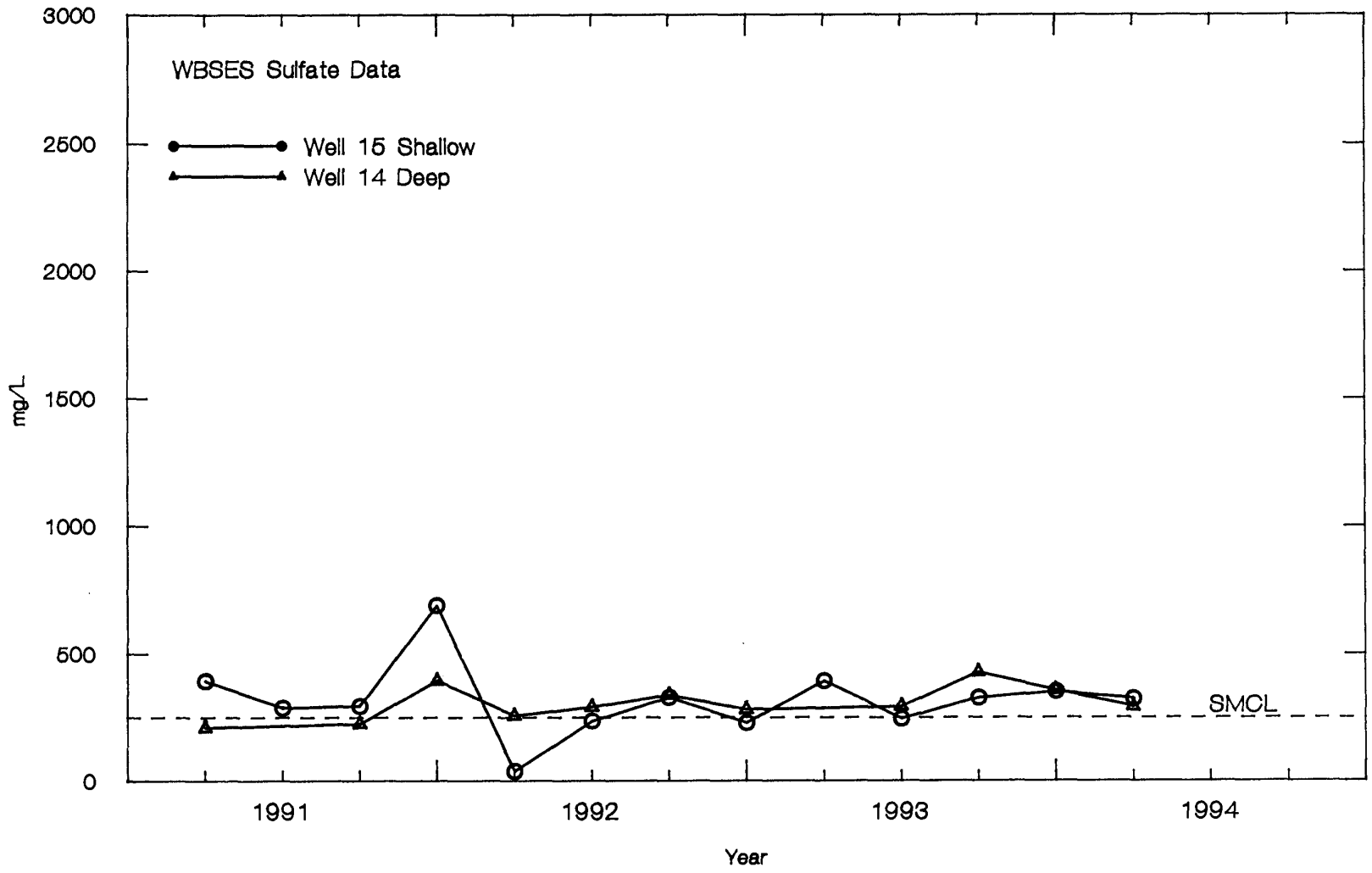

WBSES Sulfate Data
Well 4 Shallow
Well 3 Deep
3000
2500
2000
1500
1000
500
0
mg/L
SMCL
1991
1992
1993
1994
Year



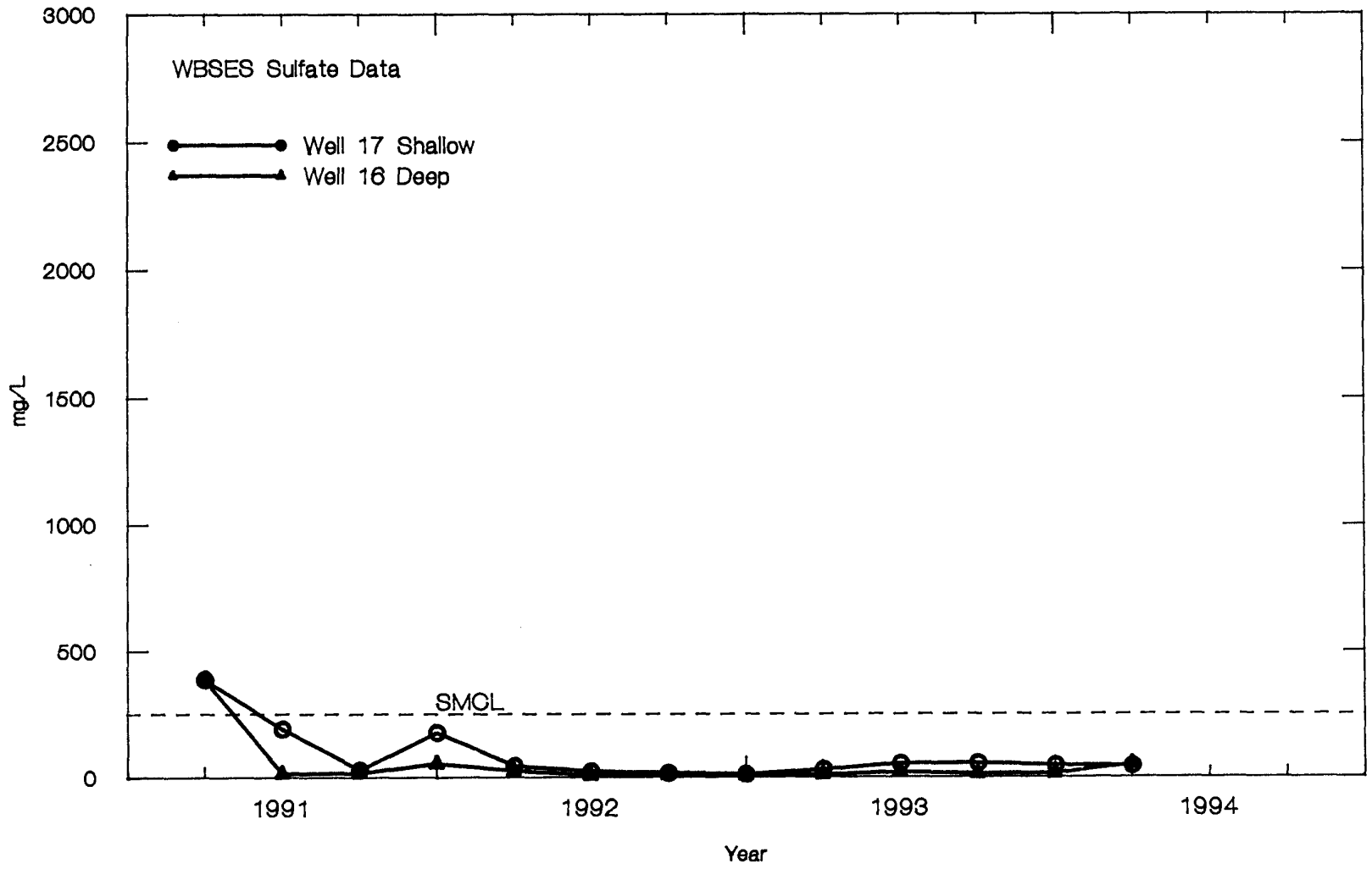
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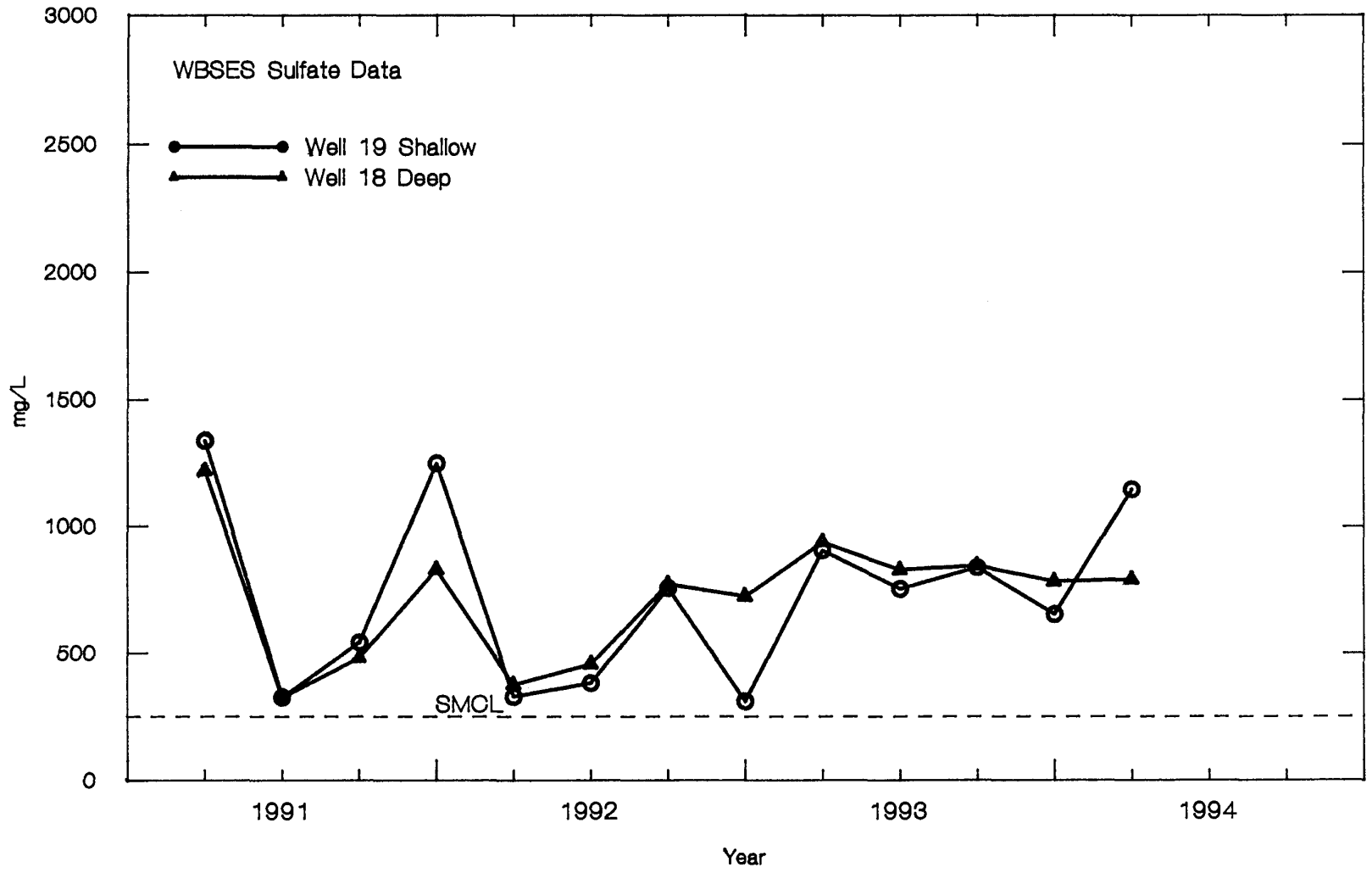


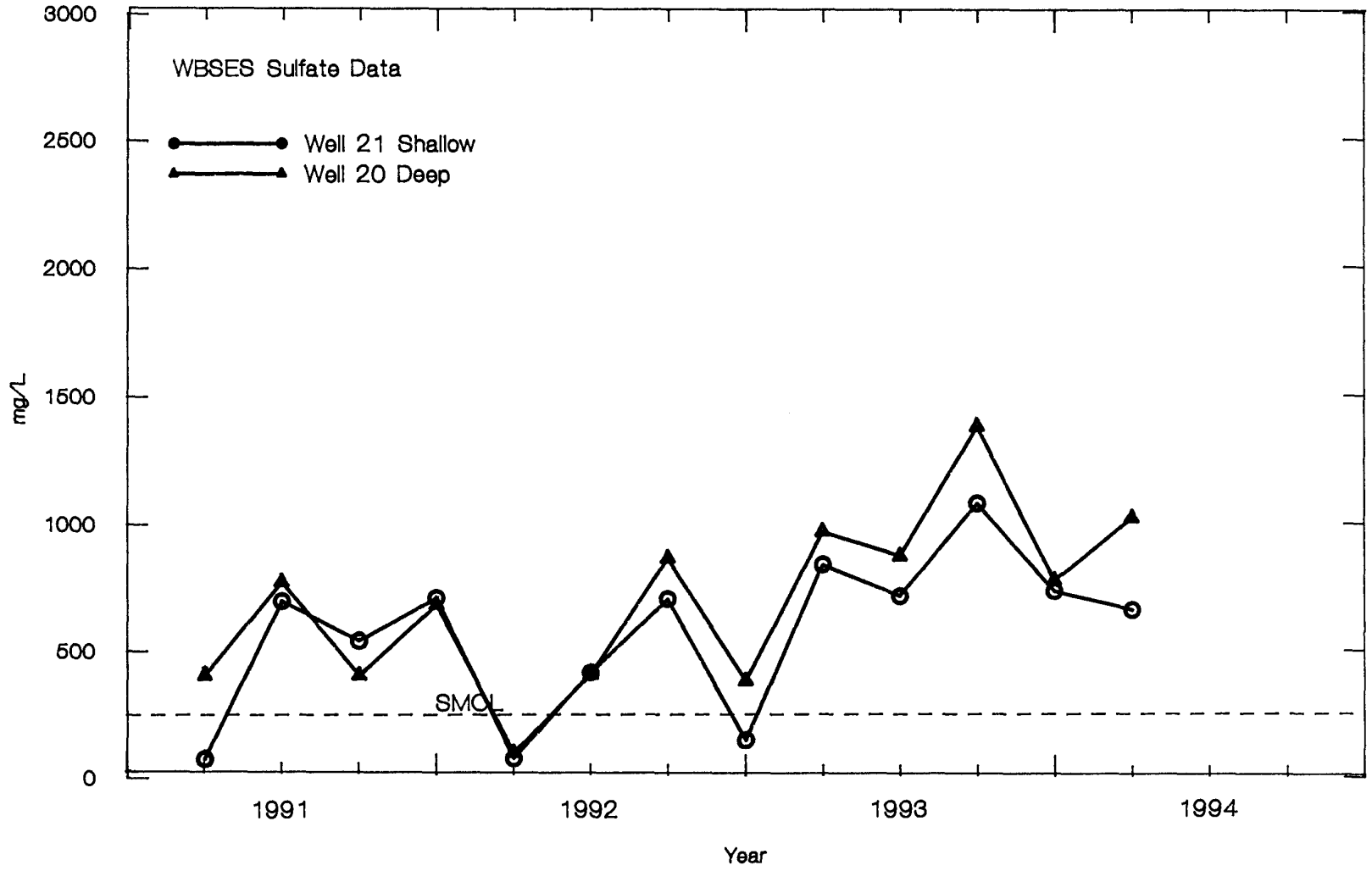
10:05 am 3/08/95
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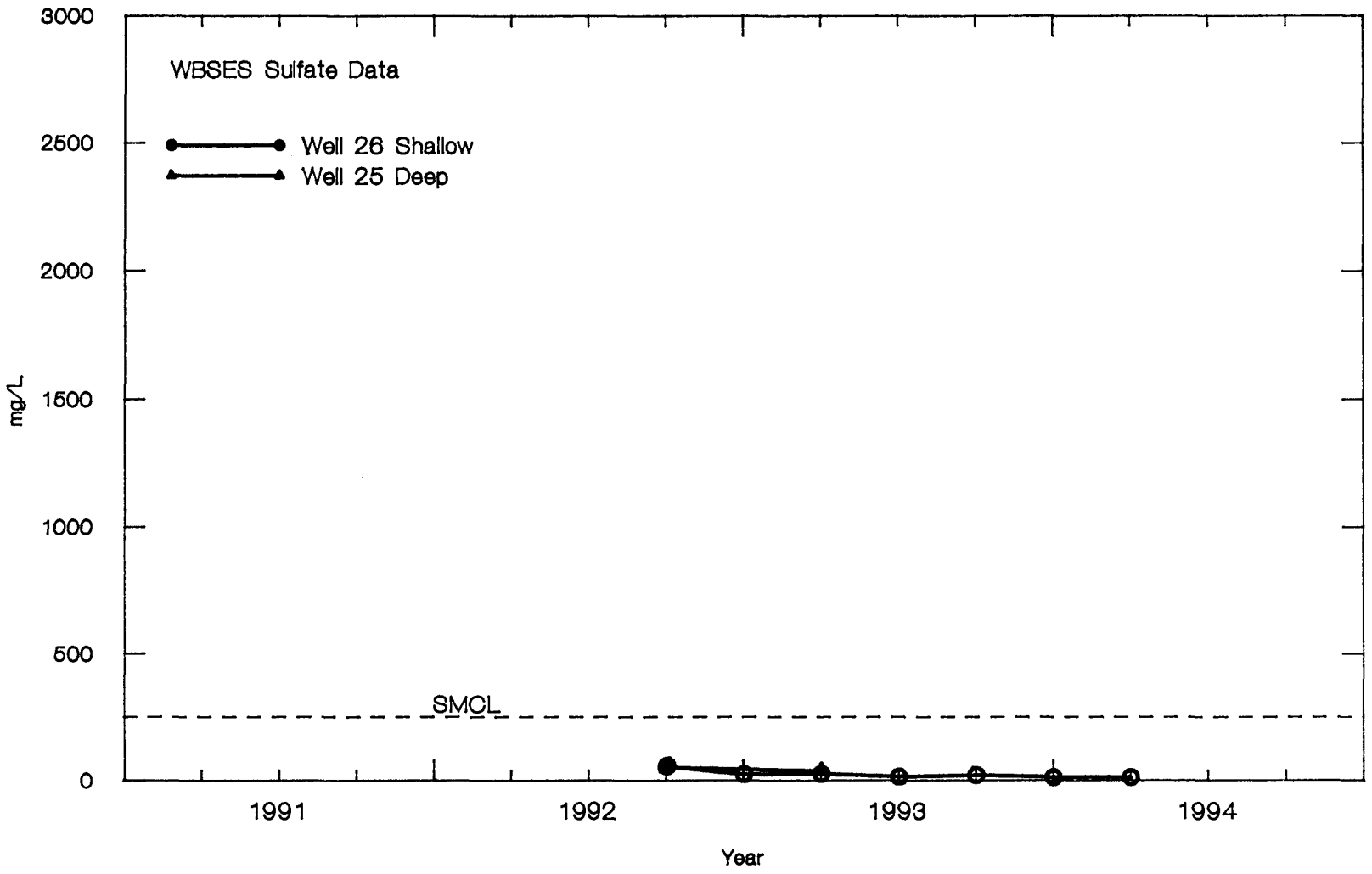


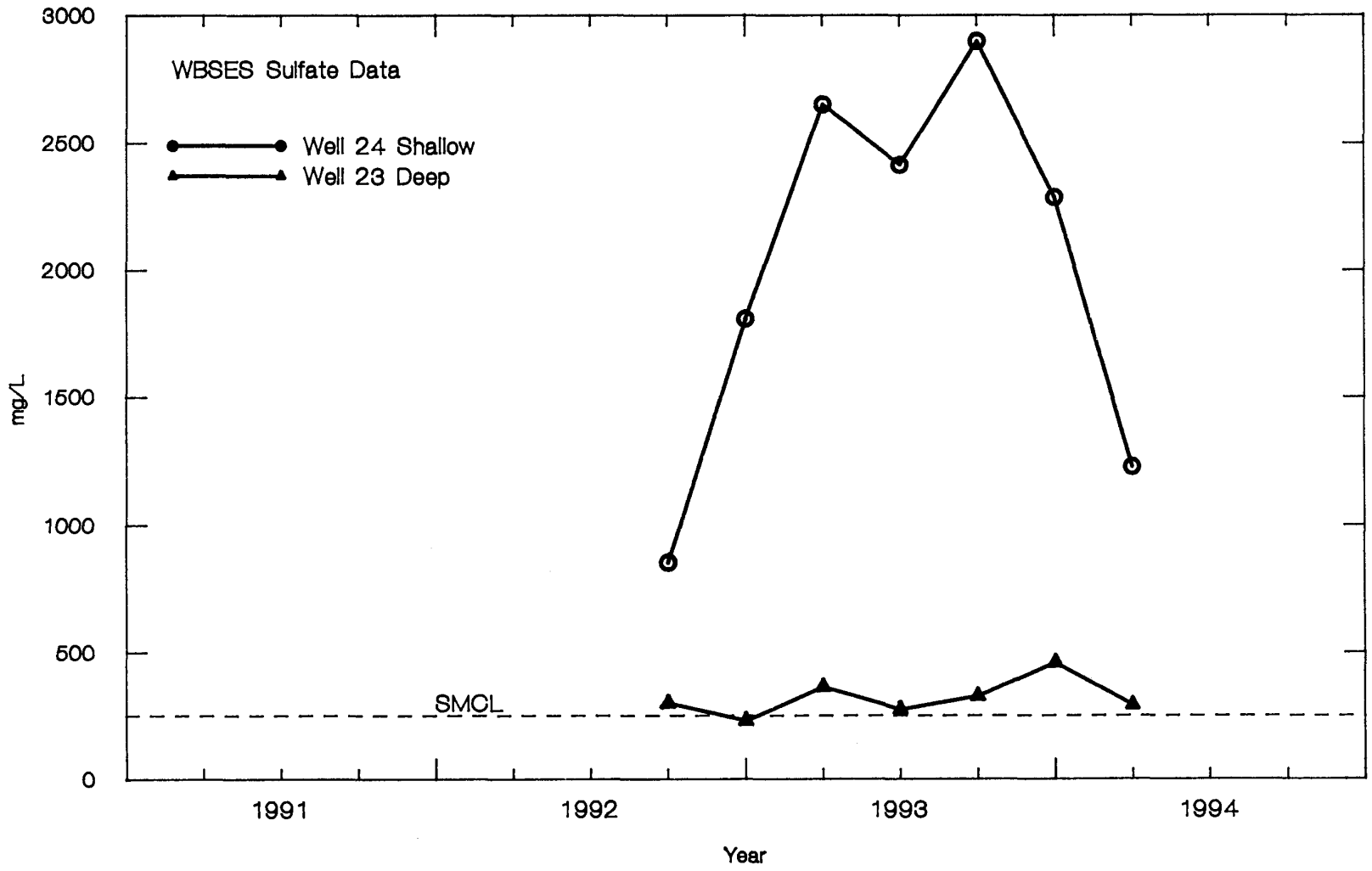
10:06 am 3/08/95
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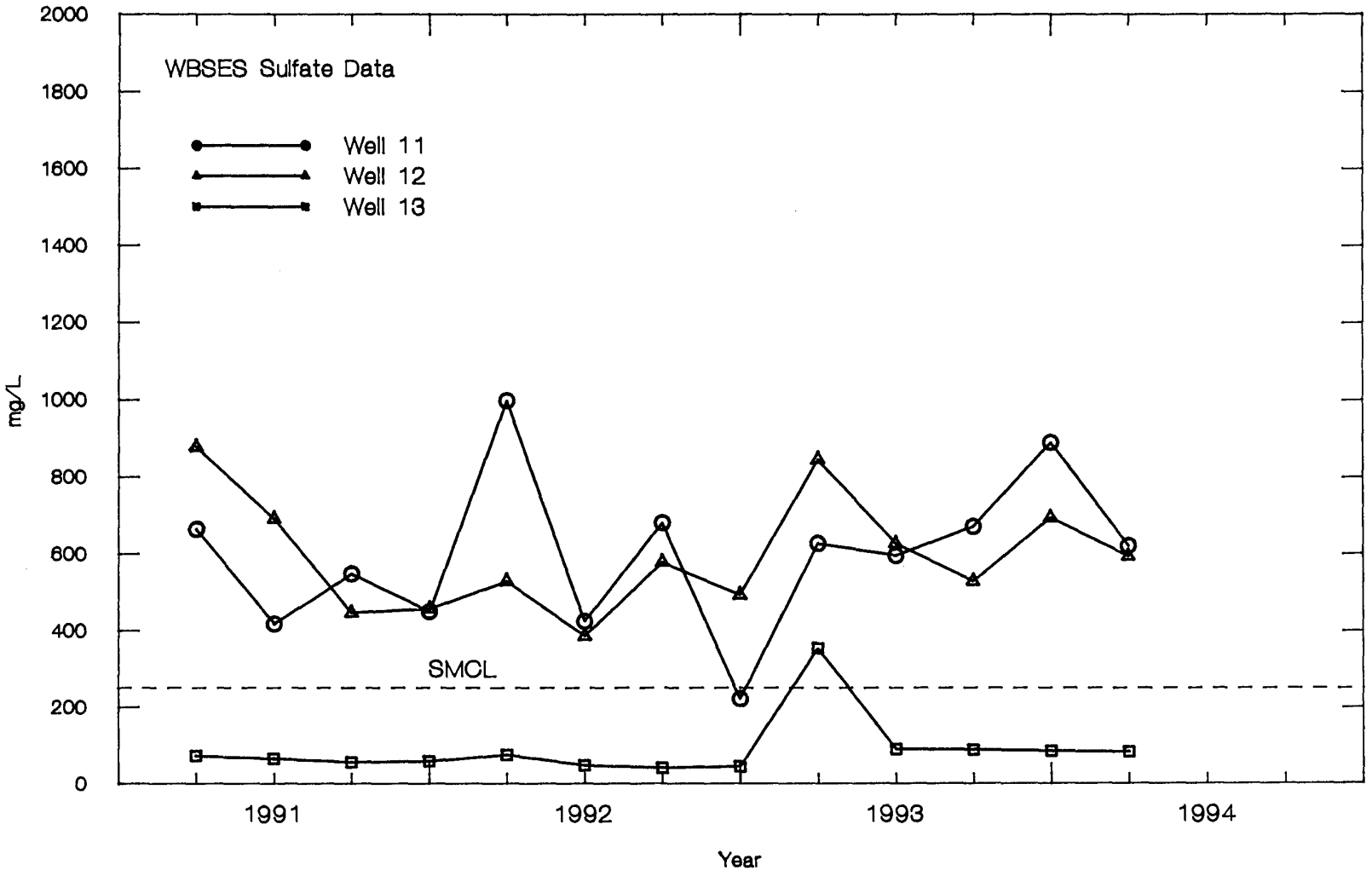

WBSES Sulfate Data
Well 17 Shallow
Well 16 Deep
3000
2500
2000
1500
1000
500
0
mg/L
SMCL
1991
1992
1993
1994
Year


WBSES Sulfate Data
Well 19 Shallow
Well 18 Deep
SMCL
mg/L
3000
2500
2000
1500
1000
500
0
1991
1992
1993
1994
Year

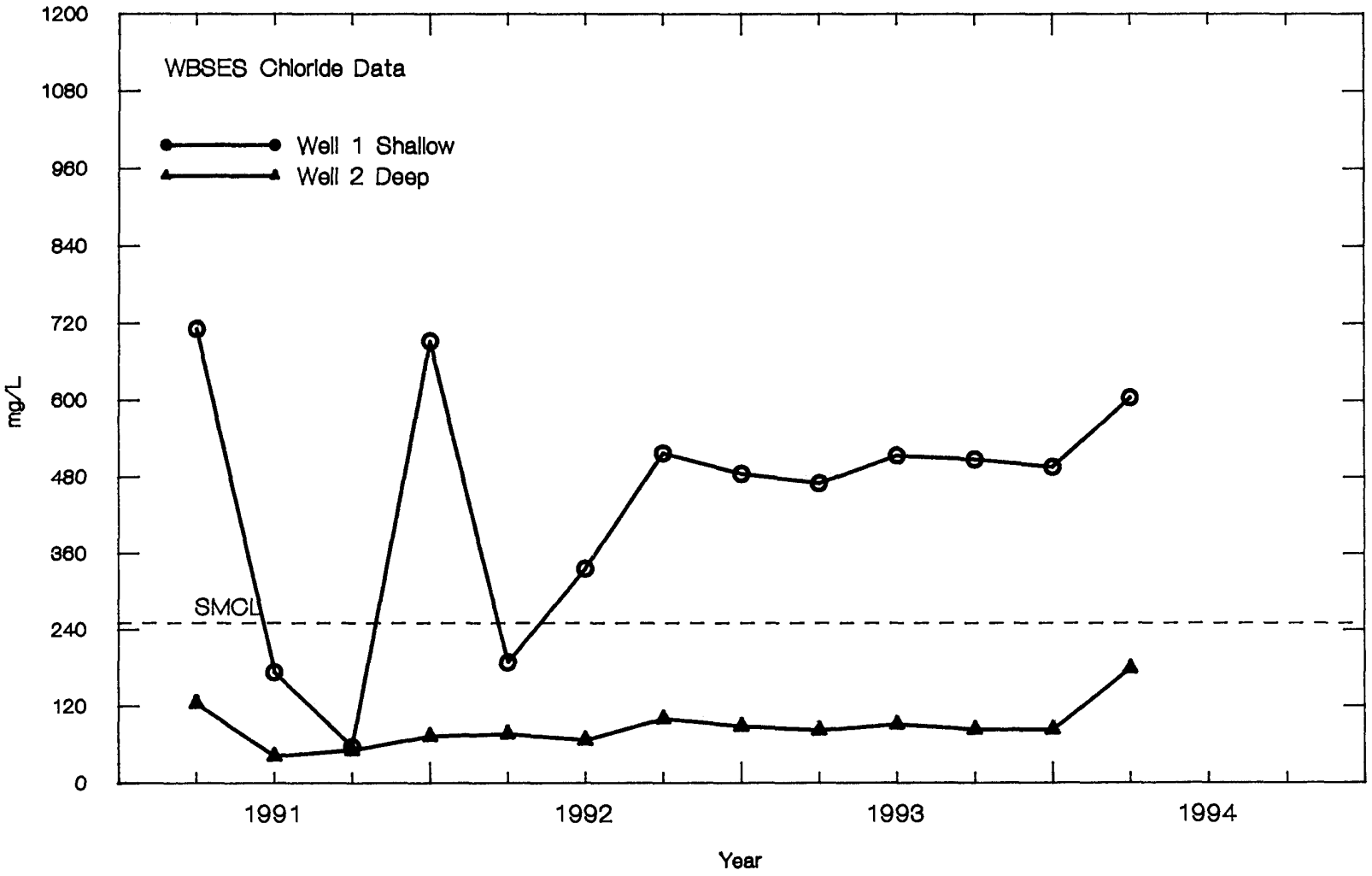

WBSES Sulfate Data
Well 21 Shallow
Well 20 Deep
3000
2500
2000
1500
1000
500
0
mg/L
SMCL
1991
1992
1993
1994
Year

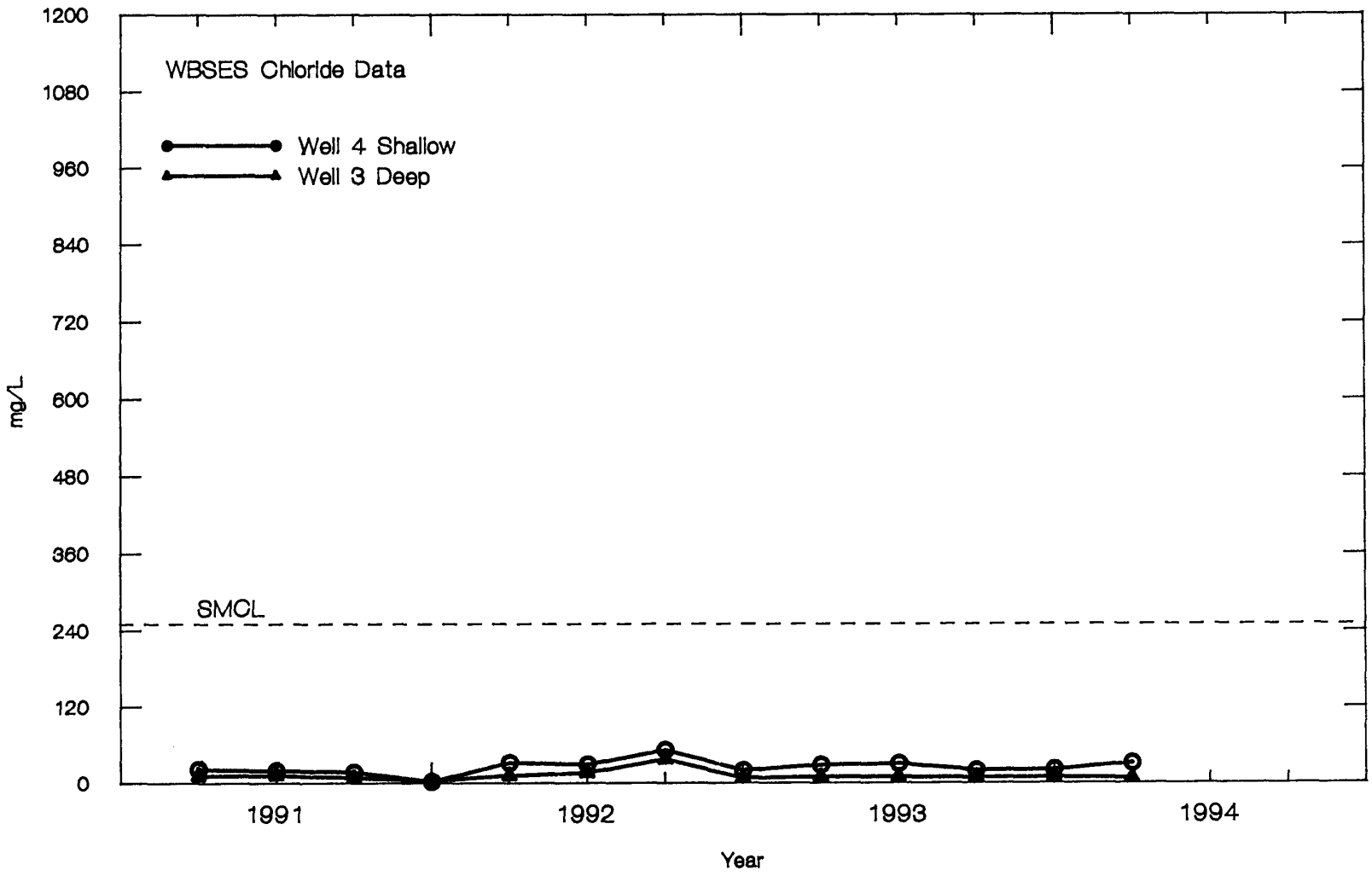

WBSES Sulfate Data
Well 26 Shallow
Well 25 Deep
3000
2500
2000
1500
1000
500
0
mg/L
SMCL
1991
1992
1993
1994
Year

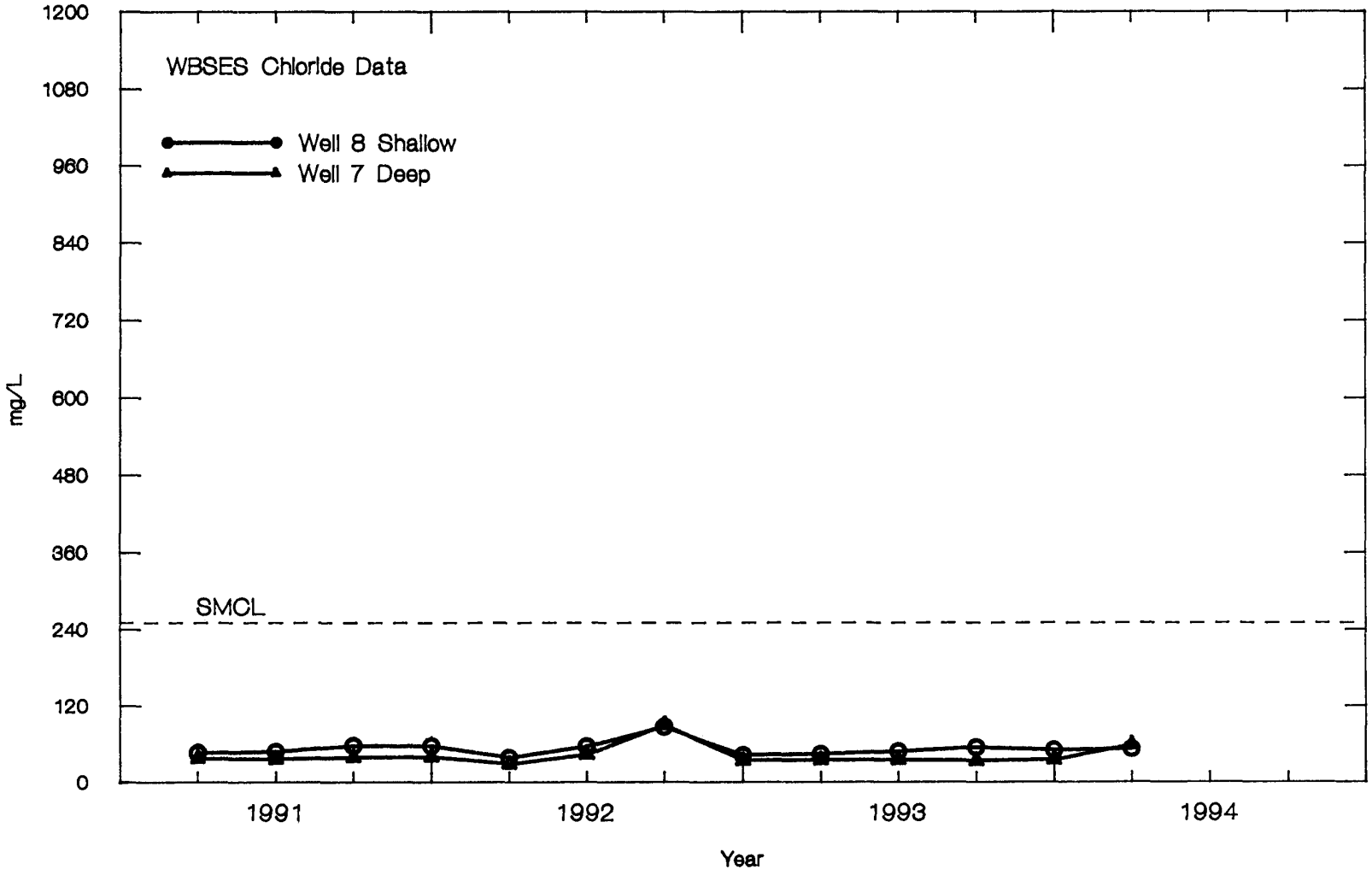

WBSES Sulfate Data
Well 24 Shallow
Well 23 Deep
SMCL
3000
2500
2000
1500
1000
500
0
mg/L
1991
1992
1993
1994
Year

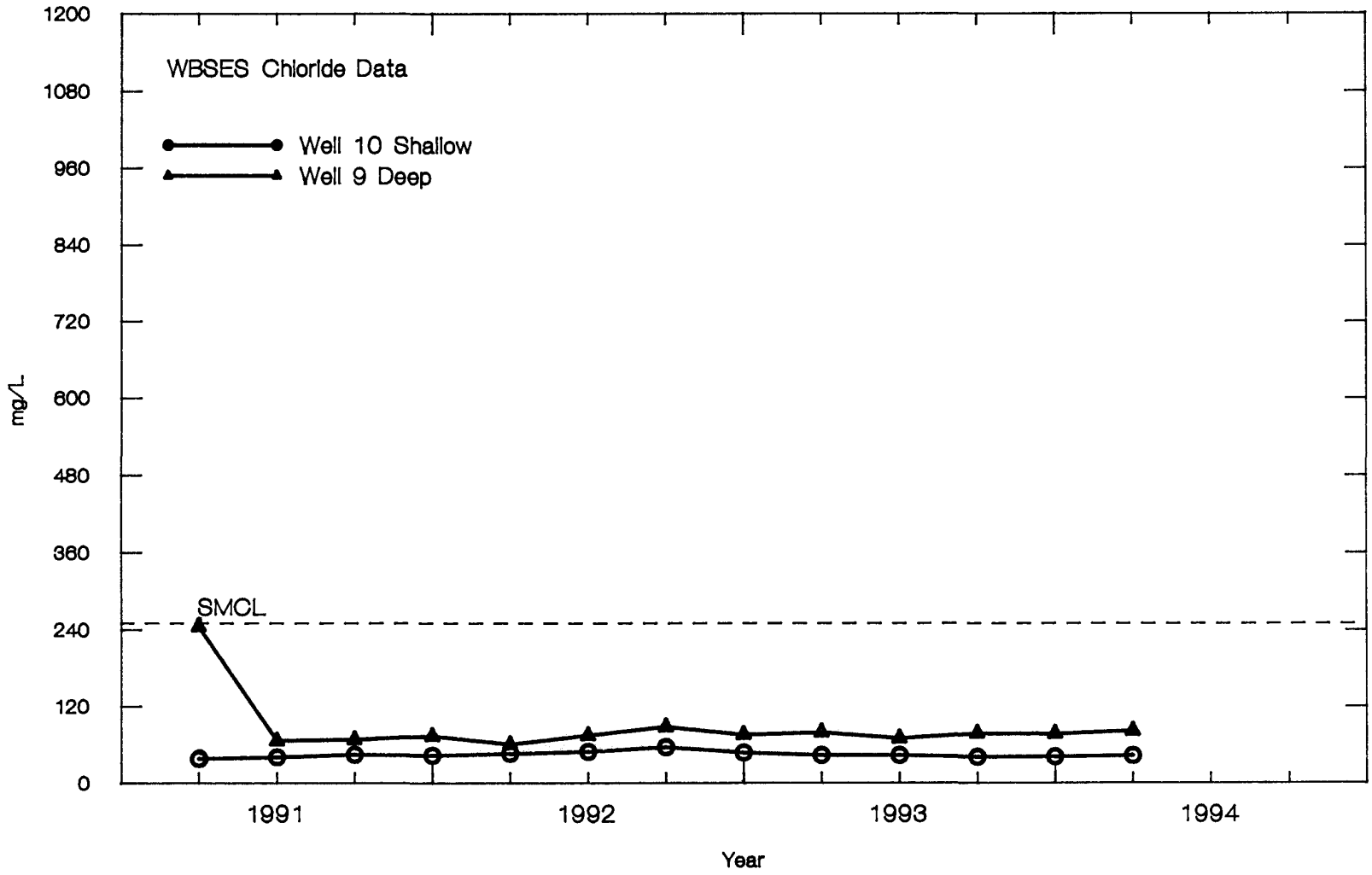


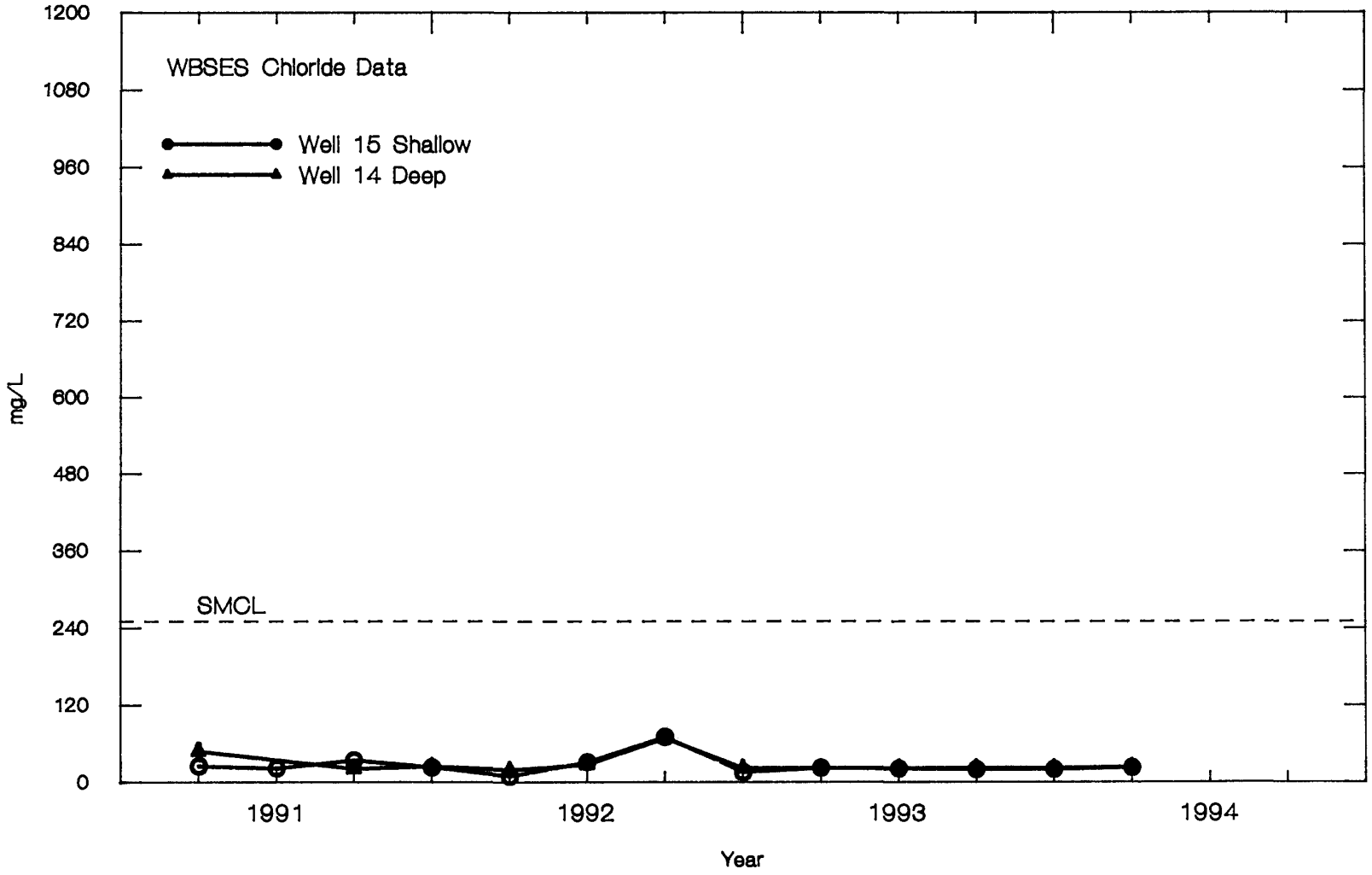
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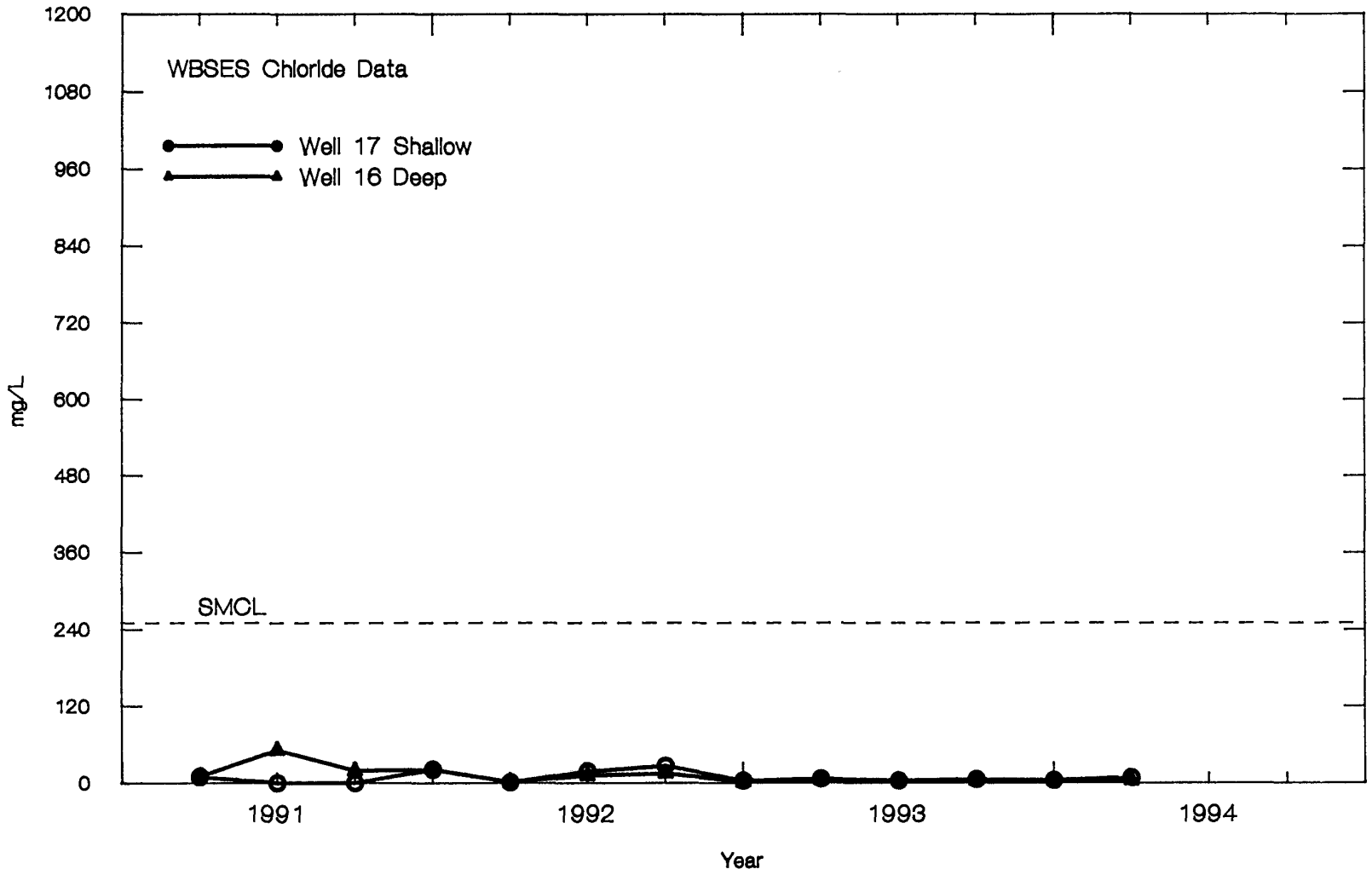

WBSES Chloride Data
Well 1 Shallow
Well 2 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

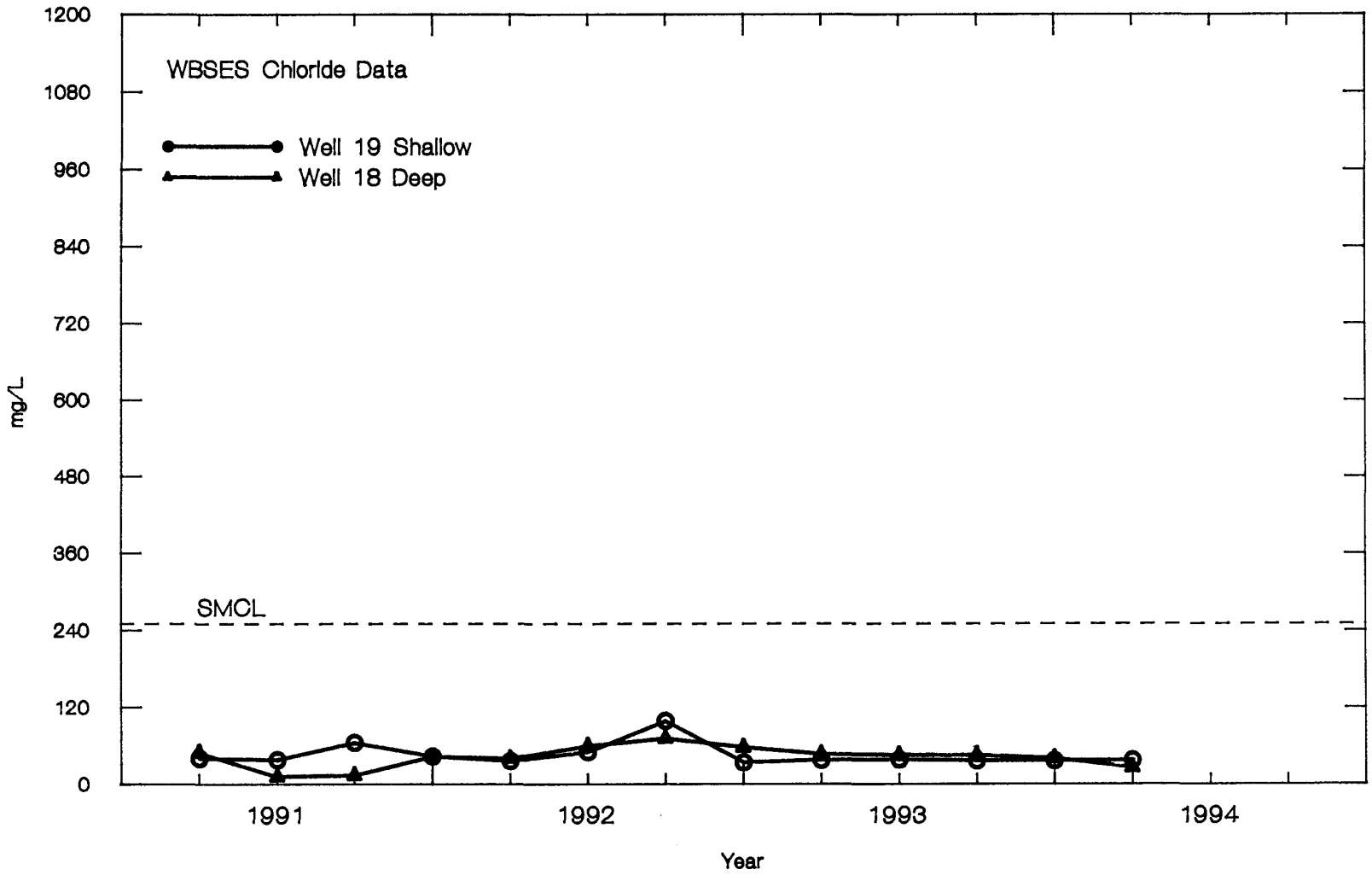

WBSES Chloride Data
Well 4 Shallow
Well 3 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

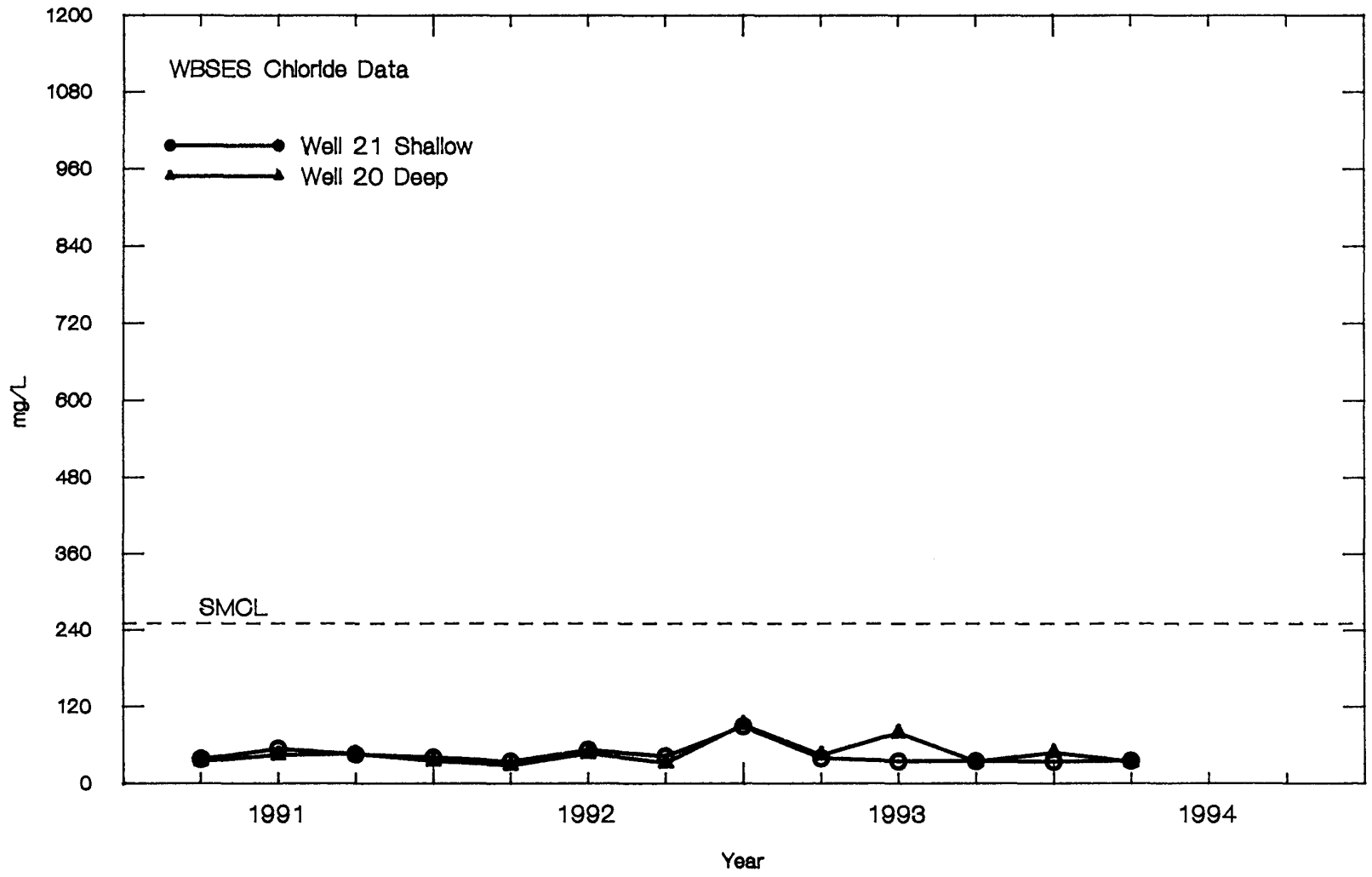

WBSES Chloride Data
Well 8 Shallow
Well 7 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

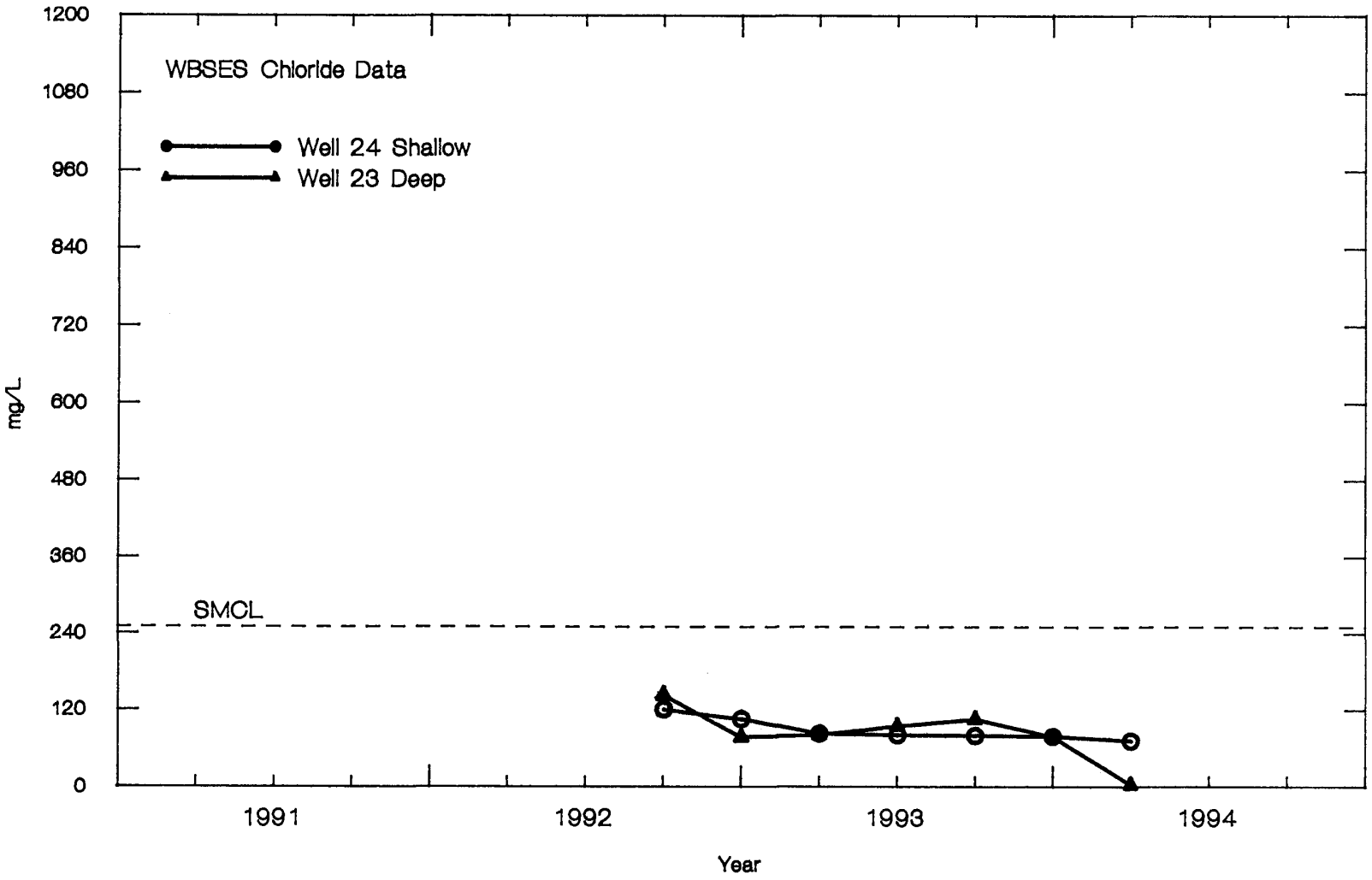

WBSES Chloride Data
Well 10 Shallow
Well 9 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

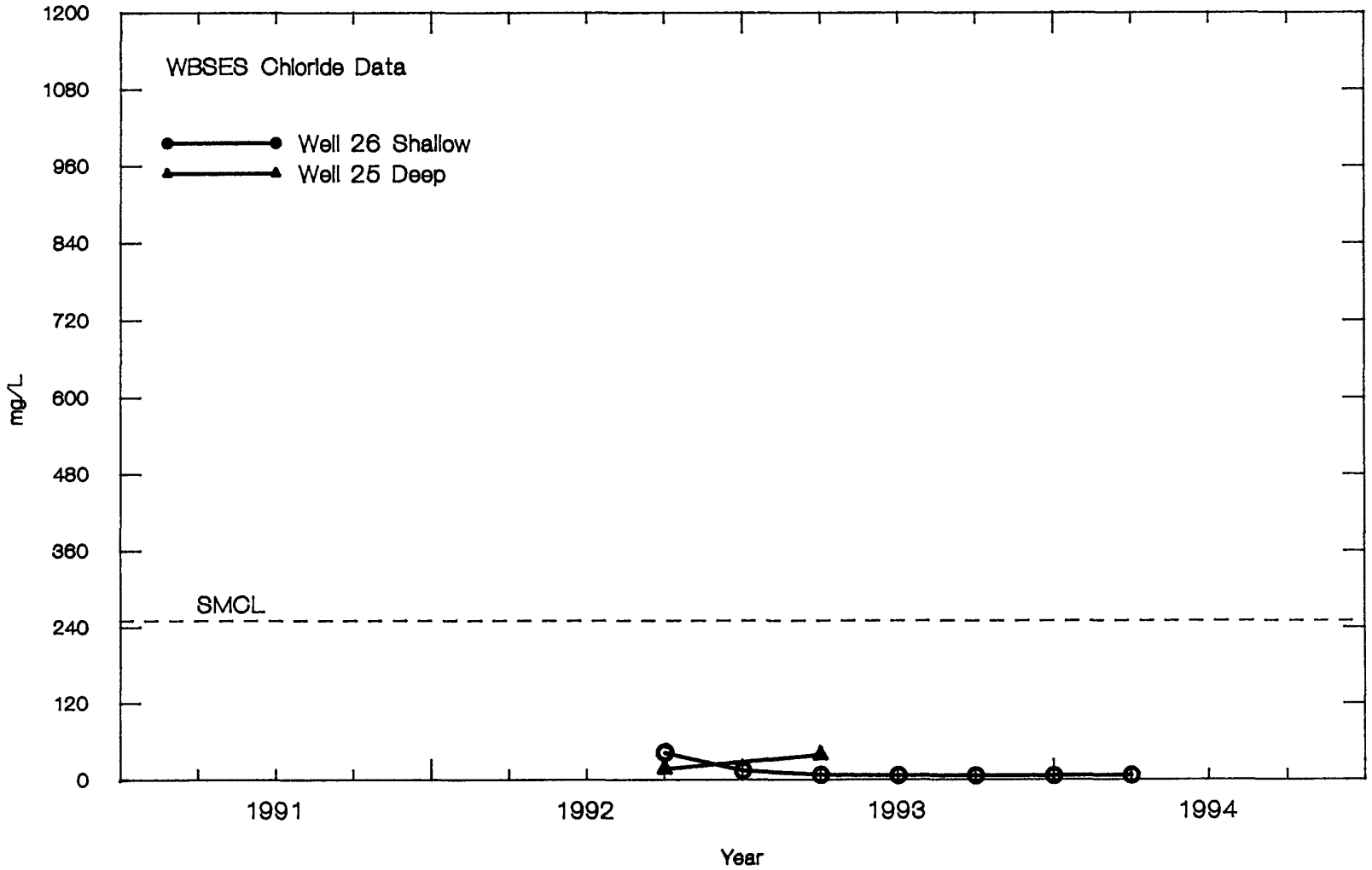

WBSES Chloride Data
Well 15 Shallow
Well 14 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

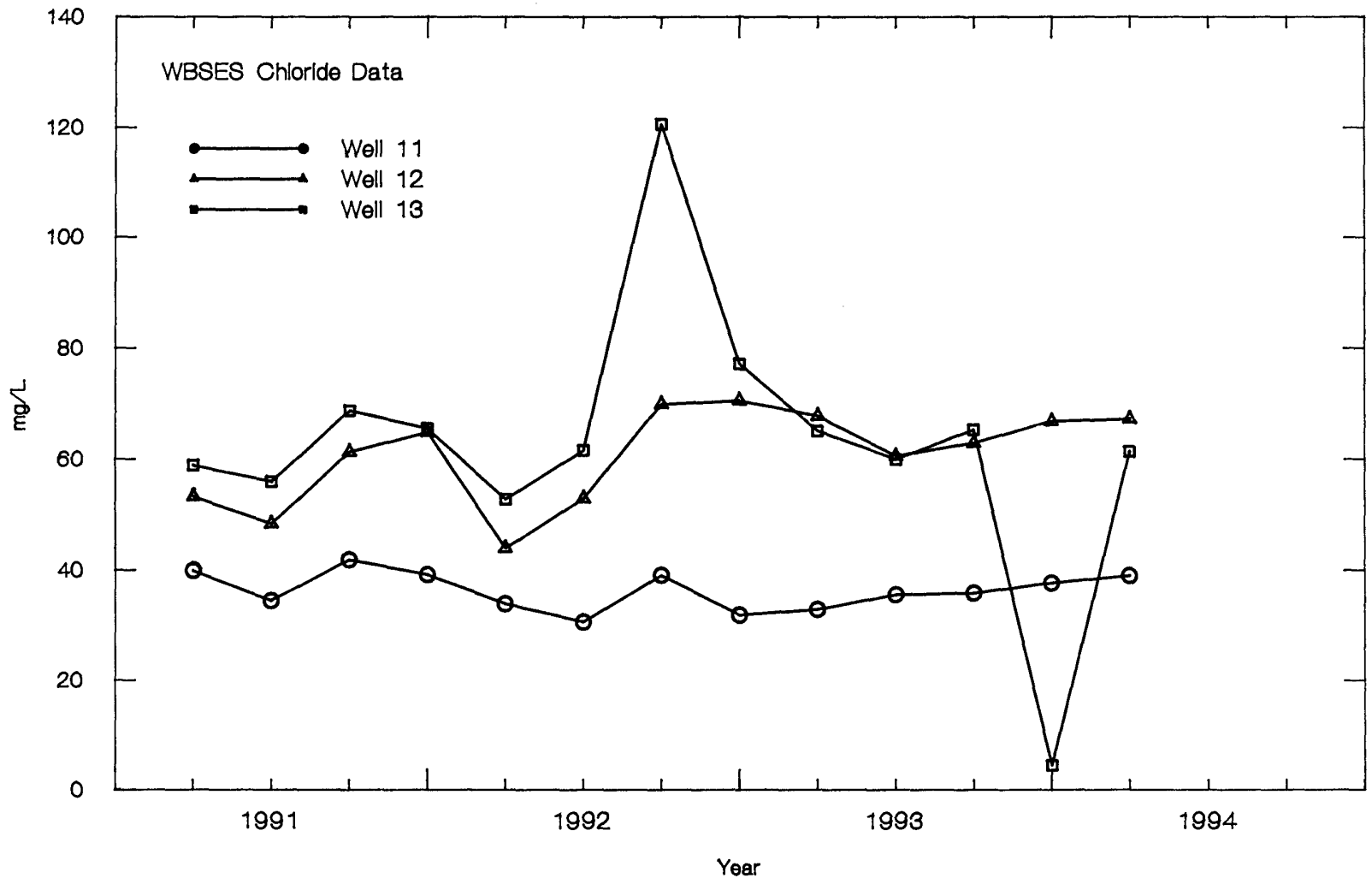

WBSES Chloride Data
Well 17 Shallow
Well 16 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year


WBSES Chloride Data
Well 19 Shallow
Well 18 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

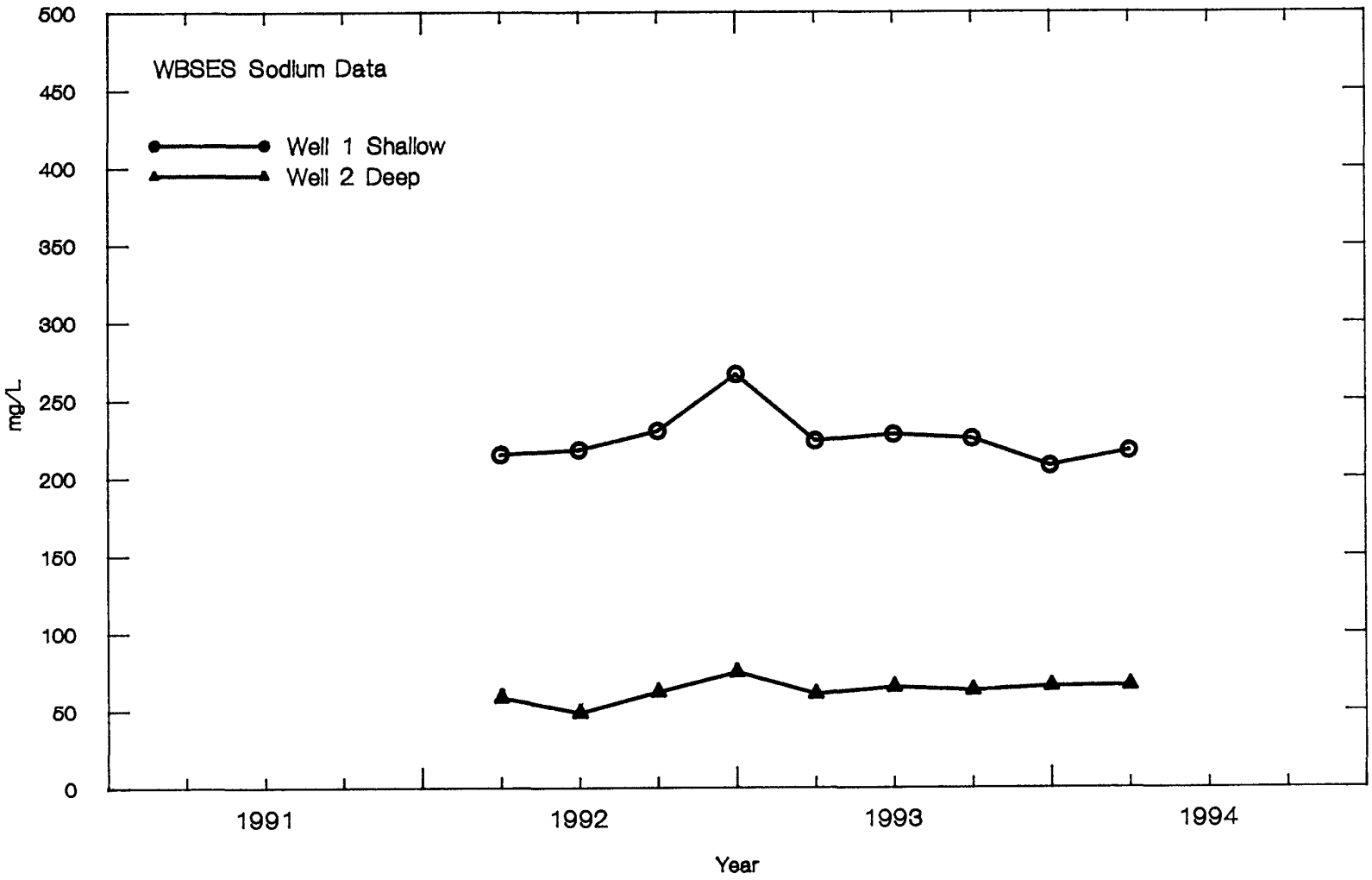

WBSES Chloride Data
Well 21 Shallow
Well 20 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

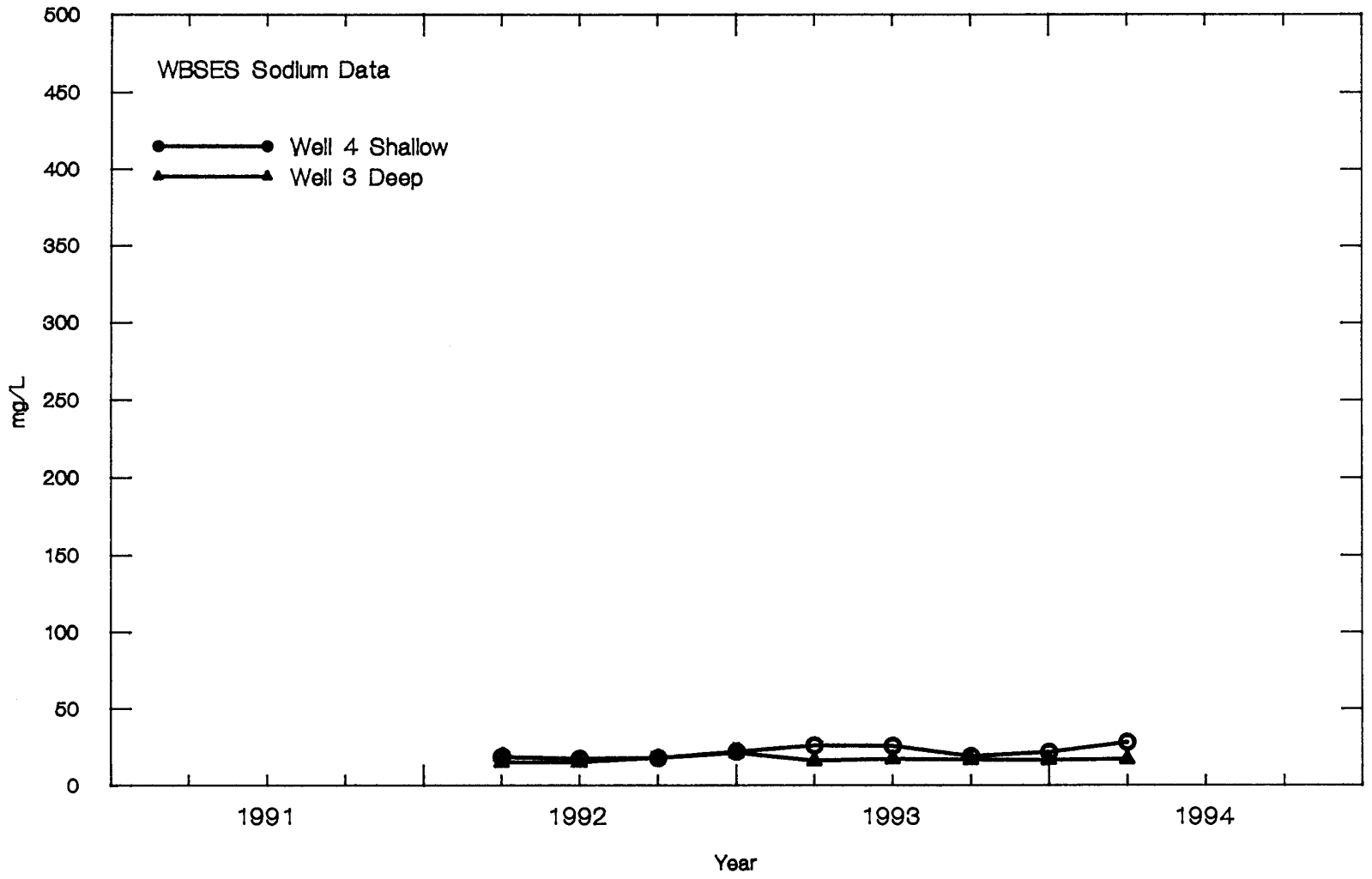

WBSES Chloride Data
Well 24 Shallow
Well 23 Deep
SMCL
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1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

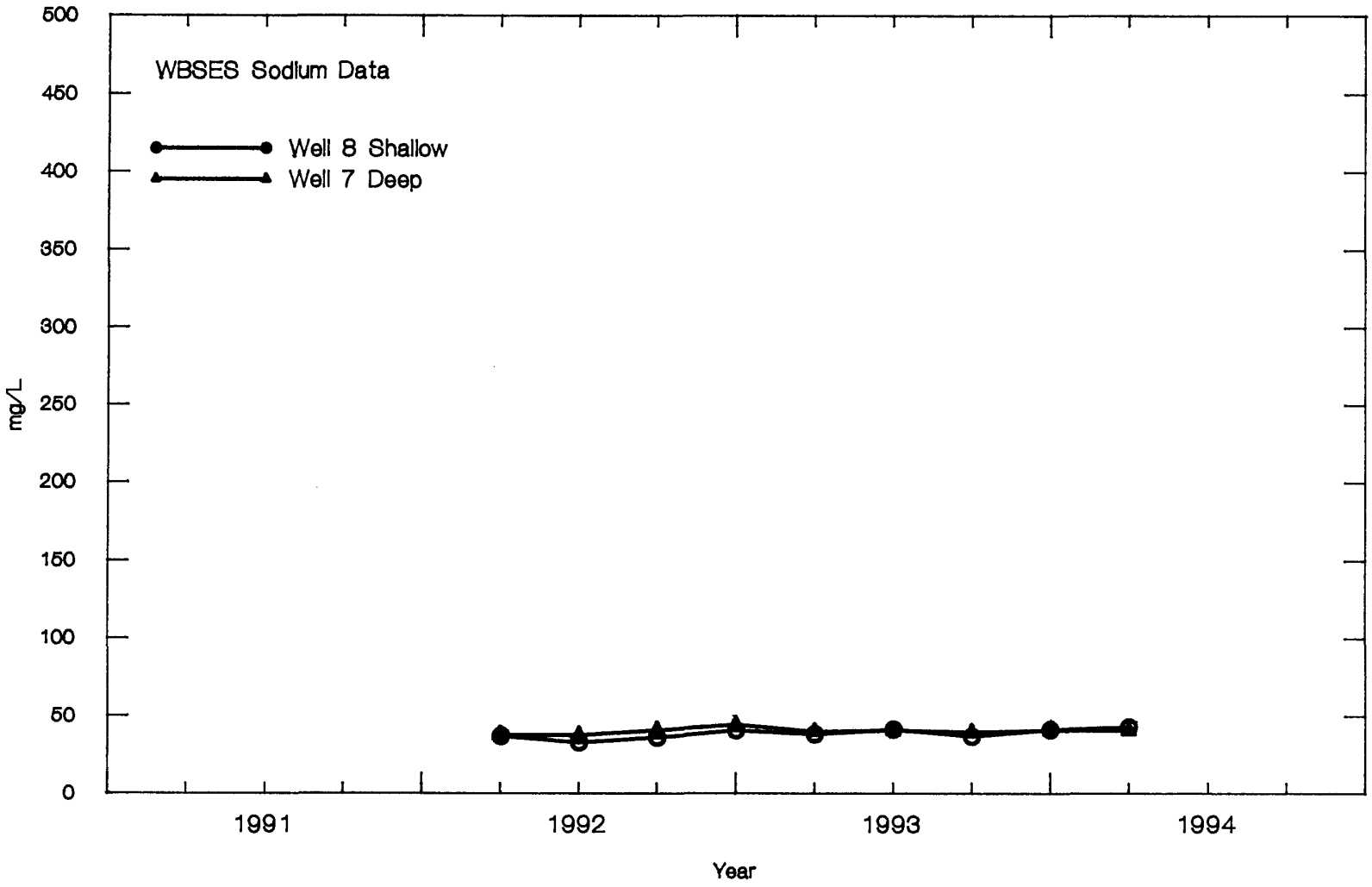

WBSES Chloride Data
Well 26 Shallow
Well 25 Deep
SMCL
1200
1080
960
840
720
600
480
360
240
120
0
mg/L
1991
1992
1993
1994
Year

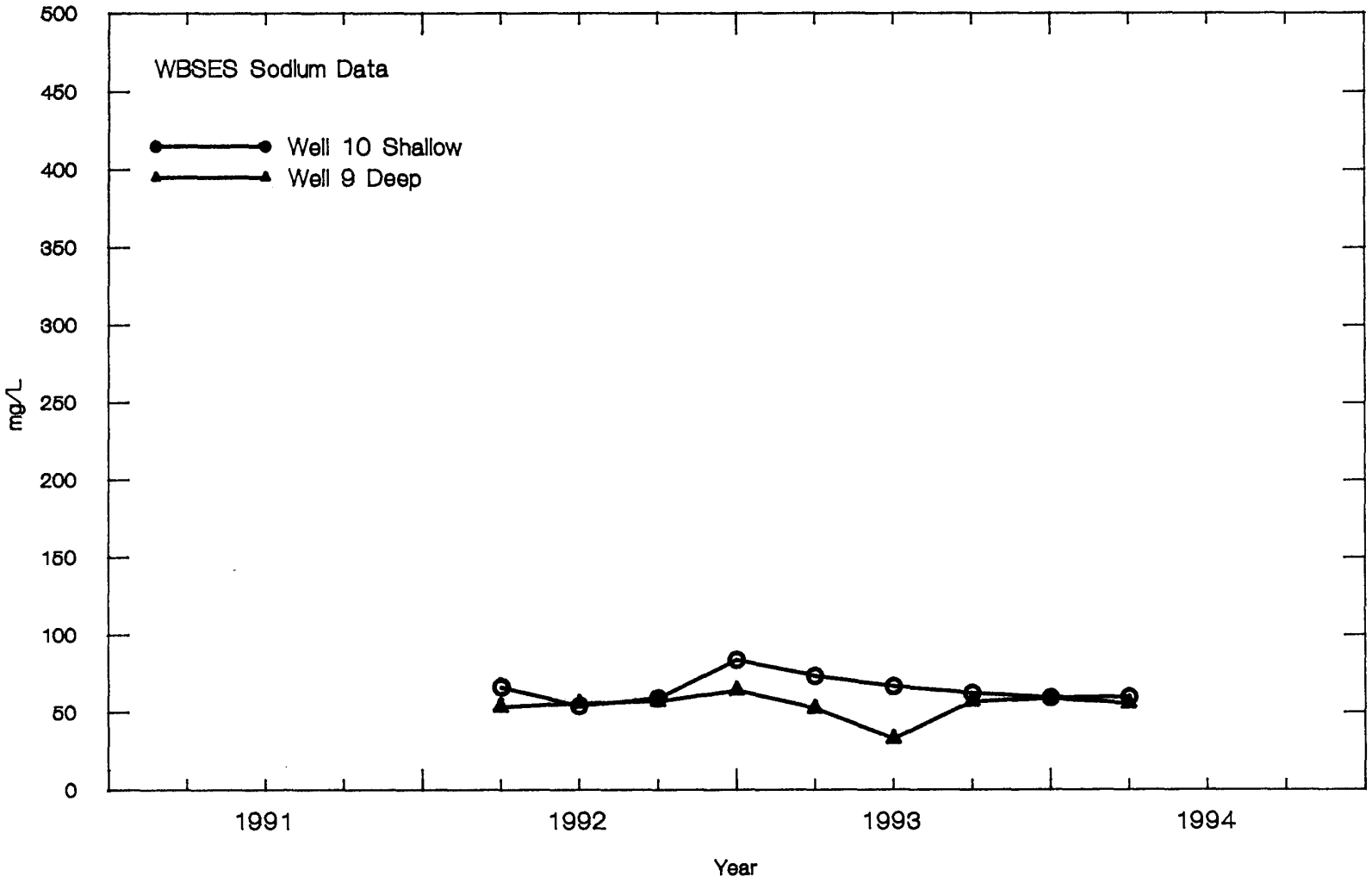


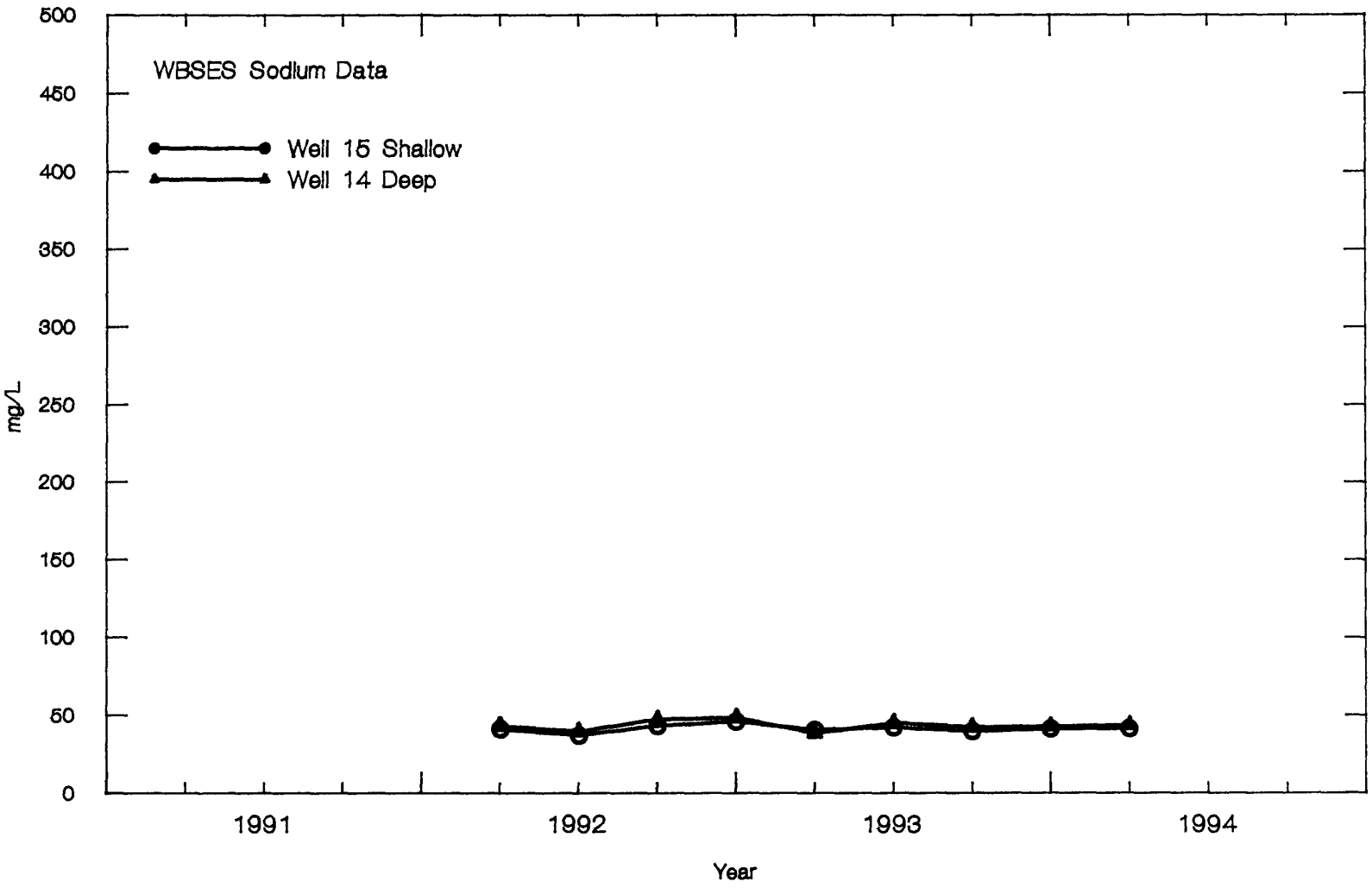
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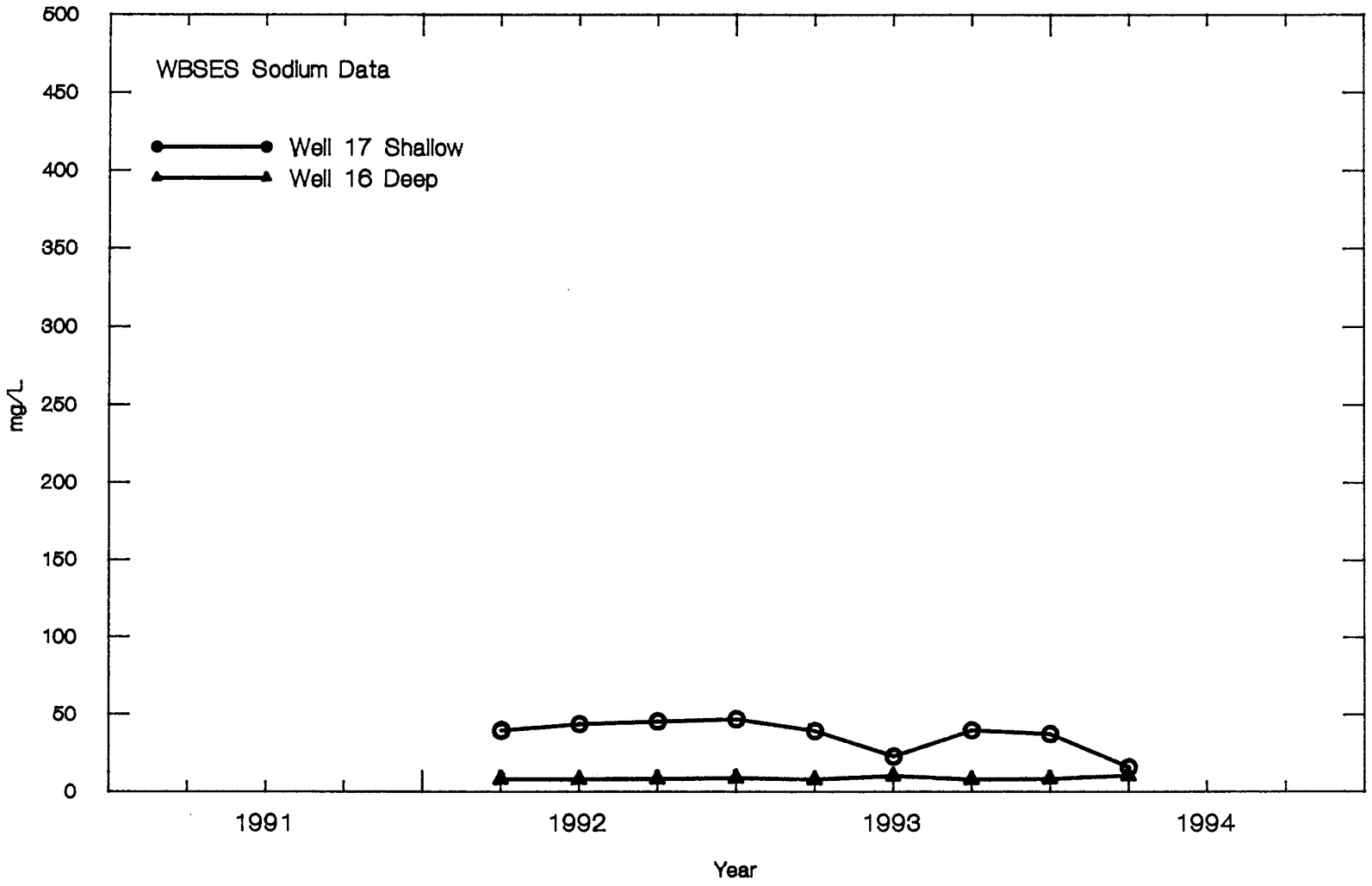

WBSES Sodium Data
Well 1 Shallow
Well 2 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

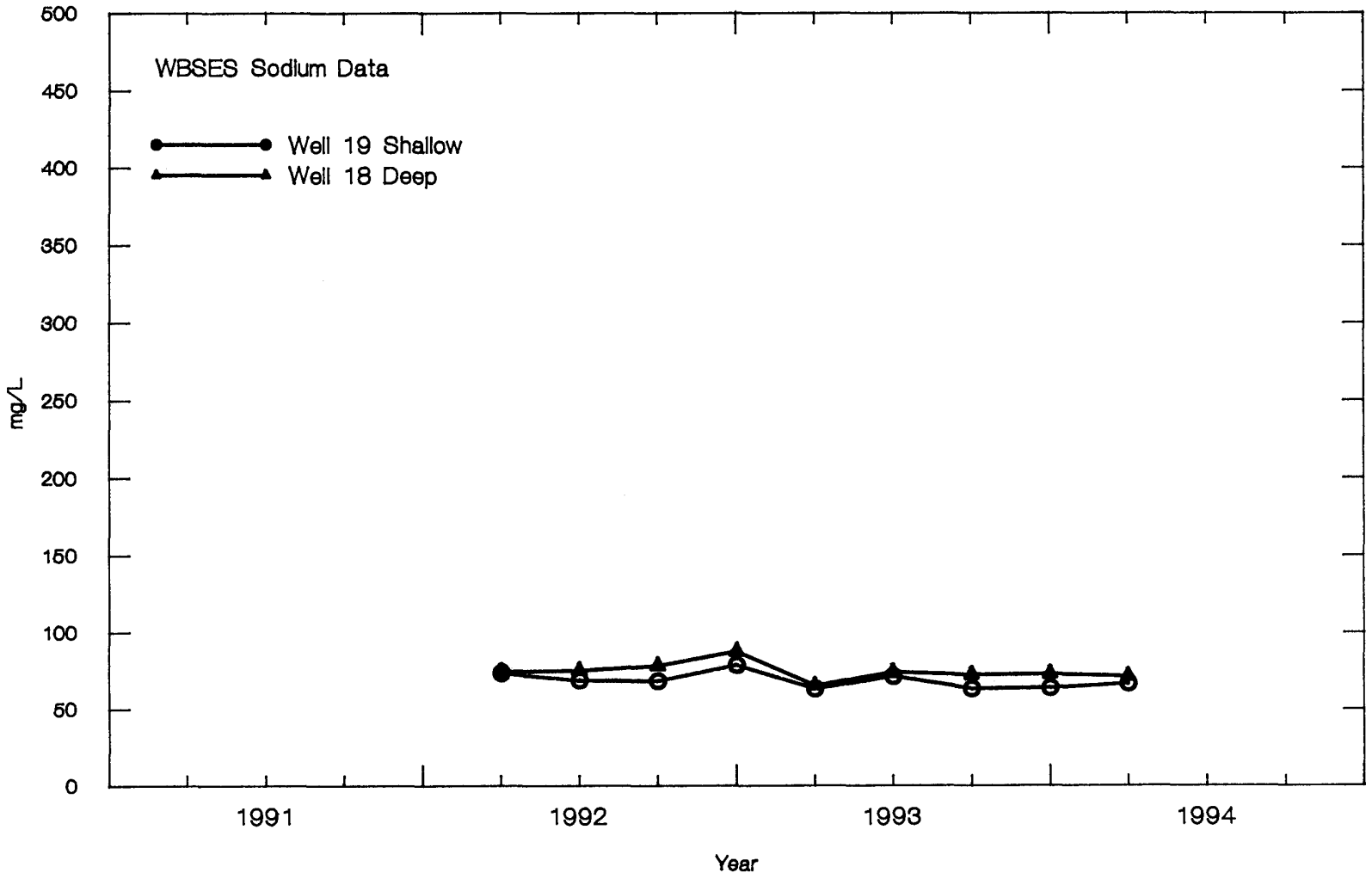

WBSES Sodium Data
Well 4 Shallow
Well 3 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

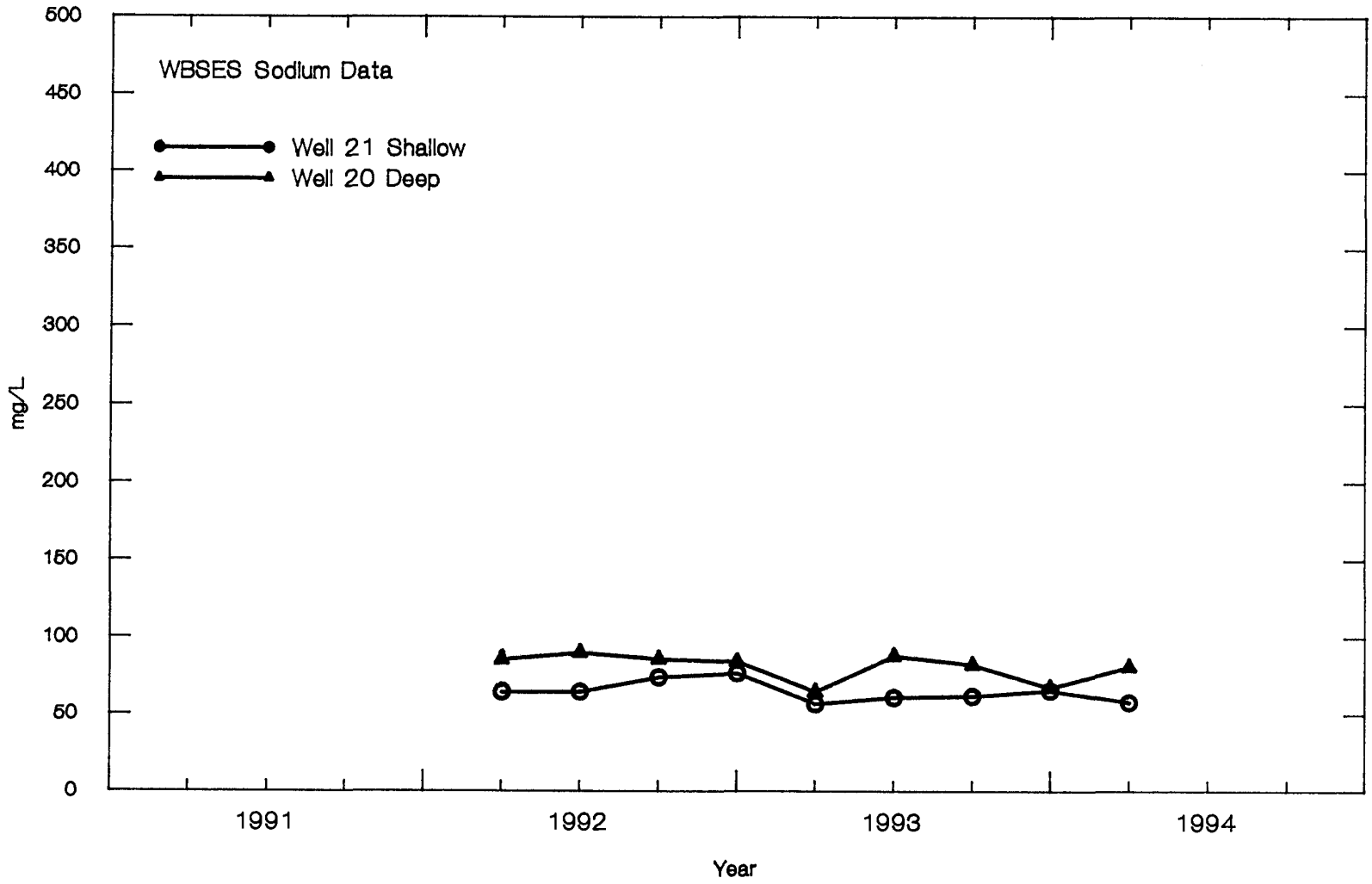

WBSES Sodium Data
Well 8 Shallow
Well 7 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

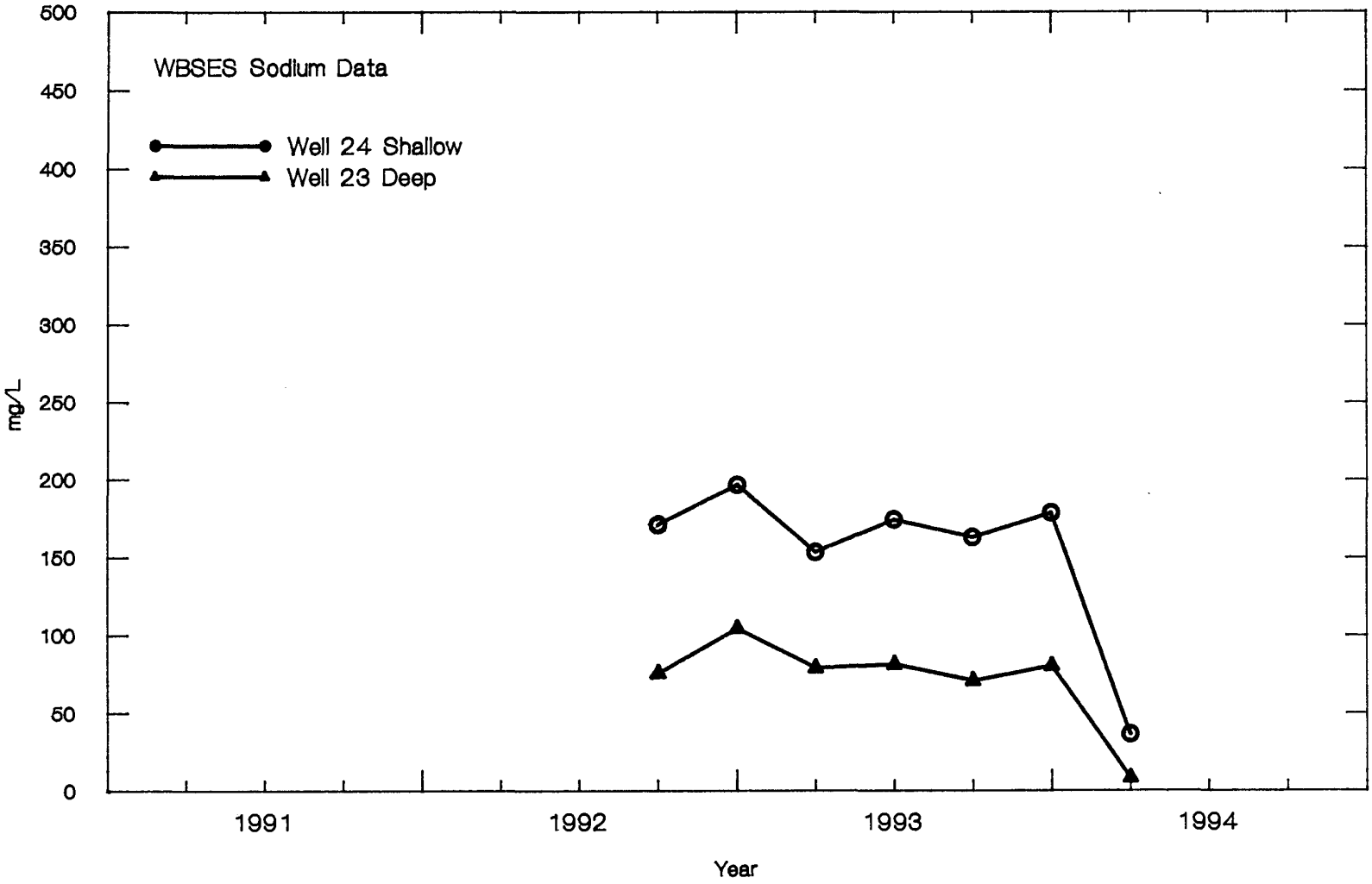

WBSES Sodium Data
Well 10 Shallow
Well 9 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

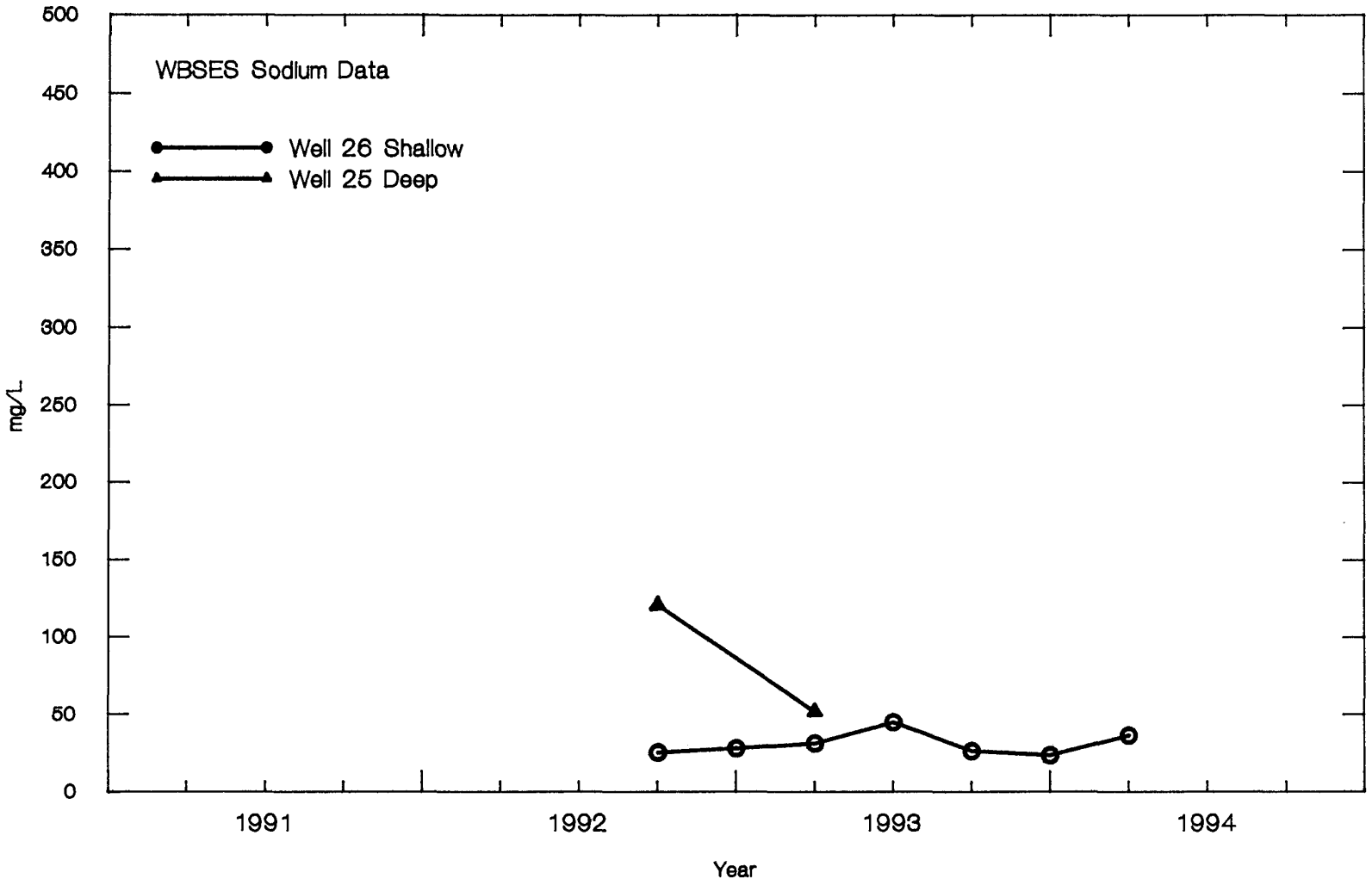

WBSES Sodium Data
Well 15 Shallow
Well 14 Deep
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450
400
350
300
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200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

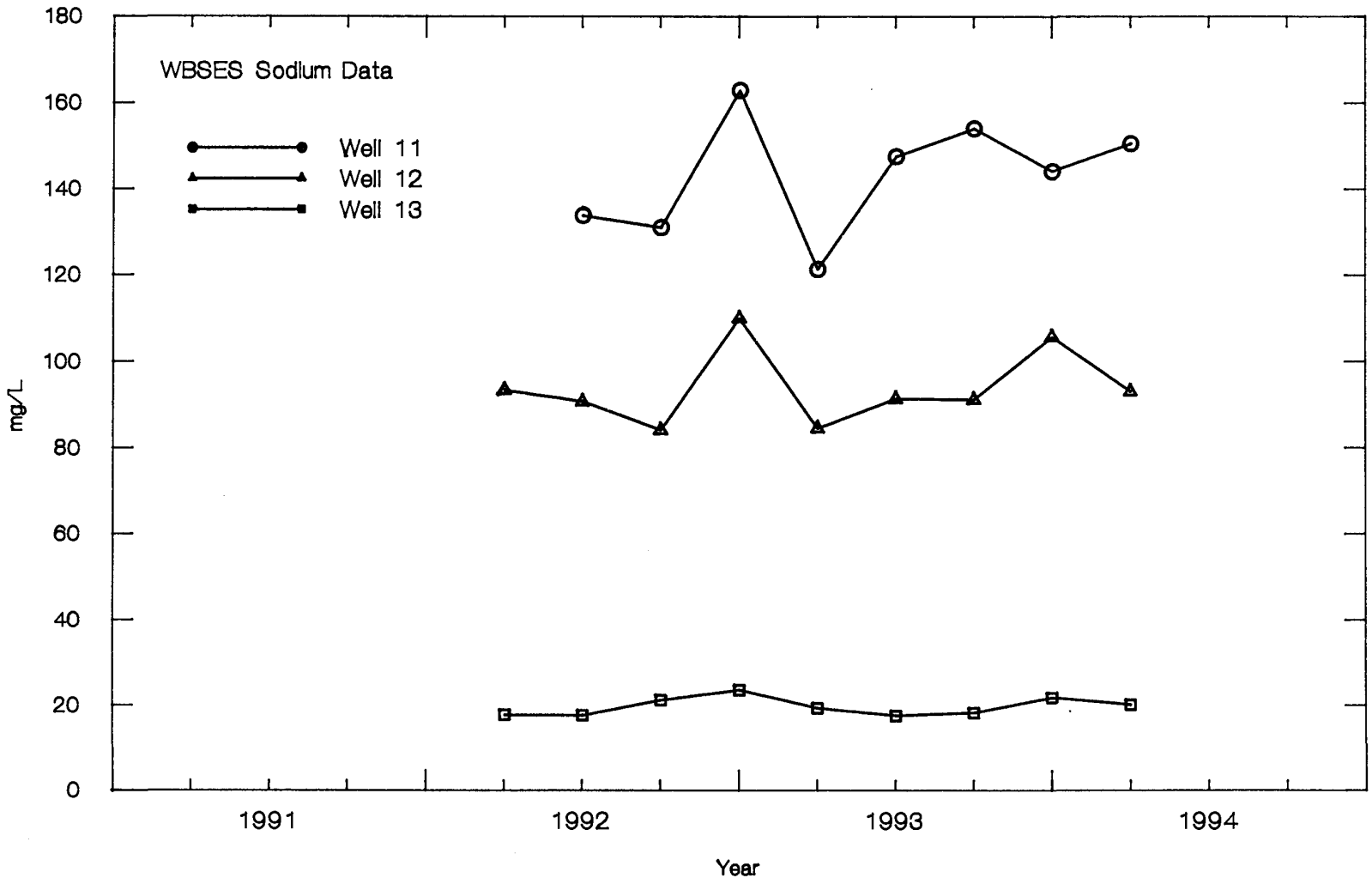

WBSES Sodium Data
Well 17 Shallow
Well 16 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year


WBSES Sodium Data
Well 19 Shallow
Well 18 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

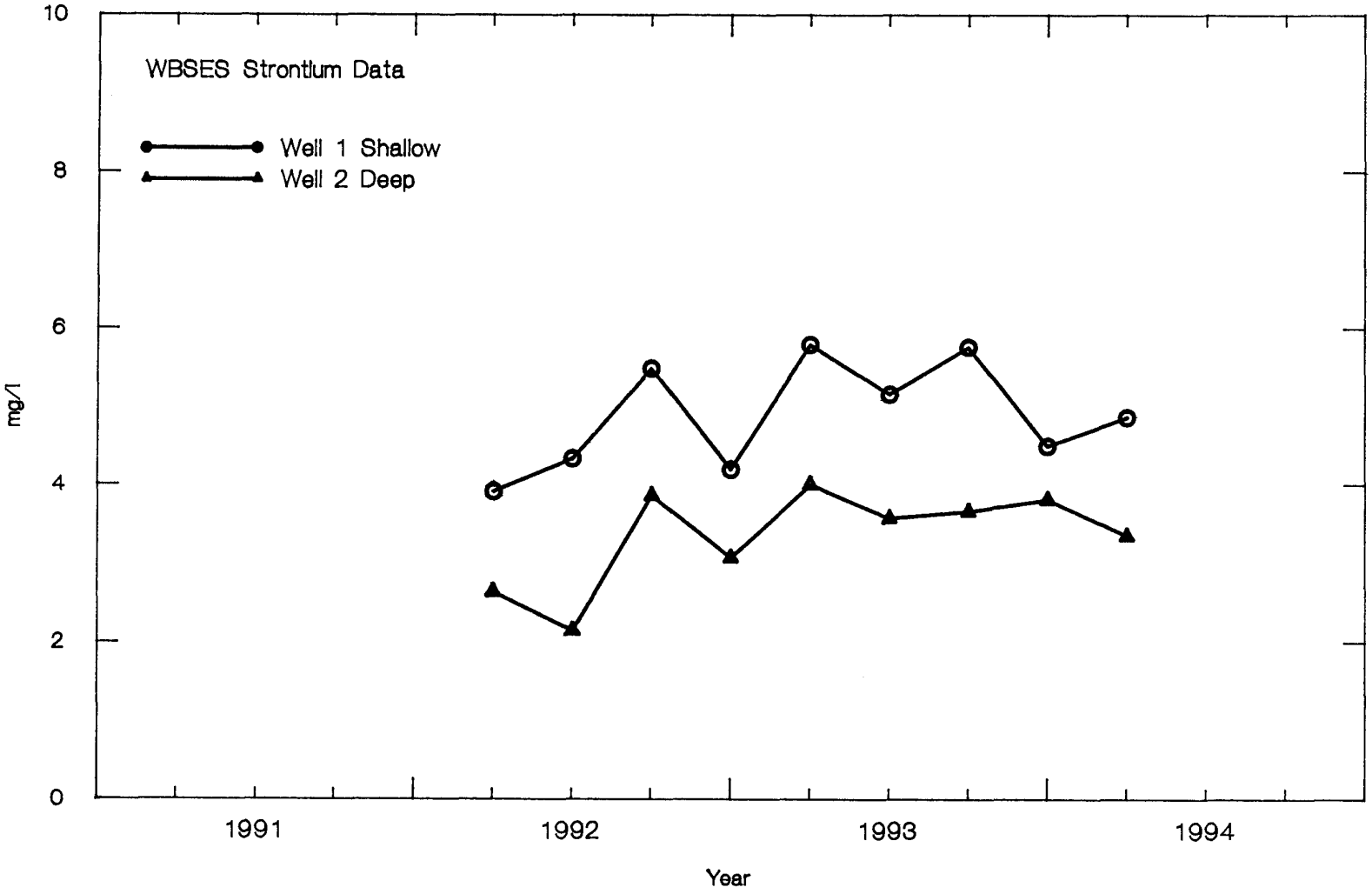

WBSES Sodium Data
Well 21 Shallow
Well 20 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

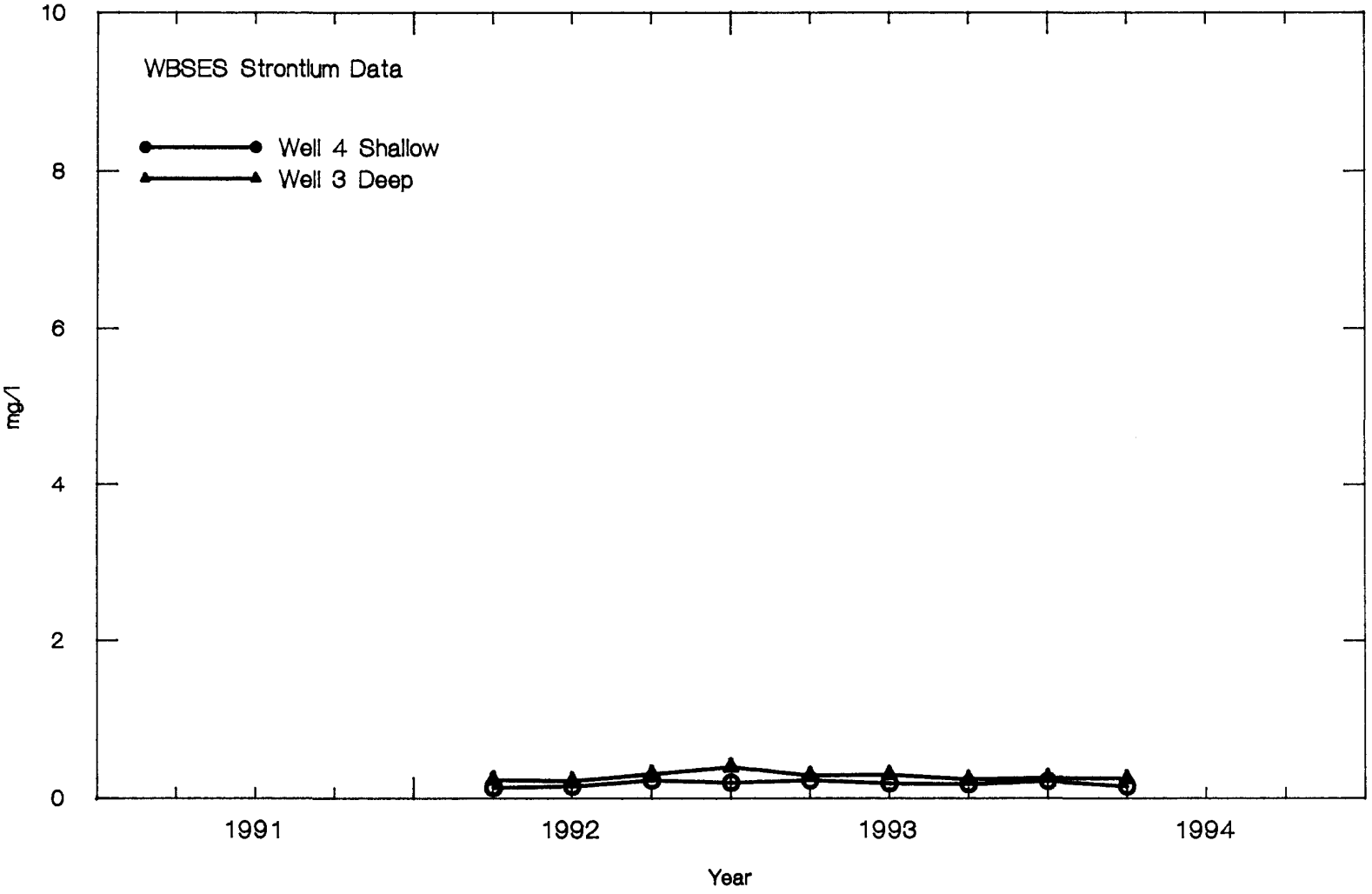

WBSES Sodium Data
Well 24 Shallow
Well 23 Deep
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450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

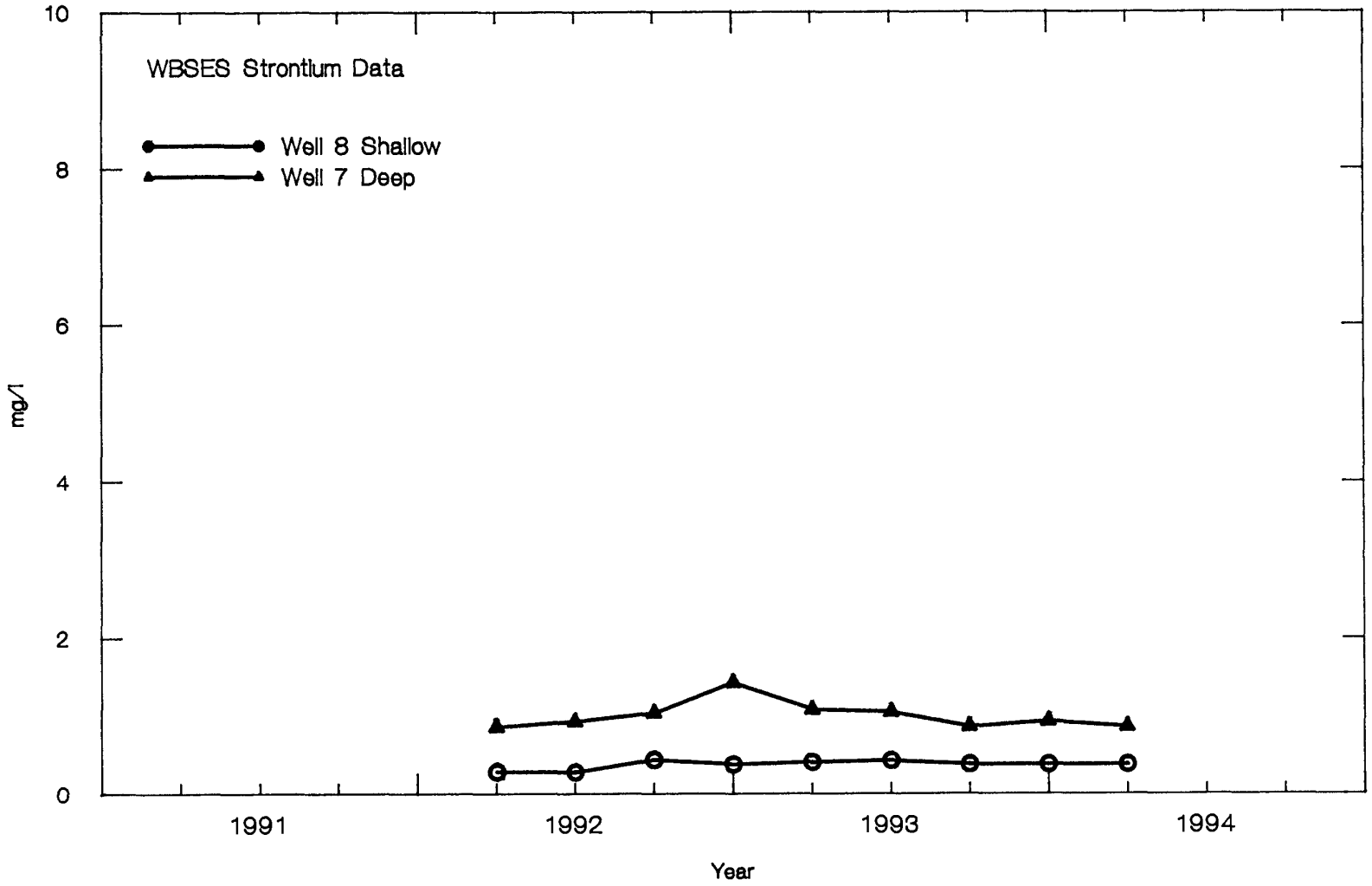

WBSES Sodium Data
Well 26 Shallow
Well 25 Deep
500
450
400
350
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year

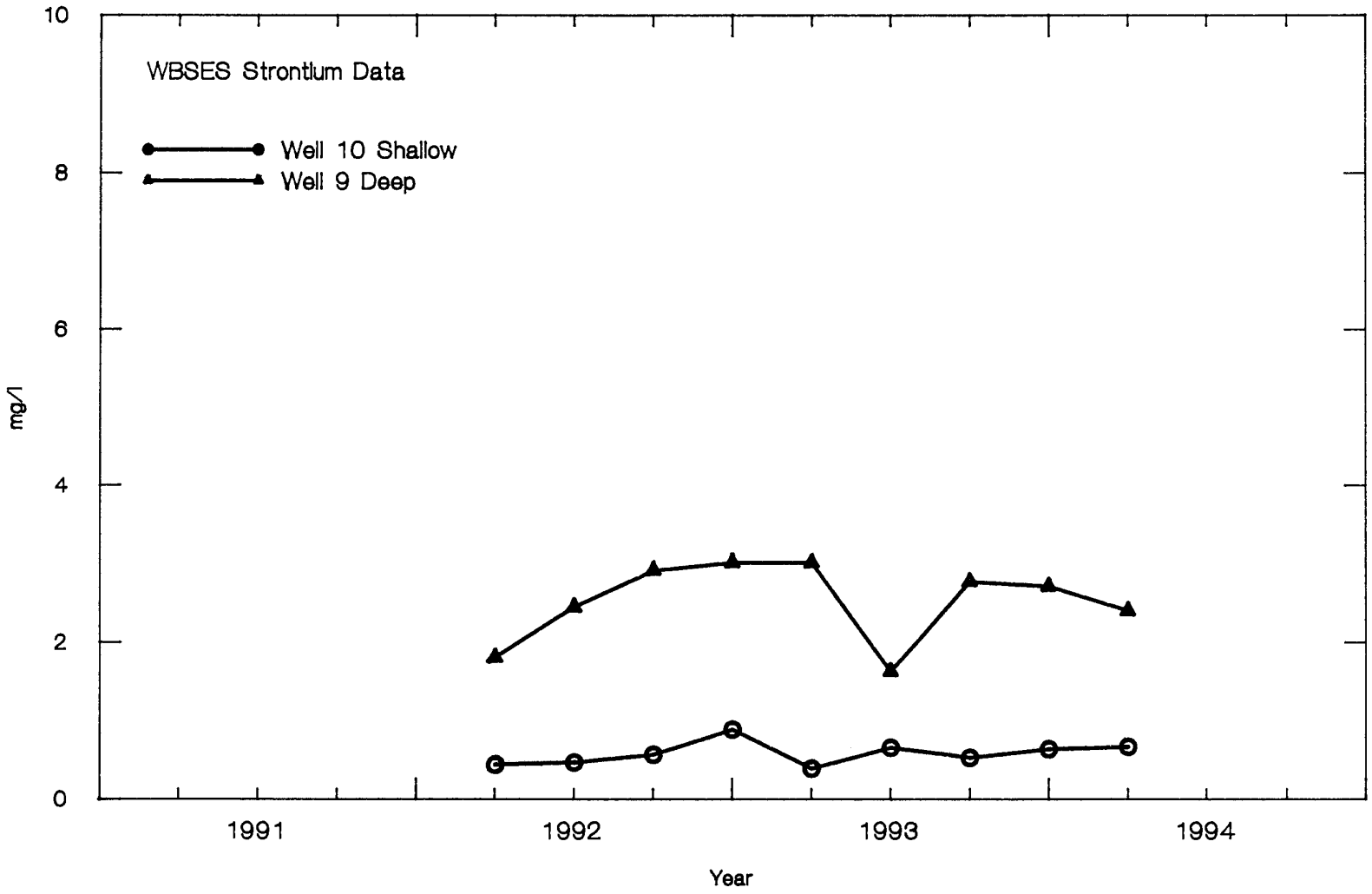


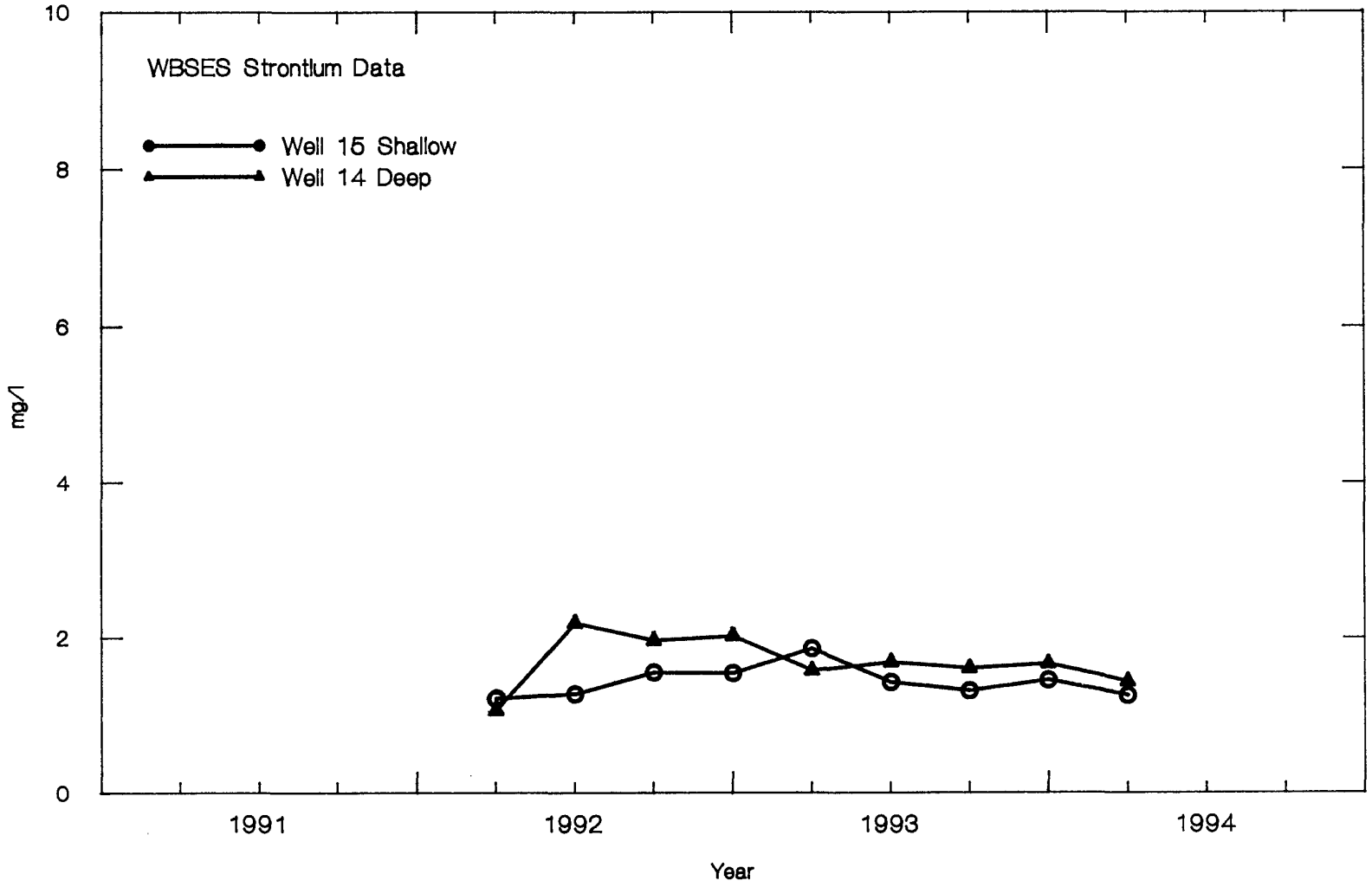
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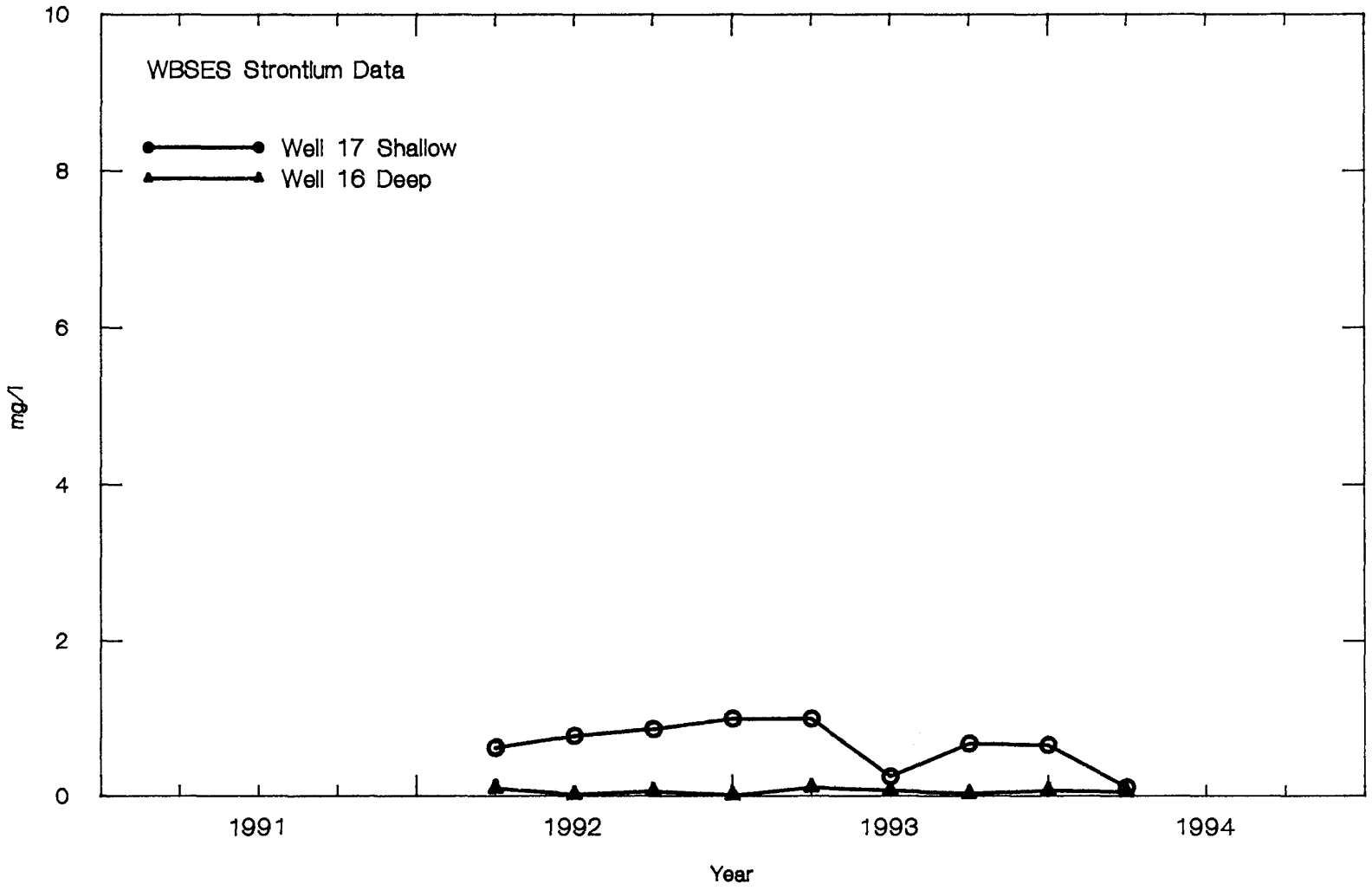

WBSES Strontium Data
Well 1 Shallow
Well 2 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

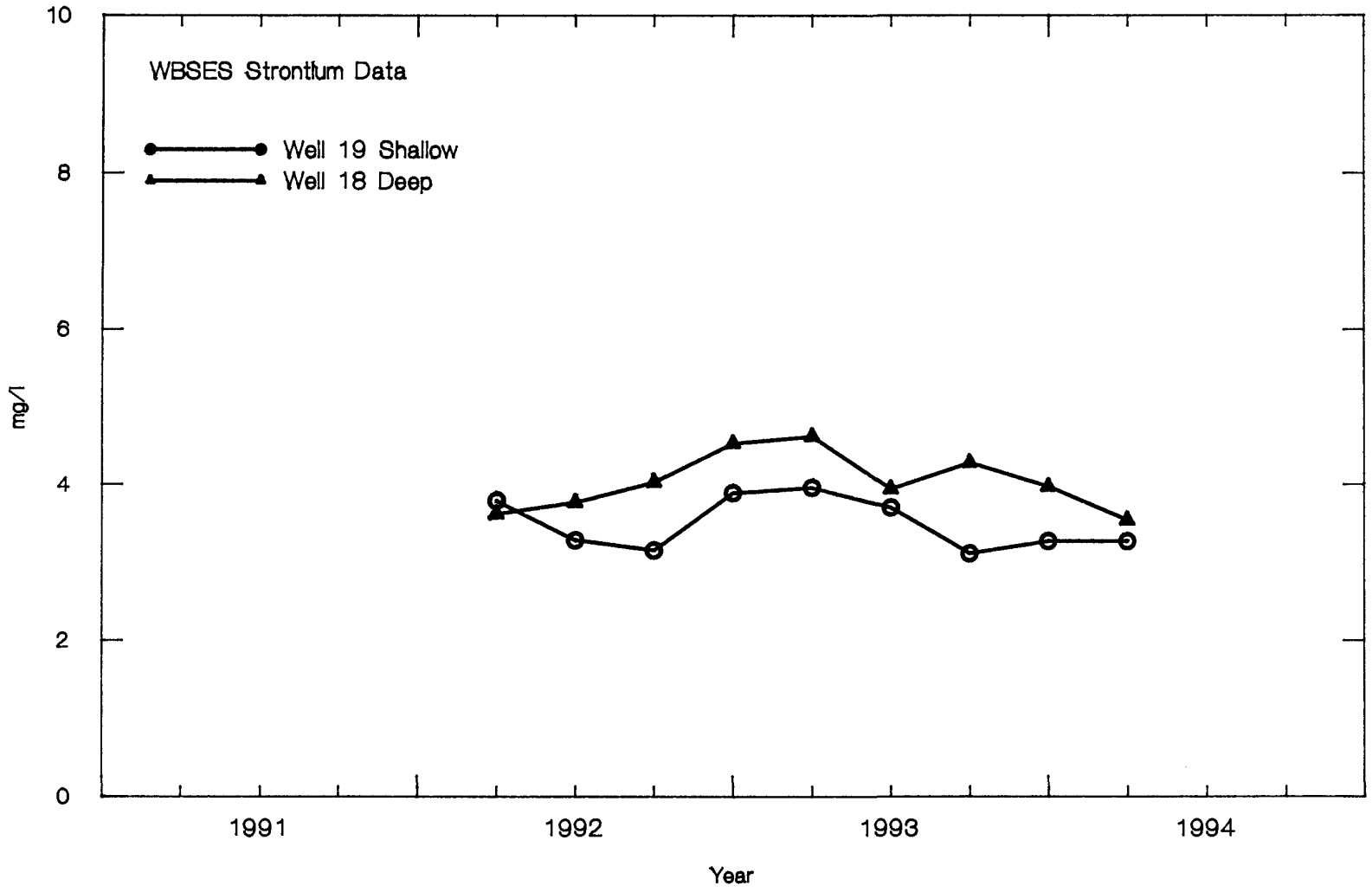

WBSES Strontium Data
Well 4 Shallow
Well 3 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

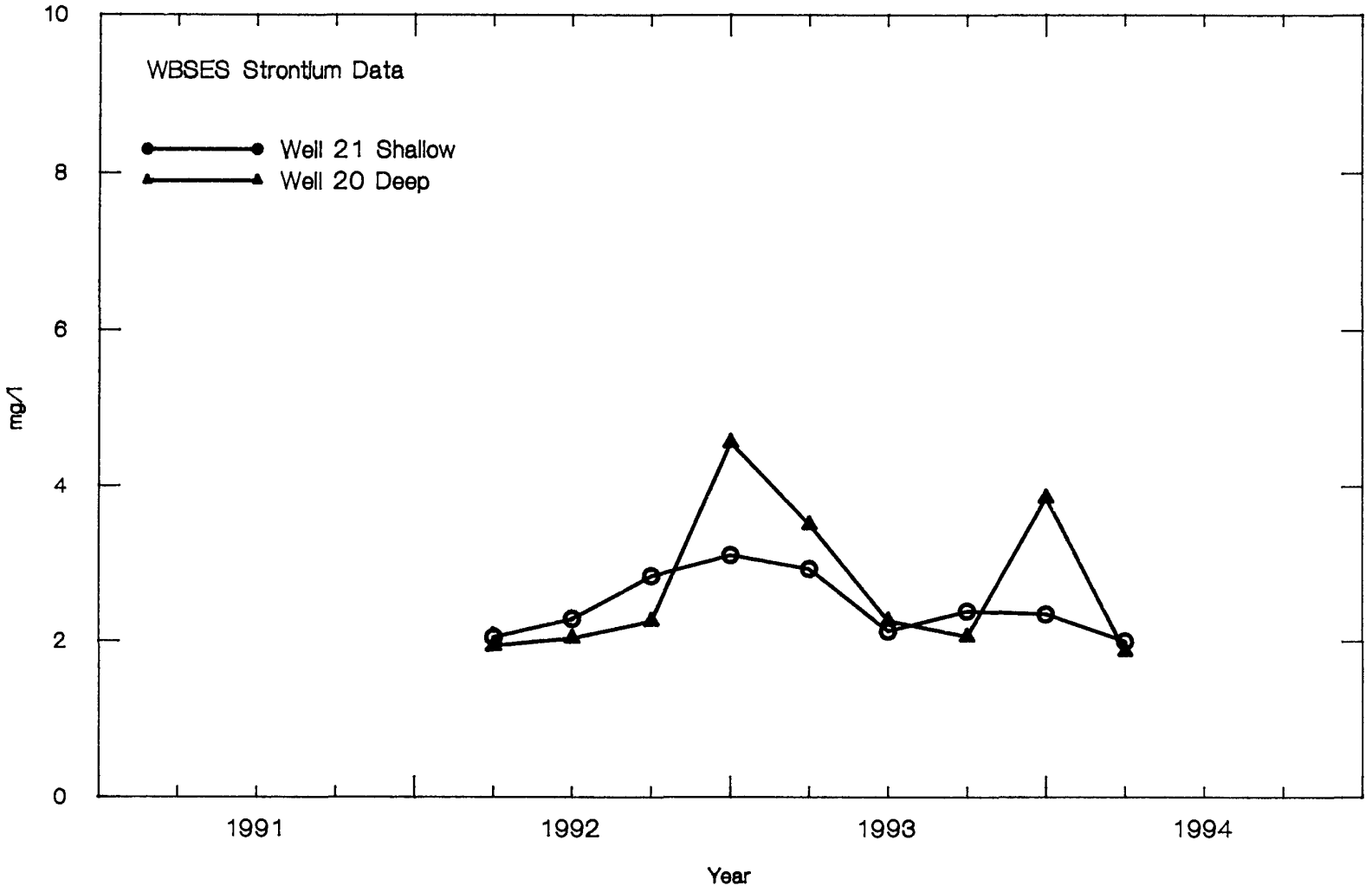

WBSES Strontium Data
Well 8 Shallow
Well 7 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

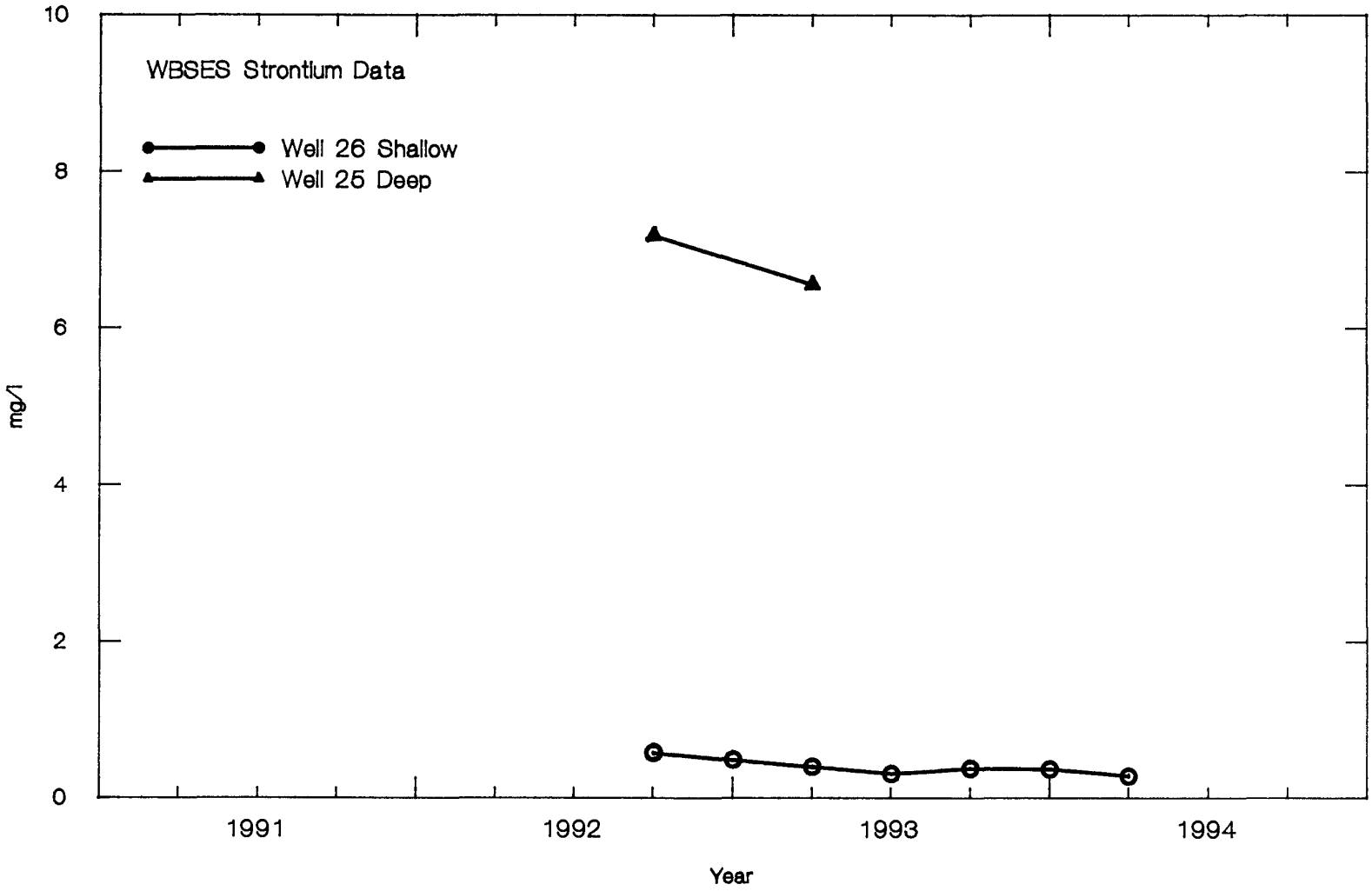

WBSES Strontium Data
Well 10 Shallow
Well 9 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

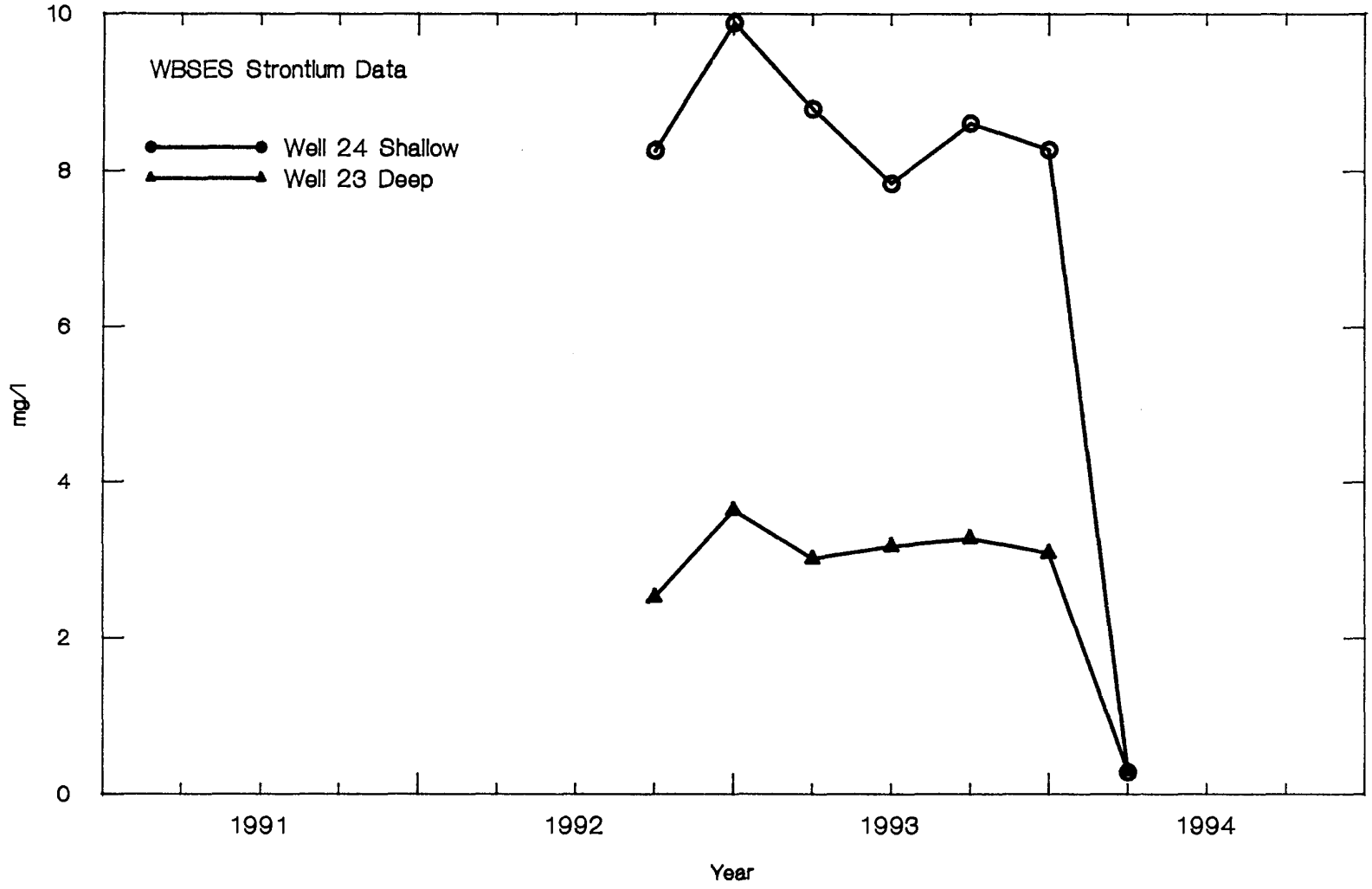

WBSES Strontium Data
Well 15 Shallow
Well 14 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

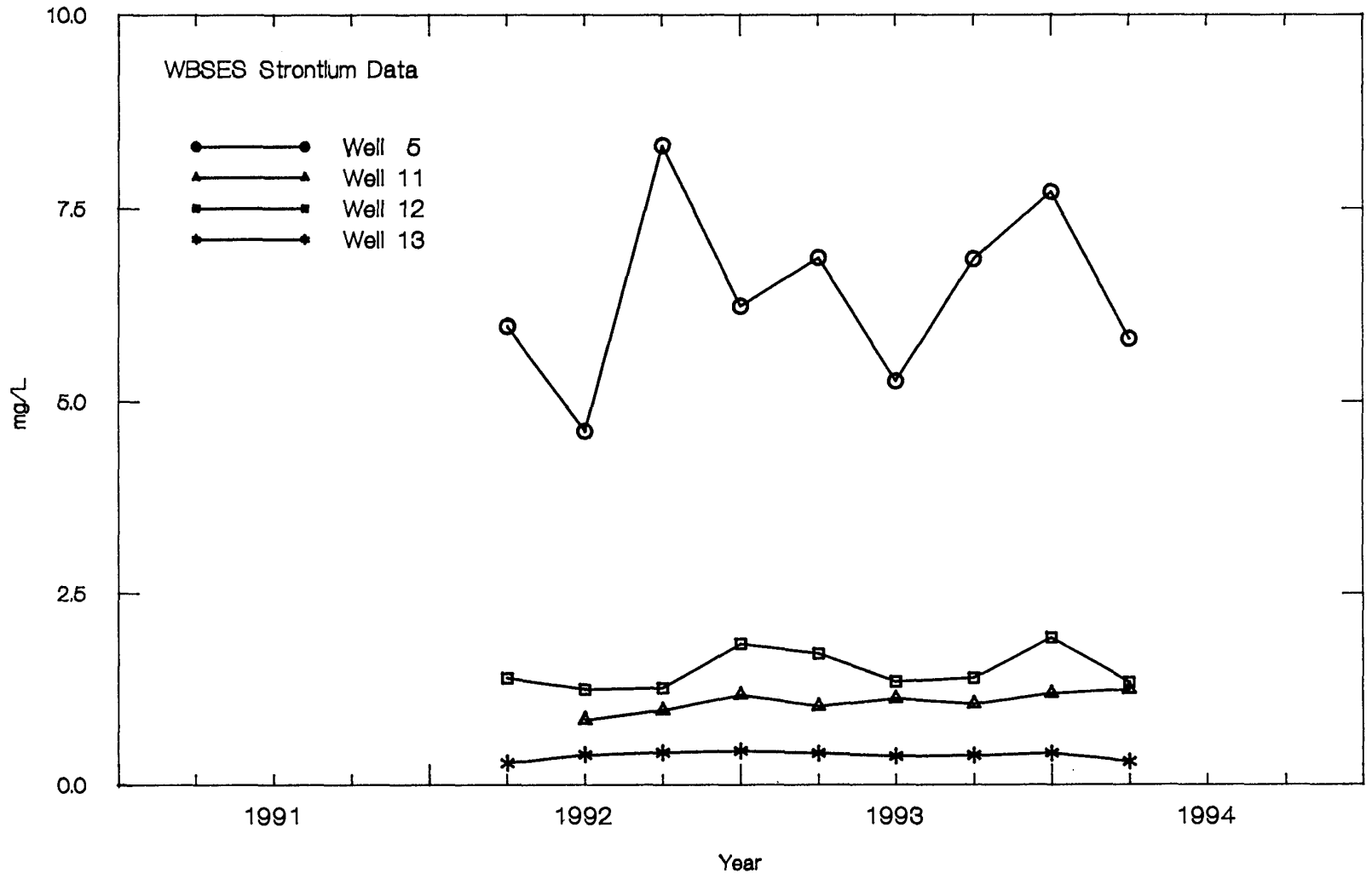

WBSES Strontium Data
Well 17 Shallow
Well 16 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year


WBSES Strontium Data
Well 19 Shallow
Well 18 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

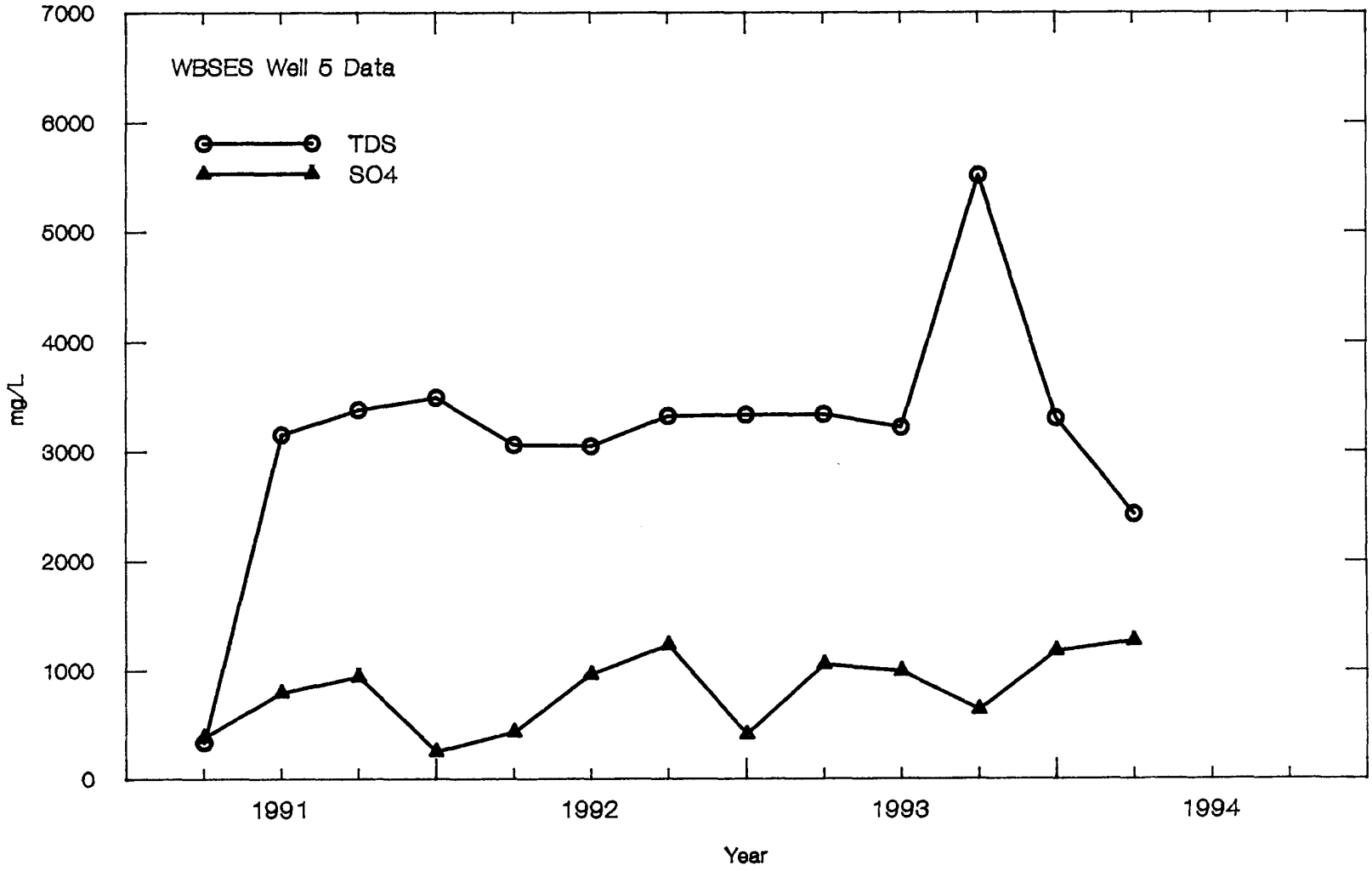

WBSES Strontium Data
Well 21 Shallow
Well 20 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

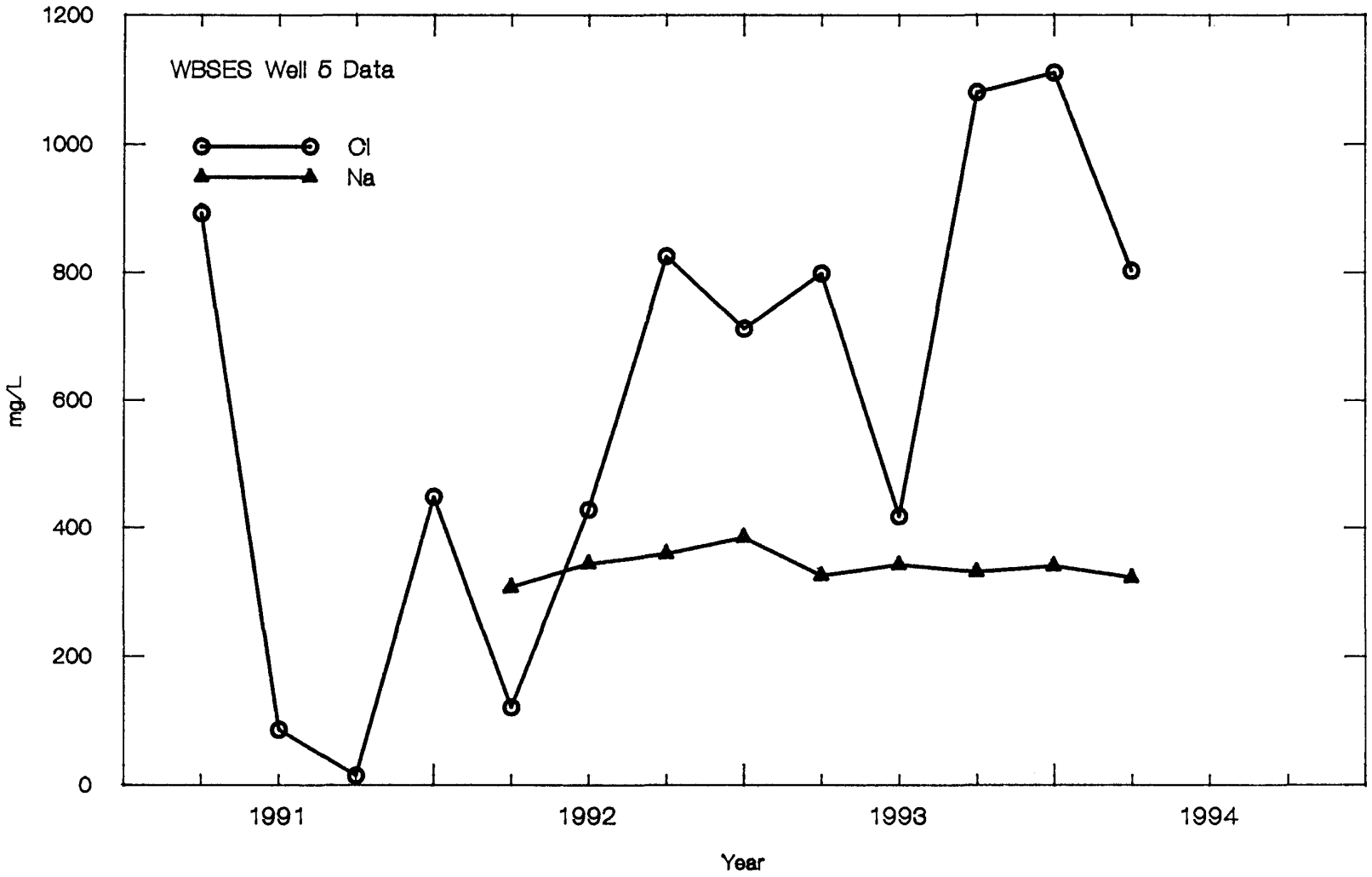

WBSES Strontium Data
Well 26 Shallow
Well 25 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

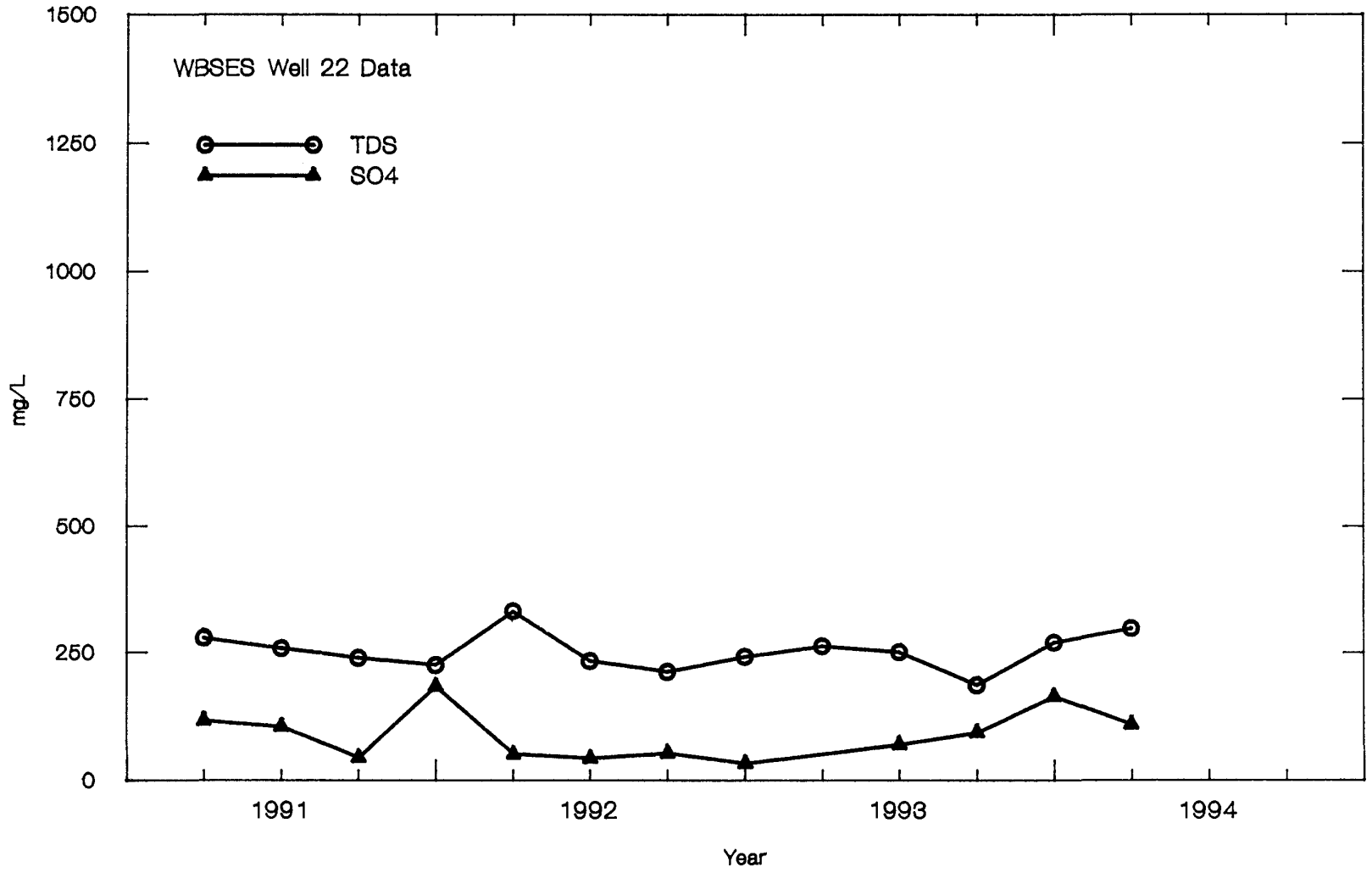

WBSES Strontium Data
Well 24 Shallow
Well 23 Deep
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

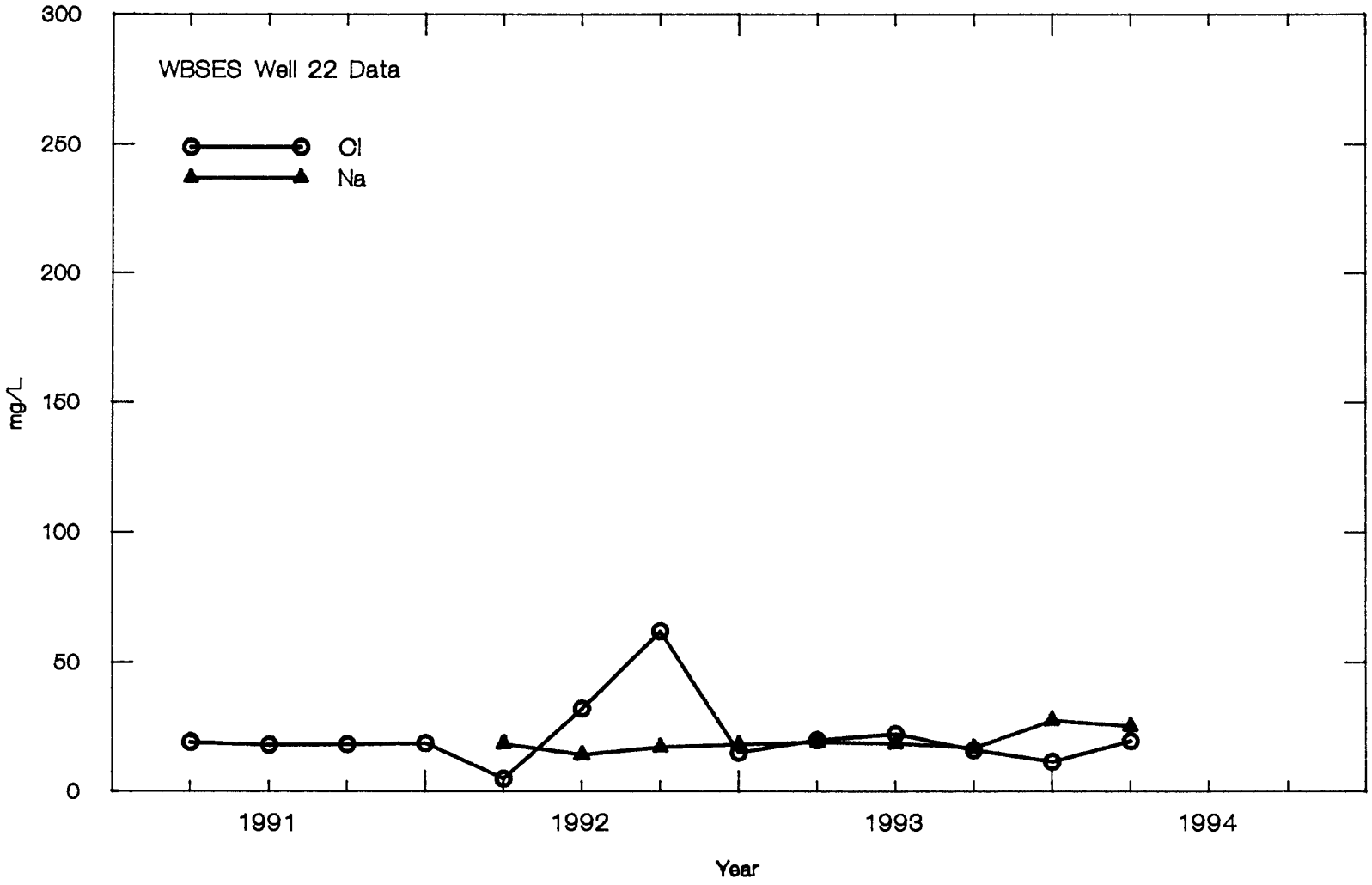


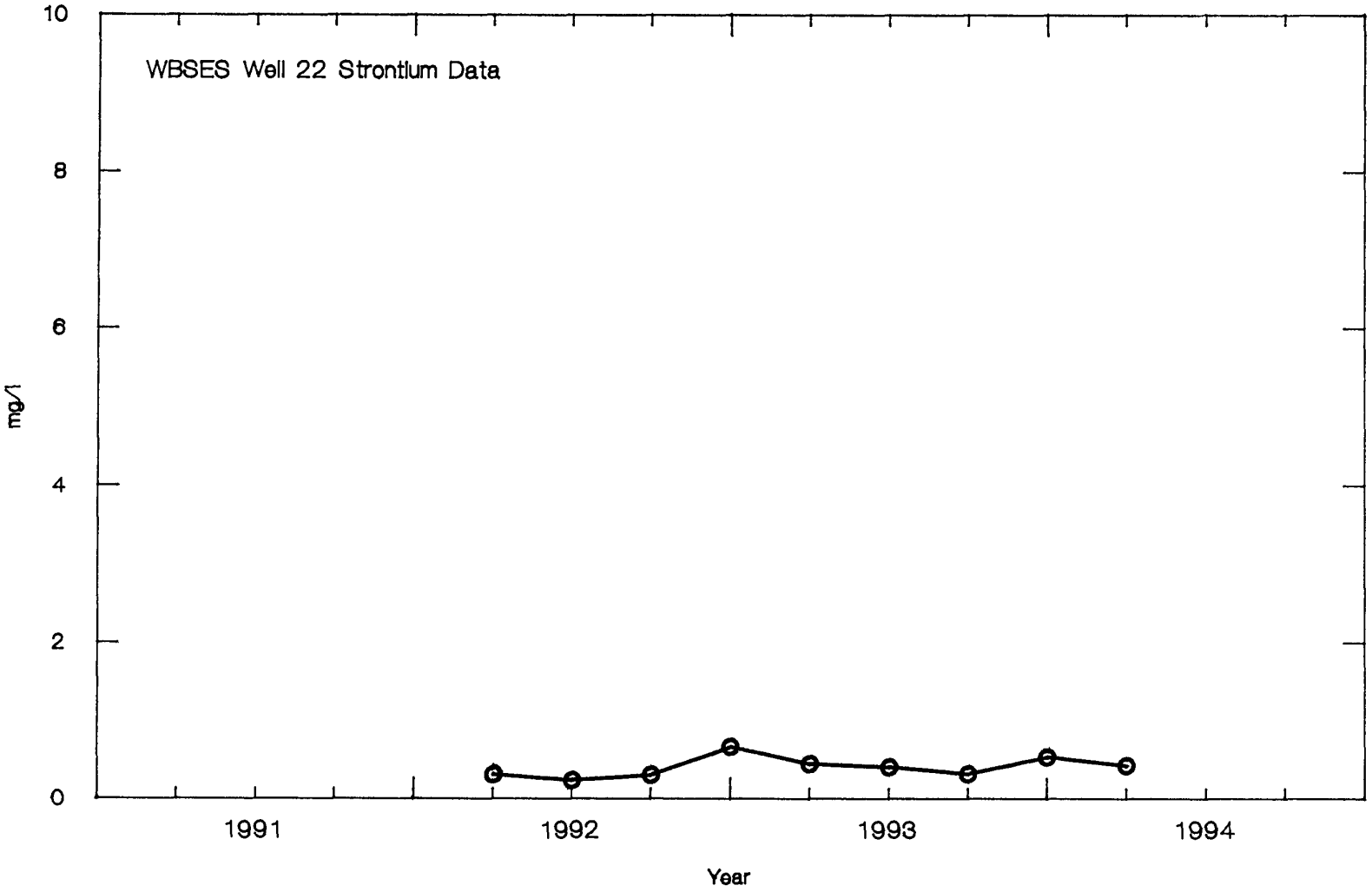
12:46 pm 3/08/95
WBLAB


WBSES Well 5 Data
TDS
SO4
7000
6000
5000
4000
3000
2000
1000
0
mg/L
1991
1992
1993
1994
Year


WBSES Well 5 Data
Cl
Na
1200
1000
800
600
400
200
0
mg/L
1991
1992
1993
1994
Year


WBSES Well 22 Data
TDS
SO4
1500
1250
1000
750
500
250
0
mg/L
1991
1992
1993
1994
Year


WBSES Well 22 Data
Cl
Na
300
250
200
150
100
50
0
mg/L
1991
1992
1993
1994
Year


WBSES Well 22 Strontium Data
10
8
6
4
2
0
mg/l
1991
1992
1993
1994
Year

APPENDIX H

Statistical Analyses

FRI 12/09/94 10:03:23 AM D:\NEWDATA\WBSES\WORKING\JUNK230.SYS

LEVELS ENCOUNTERED DURING PROCESSING ARE:

WELLNAM$

[illegible]L1	WELL10	WELL11	WELL12	WELL13	WELL15
17	WELL19	WELL21	WELL24	WELL26	WELL4
⌂5	WELL8				

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: TDS N: 171 MULTIPLE R: 0.947 SQUARED MULTIPLE R: 0.897

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	.176151E+09	13	.135501E+08	105.308	0.000
ERROR	.202014E+08	157	128671.464		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL1	2700.385	99.488	13
WELLNAM$	=WELL10	548.462	99.488	13
WELLNAM$	=WELL11	1102.357	95.869	14
WELLNAM$	=WELL12	980.308	99.488	13
WELLNAM$	=WELL13	343.692	99.488	13
[illegible]ELLNAM$	=WELL15	610.000	99.488	13
⌂LLNAM$	=WELL17	290.231	99.488	13
WELLNAM$	=WELL19	1411.308	99.488	13
WELLNAM$	=WELL21	1177.462	99.488	13
WELLNAM$	=WELL24	3571.429	135.579	7
WELLNAM$	=WELL26	280.571	135.579	7
WELLNAM$	=WELL4	221.923	99.488	13
WELLNAM$	=WELL5	3146.077	99.488	13
WELLNAM$	=WELL8	379.462	99.488	13

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LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL1	WELL10	WELL11	WELL12	WELL13	WELL15
WELL17	WELL19	WELL21	WELL24	WELL26	WELL4
L5	WELL8				

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: SO4 N: 171 MULTIPLE R: 0.874 SQUARED MULTIPLE R: 0.763

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	.342204E+08	13	2632337.947	38.930	0.000
ERROR	.106160E+08	157	67617.984		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL1	1112.777	72.121	13
WELLNAM$	=WELL10	206.892	72.121	13
WELLNAM$	=WELL11	621.036	69.497	14
WELLNAM$	=WELL12	595.792	72.121	13
WELLNAM$	=WELL13	88.862	72.121	13
WELLNAM$	=WELL15	317.331	72.121	13
LLNAM$	=WELL17	85.415	72.121	13
WELLNAM$	=WELL19	732.369	72.121	13
WELLNAM$	=WELL21	570.017	72.121	13
WELLNAM$	=WELL24	2019.257	98.284	7
WELLNAM$	=WELL26	23.071	98.284	7
WELLNAM$	=WELL4	124.869	72.121	13
WELLNAM$	=WELL5	809.977	72.121	13
WELLNAM$	=WELL8	167.338	72.121	13

LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL1	WELL10	WELL11	WELL12	WELL13	WELL15
WELL17	WELL19	WELL21	WELL24	WELL26	WELL4
L5	WELL8				

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: CL N: 171 MULTIPLE R: 0.842 SQUARED MULTIPLE R: 0.708

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	5218231.561	13	401402.428	29.343	0.000
ERROR	2147699.585	157	13679.615		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL1	441.908	32.439	13
WELLNAM$	=WELL10	44.205	32.439	13
WELLNAM$	=WELL11	36.514	31.259	14
WELLNAM$	=WELL12	60.864	32.439	13
WELLNAM$	=WELL13	62.923	32.439	13
WELLNAM$	=WELL15	25.568	32.439	13
LLNAM$	=WELL17	8.355	32.439	13
WELLNAM$	=WELL19	45.376	32.439	13
WELLNAM$	=WELL21	43.873	32.439	13
WELLNAM$	=WELL24	88.300	44.207	7
WELLNAM$	=WELL26	12.629	44.207	7
WELLNAM$	=WELL4	24.769	32.439	13
WELLNAM$	=WELL5	594.446	32.439	13
WELLNAM$	=WELL8	52.180	32.439	13

LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL1	WELL10	WELL11	WELL12	WELL13	WELL15
WELL17	WELL19	WELL21	WELL24	WELL26	WELL4
5	WELL8				

51 CASES DELETED DUE TO MISSING DATA.

DEP VAR: NATOT N: 122 MULTIPLE R: 0.986 SQUARED MULTIPLE R: 0.972

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	970781.864	13	74675.528	286.914	0.000
ERROR	28109.362	108	260.272		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL1	225.811	5.378	9
WELLNAM$	=WELL10	65.011	5.378	9
WELLNAM$	=WELL11	143.178	5.378	9
WELLNAM$	=WELL12	93.578	5.378	9
WELLNAM$	=WELL13	19.567	5.378	9
WELLNAM$	=WELL15	41.300	5.378	9
LLNAM$	=WELL17	36.667	5.378	9
WELLNAM$	=WELL19	68.578	5.378	9
WELLNAM$	=WELL21	64.711	5.378	9
WELLNAM$	=WELL24	153.414	6.098	7
WELLNAM$	=WELL26	30.686	6.098	7
WELLNAM$	=WELL4	21.756	5.378	9
WELLNAM$	=WELL5	338.989	5.378	9
WELLNAM$	=WELL8	38.567	5.378	9

LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL1	WELL10	WELL11	WELL12	WELL13	WELL15
WELL17	WELL19	WELL21	WELL24	WELL26	WELL4
L5	WELL8				

51 CASES DELETED DUE TO MISSING DATA.

DEP VAR: STTOT N: 122 MULTIPLE R: 0.940 SQUARED MULTIPLE R: 0.884

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	614.502	13	47.269	63.038	0.000
ERROR	80.984	108	0.750		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL1	4.884	0.289	9
WELLNAM$	=WELL10	0.584	0.289	9
WELLNAM$	=WELL11	1.088	0.289	9
WELLNAM$	=WELL12	1.491	0.289	9
WELLNAM$	=WELL13	0.378	0.289	9
WELLNAM$	=WELL15	1.429	0.289	9
LLNAM$	=WELL17	0.664	0.289	9
WELLNAM$	=WELL19	3.491	0.289	9
WELLNAM$	=WELL21	2.454	0.289	9
WELLNAM$	=WELL24	7.419	0.327	7
WELLNAM$	=WELL26	0.401	0.327	7
WELLNAM$	=WELL4	0.187	0.289	9
WELLNAM$	=WELL5	6.400	0.289	9
WELLNAM$	=WELL8	0.374	0.289	9

LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL1	WELL10	WELL11	WELL12	WELL13	WELL15
WELL17	WELL19	WELL21	WELL24	WELL26	WELL4
WELL5	WELL8				

51 CASES DELETED DUE TO MISSING DATA.

DEP VAR: PH N: 119 MULTIPLE R: 0.940 SQUARED MULTIPLE R: 0.883

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	178.361	13	13.720	61.124	0.000
ERROR	23.568	105	0.224		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL1	3.709	0.158	9
WELLNAM$	=WELL10	4.313	0.158	9
WELLNAM$	=WELL11	4.108	0.150	10
WELLNAM$	=WELL12	3.687	0.158	9
WELLNAM$	=WELL13	3.678	0.158	9
WELLNAM$	=WELL15	5.844	0.158	9
WELLNAM$	=WELL17	6.599	0.168	8
WELLNAM$	=WELL19	4.223	0.168	8
WELLNAM$	=WELL21	3.970	0.168	8
WELLNAM$	=WELL24	6.981	0.179	7
WELLNAM$	=WELL26	7.554	0.179	7
WELLNAM$	=WELL4	4.393	0.158	9
WELLNAM$	=WELL5	4.048	0.168	8
WELLNAM$	=WELL8	4.268	0.158	9

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LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL0	WELL1	WELL10	WELL11	WELL12	WELL13
L15	WELL17	WELL19	WELL21	WELL4	WELL5
L8					

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: TDS N: 171 MULTIPLE R: 0.839 SQUARED MULTIPLE R: 0.704

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	.138247E+09	12	.115206E+08	31.327	0.000
ERROR	.581055E+08	158	367756.408		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL0	1926.000	162.075	14
WELLNAM$	=WELL1	2700.385	168.193	13
WELLNAM$	=WELL10	548.462	168.193	13
WELLNAM$	=WELL11	1102.357	162.075	14
WELLNAM$	=WELL12	980.308	168.193	13
WELLNAM$	=WELL13	343.692	168.193	13
WELLNAM$	=WELL15	610.000	168.193	13
WELLNAM$	=WELL17	290.231	168.193	13
WELLNAM$	=WELL19	1411.308	168.193	13
WELLNAM$	=WELL21	1177.462	168.193	13
WELLNAM$	=WELL4	221.923	168.193	13
WELLNAM$	=WELL5	3146.077	168.193	13
WELLNAM$	=WELL8	379.462	168.193	13

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COL/
ROW WELLNAM$

	WELL0
	WELL1
3	WELL10
4	WELL11
5	WELL12
6	WELL13
7	WELL15
8	WELL17
9	WELL19
10	WELL21
11	WELL4
12	WELL5
13	WELL8

USING LEAST SQUARES MEANS.

POST HOC TEST OF TDS

USING MSE OF 128671.460 WITH 157. DF.
MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	774.385	0.000			
3	-1377.538	-2151.923	0.000		
4	-823.643	-1598.027	553.896	0.000	
5	-945.692	-1720.077	431.846	-122.049	0.000
6	-1582.308	-2356.692	-204.769	-758.665	-636.615
7	-1316.000	-2090.385	61.538	-492.357	-370.308
8	-1635.769	-2410.154	-258.231	-812.126	-690.077
9	-514.692	-1289.077	862.846	308.951	431.000
10	-748.538	-1522.923	629.000	75.104	197.154
11	-1704.077	-2478.462	-326.538	-880.434	-758.385
12	1220.077	445.692	2597.615	2043.720	2165.769
13	-1546.538	-2320.923	-169.000	-722.896	-600.846

	6	7	8	9	10
6	0.000				
7	266.308	0.000			
8	-53.462	-319.769	0.000		
9	1067.615	801.308	1121.077	0.000	
10	833.769	567.462	887.231	-233.846	0.000
11	-121.769	-388.077	-68.308	-1189.385	-955.538
12	2802.385	2536.077	2855.846	1734.769	1968.615
13	35.769	-230.538	89.231	-1031.846	-798.000

	11	12	13
11	0.000		
12	2924.154	0.000	
13	157.538	-2766.615	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.003	1.000			
3	0.000	0.000	1.000		
4	0.001	0.000	0.201	1.000	
5	0.000	0.000	0.665	1.000	1.000
6	0.000	0.000	0.999	0.005	0.070
7	0.000	0.000	1.000	0.399	0.858
8	0.000	0.000	0.992	0.001	0.027
9	0.319	0.000	0.001	0.955	0.668
10	0.006	0.000	0.079	1.000	0.999
11	0.000	0.000	0.941	0.000	0.007
12	0.000	0.613	0.000	0.000	0.000
13	0.000	0.000	1.000	0.011	0.122

	6	7	8	9	10
6	1.000				
7	0.989	1.000			
8	1.000	0.949	1.000		
9	0.000	0.002	0.000	1.000	
10	0.001	0.193	0.000	0.997	1.000
11	1.000	0.811	1.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000
13	1.000	0.997	1.000	0.000	0.003

	11	12	13
11	1.000		
12	0.000	1.000	
13	1.000	0.000	1.000

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LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

0	WELL1	WELL10	WELL11	WELL12	WELL13
WELL15	WELL17	WELL19	WELL21	WELL4	WELL5
WELL8					

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: SO4 N: 171 MULTIPLE R: 0.672 SQUARED MULTIPLE R: 0.452

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	.202737E+08	12	1689478.532	10.868	0.000
ERROR	.245627E+08	158	155459.964		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL0	1021.164	105.377	14
WELLNAM$	=WELL1	1112.777	109.355	13
WELLNAM$	=WELL10	206.892	109.355	13
WELLNAM$	=WELL11	621.036	105.377	14
WELLNAM$	=WELL12	595.792	109.355	13
WELLNAM$	=WELL13	88.862	109.355	13
WELLNAM$	=WELL15	317.331	109.355	13
WELLNAM$	=WELL17	85.415	109.355	13
WELLNAM$	=WELL19	732.369	109.355	13
WELLNAM$	=WELL21	570.017	109.355	13
WELLNAM$	=WELL4	124.869	109.355	13
WELLNAM$	=WELL5	809.977	109.355	13
WELLNAM$	=WELL8	167.338	109.355	13

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COL/

ROW WELLNAM$

1 WELL0
WELL1
WELL10
4 WELL11
5 WELL12
6 WELL13
7 WELL15
8 WELL17
9 WELL19
10 WELL21
11 WELL4
12 WELL5
13 WELL8

USING LEAST SQUARES MEANS.

POST HOC TEST OF SO4

USING MSE OF 67617.984 WITH 157. DF.
MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	91.613	0.000			
3	-814.272	-905.885	0.000		
4	-400.129	-491.741	414.143	0.000	
5	-425.372	-516.985	388.900	-25.243	0.000
6	-932.303	-1023.915	-118.031	-532.174	-506.931
7	-703.834	-795.446	110.438	-303.705	-278.462
8	-935.749	-1027.362	-121.477	-535.620	-510.377
9	-288.795	-380.408	525.477	111.334	136.577
10	-451.147	-542.760	363.125	-51.019	-25.775
11	-896.295	-987.908	-82.023	-496.166	-470.923
12	-211.187	-302.800	603.085	188.941	214.185
13	-853.826	-945.438	-39.554	-453.697	-428.454

	6	7	8	9	10
6	0.000				
7	228.469	0.000			
8	-3.446	-231.915	0.000		
9	643.508	415.038	646.954	0.000	
10	481.155	252.686	484.602	-162.352	0.000
11	36.008	-192.462	39.454	-607.500	-445.148
12	721.115	492.646	724.562	77.608	239.960
13	78.477	-149.992	81.923	-565.031	-402.678

	11	12	13
11	0.000		
12	685.108	0.000	
13	42.469	-642.638	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	1.000	1.000			
3	0.000	0.000	1.000		
4	0.180	0.027	0.160	1.000	
5	0.128	0.017	0.279	1.000	1.000
6	0.000	0.000	1.000	0.008	0.023
7	0.000	0.000	1.000	0.684	0.822
8	0.000	0.000	1.000	0.007	0.021
9	0.757	0.317	0.014	1.000	1.000
10	0.073	0.008	0.401	1.000	1.000
11	0.000	0.000	1.000	0.024	0.056
12	0.972	0.716	0.001	0.989	0.973
13	0.000	0.000	1.000	0.069	0.141

	6	7	8	9	10
6	1.000				
7	0.955	1.000			
8	1.000	0.949	1.000		
9	0.000	0.181	0.000	1.000	
10	0.044	0.905	0.040	0.998	1.000
11	1.000	0.989	1.000	0.001	0.100
12	0.000	0.033	0.000	1.000	0.934
13	1.000	0.999	1.000	0.004	0.224

	11	12	13
11	1.000		
12	0.000	1.000	
13	1.000	0.000	1.000

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LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL0	WELL1	WELL10	WELL11	WELL12	WELL13
L15	WELL17	WELL19	WELL21	WELL4	WELL5
L8					

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: CL N: 171 MULTIPLE R: 0.840 SQUARED MULTIPLE R: 0.706

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	5198189.984	12	433182.499	31.573	0.000
ERROR	2167741.163	158	13719.881		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL0	50.464	31.305	14
WELLNAM$	=WELL1	441.908	32.487	13
WELLNAM$	=WELL10	44.205	32.487	13
WELLNAM$	=WELL11	36.514	31.305	14
WELLNAM$	=WELL12	60.864	32.487	13
WELLNAM$	=WELL13	62.923	32.487	13
WELLNAM$	=WELL15	25.568	32.487	13
ELLNAM$	=WELL17	8.355	32.487	13
WELLNAM$	=WELL19	45.376	32.487	13
WELLNAM$	=WELL21	43.873	32.487	13
WELLNAM$	=WELL4	24.769	32.487	13
WELLNAM$	=WELL5	594.446	32.487	13
WELLNAM$	=WELL8	52.180	32.487	13

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COL/

ROW WELLNAM$

	WELL0
	WELL1
3	WELL10
4	WELL11
5	WELL12
6	WELL13
7	WELL15
8	WELL17
9	WELL19
10	WELL21
11	WELL4
12	WELL5
13	WELL8

USING LEAST SQUARES MEANS.

POST HOC TEST OF CL

USING MSE OF 13679.615 WITH 157. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	391.443	0.000			
3	-6.260	-397.703	0.000		
4	-13.951	-405.394	-7.691	0.000	
5	10.400	-381.044	16.659	24.350	0.000
6	12.459	-378.985	18.718	26.410	2.059
7	-24.896	-416.339	-18.636	-10.945	-35.295
8	-42.110	-433.553	-35.850	-28.159	-52.509
9	-5.088	-396.532	1.172	8.863	-15.488
10	-6.591	-398.035	-0.332	7.360	-16.991
11	-25.695	-417.138	-19.435	-11.744	-36.095
12	543.982	152.538	550.242	557.933	533.582
13	1.716	-389.728	7.975	15.666	-8.684

	6	7	8	9	10
6	0.000				
7	-37.355	0.000			
8	-54.568	-17.214	0.000		
9	-17.547	19.808	37.022	0.000	
10	-19.050	18.305	35.518	-1.503	0.000
11	-38.154	-0.799	16.415	-20.607	-19.104
12	531.523	568.878	586.092	549.070	550.573
13	-10.743	26.612	43.825	6.804	8.307

	11	12	13
11	0.000		
12	569.677	0.000	
13	27.411	-542.266	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	1.000	0.000	1.000		
4	1.000	0.000	1.000	1.000	
5	1.000	0.000	1.000	1.000	1.000
6	1.000	0.000	1.000	1.000	1.000
7	1.000	0.000	1.000	1.000	1.000
8	1.000	0.000	1.000	1.000	1.000
9	1.000	0.000	1.000	1.000	1.000
10	1.000	0.000	1.000	1.000	1.000
11	1.000	0.000	1.000	1.000	1.000
12	0.000	0.527	0.000	0.000	0.000
13	1.000	0.000	1.000	1.000	1.000

	6	7	8	9	10
6	1.000				
7	1.000	1.000			
8	1.000	1.000	1.000		
9	1.000	1.000	1.000	1.000	
10	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000
12	0.000	0.000	0.000	0.000	0.000
13	1.000	1.000	1.000	1.000	1.000

	11	12	13
11	1.000		
12	0.000	1.000	
13	1.000	0.000	1.000

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LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL0	WELL1	WELL10	WELL11	WELL12	WELL13
L15	WELL17	WELL19	WELL21	WELL4	WELL5
L8					

51 CASES DELETED DUE TO MISSING DATA.

DEP VAR: NATOT N: 122 MULTIPLE R: 0.959 SQUARED MULTIPLE R: 0.919

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	918063.806	12	76505.317	103.171	0.000
ERROR	80827.419	109	741.536		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL0	92.050	7.278	14
WELLNAM$	=WELL1	225.811	9.077	9
WELLNAM$	=WELL10	65.011	9.077	9
WELLNAM$	=WELL11	143.178	9.077	9
WELLNAM$	=WELL12	93.578	9.077	9
WELLNAM$	=WELL13	19.567	9.077	9
WELLNAM$	=WELL15	41.300	9.077	9
WELLNAM$	=WELL17	36.667	9.077	9
WELLNAM$	=WELL19	68.578	9.077	9
WELLNAM$	=WELL21	64.711	9.077	9
WELLNAM$	=WELL4	21.756	9.077	9
WELLNAM$	=WELL5	338.989	9.077	9
WELLNAM$	=WELL8	38.567	9.077	9

FRI 12/09/94 1:51:51 PM D:\NEWDATA\WBSES\WORKING\JUNK230.SYS

COL/

ROW WELLNAM$

1 WELL0
WELL1
WELL10
4 WELL11
5 WELL12
6 WELL13
7 WELL15
8 WELL17
9 WELL19
10 WELL21
11 WELL4
12 WELL5
13 WELL8

USING LEAST SQUARES MEANS.

POST HOC TEST OF NATOT

USING MSE OF 260.272 WITH 108. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	133.761	0.000			
3	-27.039	-160.800	0.000		
4	51.128	-82.633	78.167	0.000	
5	1.528	-132.233	28.567	-49.600	0.000
6	-72.483	-206.244	-45.444	-123.611	-74.011
7	-50.750	-184.511	-23.711	-101.878	-52.278
8	-55.383	-189.144	-28.344	-106.511	-56.911
9	-23.472	-157.233	3.567	-74.600	-25.000
10	-27.339	-161.100	-0.300	-78.467	-28.867
11	-70.294	-204.056	-43.256	-121.422	-71.822
12	246.939	113.178	273.978	195.811	245.411
13	-53.483	-187.244	-26.444	-104.611	-55.011

	6	7	8	9	10
6	0.000				
7	21.733	0.000			
8	17.100	-4.633	0.000		
9	49.011	27.278	31.911	0.000	
10	45.144	23.411	28.044	-3.867	0.000
11	2.189	-19.544	-14.911	-46.822	-42.956
12	319.422	297.689	302.322	270.411	274.278
13	19.000	-2.733	1.900	-30.011	-26.144

	11	12	13
11	0.000		
12	317.233	0.000	
13	16.811	-300.422	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	0.239	0.000	1.000		
4	0.000	0.000	0.000	1.000	
5	1.000	0.000	0.310	0.000	1.000
6	0.000	0.000	0.001	0.000	0.000
7	0.000	0.000	0.640	0.000	0.000
8	0.000	0.000	0.323	0.000	0.000
9	0.485	0.000	1.000	0.000	0.549
10	0.223	0.000	1.000	0.000	0.292
11	0.000	0.000	0.003	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.447	0.000	0.000

	6	7	8	9	10
6	1.000				
7	0.767	1.000			
8	0.952	1.000	1.000		
9	0.000	0.391	0.148	1.000	
10	0.001	0.660	0.341	1.000	1.000
11	1.000	0.877	0.984	0.001	0.004
12	0.000	0.000	0.000	0.000	0.000
13	0.898	1.000	1.000	0.230	0.468

	11	12	13
11	1.000		
12	0.000	1.000	
13	0.958	0.000	1.000

FRI 12/09/94 1:53:25 PM D:\NEWDATA\WBSES\WORKING\JUNK230.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL0	WELL1	WELL10	WELL11	WELL12	WELL13
WELL15	WELL17	WELL19	WELL21	WELL4	WELL5
WELL8					

51 CASES DELETED DUE TO MISSING DATA.

DEP VAR: STTOT N: 122 MULTIPLE R: 0.797 SQUARED MULTIPLE R: 0.636

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	442.161	12	36.847	15.854	0.000
ERROR	253.325	109	2.324		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL0	3.910	0.407	14
WELLNAM$	=WELL1	4.884	0.508	9
WELLNAM$	=WELL10	0.584	0.508	9
WELLNAM$	=WELL11	1.088	0.508	9
WELLNAM$	=WELL12	1.491	0.508	9
WELLNAM$	=WELL13	0.378	0.508	9
WELLNAM$	=WELL15	1.429	0.508	9
WELLNAM$	=WELL17	0.664	0.508	9
WELLNAM$	=WELL19	3.491	0.508	9
WELLNAM$	=WELL21	2.454	0.508	9
WELLNAM$	=WELL4	0.187	0.508	9
WELLNAM$	=WELL5	6.400	0.508	9
WELLNAM$	=WELL8	0.374	0.508	9

FRI 12/09/94 1:53:55 PM D:\NEWDATA\WBSES\WORKING\JUNK230.SYS

COL/

ROW WELLNAM$

1 WELL0
2 WELL1
3 WELL10
4 WELL11
5 WELL12
6 WELL13
7 WELL15
8 WELL17
9 WELL19
10 WELL21
11 WELL4
12 WELL5
13 WELL8

USING LEAST SQUARES MEANS.

POST HOC TEST OF STTOT

USING MSE OF .750 WITH 108. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	0.974	0.000			
3	-3.326	-4.300	0.000		
4	-2.822	-3.797	0.503	0.000	
5	-2.419	-3.393	0.907	0.403	0.000
6	-3.532	-4.507	-0.206	-0.710	-1.113
7	-2.481	-3.456	0.845	0.341	-0.062
8	-3.246	-4.221	0.080	-0.424	-0.827
9	-0.419	-1.393	2.907	2.403	2.000
10	-1.456	-2.430	1.870	1.367	0.963
11	-3.723	-4.697	-0.397	-0.900	-1.304
12	2.490	1.516	5.816	5.312	4.909
13	-3.536	-4.511	-0.211	-0.714	-1.117

	6	7	8	9	10
6	0.000				
7	1.051	0.000			
8	0.286	-0.765	0.000		
9	3.113	2.062	2.827	0.000	
10	2.077	1.026	1.791	-1.037	0.000
11	-0.190	-1.241	-0.476	-3.304	-2.267
12	6.022	4.971	5.736	2.909	3.946
13	-0.004	-1.055	-0.290	-3.117	-2.081

	11	12	13
11	0.000		
12	6.213	0.000	
13	0.186	-6.026	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.856	1.000			
3	0.000	0.000	1.000		
4	0.000	0.000	1.000	1.000	
5	0.000	0.000	0.956	1.000	1.000
6	0.000	0.000	1.000	0.995	0.822
7	0.000	0.000	0.975	1.000	1.000
8	0.000	0.000	1.000	1.000	0.979
9	1.000	0.481	0.000	0.002	0.031
10	0.235	0.001	0.066	0.516	0.931
11	0.000	0.000	1.000	0.959	0.600
12	0.000	0.330	0.000	0.000	0.000
13	0.000	0.000	1.000	0.994	0.818

	6	7	8	9	10
6	1.000				
7	0.875	1.000			
8	1.000	0.989	1.000		
9	0.000	0.021	0.000	1.000	
10	0.019	0.894	0.101	0.886	1.000
11	1.000	0.679	1.000	0.000	0.005
12	0.000	0.000	0.000	0.000	0.000
13	1.000	0.872	1.000	0.000	0.018

	11	12	13
11	1.000		
12	0.000	1.000	
13	1.000	0.000	1.000

FRI 12/09/94 1:55:01 PM D:\NEWDATA\WBSES\WORKING\230WQTMP.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$
WELL0 WELL1 WELL10 WELL11 WELL12 WELL13
WELL15 WELL17 WELL19 WELL21 WELL4 WELL5
WELL8

51 CASES DELETED DUE TO MISSING DATA.

DEP VAR: PH N: 119 MULTIPLE R: 0.937 SQUARED MULTIPLE R: 0.878

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	177.212	12	14.768	63.332	0.000
ERROR	24.717	106	0.233		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL0	7.268	0.129	14
WELLNAM$	=WELL1	3.709	0.161	9
WELLNAM$	=WELL10	4.313	0.161	9
WELLNAM$	=WELL11	4.108	0.153	10
WELLNAM$	=WELL12	3.687	0.161	9
WELLNAM$	=WELL13	3.678	0.161	9
WELLNAM$	=WELL15	5.844	0.161	9
WELLNAM$	=WELL17	6.599	0.171	8
WELLNAM$	=WELL19	4.223	0.171	8
WELLNAM$	=WELL21	3.970	0.171	8
WELLNAM$	=WELL4	4.393	0.161	9
WELLNAM$	=WELL5	4.048	0.171	8
WELLNAM$	=WELL8	4.268	0.161	9

FRI 12/09/94 1:55:40 PM D:\NEWDATA\WBSES\WORKING\230WQTMP.SYS

COL/

ROW WELLNAM$

1 WELL0
2 WELL1
3 WELL10
4 WELL11
5 WELL12
6 WELL13
7 WELL15
8 WELL17
9 WELL19
10 WELL21
11 WELL4
12 WELL5
13 WELL8

USING LEAST SQUARES MEANS.

POST HOC TEST OF PH

USING MSE OF .224 WITH 105. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-3.559	0.000			
3	-2.955	0.604	0.000		
4	-3.160	0.399	-0.205	0.000	
5	-3.581	-0.022	-0.627	-0.421	0.000
6	-3.590	-0.031	-0.636	-0.430	-0.009
7	-1.423	2.136	1.531	1.736	2.158
8	-0.669	2.890	2.285	2.491	2.912
9	-3.045	0.514	-0.091	0.114	0.536
10	-3.298	0.261	-0.343	-0.138	0.283
11	-2.875	0.684	0.080	0.285	0.707
12	-3.220	0.339	-0.266	-0.061	0.361
13	-3.000	0.559	-0.046	0.160	0.581

	6	7	8	9	10
6	0.000				
7	2.167	0.000			
8	2.921	0.754	0.000		
9	0.545	-1.622	-2.376	0.000	
10	0.292	-1.874	-2.629	-0.253	0.000
11	0.716	-1.451	-2.205	0.171	0.423
12	0.370	-1.797	-2.551	-0.175	0.077
13	0.590	-1.577	-2.331	0.045	0.298

	11	12	13
11	0.000		
12	-0.346	0.000	
13	-0.126	0.220	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	0.000	0.828	1.000		
4	0.000	0.991	1.000	1.000	
5	0.000	1.000	0.788	0.986	1.000
6	0.000	1.000	0.771	0.983	1.000
7	0.000	0.000	0.000	0.000	0.000
8	0.601	0.000	0.000	0.000	0.000
9	0.000	0.954	1.000	1.000	0.937
10	0.000	1.000	0.999	1.000	1.000
11	0.000	0.665	1.000	1.000	0.613
12	0.000	0.999	1.000	1.000	0.998
13	0.000	0.896	1.000	1.000	0.865

	6	7	8	9	10
6	1.000				
7	0.000	1.000			
8	0.000	0.553	1.000		
9	0.929	0.000	0.000	1.000	
10	1.000	0.000	0.000	1.000	1.000
11	0.592	0.000	0.000	1.000	0.991
12	0.997	0.000	0.000	1.000	1.000
13	0.852	0.000	0.000	1.000	1.000

	11	12	13
11	1.000		
12	0.999	1.000	
13	1.000	1.000	1.000

FRI 12/09/94 2:29:31 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$
WELL14 WELL16 WELL18 WELL2 WELL20 WELL22
WELL23 WELL3 WELL7 WELL9

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: TDS N: 123 MULTIPLE R: 0.976 SQUARED MULTIPLE R: 0.953

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	.312189E+08	9	3468763.665	252.685	0.000
ERROR	1551220.345	113	13727.614		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL14	658.583	33.823	12
WELLNAM$	=WELL16	108.692	32.496	13
WELLNAM$	=WELL18	1480.000	32.496	13
WELLNAM$	=WELL2	1226.769	32.496	13
WELLNAM$	=WELL20	1514.769	32.496	13
WELLNAM$	=WELL22	251.923	32.496	13
WELLNAM$	=WELL23	698.714	44.284	7
WELLNAM$	=WELL3	215.692	32.496	13
WELLNAM$	=WELL7	484.077	32.496	13
WELLNAM$	=WELL9	931.000	32.496	13

FRI 12/09/94 2:30:07 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
COL/
ROW WELLNAM$
  1 WELL14
  2 WELL16
  3 WELL18
  4 WELL2
  5 WELL20
  6 WELL22
  7 WELL23
  8 WELL3
  9 WELL7
 10 WELL9

USING LEAST SQUARES MEANS.

POST HOC TEST OF TDS

USING MSE OF 13727.614 WITH 113. DF.
MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-549.891	0.000			
3	821.417	1371.308	0.000		
4	568.186	1118.077	-253.231	0.000	
5	856.186	1406.077	34.769	288.000	0.000
6	-406.660	143.231	-1228.077	-974.846	-1262.846
7	40.131	590.022	-781.286	-528.055	-816.055
8	-442.891	107.000	-1264.308	-1011.077	-1299.077
9	-174.506	375.385	-995.923	-742.692	-1030.692
10	272.417	822.308	-549.000	-295.769	-583.769

	6	7	8	9	10
6	0.000				
7	446.791	0.000			
8	-36.231	-483.022	0.000		
9	232.154	-214.637	268.385	0.000	
10	679.077	232.286	715.308	446.923	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	0.000	0.000	1.000		
4	0.000	0.000	0.001	1.000	
5	0.000	0.000	1.000	0.000	1.000
6	0.000	0.384	0.000	0.000	0.000
7	1.000	0.000	0.000	0.000	0.000
8	0.000	0.793	0.000	0.000	0.000
9	0.143	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000

	6	7	8	9	10
6	1.000				
7	0.000	1.000			
8	1.000	0.000	1.000		
9	0.005	0.098	0.000	1.000	
10	0.000	0.047	0.000	0.000	1.000

FRI 12/09/94 2:48:05 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL14	WELL16	WELL18	WELL2	WELL20	WELL22
WELL23	WELL3	WELL7	WELL9		

4 CASES DELETED DUE TO MISSING DATA.

DEP VAR: SO4 N: 121 MULTIPLE R: 0.853 SQUARED MULTIPLE R: 0.728

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	7683568.269	9	853729.808	32.986	0.000
ERROR	2872830.249	111	25881.354		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL14	304.586	48.506	11
WELLNAM$	=WELL16	48.166	44.619	13
WELLNAM$	=WELL18	719.931	44.619	13
WELLNAM$	=WELL2	643.362	44.619	13
WELLNAM$	=WELL20	697.523	44.619	13
WELLNAM$	=WELL22	87.717	46.441	12
WELLNAM$	=WELL23	320.443	60.806	7
WELLNAM$	=WELL3	114.592	44.619	13
WELLNAM$	=WELL7	180.185	44.619	13
WELLNAM$	=WELL9	434.854	44.619	13

FRI 12/09/94 2:48:45 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
COL/
ROW WELLNAM$
1 WELL14
2 WELL16
3 WELL18
4 WELL2
5 WELL20
6 WELL22
7 WELL23
8 WELL3
9 WELL7
10 WELL9

USING LEAST SQUARES MEANS.

POST HOC TEST OF SO4

USING MSE OF 25881.354 WITH 111. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-256.420	0.000			
3	415.344	671.765	0.000		
4	338.775	595.195	-76.569	0.000	
5	392.937	649.357	-22.408	54.162	0.000
6	-216.870	39.551	-632.214	-555.645	-609.806
7	15.856	272.277	-399.488	-322.919	-377.080
8	-189.994	66.426	-605.338	-528.769	-582.931
9	-124.402	132.018	-539.746	-463.177	-517.338
10	130.267	386.688	-285.077	-208.508	-262.669

	6	7	8	9	10
6	0.000				
7	232.726	0.000			
8	26.876	-205.851	0.000		
9	92.468	-140.258	65.592	0.000	
10	347.137	114.411	320.262	254.669	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.102	1.000			
3	0.000	0.000	1.000		
4	0.004	0.000	0.997	1.000	
5	0.000	0.000	1.000	1.000	1.000
6	0.328	1.000	0.000	0.000	0.000
7	1.000	0.176	0.002	0.042	0.006
8	0.508	0.999	0.000	0.000	0.000
9	0.935	0.881	0.000	0.000	0.000
10	0.914	0.000	0.023	0.294	0.055

	6	7	8	9	10
6	1.000				
7	0.422	1.000			
8	1.000	0.592	1.000		
9	0.990	0.941	0.999	1.000	
10	0.002	0.985	0.005	0.074	1.000

FRI 12/09/94 2:49:39 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL14	WELL16	WELL18	WELL2	WELL20	WELL22
WELL23	WELL3	WELL7	WELL9		

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: CL N: 123 MULTIPLE R: 0.759 SQUARED MULTIPLE R: 0.576

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	96708.334	9	10745.370	17.040	0.000
ERROR	71257.054	113	630.593		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL14	27.969	7.249	12
WELLNAM$	=WELL16	11.144	6.965	13
WELLNAM$	=WELL18	42.162	6.965	13
WELLNAM$	=WELL2	87.131	6.965	13
WELLNAM$	=WELL20	45.662	6.965	13
WELLNAM$	=WELL22	21.510	6.965	13
WELLNAM$	=WELL23	82.986	9.491	7
WELLNAM$	=WELL3	11.591	6.965	13
WELLNAM$	=WELL7	41.543	6.965	13
WELLNAM$	=WELL9	87.312	6.965	13

FRI 12/09/94 2:50:10 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
COL/
ROW WELLNAM$
1 WELL14
2 WELL16
3 WELL18
4 WELL2
5 WELL20
6 WELL22
7 WELL23
8 WELL3
9 WELL7
10 WELL9

USING LEAST SQUARES MEANS.

POST HOC TEST OF CL

USING MSE OF 630.593 WITH 113. DF.
MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-16.825	0.000			
3	14.192	31.018	0.000		
4	59.162	75.987	44.969	0.000	
5	17.693	34.518	3.501	-41.468	0.000
6	-6.459	10.366	-20.652	-65.621	-24.152
7	55.017	71.842	40.824	-4.145	37.323
8	-16.378	0.447	-30.571	-75.540	-34.072
9	13.574	30.399	-0.618	-45.588	-4.119
10	59.342	76.168	45.150	0.181	41.649

	6	7	8	9	10
6	0.000				
7	61.476	0.000			
8	-9.919	-71.395	0.000		
9	20.033	-41.443	29.952	0.000	
10	65.802	4.326	75.721	45.768	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.970	1.000			
3	0.991	0.367	1.000		
4	0.000	0.000	0.020	1.000	
5	0.958	0.212	1.000	0.049	1.000
6	1.000	0.999	0.880	0.000	0.736
7	0.018	0.000	0.226	1.000	0.357
8	0.975	1.000	0.390	0.000	0.230
9	0.993	0.399	1.000	0.017	1.000
10	0.000	0.000	0.019	1.000	0.047

	6	7	8	9	10
6	1.000				
7	0.003	1.000			
8	0.999	0.000	1.000		
9	0.899	0.207	0.423	1.000	
10	0.000	1.000	0.000	0.016	1.000

FRI 12/09/94 2:51:16 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$
WELL14 WELL16 WELL18 WELL2 WELL20 WELL22
WELL23 WELL3 WELL7 WELL9

37 CASES DELETED DUE TO MISSING DATA.

DEP VAR: NATOT N: 88 MULTIPLE R: 0.935 SQUARED MULTIPLE R: 0.874

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	52771.599	9	5863.511	60.140	0.000
ERROR	7604.877	78	97.498		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL14	43.467	3.291	9
WELLNAM$	=WELL16	8.533	3.291	9
WELLNAM$	=WELL18	74.578	3.291	9
WELLNAM$	=WELL2	62.811	3.291	9
WELLNAM$	=WELL20	80.900	3.291	9
WELLNAM$	=WELL22	19.644	3.291	9
WELLNAM$	=WELL23	71.329	3.732	7
WELLNAM$	=WELL3	16.900	3.291	9
WELLNAM$	=WELL7	40.200	3.291	9
WELLNAM$	=WELL9	54.178	3.291	9

FRI 12/09/94 2:51:47 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
COL/
ROW WELLNAM$
  1 WELL14
  2 WELL16
  3 WELL18
  4 WELL2
  5 WELL20
  6 WELL22
  7 WELL23
  8 WELL3
  9 WELL7
 10 WELL9

USING LEAST SQUARES MEANS.

POST HOC TEST OF NATOT

USING MSE OF 97.498 WITH 78. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-34.933	0.000			
3	31.111	66.044	0.000		
4	19.344	54.278	-11.767	0.000	
5	37.433	72.367	6.322	18.089	0.000
6	-23.822	11.111	-54.933	-43.167	-61.256
7	27.862	62.795	-3.249	8.517	-9.571
8	-26.567	8.367	-57.678	-45.911	-64.000
9	-3.267	31.667	-34.378	-22.611	-40.700
10	10.711	45.644	-20.400	-8.633	-26.722

	6	7	8	9	10
6	0.000				
7	51.684	0.000			
8	-2.744	-54.429	0.000		
9	20.556	-31.129	23.300	0.000	
10	34.533	-17.151	37.278	13.978	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	0.000	0.000	1.000		
4	0.061	0.000	0.698	1.000	
5	0.000	0.000	0.993	0.109	1.000
6	0.005	0.765	0.000	0.000	0.000
7	0.001	0.000	1.000	0.964	0.926
8	0.001	0.951	0.000	0.000	0.000
9	1.000	0.000	0.000	0.011	0.000
10	0.803	0.000	0.036	0.940	0.001

	6	7	8	9	10
6	1.000				
7	0.000	1.000			
8	1.000	0.000	1.000		
9	0.033	0.000	0.007	1.000	
10	0.000	0.240	0.000	0.446	1.000

FRI 12/09/94 2:52:38 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$

WELL14	WELL16	WELL18	WELL2	WELL20	WELL22
WELL23	WELL3	WELL7	WELL9		

37 CASES DELETED DUE TO MISSING DATA.

DEP VAR: STTOT N: 88 MULTIPLE R: 0.933 SQUARED MULTIPLE R: 0.871

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	155.359	9	17.262	58.595	0.000
ERROR	22.979	78	0.295		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL14	1.686	0.181	9
WELLNAM$	=WELL16	0.058	0.181	9
WELLNAM$	=WELL18	4.033	0.181	9
WELLNAM$	=WELL2	3.346	0.181	9
WELLNAM$	=WELL20	2.704	0.181	9
WELLNAM$	=WELL22	0.409	0.181	9
WELLNAM$	=WELL23	2.711	0.205	7
WELLNAM$	=WELL3	0.278	0.181	9
WELLNAM$	=WELL7	1.004	0.181	9
WELLNAM$	=WELL9	2.522	0.181	9

FRI 12/09/94 2:53:07 PM D:\NEWDATA\WBSES\WORKING\JUNK260.SYS
COL/
ROW WELLNAM$
1 WELL14
2 WELL16
3 WELL18
4 WELL2
5 WELL20
6 WELL22
7 WELL23
8 WELL3
9 WELL7
10 WELL9

USING LEAST SQUARES MEANS.

POST HOC TEST OF STTOT

USING MSE OF .295 WITH 78. DF.
MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-1.628	0.000			
3	2.348	3.976	0.000		
4	1.660	3.288	-0.688	0.000	
5	1.019	2.647	-1.329	-0.641	0.000
6	-1.276	0.352	-3.624	-2.936	-2.295
7	1.026	2.654	-1.322	-0.634	0.007
8	-1.407	0.221	-3.755	-3.067	-2.426
9	-0.681	0.947	-3.029	-2.341	-1.700
10	0.837	2.464	-1.511	-0.823	-0.182

	6	7	8	9	10
6	0.000				
7	2.302	0.000			
8	-0.131	-2.433	0.000		
9	0.595	-1.707	0.726	0.000	
10	2.113	-0.189	2.244	1.518	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.000	1.000			
3	0.000	0.000	1.000		
4	0.000	0.000	0.616	1.000	
5	0.090	0.000	0.004	0.710	1.000
6	0.007	0.992	0.000	0.000	0.000
7	0.142	0.000	0.011	0.796	1.000
8	0.002	1.000	0.000	0.000	0.000
9	0.630	0.156	0.000	0.000	0.000
10	0.316	0.000	0.000	0.340	1.000

	6	7	8	9	10
6	1.000				
7	0.000	1.000			
8	1.000	0.000	1.000		
9	0.793	0.000	0.535	1.000	
10	0.000	1.000	0.000	0.000	1.000

FRI 12/09/94 2:54:05 PM D:\NEWDATA\WBSES\WORKING\260WQTMP.SYS
LEVELS ENCOUNTERED DURING PROCESSING ARE:
WELLNAM$
WELL14 WELL16 WELL18 WELL2 WELL20 WELL22
WELL23 WELL3 WELL7 WELL9

41 CASES DELETED DUE TO MISSING DATA.

DEP VAR: PH N: 83 MULTIPLE R: 0.928 SQUARED MULTIPLE R: 0.861

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
WELLNAM$	74.552	9	8.284	50.158	0.000
ERROR	12.056	73	0.165		

LEAST SQUARES MEANS.

		LS MEAN	SE	N
WELLNAM$	=WELL14	6.249	0.144	8
WELLNAM$	=WELL16	5.281	0.144	8
WELLNAM$	=WELL18	5.550	0.144	8
WELLNAM$	=WELL2	5.831	0.135	9
WELLNAM$	=WELL20	3.699	0.144	8
WELLNAM$	=WELL22	4.011	0.144	8
WELLNAM$	=WELL23	7.353	0.154	7
WELLNAM$	=WELL3	5.427	0.135	9
WELLNAM$	=WELL7	5.598	0.135	9
WELLNAM$	=WELL9	5.818	0.135	9

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COL/

ROW WELLNAM$

1 WELL14
2 WELL16
3 WELL18
4 WELL2
5 WELL20
6 WELL22
7 WELL23
8 WELL3
9 WELL7
10 WELL9

USING LEAST SQUARES MEANS.

POST HOC TEST OF PH

USING MSE OF .165 WITH 73. DF.

MATRIX OF PAIRWISE MEAN DIFFERENCES:

	1	2	3	4	5
1	0.000				
2	-0.968	0.000			
3	-0.699	0.269	0.000		
4	-0.418	0.550	0.281	0.000	
5	-2.550	-1.583	-1.851	-2.132	0.000
6	-2.238	-1.270	-1.539	-1.820	0.312
7	1.104	2.072	1.803	1.522	3.654
8	-0.822	0.145	-0.123	-0.404	1.728
9	-0.651	0.317	0.048	-0.233	1.899
10	-0.431	0.537	0.268	-0.013	2.119

	6	7	8	9	10
6	0.000				
7	3.342	0.000			
8	1.415	-1.926	0.000		
9	1.587	-1.755	0.171	0.000	
10	1.807	-1.535	0.391	0.220	0.000

SCHEFFE TEST.
MATRIX OF PAIRWISE COMPARISON PROBABILITIES:

	1	2	3	4	5
1	1.000				
2	0.014	1.000			
3	0.244	0.994	1.000		
4	0.872	0.562	0.990	1.000	
5	0.000	0.000	0.000	0.000	1.000
6	0.000	0.000	0.000	0.000	0.982
7	0.004	0.000	0.000	0.000	0.000
8	0.061	1.000	1.000	0.873	0.000
9	0.303	0.977	1.000	0.997	0.000
10	0.848	0.599	0.993	1.000	0.000

	6	7	8	9	10
6	1.000				
7	0.000	1.000			
8	0.000	0.000	1.000		
9	0.000	0.000	1.000	1.000	
10	0.000	0.000	0.894	0.998	1.000

AP&L

Arkansas Power & Light Company
425 West Capitol
P. O. Box 551
Little Rock, AR 72203
Tel 501 377 4000

0199-SR2

(6)

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AR-96-072

March 29, 1996

Mr. Tim Kresse
Water Division
State of Arkansas
Department of Pollution Control and Ecology
8001 National Drive
Little Rock, AR 72219-8913

Subject: 1995 Annual Groundwater Monitoring Program Report
Arkansas Power and Light (AP&L) White Bluff Plant

Dear Mr. Kresse:

We have enclosed for your review one copy of the referenced report. FTN Associates, Ltd. was contracted to evaluate the 1995 groundwater data as well as review results from the entire 5-year monitoring program. Statistical analyses were modified in 1995 to detect and quantify changes in groundwater quality that might indicate decline or improvement in water quality conditions beneath the White Bluff Plant. The major conclusions of the review of the 5-year monitoring program are as follows:

1. *Although statistical analyses suggest plant activities may have affected groundwater quality beneath the site, these effects are within the range of natural variability for the Jackson Group;*

2. *Plant effects have not resulted in significant degradation in groundwater quality beneath the site; and,*

3. *Migration of poor quality groundwater from areas beneath the site to Jackson wells within one mile of the plant site or to wells completed in the Cockfield and Sparta aquifers is highly improbable.*

WHITE BLUFF PLANT
GROUNDWATER MONITORING PROGRAM
1995 ANNUAL REPORT

3143

RECEIVED
APR 4 1996

Prepared for:

Arkansas Power and Light Company

a subsidiary of

Entergy Corporation

425 West Capitol

Little Rock, Arkansas 72203

Prepared by:

FTN Associates, Ltd.

3 Innwood Circle, Suite 220

Little Rock, AR 72211

March 15, 1996

EXECUTIVE SUMMARY

This report presents the results of the fifth year groundwater monitoring program at the White Bluff Plant at Redfield, Arkansas. Under agreement with the Arkansas Department of Pollution Control and Ecology (ADPC&E), the White Bluff Plant collects data from a shallow monitoring well network, evaluates these data, and reports the results annually to the agency. The White Bluff Plant has also reported the results of sampling wells that are completed in a deeper aquifer beneath the site since 1993. The plant's monitoring network currently consists of 26 wells that were installed to measure the quality of groundwater beneath the site and to determine if the plant's operations are affecting local groundwater quality. These wells are sampled on an annual basis.

Statistical analysis in previous years indicated that plant operations were affecting groundwater quality beneath the site. Statistical analyses were modified in 1995 to detect and quantify changes in groundwater quality that might indicate decline or improvement in water quality conditions beneath the White Bluff Plant.

FTN Associates, Ltd. (FTN) was contracted to evaluate the 1995 groundwater data collected by AP&L. Major conclusions from this evaluation are as follows:

1) Target zones for the White Bluff groundwater monitoring program are found in the Jackson Group. Regionally, the Jackson Group is not considered to be an important aquifer because it is not very productive and groundwater quality is poor. Water quality often exceeds secondary maximum contaminant limits (SMCLs) that were established by EPA based on aesthetic qualities, not human health criteria. As expected for lithologies in the Jackson Group, values for TDS, chloride, and sulfate were higher than SMCLs in several White Bluff wells, including wells that monitor background conditions.

2) Statistical trend analyses showed an increasing trend in TDS concentrations at one well location; however, TDS concentrations are at the lower end of the range of

natural variability for the Jackson Group. The source of increasing TDS is a leak in an underground water line, which was discovered and repaired in 1995. Repair of the leaking underground water line should reverse the observed trend in TDS concentration in the well and improve groundwater quality beneath the site.

3) Based on a review of data from the 5-year monitoring program, it is technically justifiable to discontinue the White Bluff Plant groundwater monitoring program because:

a) Although statistical analyses suggest plant activities may have affected groundwater quality beneath the site, these effects are within the range of natural variability for the Jackson Group;

b) Plant effects have not resulted in significant degradation in groundwater quality beneath the site; and

c) Migration of poor quality groundwater from areas beneath the site to Jackson wells within 1 mile of the plant site or to wells completed in the Cockfield and Sparta aquifers is highly improbable.

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1.0 INTRODUCTION

The White Bluff plant at Redfield, Arkansas, implemented a new groundwater monitoring program in 1991. Although not required for coal combustion waste units under current Environmental Protection Agency (EPA) regulations, the program is modeled on EPA Resource Conservation and Recovery Act (RCRA) guidelines. The monitoring program was described in correspondence dated September 18, 1990 from Arkansas Power and Light (AP&L) to the Arkansas Department of Pollution Control and Ecology (ADPC&E) (C. Longinotti, AP&L to C. Bennett, ADPC&E). The ADPC&E agreed with the program description as stated in its letter of October 1, 1990 (C. Bennett, ADPC&E to C. Longinotti, AP&L). Since 1991, AP&L has adjusted the program with ADPC&E's concurrence to improve evaluation and interpretation of program data. The purpose of the current groundwater program is to monitor the affects of the plant's operations on local groundwater quality.

FTN Associates, Ltd. (FTN) was contracted to evaluate the 1995 data collected at the White Bluff Plant. This document is the fifth annual report. By agreement between AP&L and ADPC&E, only data from wells screened in the Shallow, or uppermost aquifer are evaluated and reported annually to the agency. White Bluff's internal monitoring of wells screened in the Deep aquifer, however, showed statistical differences between background wells and some downgradient monitoring wells; therefore, beginning in 1994, AP&L's annual reports have addressed these data as well.

Section 2.0 of this annual report presents a description of the facility's groundwater monitoring program. The results of the fifth year program are in Section 3.0. Section 4.0 summarizes the 5-year groundwater monitoring program and discusses program closure. Selected references are provided in Section 5.0.

2.0 GROUNDWATER MONITORING PROGRAM

This section provides the background and regulatory basis for the White Bluff Plant's groundwater monitoring program, discusses improvements made to the program in 1995, and describes both the groundwater monitoring network and the sampling and analysis plan for the facility.

2.1 Facility Description

The White Bluff Plant is a two-unit coal-fired power plant operated in Jefferson County, Arkansas, about 24 miles south of Little Rock. The facility is located near the town of Redfield and is about 1.5 miles north of the Pine Bluff Arsenal. The facility is operated by AP&L, which owns about 3,400 acres; 1,100 acres have been cleared for plant use.

Each of the two power generation units is designed to produce about 850 megawatts of electricity under full load. Power is generated through combustion of western coal from the Powder River basin in Wyoming. Coal combustion waste is transferred by pneumatics for the fly ash component and by water slurry for the bottom ash/pyritic component. Most fly ash is sold as a concrete additive, and remaining amounts of both ash components are disposed of on site in a solid waste landfill.

Slurry water is recycled from surface impoundments that are dredged periodically to remove bottom ash sediments. Storm water runoff and coal yard dust suppression water from the facility are collected in the surge pond basin and recovered for use as ash slurry water makeup and cooling tower makeup.

Cooling water is obtained from the Arkansas River and is cycled through hyperbolic natural draft cooling towers. Evaporative concentration results in 5- to 8-fold increases in concentration of raw water components within the cooling water system. Dissolved mineral concentrations are maintained within cooling tower design specifications by adjusting raw water makeup and blowdown ratios. Blowdown from the cooling tower basins is discharged through an NPDES-permitted outfall to the Arkansas River.

2.2 Program Background

In 1983, AP&L initiated an assessment of groundwater conditions at the plant to evaluate the potential effects of plant operations on groundwater resources beneath the facility (Geraghty & Miller, 1984). This study was based entirely on the interpretation of engineering, soils, and environmental data compiled from the files of ADPC&E, contractors, and state and federal agencies. Twelve monitoring wells were installed in 1989 to monitor groundwater conditions beneath the coal yard. An evaluation of onsite migration of contaminants from external sources and the risks associated with offsite migration of potential contaminants, if any, produced at the plant was completed by Ludwig (1990).

The current groundwater monitoring program is an outgrowth of a circumstance that developed in 1989. ADPC&E was concerned that operations at the White Bluff facility were adversely affecting the Shallow aquifer and residential wells to the south. Consequently, ADPC&E requested revisions in the scope of the original surface water and well water monitoring program at the White Bluff Plant. As a result, a new, formal groundwater monitoring program was established by agreement between AP&L and ADPC&E in 1991.

2.3 1995 Program Improvements

The White Bluff Plant currently monitors groundwater on an annual basis. The parameter list includes the major constituents that are indicative of groundwater quality beneath the site and some metals. The plant discontinued volatile and semi-volatile organic analysis this year because the volatile and semi-volatile compounds that were monitored had not been detected. Also, statistical trend analyses were conducted to detect and quantify changes in groundwater quality beneath the White Bluff Plant.

White Bluff also elected to continue the independent review program that was initiated in 1992 and that resulted in several modifications to the program. The ESI System Chemistry Laboratory's (System Chemistry) field and laboratory quality assurance/quality control (QA/QC) procedures were evaluated during 1995. Results and recommendations from these reviews were used to document adherence to the *Sampling and Analysis Plan* (Appendix A) and to support the reliability and validity of the data.

2.4 Groundwater Monitoring Network

Figure 2.1 shows the location of facility monitoring wells. These monitoring wells are designated as Shallow aquifer (screened in the "260-ft Aquifer") wells and Deep aquifer (or "230 ft Aquifer") wells. Monitoring wells are sampled on an annual basis by staff from System Chemistry in Little Rock, Arkansas.

The current monitoring well network consists of 26 monitoring wells and piezometers (Table 2.1) that were installed onsite between 1989 and 1992. Monitoring Wells 1 through 12 were installed in 1989 to monitor groundwater quality beneath the coal yard. Monitoring Wells 13 through 22 were installed in 1990 to expand the monitoring network and provide long-term data for the evaluation of water quality beneath the plant site. White Bluff further expanded the monitoring network in 1992 with the installation of monitoring Wells 23 through 26 to establish background groundwater quality west (upgradient) of the plant. Well 25 was removed from the water quality program during 1993 because it would not yield a representative sample of groundwater due to well construction problems. Table 2.2 identifies nested wells and the aquifer monitored by each well.

2.5 Sampling and Analysis Plan

The fifth year groundwater monitoring program consisted of annual measurement of water levels in wells and annual sampling, analysis, and evaluation of the following parameters:

1) Field parameters (i.e., pH, conductivity, turbidity, and groundwater temperature);
2) Total Dissolved Solids (TDS);
3) Sulfate;
4) Chloride;
5) Sodium;
6) Strontium;
7) Lead;
8) Nickel; and
9) Boron (at selected wells).

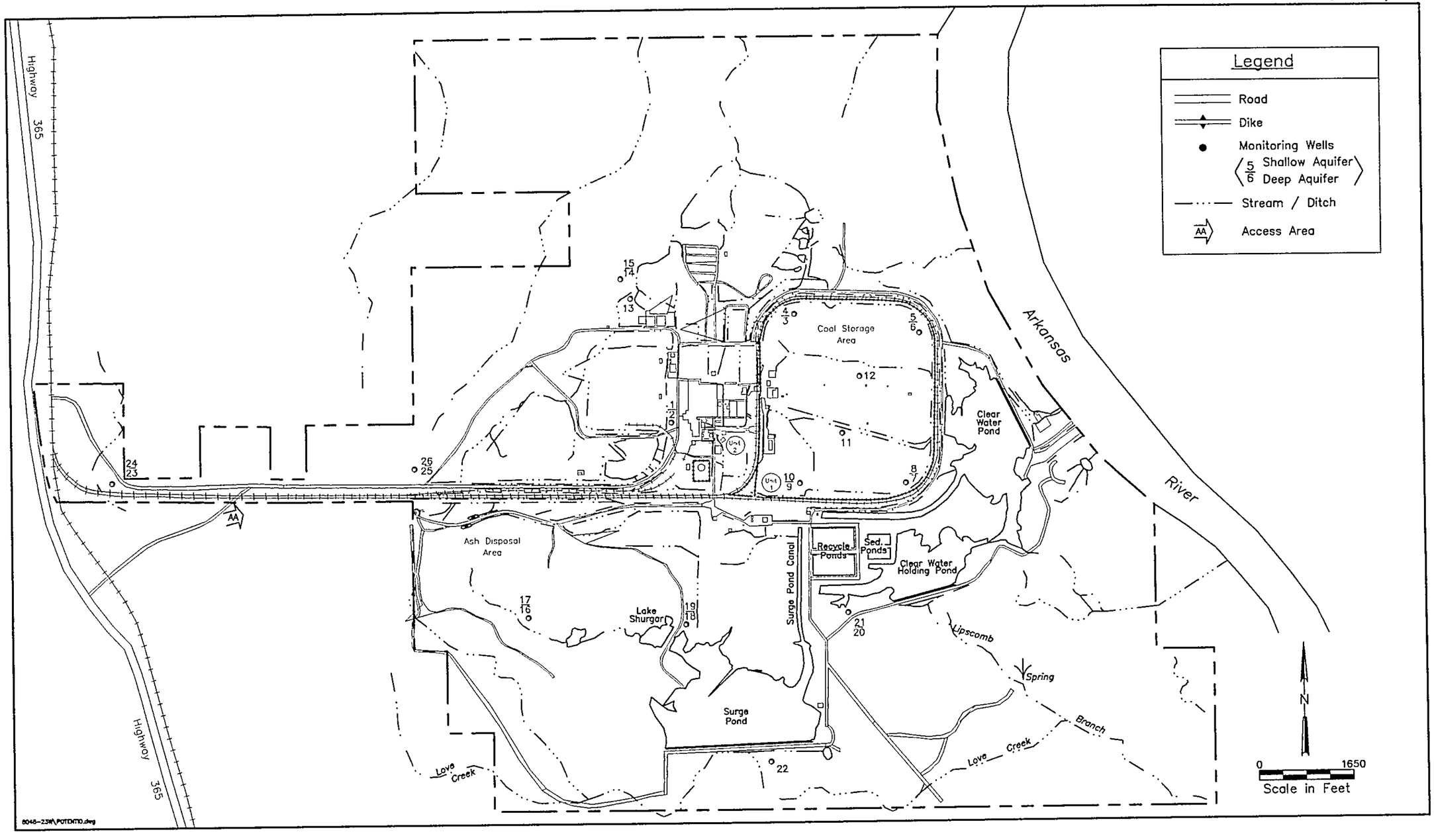


Figure 2.1. Location of White Bluff Plant monitoring wells.

Table 2.1. White Bluff Plant well construction data.

Well Number	Well Installation Date	Aquifer	Ground Surface Elevation (ft)	Top of Casing Elevation (ft)	Total Depth (ft bgs)[b]	Screen Interval (ft bgs)[b,c]	Sand Pack Interval (ft bgs)[b]	Bentonite[d] Interval (ft bgs)[b]
1	11/7/89	Shallow	311.0	312.91	37	25–37	20–37	18–20
2	11/6/89	Deep	310.9	312.98	80	60–80	58–80	56–58
3	11/10/89	Deep	289.6	291.68	50	34–50	32–50	30–32
4	11/10/89	Shallow	289.7	291.37	12	2–12	2.5–12	0.5–2.5
5	11/14/89	Shallow	282.2	284.24	18	3–18	2.5–18	1.5–2.5
6	11/13/89	Deep	282.0	284.0	50	40–50	32–50	30–32
7	11/9/89	Deep	279.9	282.32	70	52–70	42–70	41–42
8	11/9/89	Shallow	280.6	282.59	27	12–27	10–27	8–10
9	11/8/89	Deep	280.8	282.97	50	40–50	34–50	32–34
10	11/8/89	Shallow	281.8	284.08	17	7–17	5–17	4–5
11	11/14/89	Shallow	289.9	291.24	25	9–25	8–25	5–8
12	11/14/89	Shallow	287.8	289.81	16	6–16	4–16	3–4
13	10/30/90	Shallow	NA[a]	288.47	25	15–25	14–25	12–14
14	11/5/90	Deep	NA[a]	310.56	95	85–95	60–95	56–60
15	11/5/90	Shallow	NA[a]	310.5	53	43–53	42–53	38–42
16	11/7/90	Deep	NA[a]	346.17	113	103–113	82–113	76–82
17	11/7/90	Shallow	NA[a]	346.61	80	70–80	60–80	57–60
18	10/31/90	Deep	NA[a]	292.89	95	85–95	40–95	37–40
19	10/31/90	Shallow	NA[a]	293.34	35	25–35	22–35	19–22
20	11/2/90	Deep	NA[a]	294.83	95	85–95	45–95	42–45
21	11/2/90	Shallow	NA[a]	295.13	43	33–43	22–43	18–22

Table 2.1. Continued.

Well Number	Well Installation Date	Aquifer	Ground Surface Elevation (ft)	Top of Casing Elevation (ft)	Total Depth (ft bgs)[b]	Screen Interval (ft bgs)[b,c]	Sand Pack Interval (ft bgs)[b]	Bentonite[d] Interval (ft bgs)[b]
22	10/31/90	Deep	NA[a]	248.50	30	9.5–29.5	8.5–30	7–8.5
23	8/25/92	Deep	358.01	357.60	114	104.5–114.5	97.5–114.5	78–97.8
24	8/28/92	Shallow	358.11	357.78	60	48.9–58.9	44–58.9	38–44
25	8/27/92	Deep	384.69	384.28	111	99.9–109.9	93–111	60–93
26	8/26/92	Shallow	384.89	384.59	60	49.9–59.9	44–60	38–44

Note: [a] NA - Data Not Available
[b] bgs - below ground surface
[c] All wells were constructed of 2-inch Sch 40 PVC
[d] All wells were grouted from top of bentonite seal to ground surface

Table 2.2. Aquifers monitored by each well.

Nest (N) or Single (S)	Shallow Aquifer	Deep Aquifer
N	Well 1	Well 2
N	Well 4	Well 3
N	Well 5	Well 6
N	Well 8	Well 7
N	Well 10	Well 9
S	Well 11	
S	Well 12	
S	Well 13	
N	Well 15	Well 14
N	Well 17	Well 16
N	Well 19	Well 18
N	Well 21	Well 20
S		Well 22
N	Well 24	Well 23
N	Well 26	Well 25

All field sampling activities were conducted in accordance with EPA guidelines. System Chemistry used analytical methods that conform to 40 CFR Part 136.3 and SW-846. System Chemistry also used internal QA/QC procedures to evaluate data quality. Appendix A presents the *Sampling and Analysis Plan* that AP&L prepared and implemented.

3.0 DATA PRESENTATION AND EVALUATION

This section presents findings from the 1995 annual groundwater monitoring program at the White Bluff Plant. Section 3.1 addresses site geology and hydrogeology. System Chemistry staff sampled monitoring wells on September 19 and 20, 1995. Sections 3.2 and 3.3 present the resulting water level and groundwater water quality data, and the results of data evaluation. Section 3.4 provides a summary and the conclusions of this evaluation. Data quality was evaluated by reviewing duplicate data, QA/QC sample results, comparisons to previous data, and independent field and laboratory reviews.

3.1 Site Geology and Hydrogeology

Appendix B includes background information on local and site geology and hydrogeologic characteristics. This appendix repeats the information that has been presented in previous annual reports and is included to facilitate the reader's review of this document.

3.2 Water Level Data

Static water level measurements were made to determine the volume of water to remove during purging and to contour the potentiometric surface of each aquifer. This section describes well hydrographs for the period of record and addresses hydraulic gradient and subsurface flow direction.

3.2.1 Water Level Measurement and Well Hydrographs

Water level elevations that were measured on September 19, 1995 are shown on well hydrographs in Appendix C. During the 1995 sampling event, depth to water ranged from 5 to 41 feet in the Shallow aquifer and 9 to 94 feet in the Deep aquifer. Based on well hydrographs for the period of record, temporal variations in both the Shallow and Deep aquifers range from approximately 0.5 to 10 feet except in nested Wells 17 and 16 where larger water level fluctuations have been observed. Well hydrographs also show that the potentiometric heads between the Shallow and Deep aquifers differ by approximately 10 to 57 feet, except at nested Wells 15 and 14, where the difference is negligible. As discussed in previous annual reports, well

construction problems could account for the similar water levels in Wells 15 and 14. Measured water levels at Wells 17 and 16 that are higher than levels observed in the past have coincided with ash disposal activities in the wells' vicinity. This could result from the ash exerting a greater pressure head at those wells. Water level elevations that were measured during 1995 annual monitoring generally fell within the range of water level fluctuations anticipated for each aquifer; however, a few exceptions were noted. For example, the water levels in Wells 4, 13, and 25 were approximately 1 to 2 feet lower than the lowest historical water levels. The extended dry conditions that were experienced at the time of these water measurements (September 1995) probably account for these deviations from the usual fluctuations. In addition, the water level in Well 1 was approximately 10 feet lower than the lowest water level recorded historically. Although conditions were dry at the time, this measurement is suspect.

3.2.2 Hydraulic Gradient and Flow Direction

Figures 3.1 and 3.2 are potentiometric surface maps for the Shallow and Deep aquifers. As shown on these maps, groundwater generally flows from west to east across the site at gradients of 0.003 to 0.013 ft/ft, discharging to the Arkansas River and its tributaries. Groundwater hydrology beneath the site is further discussed in Section 3.4.

3.2.3 Groundwater Flow Beneath the White Bluff Plant

Potentiometric surface maps constructed from September 1995 water level data for the Shallow and Deep aquifers show that monitoring Wells 1, 2, 23, 24, and 26 are located hydraulically upgradient of the facility. As shown on these maps (Figures 3.1 and 3.2), groundwater generally flows east beneath the site towards the Arkansas River and its tributaries. The hydraulic gradient ranges from 0.004 to 0.013 ft/ft in the Shallow aquifer and 0.003 to 0.009 ft/ft in the Deep aquifer. The difference in total head in the Shallow and Deep aquifers across the site was approximately 80 feet and 50 feet, respectively, during 1995. A comparison of these maps to previous potentiometric maps show that groundwater flow patterns are stable with little change in the configuration of the potentiometric surface through time.

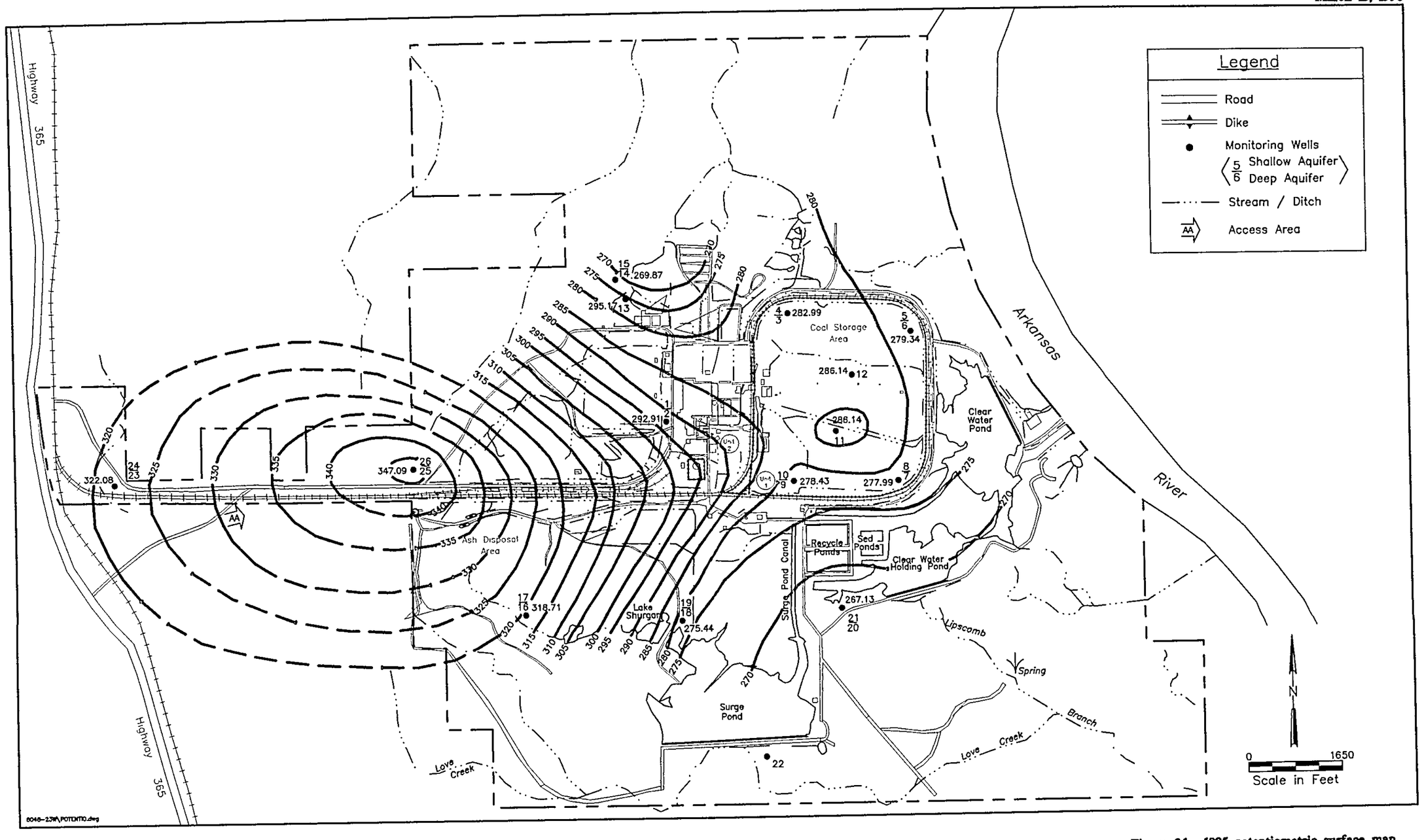


Figure 3.1. 1995 potentiometric surface map, Shallow aquifer, White Bluff Plant (September 19, 1995)

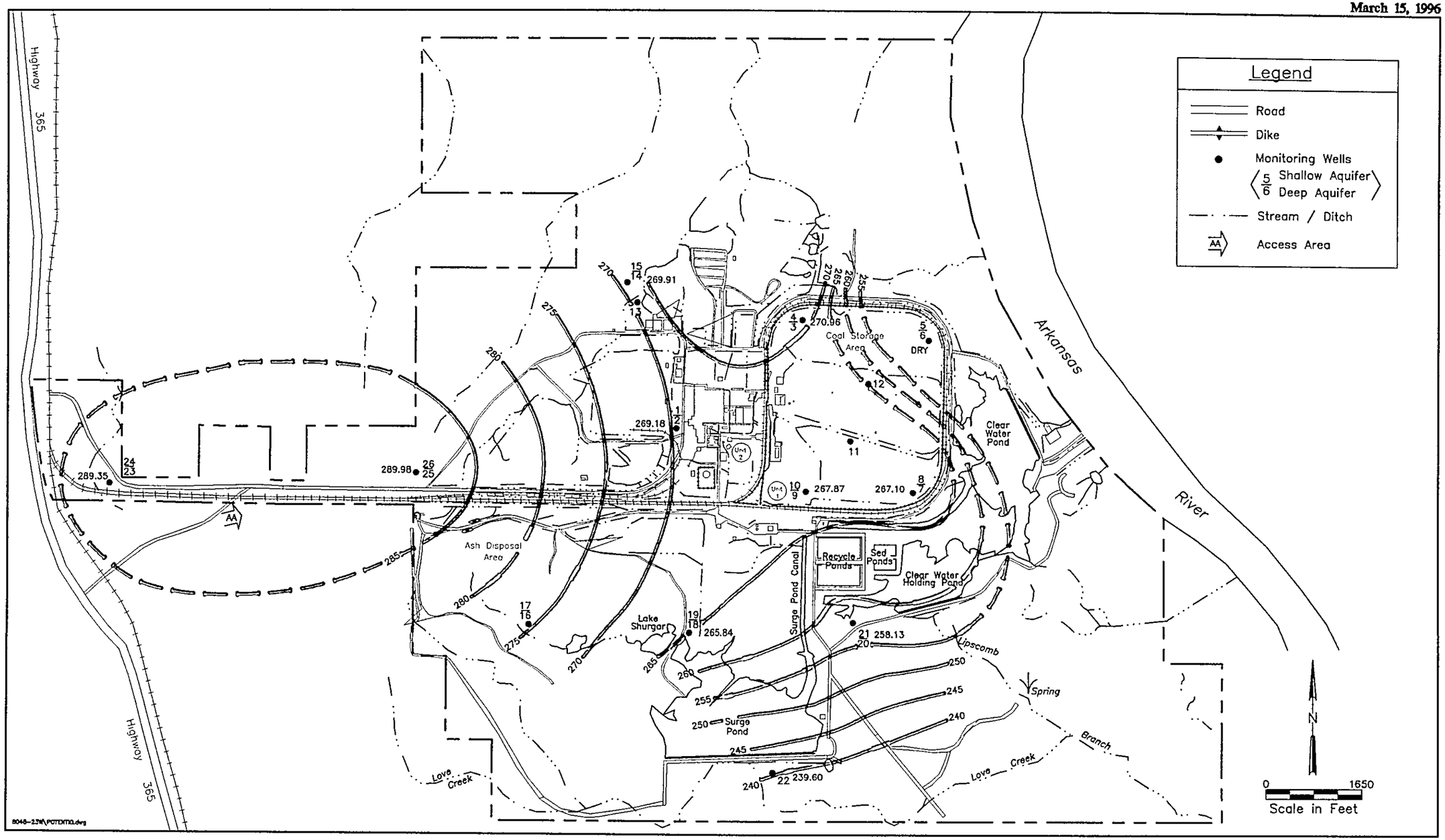


Figure 3.2. 1995 potentiometric surface map, Deep aquifer, White Bluff Plant (September 19, 1995)

3.3 Groundwater Quality Data

This section addresses the analytical results of sampling of the shallow and deep monitoring wells. Appendix D presents the raw laboratory data for 1995. Appendix E lists period of record data collected from monitoring wells and facility sources at the White Bluff Plant from 1991 through 1995. Appendix F presents summary statistics for each monitoring well based on historical data. Sampling data falling outside of historical ranges on time series plots (i.e., outliers) were not used to calculate statistical parameters.

3.3.1 Shallow Monitoring Wells

Table 3.1 presents 1995 summary statistics for the constituents of interest in the shallow aquifer. The results of field parameter, major ion, and metals analyses follow:

1) The range of pH values was 3.5 to 6.9 su with a mean of 4.9 su.

2) The range of conductivity in these wells was 126 to 4,340 μmhos with a mean value of 1,319 μmhos. Conductivity values are consistent with TDS data described below in (5).

3) The range of measured groundwater temperatures was 16.6 to 23.1°C with a mean groundwater temperature of 18.7°C.

4) Turbidity levels were greater than 100 NTU in Wells 4, 5, 10, and 11.

5) TDS ranged from 152 to 3,278 mg/L with a mean of 1,127 mg/L. TDS levels exceeded 2,000 mg/L in samples from Wells 1, 5, and 24 (background well); exceeded 1,000 mg/L in samples from Wells 11, 12, 19, and 21; exceeded the SMCL of 500 mg/L in samples from Wells 10 and 15; and were less than 500 mg/L in Wells 4, 8, 13, 17, and 26 (background well). Figure 3.3 shows the distribution of TDS in Shallow aquifer.

Table 3.1. 1995 summary statistics for the field parameters, major ions, and metals in samples from the shallow and deep wells at the White Bluff Plant.

Parameter	SHALLOW AQUIFER					DEEP AQUIFER				
	N cases	Min	Max	Mean	Std Dev	N cases	Min	Max	Mean	Std Dev
pH (su)	14	3.5	6.9	4.9	1.2	10	3.8	7.8	5.7	1.3
Conductivity (μmhos)	14	126	4,340	1,319	1,223	10	72	1,623	812	581
Turbidity (NTU)	14	0.53	391	88	116	10	10.6	303	77.3	87.2
Temp (°C)	14	16.6	23.1	18.7	1.7	10	16.1	20.9	18.2	1.4
TDS (mg/L)	14	152	3,278	1,127	982	10	139	1,505	699	523
Sulfate (mg/L)	14	15.5	1,063	362	354	10	21.2	690	274	259
Chloride (mg/L)	14	3.0	729	113	206	10	6.0	96.0	31.9	31.8
Sodium (mg/L)	14	11.6	341	94.0	95.5	10	9.2	81.7	43.2	25.6
Strontium (mg/L)	14	0.17	6.77	2.27	2.26	10	0.24	4.51	2.03	1.54
Lead (mg/L)	14	<0.001	<0.001	<0.001	0.000	10	<0.001	0.007	0.002	0.002
Nickel (mg/L)	14	<0.005	0.348	0.066	0.099	10	<0.005	0.208	0.029	0.063
Boron (mg/L)	4	0.36	0.64	0.47	0.12	3	0.27	0.38	0.33	0.06

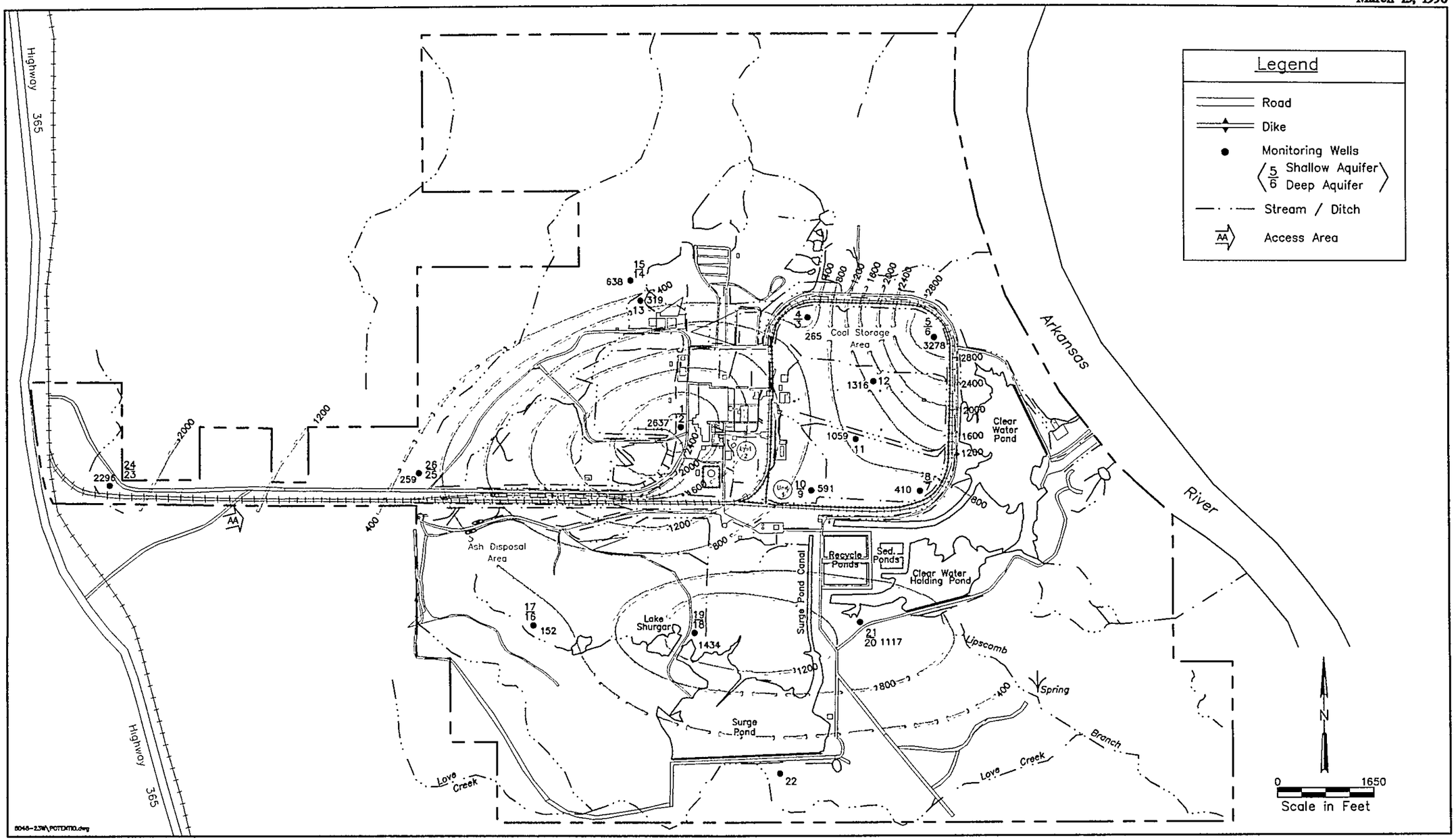


Figure 3.3. 1995 TDS isopleths (mg/L), Shallow aquifer, White Bluff Plant (September 19 and 20, 1995)

6) Sulfate concentrations ranged from 15.5 to 1,063 mg/L with a mean of 362 mg/L. Sulfate levels were the highest in Well 1 (1,063 mg/L) and background Well 24 (1,063 mg/L); sulfate levels also exceeded the 250 mg/L SMCL in Wells 10 (352 mg/L), 11 (423 mg/L), 12 (530 mg/L), 19 (601 mg/L), and 21 (407 mg/L). Figure 3.4 shows the distribution of sulfate in the Shallow aquifer.

7) Chloride levels ranged from 3.0 to 729 mg/L with a mean of 113 mg/L. Chloride concentrations were measured above the SMCL of 250 mg/L in samples from Wells 1 (426 mg/L) and 5 (729 mg/L).

8) Sodium levels ranged from 11.6 to 341 mg/L with a mean of 94.0 mg/L. Sodium levels greater than the mean were found in Wells 1 (241 mg/L), 5 (341 mg/L), 11 (131 mg/L), 12 (119 mg/L), and background Well 24 (142 mg/L) .

9) Strontium was detected in all shallow wells during the 1995 sampling event in concentrations ranging from 0.17 to 6.77 mg/L with a mean of 2.27 mg/L. The highest strontium values were found in Wells 1 (5.37 mg/L), 5 (6.77 mg/L), and background Well 24 (5.88 mg/L).

10) Lead was not found in shallow monitoring wells during the 1995 sampling event.

11) Nickel concentrations ranged from less than detection (<0.005 mg/L) to 0.348 mg/L in shallow wells with a mean value of 0.066 mg/L. Nickel concentrations exceeded the primary drinking water maximum contaminant level (MCL) of 0.1 mg/L in the samples from Wells 1 (0.348 mg/L) and 5 (0.229 mg/L).

12) Samples were collected from monitoring Wells 1, 17, 19, and 21 for the analysis of boron, which ranged from 0.26 to 0.64 mg/L.

March 15, 1996

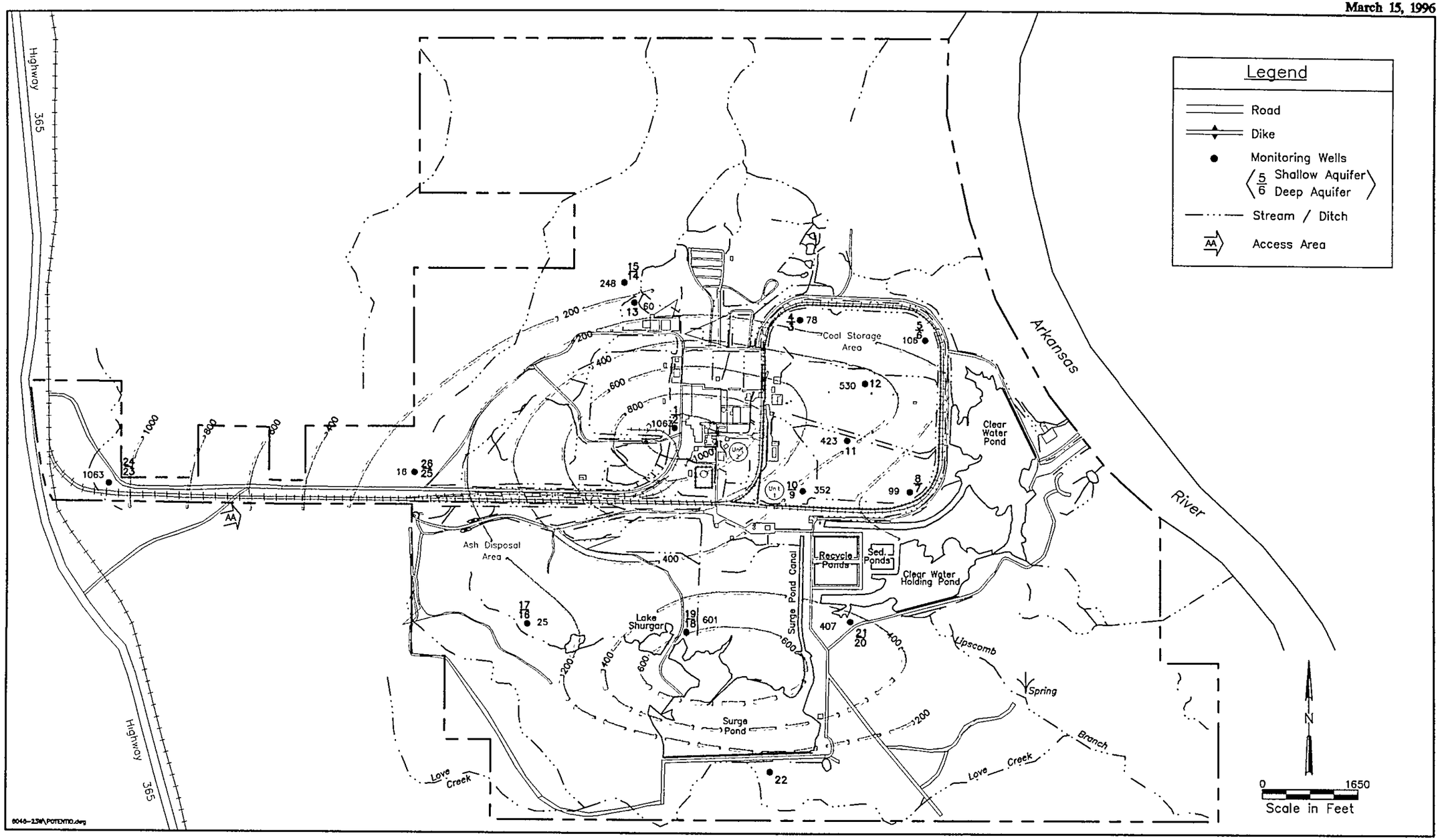


Figure 3.4. 1995 Sulfate isopleths (mg/L), Shallow aquifer, White Bluff Plant (September 19 and 20, 1995)

3.3.2 Deep Monitoring Wells

Table 3.1 also presents 1995 summary statistics for field parameters, major ions, and metals in the Deep aquifer, which are discussed below:

1) The range of pH values was 4.0 to 7.8 su with a mean of 5.7 su.

2) The range of conductivity in these wells was 72 to 1,623 μmhos with a mean of 812 μmhos. Conductivity values are consistent with TDS data described below in (5).

3) The range of measured groundwater temperatures was 16.1 to 20.9°C with a mean groundwater temperature of 18.2°C.

4) Turbidity levels exceeded 100 NTU in Wells 14 and 16, and background Well 23.

5) TDS ranged from 139 to 1,505 mg/L with a mean of 699 mg/L. TDS levels exceeded 1,000 mg/L in samples from Wells 2, 18, and 20; and exceeded the 500 mg/L SMCL in samples from Wells 9 and 14. Figure 3.5 shows the distribution of TDS in deep groundwater.

6) Sulfate concentrations ranged from 21.2 to 690 mg/L with a mean of 274 mg/L. The highest sulfate levels were observed in Wells 2 (621 mg/L), 18 (530 mg/L), and 20 (690 mg/L). Sulfate concentrations also exceeded the 250 mg/L SMCL in Well 9 (316 mg/L), and Well 14 (300 mg/L). Figure 3.6 shows the distribution of sulfate in deep groundwater.

7) Chloride values did not exceed 250 mg/L SMCL. The highest values were found in Wells 2 (96 mg/L) and 9 (78 mg/L).

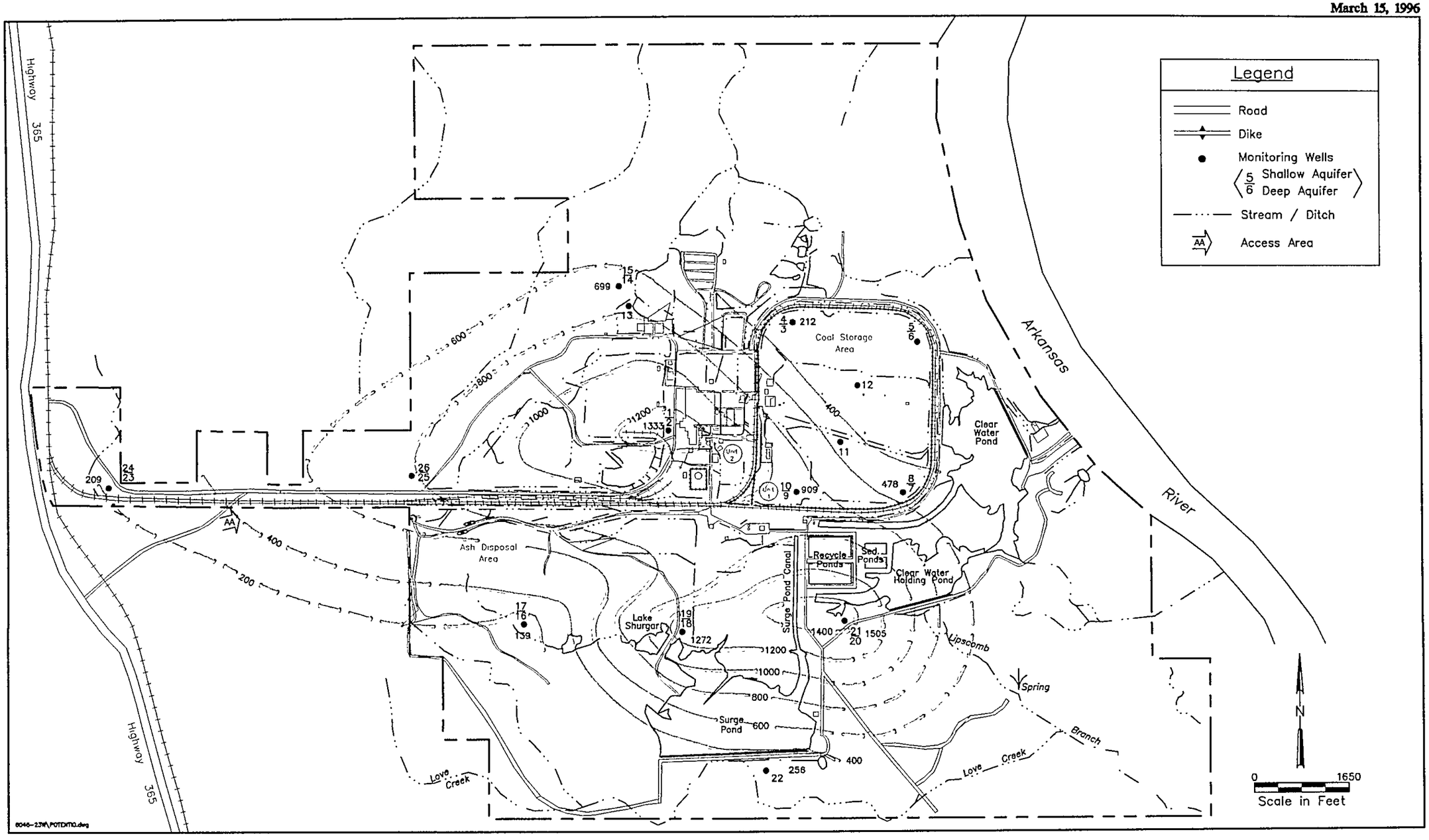


Figure 3.5. TDS isopleths (mg/L), Deep aquifer, White Bluff Plant (September 19 and 20, 1995)

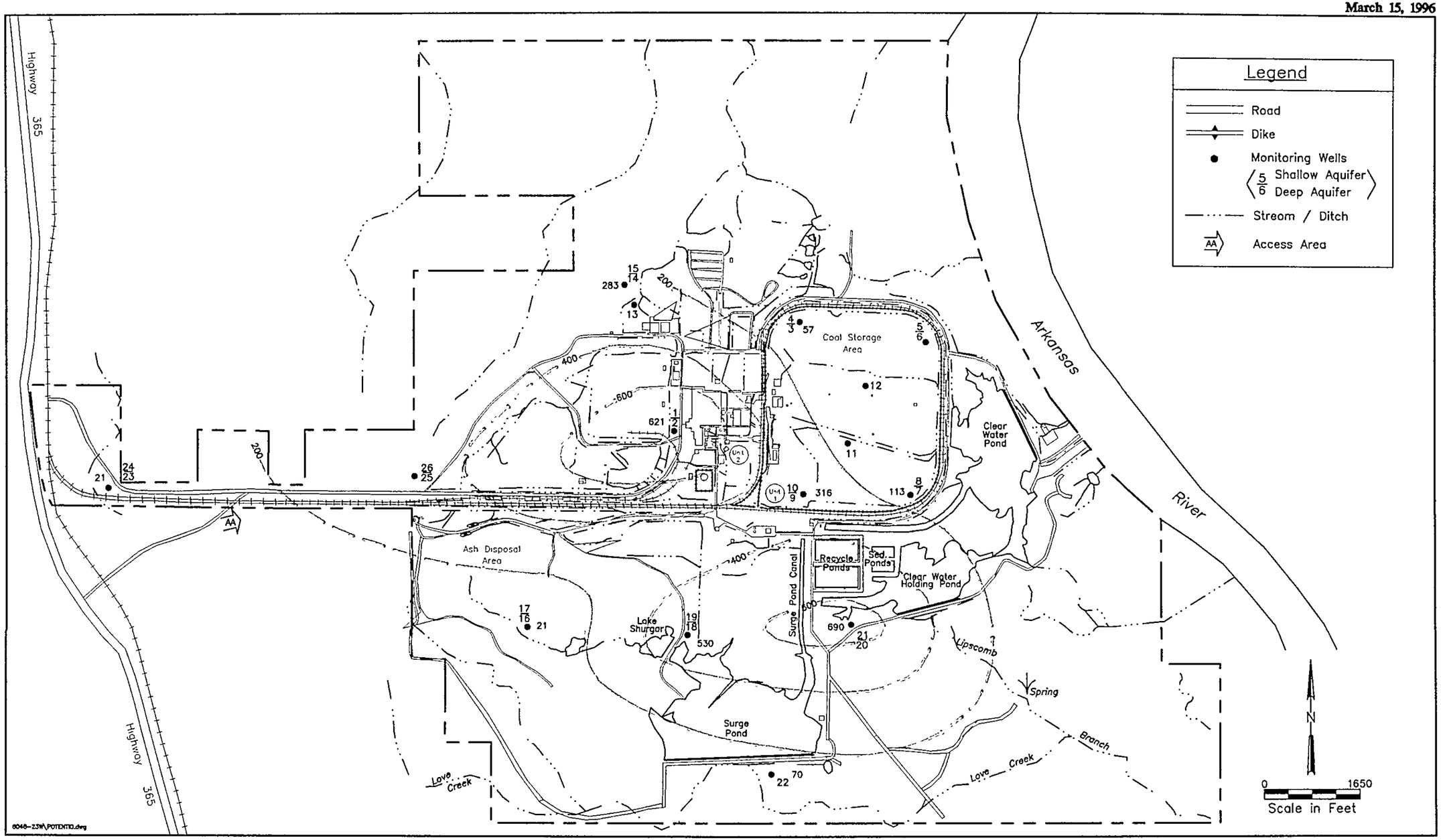


Figure 3.6. 1995 Sulfate isopleths (mg/L), Deep aquifer, White Bluff Plant (September 19 and 20, 1995)

8) Sodium values ranged from 9.2 to 81.7 mg/L with a mean of 43.2 mg/L. Sodium levels greater than the mean were found in Wells 2 (70.1 mg/L), 9 (57.5 mg/L), 14 (44.3 mg/L), 18 (69.4 mg/L), and 20 (81.7 mg/L).

9) Strontium was detected at levels ranging from 0.24 to 4.51 mg/L with a mean value of 2.03 mg/L. The highest strontium values were found in Wells 2 (3.8 mg/L), 9 (4.5 mg/L), and 18 (3.7 mg/L).

10) Lead was found at a concentration of 0.007 mg/L in the sample from Well 16 and at a concentration of 0.004 mg/L in the sample from background Well 23.

11) Nickel was found in concentrations ranging from 0.008 to 0.208 mg/L in 6 out of 10 wells during the 1995 sampling event. Nickel concentrations exceeded the MCL of 0.1 mg/L in the sample from Well 20 (0.208 mg/L).

12) Samples were collected from monitoring Wells 16, 20, and 22 for the analysis of boron, which ranged from 0.27 to 0.35 mg/L.

3.3.3 Trend Analysis

Appendix G presents time series graphs for selected parameters measured in the shallow and deep monitoring wells. Based on these time series graphs, statistical trend analysis was applied to TDS and sulfate data for Shallow and Deep aquifer wells and to strontium data for Wells 1, 2, 5, 11, 12, 13, and 22. The objective of the trend analyses was to detect and quantify changes in groundwater quality that might indicate decline or improvement in water quality beneath the White Bluff Plant. Most water quality time series contain a number of characteristics, or statistical complexities, that violate assumptions underlying standard parametric approaches to trend detection (e.g., linear regression methods). The Mann Kendall (MK) test was selected because it has been shown to be an effective approach for detecting trends in water quality time series (Gilbert, 1987), and it retains the general advantages of nonparametric approaches over

standard parametric approaches. The Mann Kendall statistic (MK) was applied to detect the presence of trends, and Sen's (1968) nonparametric slope estimator was applied to quantify the magnitude of those trends, where present. The analysis followed the methods in Gilbert (1987). The procedure is described in detail in Appendix H, along with trend analysis summary sheets for the tests conducted. Based on EPA guidance, trends were determined to be significant if the probabilities (P) were less than or equal to 0.01.

Significant decreasing trends in TDS concentrations were observed in Wells 7, 17, 18, and 21, ranging in magnitude from 23 to 258 mg/L per year. A significant increasing trend in TDS concentrations was detected at Well 10, increasing at a rate of 42 mg/L per year, with a 99% confidence interval of 5 to 133 mg/L per year. Significant trends were not observed in sulfate data or in wells where strontium data was analyzed.

3.5 Summary and Conclusions

The following summary and conclusions were based on a review of the 1995 data from the White Bluff Plant monitoring wells and are similar to conclusions found in previous Annual Reports.

1) The potentiometric surface maps drawn for the Shallow and Deep aquifers beneath the site support the supposition that monitoring Wells 1, 2, 23, 24 and 26, are located hydraulically upgradient of the facility.

2) Analytical results were generally within the range of values observed in previous years. Water quality varies beneath the site; however, this is expected given the size of the area being monitored (approximately 3 mi^2), and the low permeability and heterogeneity of subsurface materials.

3) As expected for lithologies in the Jackson Group, groundwater quality is poor and generally not suited as a potable water supply. TDS was higher than the 500 mg/L SMCL in 9 shallow wells (including background Well 24) and 5 deep wells. Sulfate

was higher than the 250 mg/L SMCL in 7 shallow wells (including background Well 24) and 5 deep wells (including background wells), and chloride was higher than the 250 mg/L SMCL in 2 shallow wells.

4) Results of statistical trend analysis indicate that plant operations are not degrading groundwater quality beneath the White Bluff facility. Out of the 24 wells where data was tested for trend detection, only Well 10 exhibited an increasing trend in TDS concentration. TDS concentrations are relatively low at Well 10, are at the lower end of the range of natural variability for the Jackson Group, and have exceeded the SMCL of 500 mg/L in only 11 of 19 sampling events during the past 5 years. The increasing trend in TDS concentration at this well is related to a leak in the cooling tower makeup line, which was discovered and repaired in 1995 (see Section 4.0).

5) Of the trace metals with MCLs that are monitored, lead was not detected at significant levels in groundwater beneath the site, and nickel exceeded the MCL in only 3 out of 24 wells sampled.

6) FTN's review of Entergy's groundwater monitoring operations have resulted in the following conclusions:

   a) Field and laboratory personnel associated with the operations are well trained and knowledgeable of the tasks (sampling and analytical) that they perform,

   b) The field equipment and laboratory instrumentation that is used is well maintained,

   c) System Chemistry personnel follow appropriate sampling and analytical protocols during the groundwater operations in the field and laboratory, and these protocols are documented.

d) Sampling activities (including field analyses and field QA/QC) are well organized, completed according to applicable guidance from EPA and Standard Methods, and are carefully documented; and

e) Analytical protocols and laboratory QA/QC are based on EPA accepted methodologies.

Based on the above conclusions and regional/historical groundwater data, the data generated by the System Chemistry groundwater monitoring operations/program are considered to be representative of groundwater quality at the White Bluff Plant.

4.0 PROGRAM CLOSURE

This section presents a summary of the 5-year groundwater monitoring program at the White Bluff Plant, including a review of program adjustments, the condition and trends in groundwater quality beneath the site, and the potential for offsite migration to domestic wells. Based on information that is presented in this section, the White Bluff Plant is notifying the agency that the facility's groundwater monitoring program has been terminated.

4.1 5-Year Program Summary

The White Bluff Plant initiated a formal groundwater monitoring program in 1991 to monitor the affects of the plant's operations on local groundwater quality. The groundwater monitoring network consists of 26 monitoring wells that were installed on site between 1989 and 1992 to monitor groundwater quality beneath the coal yard and plant site and to establish background conditions at the site. Monitoring wells were resurveyed in 1992 to verify horizontal and vertical control. Field sampling activities have been conducted in accordance with EPA guidelines, and laboratory analysis has conformed to 40 CFR Part 136.3 and SW-846. In 1992, the White Bluff Plant augmented the program by reviewing System Chemistry's QA/QC and field sampling programs on an annual basis. These independent reviews have been conducted to document adherence to the SAP and to support the reliability and validity of the data.

The 1991 program consisted of quarterly sampling and analysis of parameters listed in Table 4.1 with monthly measurements of water levels, pH, specific conductivity, and temperature. Several changes were made to the groundwater monitoring program in 1992 to generate more reliable data and to enhance the interpretation of the data. The improvements included the installation of additional monitoring wells and dedicated bladder pumps, the purchase of new field instruments, and improved field decontamination procedures and laboratory detection limits. Turbidity was added to the field parameter list, samples were collected for the analysis of both total and dissolved metals, and analysis of volatile and semivolatile compounds was reduced to a semi-annual frequency.

Table 4.1. 5–year summary of changes in the White Bluff Plant's groundwater monitoring program.

PARAMETER	1991	1992	1993	1994	1995
Field					
pH	M	M	Q	A	A
Conductivity	M	M	Q	A	A
Temperature	M	M	Q	A	A
Turbidity	--	M	Q	A	A
Lab					
TDS	Q	Q	Q	A	A
Sulfate	Q	Q	Q	A	A
Chloride	Q	Q	Q	A	A
Sodium	Q	Q*	Q	A	A
Nickel	Q	Q*	Q	A	A
Strontium	Q	Q*	Q	A	A
Lead	Q	Q*	Q	A	A
Boron	Q	Q	Q	--	A**
Volatile Organics Compounds	Q	S	A	A	--
Semivolatile Organics Compounds	Q	S	A	A	--
Calcium	Q	Q*	Q	--	--
Magnesium	Q	Q*	Q	--	--
Iron	Q	Q*	Q	--	--
Fluoride	Q	Q	Q	--	--
Nitrite & Nitrate	Q	Q	Q	--	--
Aluminum	Q	Q*	Q	--	--
Titanium	Q	Q*	Q	--	--
Molybdenum	Q	Q*	Q	--	--
Chromium	Q	Q*	Q	--	--
Mercury	Q	Q*	Q	--	--
Arsenic	Q	Q*	--	--	--
Selenium	Q	Q*	--	--	--
Cadmium	Q	Q*	--	--	--

Frequency Legend

M - Monthly
Q - Quarterly
S - Semi-annual
A - Annual

Notes: *Analysis of unfiltered and filtered samples.
-- Eliminated from program
** Selected wells

The purpose of adjustments in the 1993 program was to eliminate measurements or analyses that did not contribute significantly to an evaluation of hydrogeologic or water quality beneath the site. These program changes included the following:

- The frequency of water level measurements was reduced to quarterly because the configuration of the potentiometric surface in both aquifers had not changed from month to month;

- Arsenic, cadmium, and selenium were eliminated because these metals had not be detected in six quarters of sampling;

- The analysis of volatile and semivolatile organic compounds was reduced to an annual basis; and

- Analysis of filtered samples was discontinued except in wells where turbidity levels exceeded 100 NTU because data showed differences between dissolved and total concentrations in these wells.

In addition, sufficient data had been collected by the end of 1993 to statistically compare the groundwater quality in background and downgradient background monitoring wells.

The White Bluff Plant modified the program in 1994 by reducing the frequency of sampling to annually and selecting only those parameters that had been indicative of groundwater quality beneath the site including two metals from the original parameter list (Table 4.1). In addition, analysis of filtered samples had not improved the interpretation of data, so this analysis was eliminated and only totals reported. ADPC&E agreed with these changes in their letter dated July 12, 1994.

In 1995, the White Bluff Plant discontinued volatile and semivolatile organic analysis because the volatile and semi-volatile compounds that were monitored had not been found in groundwater beneath the facility in 4 years of sampling. Also, statistical trend analyses were used

to quantify changes in groundwater quality that might indicate a decline or improvement in water quality beneath the White Bluff Plant.

4.2 Groundwater Quality Beneath the White Bluff Plant

Groundwater quality beneath the White Bluff Plant is generally poor and not suitable as a drinking water supply. Water quality varies beneath the site; however, this is expected given the size of the area being monitored (approximately 3 mi^2), and the low permeability and heterogeneity of subsurface materials. The White Bluff Plant monitored organic compounds and metals for which EPA has established primary drinking water MCLs based on human health criteria. It was found that these organic compounds are not present in groundwater beneath the facility and metals are generally not present in significant concentrations. Nickel was the only metal found to periodically exceed the MCL in samples from some monitoring wells, including a background well.

Target zones for the groundwater monitoring program include the Shallow and Deep aquifers, which are found in the Jackson Group. Regionally, the Jackson Group is not considered to be an important aquifer because of low productivity and poor groundwater quality. Groundwater quality in the Jackson Group often exceeds secondary MCLs that were established by EPA based on aesthetic qualities, not human health criteria. Where large quantities of good quality water are needed in the outcrop area of the Jackson Group, it is usually necessary to drill deeper into the Cockfield Formation or Sparta Sand. Groundwater quality beneath the White Bluff Plant is within the range of natural variability for the Jackson Group and, as expected for lithologies in the Jackson Group, values for TDS, chloride, iron, and sulfate are higher than secondary MCLs in several White Bluff wells, including wells that monitor background conditions. Table 4.2 compares regional groundwater quality in the Jackson Group to groundwater quality beneath the White Bluff Plant. Based on information found in Terry et. al. (1986) and the USGS database for 68 regional wells completed in the Jackson Group, TDS ranges from 83 to 5,330 mg/L with an average of about 852 mg/L. Average specific conductance is about 839 μmhos and values range from 35 to 5,490 μmhos.

Table 4.2. Comparison of groundwater quality in the Jackson Group.

Parameter[1]	Jackson Group					
	Regional[2]		White Bluff Historical		White Bluff Background[3]	
	Min	Max	Min	Max	Min	Max
pH (su)	3.3	8	3.2	7.8	5.8	9.4
TDS (mg/L)	83	5,330	63	3,490	100	4,210
Sulfate (mg/L)	1.4	2,400	5.2	1,883	11.6	2,898
Chloride (mg/L)	1.8	850	0.2	1,110	2.7	143
Sodium (mg/L)	2.2	450	7.7	384	8.0	197

[1]Concentrations in mg/L unless otherwise noted.
[2]Data for 68 wells sampled between 1949 - 1966 was provided by the USGS.
[3] Range of values for monitoring Wells 23, 24 and 26

Concentration ranges for sulfate and chloride are 1.4 to 2,400 mg/L and 1.8 to 850 mg/L, respectively. Sodium can be found as high as 450 mg/l, pH ranges from 3.3 to 8.0 su, and iron ranges from 0.1 to 19 mg/L. Hardness ranges from 4 to 2,620 mg/L and averages about 379 mg/L, indicating that water from the Jackson is generally hard.

ANOVA and post-ANOVA comparisons of groundwater quality in background and downgradient monitoring wells during 1993 and 1994 suggested plant activities may have affected groundwater quality near the Cooling Towers (Wells 1&2), beneath the Coal Storage Yard (Well 5), near Lake Shugar (Well 18), and in the vicinity south of the Recycle Ponds (Well 20). The 1995 statistical trend analysis did not indicate degrading groundwater quality in these areas, but actually showed improving groundwater quality conditions (i.e., TDS concentrations) at Well 18.

The TDS trend analysis showed a decline in groundwater quality at only one of 24 monitoring well locations (i.e., Well 10). The mean TDS concentration in this well is 550 mg/L, which is approximately eight times lower than maximum TDS concentrations observed in background wells. Well 10 is located hydraulically downgradient and east of Cooling Tower Unit 1 and is completed in the Shallow aquifer. The White Bluff Plant discovered a leak in a 24-inch carbon steel water line that provides makeup water to the cooling tower. The ruptured section of water line is located upgradient of Well 10 at a depth of approximately 15 feet below ground surface. This leaking underground water line is the most likely source of increasing TDS concentrations observed in Well 10. In November 1995, the White Bluff Plant repaired and replaced a 60- foot section of the corroded water line. This effort to mitigate leakage from the water line will improve the quality of groundwater in the vicinity of Well 10.

As shown on potentiometric maps for the Shallow aquifer, groundwater flows from Well 10 toward the Recycle Ponds, Sedimentation Ponds, Clear Water Holding Pond, and Wells 21&20, a total distance of approximately 3,500 feet; then it discharges to Lipscomb Spring Branch. Degrading trends in groundwater quality were not observed in the data from Wells 21&20, which are located approximately 2,500 feet downgradient of Well 10.

4.3 Potential for Offsite Groundwater Degradation

The White Bluff groundwater monitoring program was launched out of concern for potential adverse effects of plant activities on residential wells located south of the facility. To assess potential risks associated with degradation of offsite groundwater quality from plant activities, the White Bluff Plant identified groundwater users in the vicinity of the plant (FTN 1994). The study concluded that the migration of groundwater from areas beneath the site to Jackson wells within 1 mile of the plant site or to wells completed in the Cockfield and Sparta aquifers is highly improbable for the following reasons:

- The plant is within a hydrologically isolated system that is bounded laterally by the Arkansas River and streams that receive groundwater flows that subsequently discharge to the Arkansas River.

- The Deep aquifer is bounded below by approximately 150 to 200 feet of thick, low permeability materials of the Jackson Group; therefore, poor groundwater quality is unlikely to affect the quality of groundwater in domestic or industrial wells completed in the underlying Cockfield or Sparta aquifers. The confining features of the Jackson Group are further demonstrated by the 1969 potentiometric surface of the Cockfield, which, if it were the same today, would be above land surface in many places at the plant site (Geraghty & Miller, Inc., 1984)

- FTN identified six domestic wells that were located approximately 0.7 mile south of the facility boundary (see Figure B.2, Appendix B). Well construction data for these wells was not found; therefore, it could not be determined if these wells were completed in the Jackson Group or the deeper Cockfield and Sparta aquifers. These wells are located on the opposite side of a hydrologic boundary (i.e., Love Creek) and on the surface water divide between the Love Creek and Carver Mill Creek watersheds. Consequently, even if these wells were completed in the Jackson Group they would likely not be affected by plant activities.

4.4 Program Closure

The White Bluff Plant believes there is sufficient justification for termination of its groundwater monitoring program. The rationale for this request is summarized, as follows:

- Although statistical analyses suggest plant activities may have affected groundwater quality beneath the site, these effects are within the range of natural variability for the Jackson Group;

- Plant effects have not resulted in significant degradation in groundwater quality beneath the site; and

- Migration of poor quality groundwater from areas beneath the site to Jackson Group wells within 1 mile of the plant site or to wells completed in the Cockfield and Sparta aquifers is highly improbable.

The White Bluff Plant plans to decommission monitoring wells that compose the groundwater monitoring network during June 1996.

5.0 SELECTED REFERENCES

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Appendix A

Sampling and Analysis Plan

INDEPENDENCE AND WHITE BLUFF STEAM ELECTRIC STATIONS
GROUNDWATER MONITORING PROGRAMS
1993 SAMPLE AND ANALYSIS PLAN

1.0 INTRODUCTION

This Sample and Analysis Plan will govern activities associated with the groundwater monitoring programs for the White Bluff and Independence Steam Electric Stations. Elements of this S&A plan include procedures and techniques for sample collection, sample chain-of-custody control and field and laboratory quality assurance/ quality control procedures.

2.0 SAMPLE COLLECTION PROCEDURES

2.1 SAMPLING AND ANALYSIS PERSONNEL

Entergy power plant and Entergy Services. Inc. (ESI) System Chemistry personnel will determine water levels and acquire groundwater samples from monitoring wells installed at White Bluff and Independence Steam Electric Stations.

Field and laboratory analyses will be conducted by Entergy power plant and/or System Chemistry personnel. Contract laboratories may be utilized for some analytical parameters.

It is recognized that the quality of analytical data derived from any environmental monitoring is heavily dependent upon the expertise of the involved personnel. Therefore, all personnel involved in the acquisition and analysis of samples associated with the groundwater monitoring projects shall be trained for the task to which they are assigned and be thoroughly familiar with the elements of this S&A Plan.

2.2 SAMPLING FREQUENCY

Frequency of sampling for chemical characterization of groundwater is to be quarterly. Piezometric readings and gross water quality field analyses (pH, specific conductivity, and temperature) will be performed quarterly. If analytical results for a sample acquired from a given well indicates significant changes, the affected well(s) will be re-sampled as soon as practicable in order to verify the data.

2.3 SAMPLING METHODOLOGY

Major activities that will occur during a groundwater sampling event are summarized as follows:

- Schedule sampling date with power plant staff
- Assembly and preparation of equipment and supplies
- Groundwater field measurements and sampling
- Sample preservation and transport
- Field data/chain-of-custody record archiving
- Sample analysis
- QA\QC and sample analytical data evaluation
- Data archiving (QA\QC and sample analytical results)
- Comparison of upgradient/downgradient well data
- Report generation

2.3.1 Scheduling of Sampling Date

Efforts will be made to have quarterly well sampling events occur on approximately the same date during each month. However, power plant /System Chemistry activities and/or weather conditions may occasionally necessitate slight deviations from this schedule.

2.3.2 Assembly and Preparation of Equipment and Supplies

2.3.2.1 Field Instrumentation and Sampling Apparatus

Prior to each sampling event, all required equipment will be inventoried and verified to perform to manufacturer's specifications. Any test equipment requiring repair that cannot be performed by the operator should be removed from service and alternate equipment substituted. Defective equipment should be repaired or replaced as soon as possible.

2.3.2.2 Equipment Decontamination

Prior to each sampling event all apparatus and equipment that will contact or contain the sample will be thoroughly cleaned before use unless purchased "EPA clean". EPA cleaning protocols will be used where practicable with the following materials:

- All sample containers except volatile organic compounds; and sample bailer and bailer cable initial cleaning.
- Sample containers for volatile organic chemicals
- Electronic water level indicators should be rinsed with Type I distilled water before use and between wells.

- Membrane filters for trace metal sample filtration will be purchased as disposable preassembled units. Tygon tubing for the peristaltic pump will be cleaned using EPA general cleaning procedure with the omission of the hexane rinse and packaged in individual plastic bags.
- Garden sprayers used for field cleaning apparatus should be emptied and refilled with fresh demineralized water immediately before a sampling event. Note: these sprayers are to be filled with de mineralized water only.

2.3.2.3 Sample Container Kit and Field Notebook Preparation

As a part of each sample trip preparation, a sample log sheet will be generated that will assign each location a discrete laboratory sample identification number. The sample identification number consists of a five-digit number. The first two digits from the left correspond to the sample year and the remaining three digits are arranged 001-999 in consecutive order. Therefore, 93001 would correspond to the first sample acquired during 1993. The sample log sheet is archived in the System Chemistry sample groundwater log book.

The sample log sheet is then used to generate a container label packet for each sample location. These labels will bear the following information:

1. Site name.
2. Location name.
3. Container fill order
4. Laboratory sample I.D. number
5. Analytes to be measured
6. Date sampled
7. Collection time
8. Sample team
9. Sample holding time
10. Sample expiration date
11. Remarks-- preservatives, storage temperature, or special consideration in collection

A copy of the site map for the facility being sampled will be obtained and a sampling strategy determined. Once the well sampling sequence is finalized, the map will be marked to correlate the sample location to the ice chest that will contain the corresponding sample container kit. A copy of the sample log sheet, site map, field date sheets and field instrument calibration sheets are then assembled into a notebook that will accompany each sampling team into the field and will be archived as a permanent record upon returning to the laboratory.

The required sample preservatives will be added to the cleaned sample

containers and the containers will be grouped into the appropriate type and number for each sample location. Each sample container in the group will be labeled and the cap verified to be tightly sealed. Sample bottles containing nitric acid as a preservative shall be sealed in a plastic bag. This is done as a precaution against breakage and to ensure isolation of any acid vapor from the other sample containers. 2.5 -liter amber glass jugs for containing semi-volatile organic samples should be placed in either a bubble-pak ziplock bag, covered with bubble-pak plastic or placed inside protective plastic webbing as protection against breakage. Volatile organic sample containers should be placed in a bubble-pak pouch as a precaution against breakage. All the containers within each sample location group will then be placed in a plastic bag marked with the sample location on the outside and will be placed into the appropriate ice chest as determined by the sampling sequence. The outside of each ice chest will be marked so as to identify the groups contained within.

2.3.3 GROUNDWATER SAMPLING

2.3.3.1 Well Evacuation/Sample Collection Equipment

Monitoring well will be evacuated utilizing either fluorocarbon resin (Teflon) bailers attached to polypropylene rope or bladder pumps with Teflon-lined discharge lines. Bailer and rope assembly will be thoroughly rinsed before beginning sampling and between well with Type I demineralized water and housed in a PVC tube for transport between wells and for storage. Groundwater samples will be collected using teflon bailer and cable assembles dedicated to the individual well. Sample collection assemblies will be stored in situ suspended in the well casing between sampling events.

2.3.3.2 Well Head Security

All monitoring wells will be protected by installation of a locked steel overcap that is anchored into the concrete apron surrounding the casing. Access to the lock key shall be restricted only to personnel directly involved in the monitoring project in order to protect the integrity of the monitoring point. The security cap will remain locked in place between sampling events.

2.3.3.3 Field Testing Instrumentation Calibration

All field testing equipment will be calibrated at the first well head in the following manner:

- pH meters will be calibrated to commercially prepared buffers at the pH 4.00, 7.00, and 10.00 S.U. levels.

- Conductivity meters will be calibrated the 75, 200, and 720 uohm activity levels with commercially available conductivity standards.

- Turbidity meters will be calibrated to 0.1, 1.0, 10.0 and 100.0 NTU Formazin turbidity standards.

- Temperature readout of meters will have been verified against NIST-traceable thermometers prior to use.

- "Electric tape" water level measurement devices will be verified to be in working order.

All field instrumentation calibration data will be recorded on the calibration log forms contained in the field data notebook.

2.3.3.4 Well Evacuation and Sampling Methodology

Prior to opening the well casing cover all debris is removed from the vicinity of the well. A new clean plastic trash bag will be placed over the well casing and secured to the top with duct tape so that only the interior of the casing is visible. This will prevent the contamination of equipment that inadvertently contacts the outside of the casing.

Applicable data (date, time, etc.) will be entered on the well survey report form for the well being sampled.

The well casing cap will be removed and any odors emanating from the casing interior will be noted on the well survey report form. Every person handling sampling equipment will don a clean pair of disposable latex (or similar) gloves.

2.3.3.5 Water Level Measurement

Depth below ground-level to the top of the water column is determined by lowering the electric tape probe until the annunciator and/or indicator light illuminates. Depth is determined by comparing relative positions of gradations on the tape to the survey benchmark on the top rim of the well casing. This reading is recorded on the well survey report form to the nearest 0.01 feet. The electric tape is withdrawn from the casing and the probe examined for any evidence of low-density organic compounds (floaters) and their presence noted on the well survey report form.

2.3.3.6 Well Bore Evacuation

In order to ensure collection of a representative groundwater sample, "stagnant" water will be removed from the well bore. This will be accomplished by removing three well water column volumes of water from the well casing in high yield aquifers or by bailing until dry in wells in low yield formations (Note: do not allow recharge water to cascade in well.) The quantity of water required to be purged from the well will be calculated according to the formula on the well survey report form. When using bladder pumps to purge the well casing the discharge rate of the pump should be determined and time on/time off noted in order to verify removal of the required water volume. If warranted, water purged from the wells will be collected and transported to the facility waste water processing system.

2.3.3.7 Sample Extraction

When extracting the sample, the bailer will be lowered gently to minimize splashing and retrieved from the water surface slowly to minimize surface agitation or vacuum formation in the water column. The first bailer volume removed for sampling shall be analyzed for pH, specific conductivity, temperature and turbidity. These values will be recorded on the well survey report form. Subsequent bailer volumes will be utilized for laboratory analysis. Sample containers will be filled in the following order:

- Volatile organics (VOA)
- Semi-volatile organics
- Trace metals
- Unpreserved (including total alkalinity)
- Nitrate

Sample containers will be filled completely full to minimize headspace so as to preclude volatilization of organic compounds.

Sample containers will be tightly sealed, replaced in any protective overwrap, replaced in plastic kit bag and returned to ice chest. Upon filling all kits within an ice chest, ice (in bags) will be placed on top of samples and maintained until transported to the System Chemistry laboratory where they will be

stored at < 4.C.

3.0 SAMPLE CHAIN-OF CUSTODY

3.1 SAMPLE CONTAINER SEALS

Since the samples will remain in ESI System Chemistry's custody from acquisition until analysis, the use of security seals is deemed unnecessary.

3.2 FIELD LOGBOOK

A field logbook containing the well survey report forms for the well to be sampled will be an integral part of the required sampling supplies.

3.3 SAMPLE CHAIN-OF CUSTODY

If samples are retained in ESI custody from acquisition through analysis, the well survey report will suffice as a chain-of-custody document. However, if a sample is submitted to an independent analytical laboratory for analysis, a sample chain -of-custody record will be required from that laboratory. All well survey reports and contract laboratory sample chain-of-custody forms will be archived as permanent records.

3.4 ANALYSIS NOTEBOOKS

All phases of sample preparation and analysis, including extractions and digestions, will be documented in analysis notebooks for each analytical parameter and archived as permanent records.

4.0 GROUNDWATER SAMPLE ANALYSIS

4.1 ANALYTICAL PROCEDURES

All procedures for the analysis of groundwater samples obtained in support of this project shall conform to the United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, SW-846 , Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Vols. IA, IB, IC, AND II, Third Edition, Rev.1, December 1987 or equivalent as specified by 40CFR part 136. Specific analytical parameters, SW-846/40 CFR Part 136 procedure reference numbers and PQL's are designated in Attachment I .

5.0 FIELD AND LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Project analytical data validation shall begin with the initial phases of preparation, follow throughout every phase of a sampling event and will consist of the following:

- Sampling and analysis procedure training
- Field instrumentation operational status verification
- Preparation of trip blanks. field spike samples and field blanks
- Field instrumentation calibration documentation
- Documentation of field activities on the well survey report
- Documentation and justification on the well survey report of field sampling activities contrary to the S&A plan.
- Sample chain-of custody documentation
- Audit of independent analytical laboratory QA/QC, analytical, and sample handling/storage procedures if necessary

5.1.1 SAMPLING AND ANALYSIS PROCEDURE TRAINING

Personnel involved in the sample acquisition and/or sample analysis phase of this project shall review all components of the S&A Plan and receive "hands on" training on the task for which they are responsible.

5.1.2 PREPARATION OF TRIP BLANKS, FIELD SPIKES AND FIELD BLANKS

It will be required to prepare trip blank , field spike and field blank samples for every sampling event. These samples are prepared as follows:

5.1.2.1 Trip Blank

Prepared by adding laboratory Type I deionized water to a kit of cleaned sample containers with all preservatives added. These containers will be placed in their respective ice chests upon departure to the plant site and shall accompany the other samples through all phases of sample storage, preparation and analysis. This provides a check on container cleaning, sample storage and sample processing techniques.

5.1.2.2 Field Spikes

Prepared by adding, to half capacity, commercially (or EPA) prepared multi-element inorganic check standards to a kit of clean sample

bottles containing all required preservatives. Sample containers will be placed in ice chests and upon arrival at a previously selected well head will be filled to capacity during sample collection at that location. Wells selected for the spike sample will be rotated quarterly until all wells have been included. The cycle will then be repeated. Field spikes will accompany the other samples throughout all phases of sample storage, preparation and analysis.

5.1.2.3 Field Blanks

Prepared by adding Type I deionized water that is transported from the ESI System Chemistry Laboratory to the plant site into a kit of cleaned sample bottles containing all required preservatives at a preselected well head. Sample bottles are transported to the site in their respective ice chests, filled and then returned to the ice chests and shall accompany the other samples through all phases of sample storage, preparation, and analysis.

5.1.3 DOCUMENTATION OF FIELD INSTRUMENTATION CALIBRATION

Field instrumentation calibrations will be performed at the first well head prior to being used during a sampling event. Calibrations will be performed according to manufacturer's specifications and the results will be recorded on the instrument calibration log sheet. These logs will be archived as permanent records.

5.1.4 DOCUMENTATION OF FIELD ACTIVITIES

All field activities and measurements will be recorded in the appropriate space on the well survey report. These reports will be archived as permanent records.

5.1.5 DOCUMENTATION AND JUSTIFICATION OF ACTIVITIES CONTRARY TO THE PROJECT S&A PLAN

Any deviation from the S&A Plan during a sample event shall be documented in the comments section of the well survey report form. This documentation will include justification for the deviation. Unusual circumstances should also be noted on the well survey report (e.g., plant maintenance activities that could influence field readings and/or analytical results.

5.1.6 SAMPLE CHAIN-OF-CUSTODY DOCUMENTATION

Sample chain-of-custody documentation will be required for sample analysis by independent analytical laboratories and will be archived as a permanent record.

5.1.7 AUDIT OF INDEPENDENT ANALYTICAL LABORATORIES

If independent analytical laboratories are utilized for the analysis of samples from this project, periodic audits will be conducted. Scope of these audits should include sample chain-of-custody integrity; procedures for sample storage, preparation and analysis; and laboratory QA/QC procedures. Results of these audits will be compiled as a report and archived as a permanent record.

5.2 SYSTEM CHEMISTRY WATER QUALITY LABORATORY QA/QC PROCEDURES

The analytical laboratory portion of the QA/QC for the groundwater monitoring project shall consist of the following individual components:

- Utilization of EPA-approved procedures
- Analytical procedure training
- Laboratory instrumentation's maintenance/calibration procedures
- Verification of sample extraction/concentration procedures
- Utilization of multiple point calibration curves
- Utilization of surrogate compounds and internal standards in the analysis of organic compounds
- Utilization of BFB and DFTPP GC/MS tuning
- Maintenance of an organic analysis extraction log
- Analysis of intralaboratory (accuracy) standards
- Analysis of duplicate (precision) samples
- Analyses of matrix spikes
- Computerized statistical inorganic QA/QC data comparison utilizing +/- two sigma warning limits and +/- three sigma control limits
- "Blind" analysis of commercially prepared inorganic quality control standards quarterly

5.2.1 UTILIZATION OF EPA APPROVED PROCEDURES

EPA SW-846 analytical methods or equivalent as approved under 40 CFR Part 136 shall be used for all analyses performed in support of this groundwater monitoring project.

5.2.2 ANALYTICAL PROCEDURE TRAINING

All personnel involved in the analysis of samples acquired in support of this project shall be thoroughly trained for the task to which they are assigned.

5.2.3 VERIFICATION OF SAMPLE EXTRACTION/CONCENTRATION PROCEDURES

All extraction/concentration procedures, distillations and digestions shall be verified to provide sufficient analyte recovery through the utilization of field spikes, surrogates, and matrix spike samples.

5.2.4 STANDARD CALIBRATION CURVES

A minimum of four calibration points will be utilized for all calibration curves. New calibration curves will be generated for each sample batch. Reagent blank corrections shall be made where applicable. All calibration curves shall be archived as permanent records.

5.2.5 USE OF SURROGATE AND INTERNAL STANDARDS

Surrogate and internal standards shall be utilized for all GC/MS determinations.

5.2.6 USE OF EPA GC/MS TUNING CRITERIA

GC/MS system shall be tuned to BFB and DFTPP acceptance criteria for the analysis of volatile and semi-volatile organic compounds, respectively.

5.2.7 USE OF GC/MS SYSTEM PERFORMANCE CHECK STANDARDS

GC/MS system will be evaluated using the system performance check standards prior to the analysis of each sample batch.

5.2.8 ORGANIC CHEMICAL ANALYSIS EXTRACTION LOG

A log shall be maintained of samples extracted for semi-volatile organic compound determinations. Sample status will be tracked using laboratory sample log numbers.

5.2.9 ANALYSIS OF INTRALABORATORY ACCURACY QUALITY CONTROL STANDARDS

Intralaboratory accuracy standards shall be prepared using standard reference materials as solutes. Analytes will be prepared as combined standards in synthetic matrices if feasible. Otherwise, the material will be dissolved in Type I reagent water as individual standards. Accuracy standards shall be analyzed after every eighth sample or every time analyses are performed if batch size is less than eight.

5.2.10 ANALYSIS OF DUPLICATE PRECISION SAMPLES

Every eighth sample collected in a sampling event shall be a duplicate and shall serve as a precision check for all aspects of sample storage, preparation and analysis.

5.2.11 ANALYSIS OF MATRIX SPIKES

Matrix spikes shall be prepared by diluting accuracy standards in a 1:1 ratio with duplicate standards. These analyses shall provide information of matrix effects on analyte recovery.

5.1.12 STATISTICAL TRACKING OF QA DATA

Inorganic accuracy, precision ad matrix spike quality control data will be statistically evaluated at the +/- two sigma warning and +/- three sigma control limits utilizing computer software.

5.1.13 ANALYSIS OF COMMERCIALLY PREPARED QUALITY CONTROL STANDARDS

Commercially (or EPA) prepared inorganic wastewater/drinking water quality control check standards shall be analyzed once per quarter on a "single blind" basis when available.

6.0 DATA EVALUATION AND REPORTING

6.1.1 Reporting of Low and Zero Concentration Values

Detection limits for analytical parameters monitored by this project are specified in Attachment I. These limits will be consistently applied to analytical data generated between sample locations as well as between sampling intervals.

6.1.2 Statistical Analysis of Data

Statistical evaluation methods will be applied to the analytical data derived from these programs upon acquisition of an adequate data population.

6.1.3 Report Frequency

1993 annual reports for these programs will be generated during the first quarter of 1994 and delivered to the appropriate people upon completion.

7.0 PLANNED 1993 PROGRAM ADJUSTMENTS

Prior to 1993, water level adjustments were made on a monthly basis. However, in 1993 water level measurements shall be performed once per calendar quarter at both ISES and WBSES during a twenty-four hour period, and preferably during an eight hour span at each plant.

Groundwater samples shall not be filtered for metals analysis at either plant site unless the turbidity exceeds 100 NTU.

Mercury analyis of groundwater samples from ISES shall be discontinued and cadmium, selenium, and arsenic analysis of groundwater samples from WBSES shall be discontined because analysis of these metals have historically been at or below the detection limits set for these parameters.

ENTERGY SERVICES, INC., SYSTEM CHEMISTRY
ANALYTICAL PROCEDURES REFERENCE LIST
1993 INDEPENDENCE AND WHITE BLUFF SES GROUNDWATER MONITORING PROGRAMS

PARAMETER	PROCEDURE NUMBER	40 CFR PART 136/SW-846 TEST METHODS FOR EVALUATING SOLID WASTES REFERENCE METHODS	PQL (mg/L)
		COLORIMETRIC/GRAVIMETRIC/TITRATION	
BORON, FILTERED	212.3	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.20
CHLORIDE,FILTERED	407.A	STD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER	1.0
FLUORIDE, FILTERED	340.2	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.20
NITRATE-NITRITE (SCREEN)	4500D	STD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER	0.50
SULFATE,FILTERED	600/4-79-020	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	5.0
TOTAL DISSOLVED SOLIDS	160.1	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	1.0
		TRACE METAL PROCEDURES (TOTAL METALS, unless turbidity exceeds 100 NTU)	
ALUMINUM	7020	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.10
IRON	7380	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.1
MOLYBDENUM	7481	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.025
TITANIUM	283.2	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.025
ARSENIC	7060	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.005
CADMIUM	7131	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.001
CALCIUM	7140	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	1.0
CHROMIUM	7191	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.005
LEAD	7421	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.001
MAGNESIUM	7450	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	1.0
MERCURY	7470	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.0005
NICKEL	249.2	EPA-- METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES	0.005
SELENIUM	7740	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	0.005
STRONTIUM	I-1800-85	USGS-- METHODS FOR DET. OF INORG. SUBST. IN WATER AND FLU. SED.	0.01
SODIUM	7770	EPA-- SW-846 TEST METHODS FOR EVALUATING SOLID WASTES	1.0

Appendix B

Site Geology and Hydrogeology

APPENDIX B
SITE GEOLOGY AND HYDROGEOLOGY

The purpose of this appendix is to provide background information on local and site geology and hydrogeologic characteristics. This section also repeats information that has been presented in previous annual reports and is included to facilitate the reader's review of the current annual report.

B.1 Site Geology

The White Bluff plant is located on a bluff overlooking the Arkansas River. The surface topography ranges in elevation from 230 to 375 feet National Geodetic Vertical Datum (1929) (NGVD). Before plant construction the surface was rolling hills with some steep slopes. During construction, the plant site was graded by cutting and filling. The site is highly dissected by small creeks and branches that drain primarily south and east to the Arkansas River.

The geologic units underlying the plant consist of unconsolidated Quaternary deposits overlying thick (up to 3,500 feet) Tertiary sediments, of which the Jackson Group is the upper geologic unit. Table B.1 is a stratigraphic column that summarizes the sedimentary units beneath the White Bluff plant.

The Quaternary terrace deposits consist of thin beds of silty and sandy clay that cover the crest of hills with a thickness of up to 30 feet. These deposits have been eroded from the stream valleys and modified by grading of the plant site during construction.

The Jackson Group consists of the Redfield and White Bluff Formations, which consist primarily silty and sandy clay beds with sand and thin lignite beds. Depending on the location and elevation at the plant site, the Redfield Formation is between 90 to 150 feet thick. The White Bluff Formation is about 60 to 100 feet thick. The formation is reported to consist mostly of clay or sandy clay and may have more sand than the overlying Redfield Formation.

Table B.1. Stratigraphic column of geologic formations underlying the White Bluff plant.

System	Series	Geologic Unit		Lithology	Approximate Thickness (Feet)
Quaternary	Pleistocene	Terrace deposits		Silt, sand, clay with gravel	0 to 30
Tertiary	Eocene	Jackson Group	Redfield Formation of Wilbert (1953)	Clay and silt, lignite, and minor amounts of fine sand	90 to 150
			White Bluff Formation of Dall (1898)	Very fine to fine argillaceous sand; fossiliferous silt and clay; in southeast corner of Grant County contains much more clay	60 to 100
		Claiborne Group	Cockfield Formation	Sand, fine to very fine, and Carbonaceous clay	150 to 200
			Cook Mountain Formation	Clay, carbonaceous, sandy; locally glauconitic; contains beds of sand 10-30 feet thick	150 to 200
			Sparta Sand	Sand, medium to very fine; little sandy lignitic clay. Sand occurs as much as 300 feet thick in Grant County; in Hot Springs County, in beds commonly 20-60 feet thick; and in places, 100-feet thick	400 to 500
			Cane River Formation	Clay, lignitic, sandy, and fine sand. Sand occurs commonly in beds 20-60 feet thick; in places, 150 feet thick	150
			Carrizo Sand	Sand, very fine to medium, and carbonaceous lignitic clay. Sand occurs commonly in beds 20-60 feet thick; in places, 150 feet thick	150

Modified from Geraghty and Miller (1984)

The Claiborne Group underlies the Jackson Group and includes the Cockfield Formation, Cook Mountain Formation, Sparta Sand, Cane River Formation, and the Carizzo Sand. Table B.1 provides a brief description of these geologic units. These formations are not included in the groundwater monitoring program. Both the Cockfield Formation and Sparta Sand, however, are regional aquifers. The Cockfield aquifer, which is confined above by the Jackson Group and below by the Cook Mountain Formation, is reported to yield up to 25 gpm to wells. The Sparta aquifer has been used for potable water supply since the early 1900s. Two production wells at the plant produce water from the Sparta aquifer. The groundwater is used for boiler make-up by demineralization, potable water, and sanitary waste system water. Each well is capable of producing 1,000 gpm, and they are pumped alternately with an equivalent pumpage of about one full-time well.

B.2 Target Zones in the Jackson Group

Geraghty and Miller (1984) used the logs of soil borings that were prepared as part of the plant construction program to describe site subsurface geology to a depth of about 60 feet. They identified two silty sandy units in the Jackson Group as target zones and referred to these zones as the "260-foot sand" and the "230-foot sand." These sand units are reported to be 5 to 15 feet thick and are identified by the approximate elevation at which they occur in the section. These sand units were thought to be uppermost aquifers beneath the site, and subsequent groundwater monitoring reports refer to a "260-foot Aquifer" and a "230-foot Aquifer." The 260-foot sand was expected to be the principal conduit for potential contaminants because of its area of occurrence and proximity to the land surface. This annual report largely drops these references and refers to "shallow" and "deep" aquifers instead. An explanation for this change in designation follows.

Figure B.1 shows the relative position of the sand zones on a cross section prepared by Geraghty and Miller (1984). The section is drawn north-south through the plant site near Wells 1 and 2. This cross section clearly shows the existence of two layers of sand; however, the shallowest sand layer is at an elevation of 280 feet national geodetic vertical

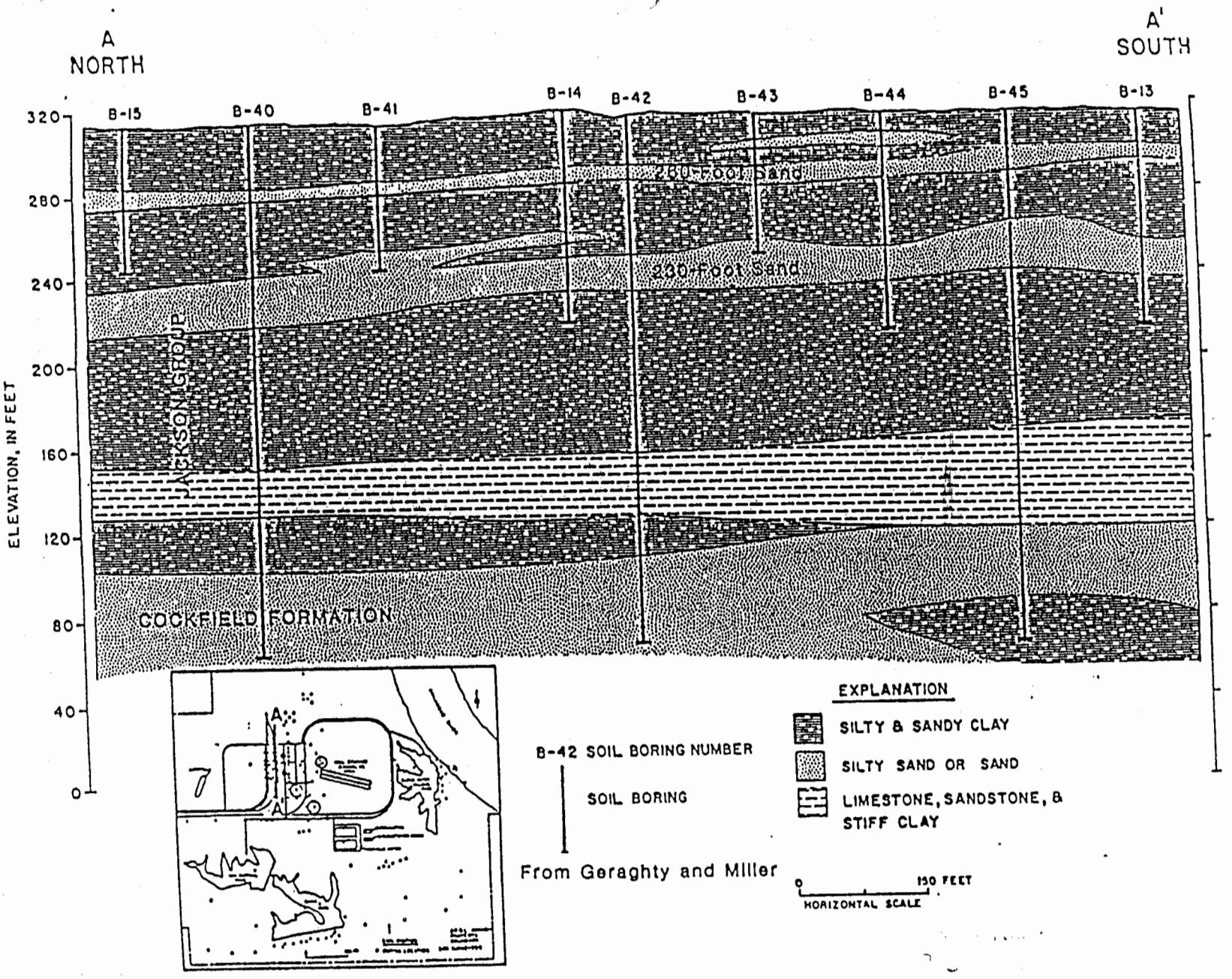


Figure B.1. Geologic cross section beneath the White Bluff plant showing relative positions of the 260-ft and 230-ft sands.

datum (NGVD) and the next unit below that is between 230 and 260 feet (NGVD); that is, there are no distinct "260-foot" and "230-foot" sand layers shown on this section. Furthermore, subsequent drilling for the installation of monitoring wells indicate the presence of sand units between 260 feet (NGVD) and approximately 320 feet (NGVD), but a well defined sand unit at an elevation of 230 feet (NGVD) does not occur, except at the location of Well 22.

Based on the boring logs and well construction data for the plant's monitoring wells, the first two saturated zones that were encountered during drilling were screened for the purpose of groundwater monitoring with lesser importance given to the actual elevation of the saturated zone. For example, monitoring wells screened in the "260-foot aquifer" have screen midpoint elevations from 257 to 281 feet (NGVD). Descriptions of this aquifer include:

- "medium, dense, silty fine sand with lignite partings,"
- "stiff, dark gray, fine sandy clay with light gray fine sandy silt partings,"
- "stiff clay with fine sand partings and pockets," and
- "dense, gray, clayey [or] silty sand."

The "260-foot sand" extends laterally from the plant site but varies in thickness and character and outcrops along the hillsides north, east, and south of the plant area. The sand tends to thin in the direction of the Ash Disposal Area and extends only a short distance downgradient of the plant site.

The "230-foot aquifer" is described as "alternating seams and layers of gray clay and fine gray sand with traces of lignite" at most of the well sites. The screen midpoint elevations of these wells range from 199 to 248 feet (NGVD). The only "sand" layer shown on the boring logs for this aquifer is a 5-foot sand that occurs at an elevation of 234 feet (NGVD) in Well 22. The three wells closest to Well 22 were completed at elevations well below 230 feet (NGVD) without encountering the sand unit observed at Well 22; therefore, this sand unit does not appear to be laterally extensive.

Because the plant's wells monitor the two uppermost saturated zones beneath the site and the "260-foot" and "230-foot" sands are discontinuous, or these sands are not well defined with respect to their approximate elevation, the target zones are referred to as the "shallow" and "deep" aquifers. Neither the shallow nor the deep aquifers produces enough water for use as a water supply, and groundwater from these units discharges from seeps in ravines and hillsides and eventually discharges as surface runoff to the Arkansas River.

B.3 Groundwater Users

To address potential risks associated with degradation of offsite groundwater quality from plant activities, if any, existing groundwater users in the vicinity of the plant were identified in 1993. The survey involved collection of information from various sources and field verification. User data was obtained from a search of well installation records maintained by the Arkansas Geological Commission and later field verified. Table B.2 lists groundwater users within a mile radius of the facility, provides some well information, and indicates if the well is used for domestic water supply or other purpose. The table also indicates observations that were made during field verification. As shown on Figure B.2, there are 6 domestic wells located 0.7 to 0.8 mile south of the property boundary on the downgradient side of the plant. Well construction data concerning depth of completion for these wells were not found; therefore, it can not be determined if these wells were completed in the Jackson Group or deeper aquifers.

Table B.2. Groundwater users located in the vicinity of the White Bluff plant.

Map Identifier	Location	Owner	Distance from site Feet (Miles)	Well Depth	Well Type	Production Rate (GPM)
1a	T3S, R11W, S25	Brown & Root	Inside Property	636.2	Monitoring	1000
2a	T3S, R11W, S27	Odis Perry	8648 (1.6)	60'	Domestic	3.33
3a	T3S, R11W, S2	George Brittian	7449 (1.4)	435'	Domestic	60
4a	T3S, R10W, S30	Holloway Construction Co.	Inside Property	443'	Domestic	12
5a	T3S, R10W, S32	Lock & Dam 5	2125 (0.4)	552'	Other	25
6b	T4S, R10W, S5	NA	3473 (0.7)	NA	Domestic	NA
7b	T4S, R10W, S5	NA	3491 (0.7)	NA	Domestic	NA
8b	T4S, R10W, S5	NA	4170 (0.8)	NA	Domestic	NA
9b	T4S, R10W, S5	NA	4277 (0.8)	NA	Domestic	NA
10b	T4S, R10W, S6	NA	4852 (0.9)	NA	Domestic	NA
11b	T3S, R10W, S34	NA	1292 (0.3)	NA	Domestic	NA
12b	T3S, R10W, S34	NA	1673 (0.3)	NA	Domestic	NA
13b	T3S, R10W, S4	Cliff Locell	4083 (0.8)	NA	Domestic	NA

a - Sources: Arkansas Geological Commission well construction logs.
b - Field Identified.
NA - Not Available

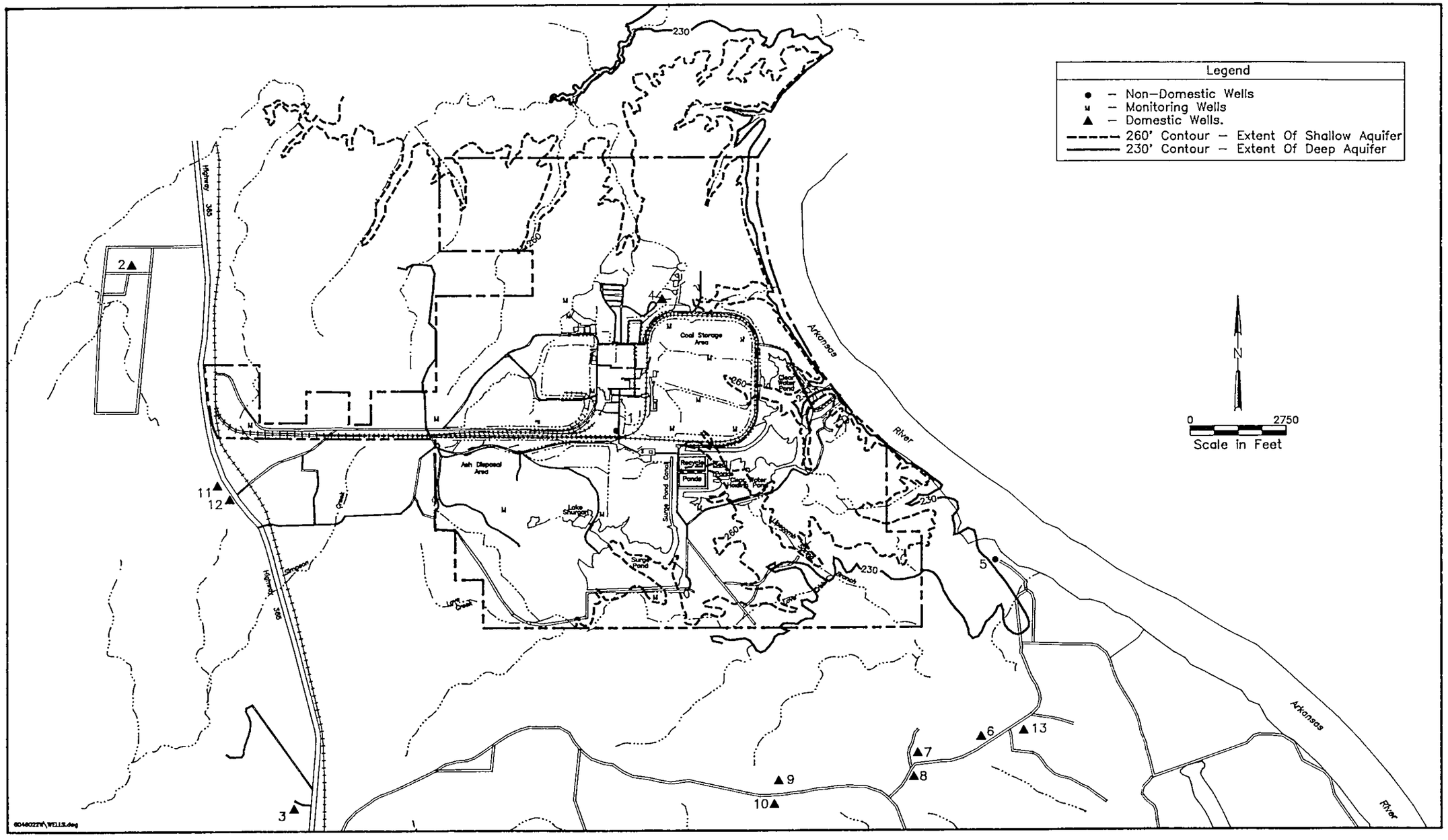
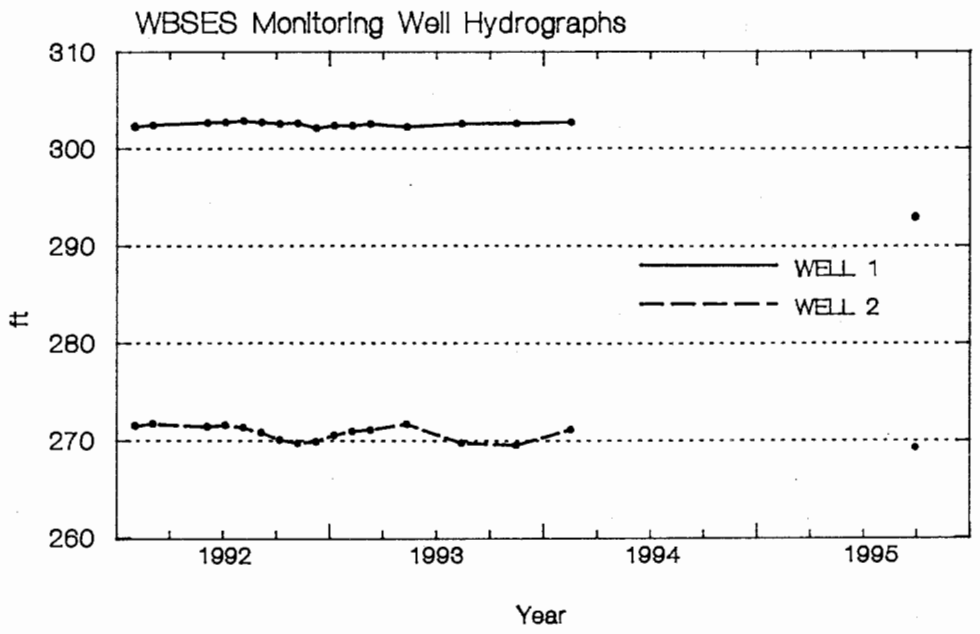
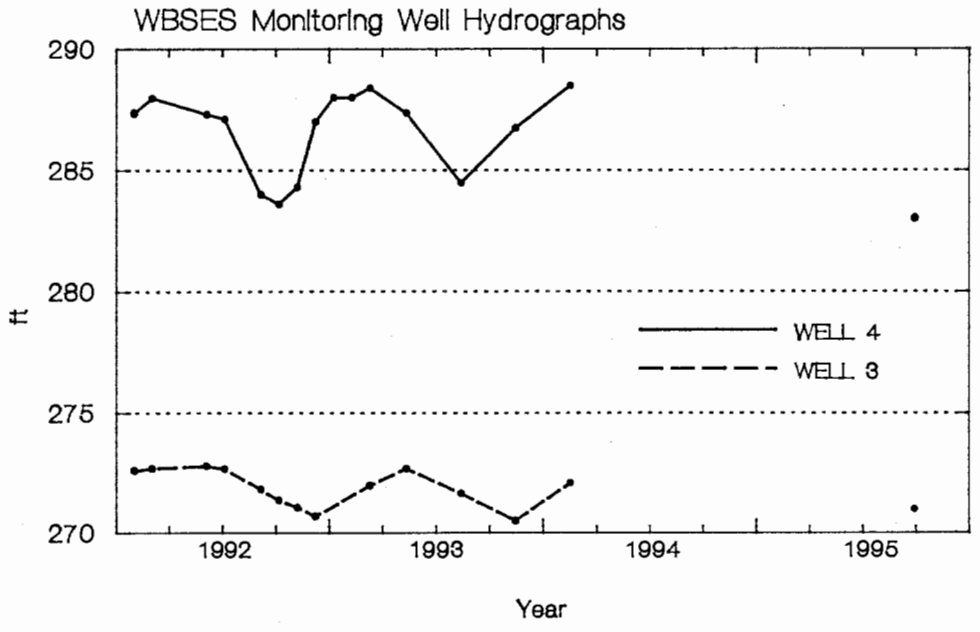


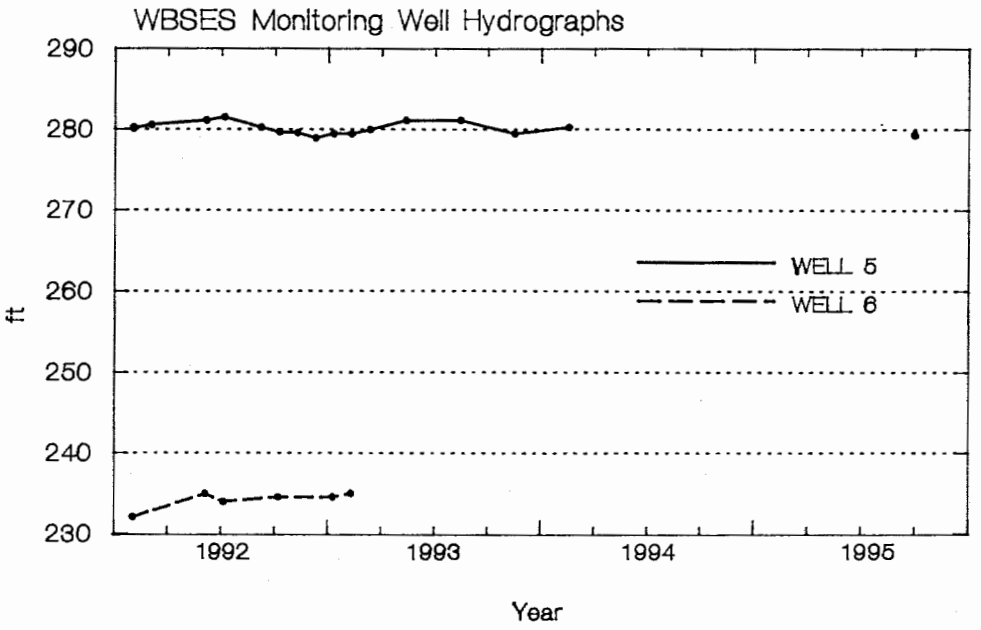
Figure B.2. Groundwater users in the vicinity of the White Bluff plant.

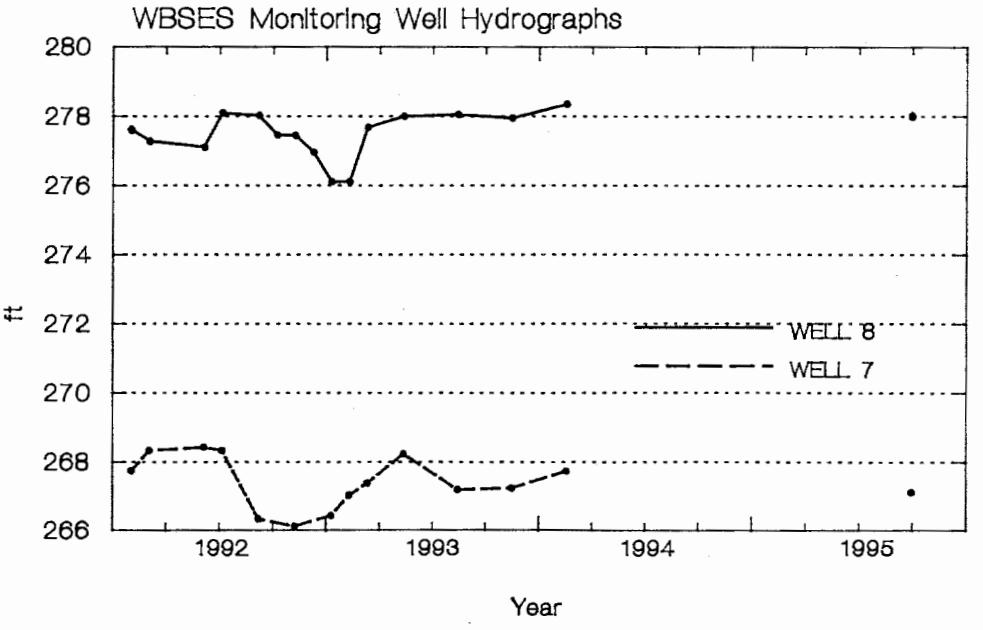
Appendix C

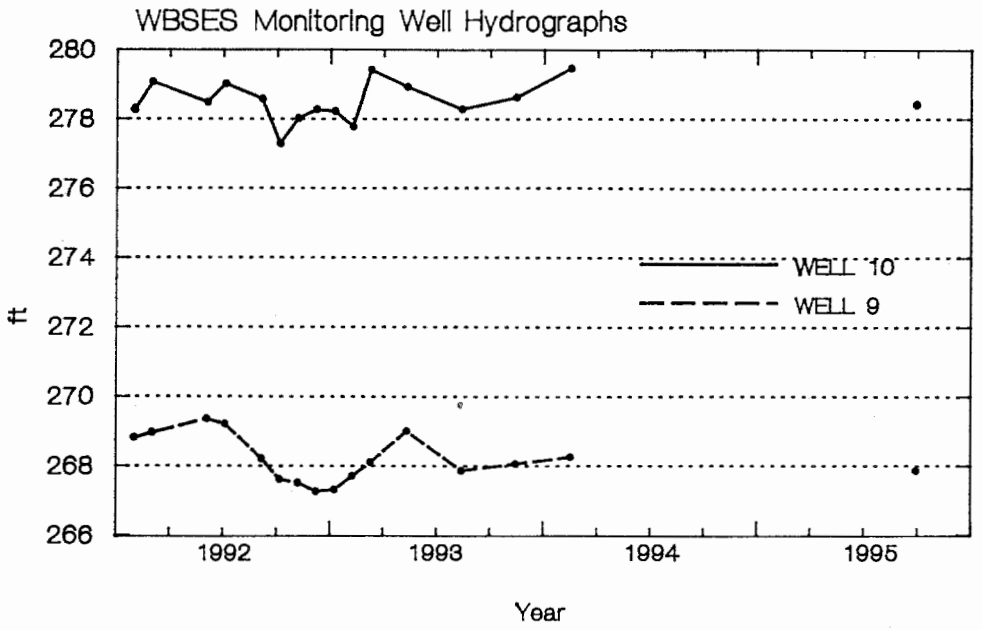
Monitoring Well Hydrographs

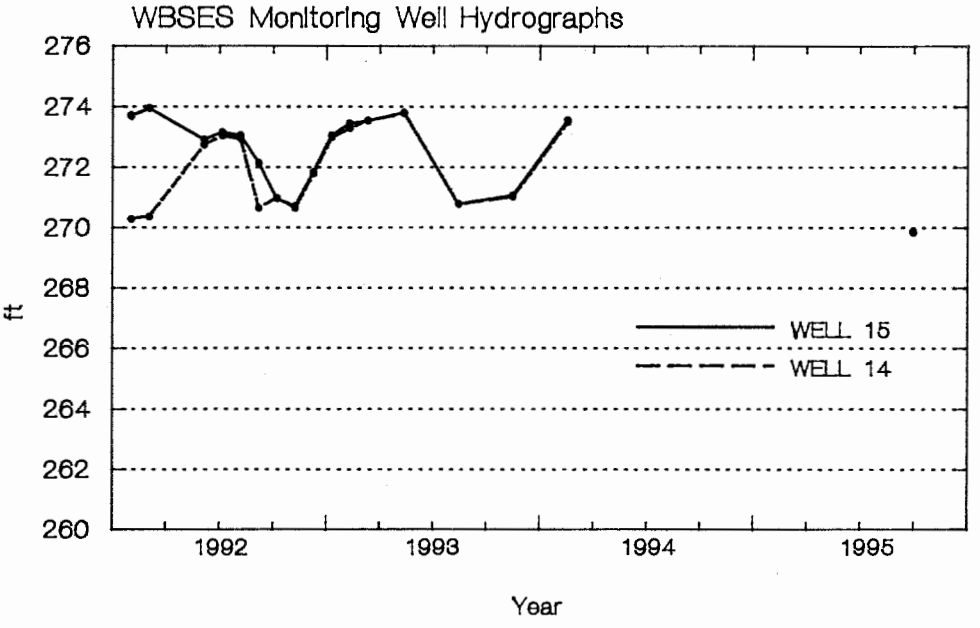

WBSES Monitoring Well Hydrographs
310
300
290
280
270
260
ft
1992
1993
1994
1995
Year
WELL 1
WELL 2

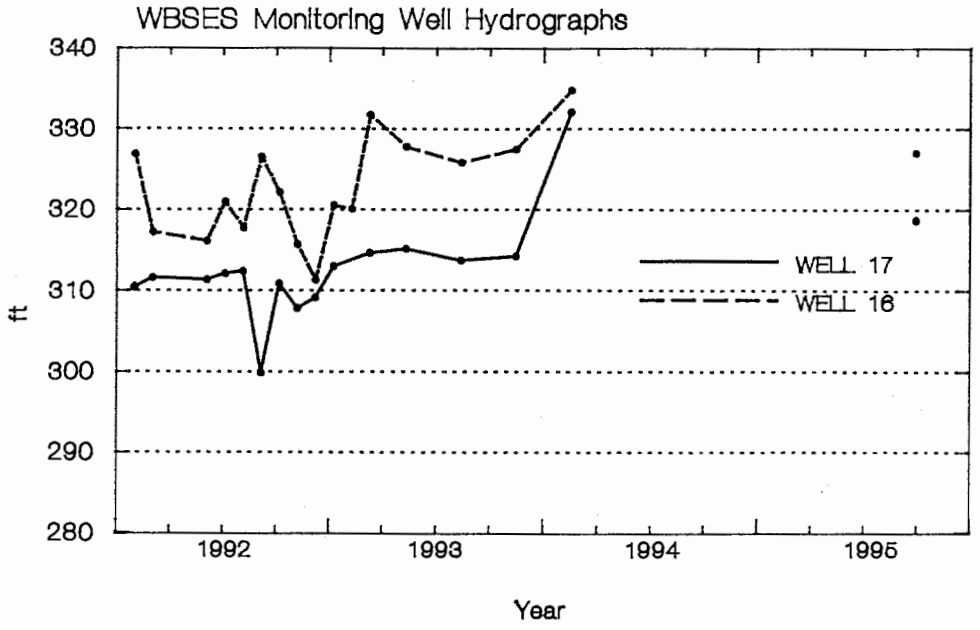

WBSES Monitoring Well Hydrographs
290
285
280
275
270
ft
1992
1993
1994
1995
Year
WELL 4
WELL 3

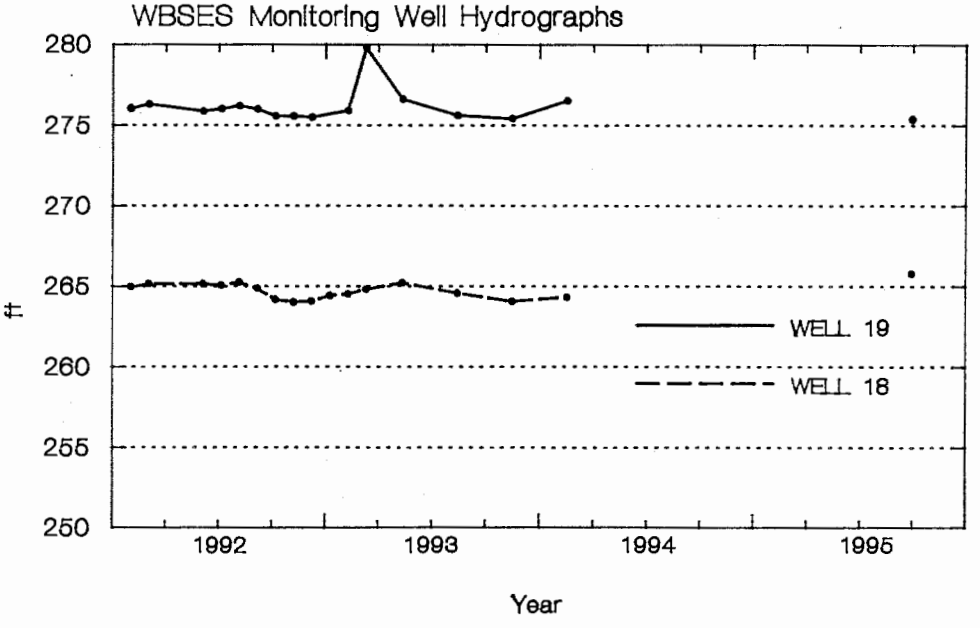

WBSES Monitoring Well Hydrographs
290
280
270
260
250
240
230
ft
1992
1993
1994
1995
Year
WELL 5
WELL 6

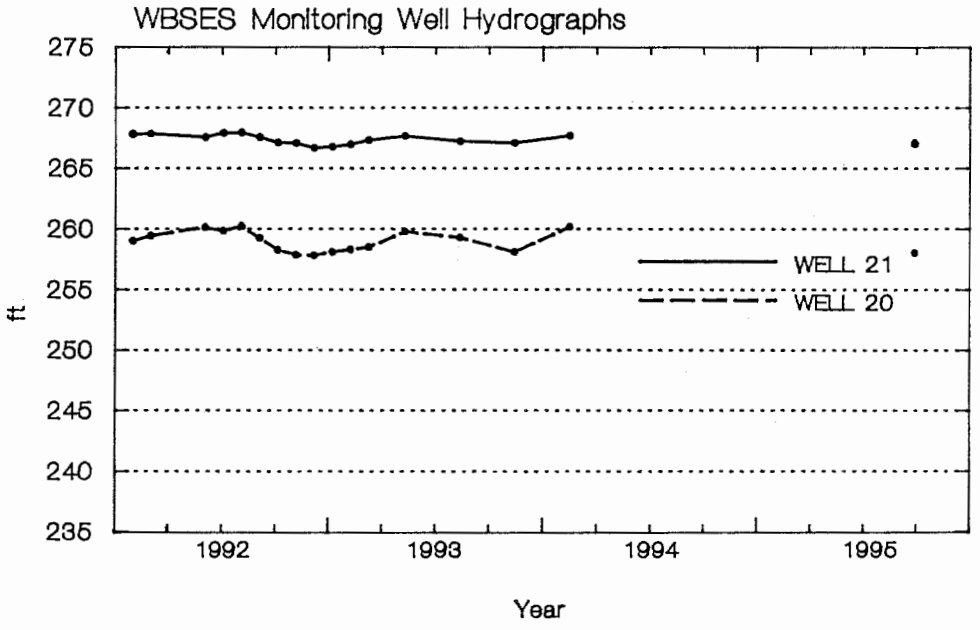

WBSES Monitoring Well Hydrographs
280
278
276
274
272
270
268
266
ft
1992
1993
1994
1995
Year
WELL 8
WELL 7

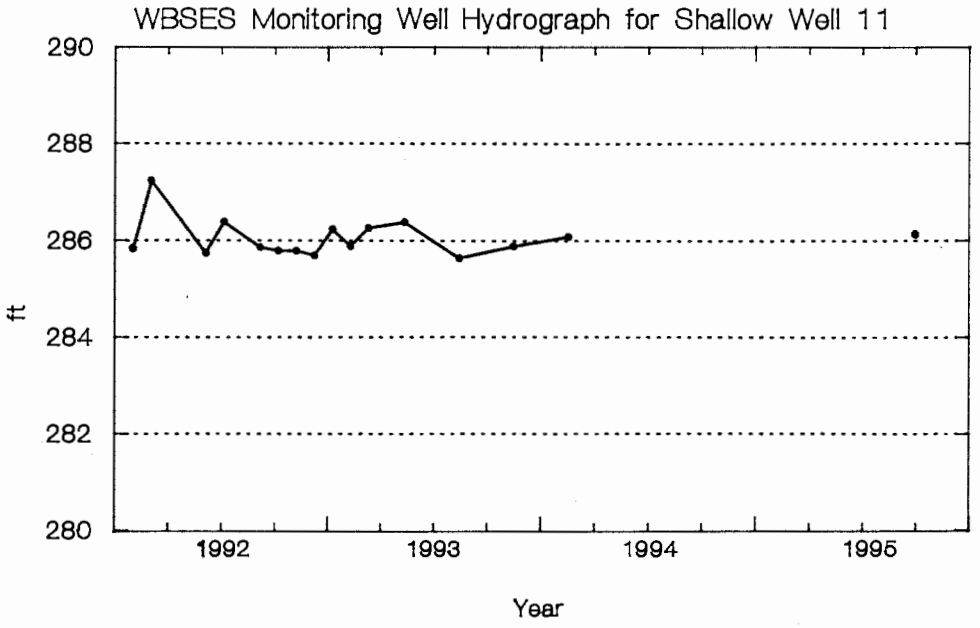

WBSES Monitoring Well Hydrographs
280
278
276
274
272
270
268
266
ft
1992
1993
1994
1995
Year
WELL 10
WELL 9

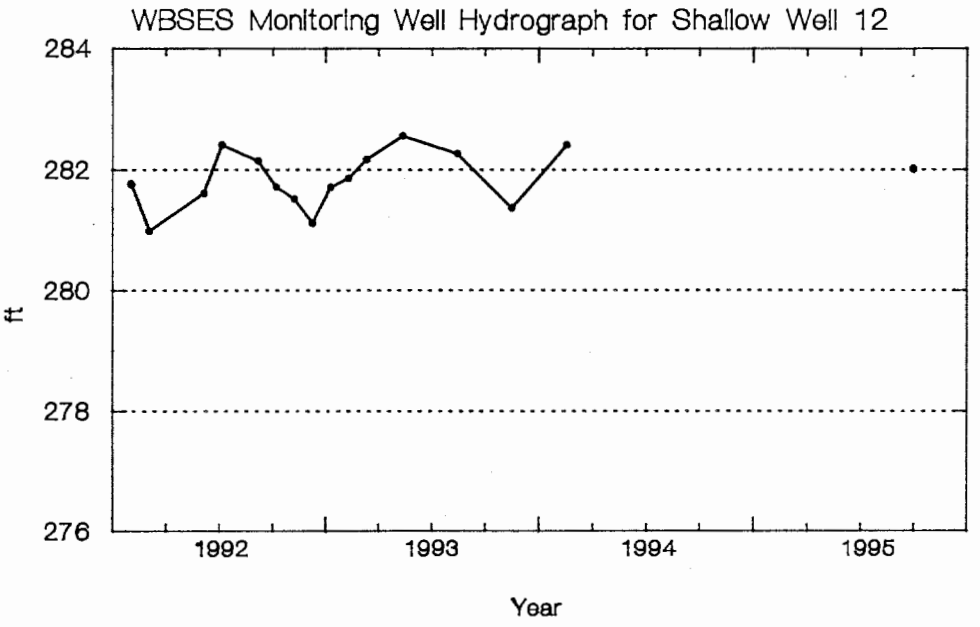

WBSES Monitoring Well Hydrographs
276
274
272
270
268
266
264
262
260
ft
1992
1993
1994
1995
Year
WELL 15
WELL 14

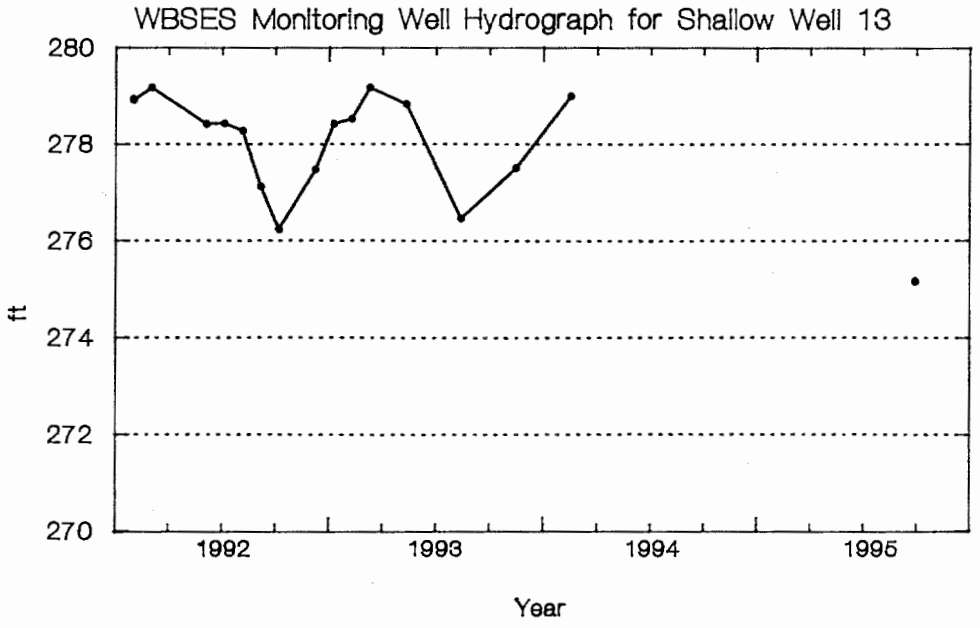

WBSES Monitoring Well Hydrographs
340
330
320
310
300
290
280
ft
1992
1993
1994
1995
Year
WELL 17
WELL 16

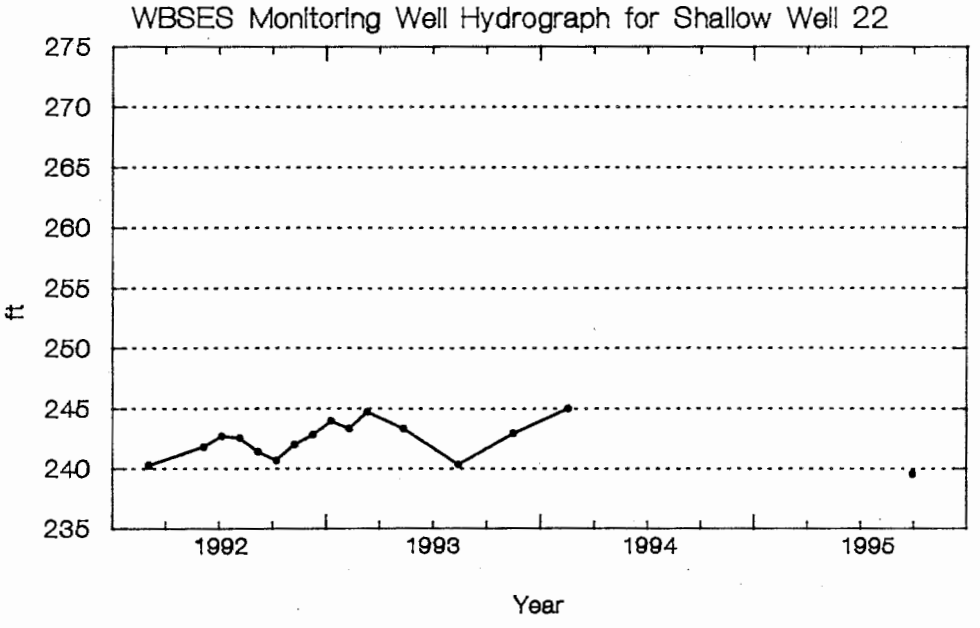

WBSES Monitoring Well Hydrographs
280
275
270
265
260
255
250
ft
1992
1993
1994
1995
Year
WELL 19
WELL 18

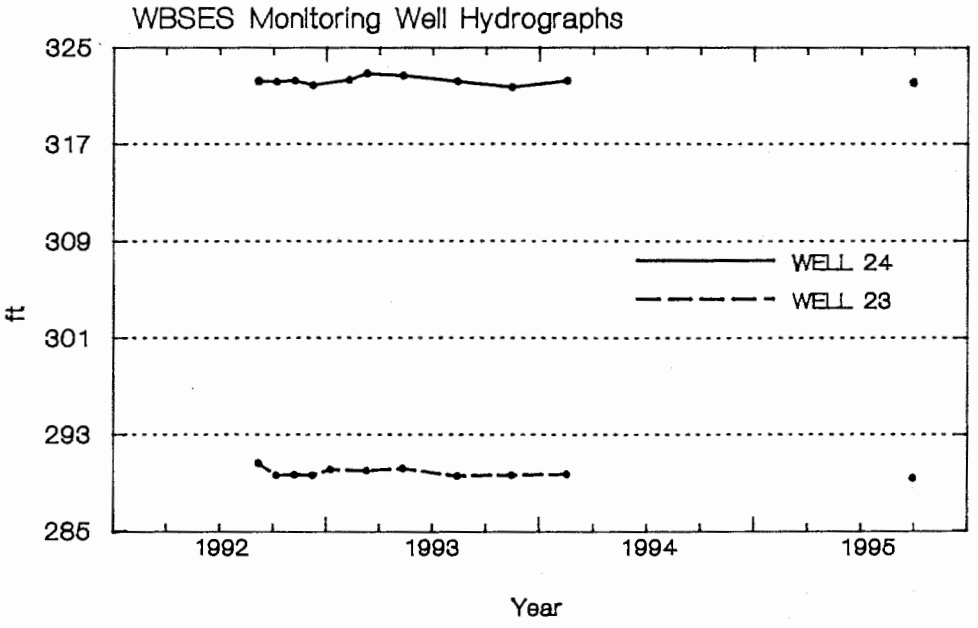

WBSES Monitoring Well Hydrographs
275
270
265
260
255
250
245
240
235
ft
1992
1993
1994
1995
Year
WELL 21
WELL 20

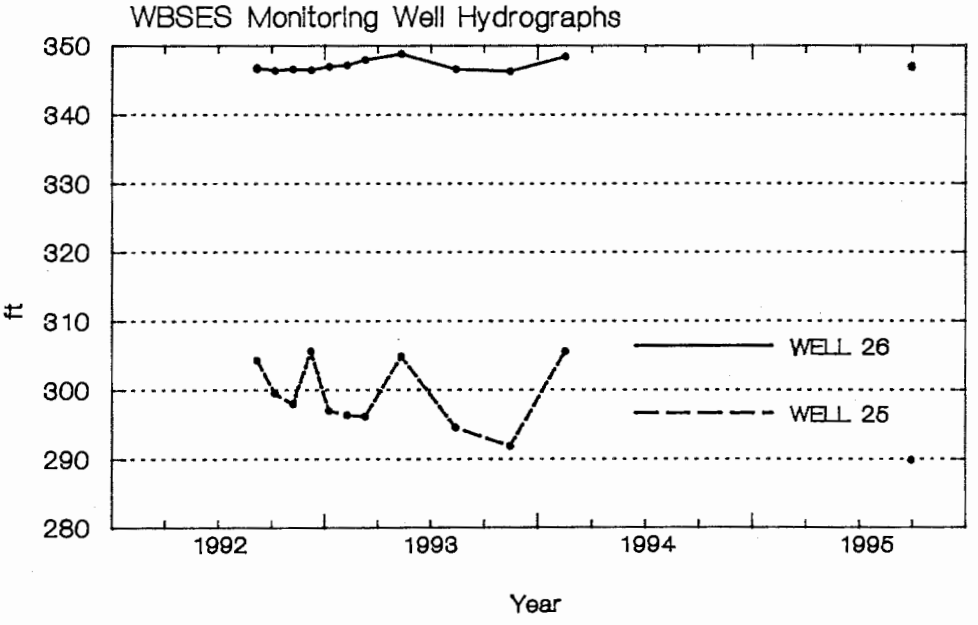

WBSES Monitoring Well Hydrograph for Shallow Well 11
290
288
286
284
282
280
ft
1992
1993
1994
1995
Year


WBSES Monitoring Well Hydrograph for Shallow Well 12
284
282
280
278
276
ft
1992
1993
1994
1995
Year


WBSES Monitoring Well Hydrograph for Shallow Well 13
280
278
276
274
272
270
ft
1992
1993
1994
1995
Year


WBSES Monitoring Well Hydrograph for Shallow Well 22
275
270
265
260
255
250
245
240
235
ft
1992
1993
1994
1995
Year


WBSES Monitoring Well Hydrographs
325
317
309
301
293
285
ft
WELL 24
WELL 23
1992
1993
1994
1995
Year


WBSES Monitoring Well Hydrographs
350
340
330
320
310
300
290
280
ft
WELL 26
WELL 25
1992
1993
1994
1995
Year

Appendix D

1995 Laboratory Data

TOTALS	PLANT:	WBSES										SAMPLE DATE:		9/19/95 - 9/20/95	
						SAMPLE NUMBERS									
PARAMETERS	9519941	9519942	9519943	9519944	9519945	9519946	9519947	9519948	DUP						
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L		L	MATRIX SPIKE		
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L	INTRA	L			
NOTED.	D SRECYCLE	D AR. RIVER	D WELL1	D WELL2	D WELL3	D WELL4	D WELL5	D FIELD BLK-A	D FIELD BLK-B	D		D	A + I		B + I
pH (SU)	9.05	7.72	3.97	5.79	5.44	4.28	3.79								
COND. (uMHO)	735	635	3016	1620	183	265	4340								
TURB. (NTU)	15.80	12.31	0.90	43.20	17.5	116.5	261.0								
W. TEMP. (C)	26.4	25.5	18.1	18.2	18.0	19.2	19.2								
ELEV. FT. MSL															
A. TEMP (C)	23.0	22.1	23.6	23.6	22.2	22.2	23.6								
TDS	444.0	366.0	2637.0	1333.0	212.0	265.0	3278.0	4.0	< 1.0		76.0		73.0		75.0
SULFATE	124.1	49.4	1063.3	620.6	56.5	77.5	106.3	< 5.0	< 5.0		24.1		7.0		6.5
CHLORIDE	69.0	78.0	426.0	96.0	6.0	9.0	729.0	1.8/18.0	2.1/21.0		9.9		2.1		1.8
BORON			0.43												
NICKEL	< 0.005	< 0.005	0.348	0.019	0.012	0.031	0.229	< 0.005	< 0.005		0.020		0.010		0.010
SODIUM	57.2	58.2	240.6	70.1	16.8	20.3	341.4	< 1.0	< 1.0		67.7		34.3		33.6
STRONTIUM	1.46	0.61	5.37	3.80	0.34	0.35	6.77	0.11	0.11		4.94		2.61		2.59
LEAD	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		0.005		0.003		0.002
BN/A ORG. **															
VOL. ORG. **															
** ANALYSES PERFORMED ANNUALLY.															

TOTALS	PLANT:	WBSES									SAMPLE DATE:		9/19/95 - 9/20/95	
						SAMPLE NUMBERS								
PARAMETERS	9519949	9519950	9519951	9519952	9519953	9519954	9519955	9519956	DUP					
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L	L		MATRIX SPIKE	
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L	L			
NOTED.	D WELL7	D WELL8	D WELL9	D WELL10	D WELL11	D WELL12	D WELL13	D WELL14	D WELL14	D	D	INTRA	A + I	B + I
pH (SU)	5.74	4.05	7.83	6.11	3.93	3.48	4.09	5.10	5.10					
COND. (uMHO)	531.0	515.0	1044.0	746.0	1551.0	1627.0	427	866	866					
TURB. (NTU)	38.90	32.10	49.70	391.00	176.00	98.8	66.6	111.4	111.4					
W. TEMP. (C)	18.3	19.1	18.3	20.8	19.6	23.1	18.8	16.6	16.6					
ELEV. FT. MSL														
A. TEMP (C)	21.1	21.2	21.0	21.0	21.7	21.3	24.2	24.1	24.1					
TDS	478.0	410.0	909.0	591.0	1059.0	1316.0	319.0	676.0	699.0			83.0	770.0	771.0
SULFATE	113.0	98.8	316.2	351.8	422.9	529.7	60.1	12.0/300.4	11.3/282.6			25.0	12.4	12.0
CHLORIDE	30.0	51.0	78.0	42.0	36.0	54.0	66.0	1.2/12.0	1.5/15.0			9.6	2.1	2.4
BORON														
NICKEL	< 0.005	0.026	0.008	0.020	0.058	0.066	0.035	< 0.005	< 0.005			0.019	0.010	0.012
SODIUM	39.7	39.2	57.5	64.0	130.5	118.5	19.4	44.3	45.4			65.4	56.6	56.2
STRONTIUM	1.01	0.56	4.51	0.85	0.92	2.46	0.49	1.98	1.95			4.94	3.43	3.39
LEAD	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.005	0.003	0.003
BN/A ORG. **														
VOL. ORG. **														
** ANALYSES PERFORMED ANNUALLY.														
*** SEE BN/A RESULTS.														

TOTALS	PLANT:	WBSES							SAMPLE DATE:	9/19/95 - 9/20/95		
					SAMPLE NUMBERS							
PARAMETERS	9519925	9519926	9519927	9519928	9519929	9519930	9519931	9519932	DUP		MATRIX SPIKE	
*- - ALL DATA	L	L	L	L	L	L	L	L	L	L	L	
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L INTRA	L	
NOTED.	D WELL16	D WELL17	D WELL18	D WELL19	D WELL20	D WELL21	D WELL22	WELL23	D WELL23	D	D A + I	B + I
pH (SU)	5.72	6.06	6.02	4.7	3.76	4.17	4.01	7.48	7.48			
COND. (uMHO)	71.5	955.0	1367.0	1448.0	1623.0	126.0	319.0	497.0	497.0			
TURB. (NTU)	120.0	50.0	46.8	5.4	31.8	6.4	10.6	303.0	303.0			
W. TEMP. (C)	17.6	17.6	17.6	18.2	16.1	16.8	20.9	20.0	20.0			
ELEV. FT. MSL												
A. TEMP (C)	26.9	26.9	27.5	27.5	26.1	26.1	22.8	21.7	21.7			
TDS	139.0	152.0	1272.0	1434.0	1505.0	1117.0	256.0	209.0	209.0	76.0	286.0	286.0
SULFATE	21.2	24.5	529.7	600.8	689.8	407.1	70.4	4.9/24.5	4.2/20.9	24.8	8.5	7.7
CHLORIDE	6.0	21.0	42.0	39.0	30.0	54.0	12.0	7.0	6.0	9.3	1.5	1.2
BORON	0.27	0.36		0.64	0.38	0.45	0.33					
NICKEL	0.017	0.009	< 0.005	0.005	0.208	0.047	< 0.005	0.008	0.008	0.018	0.015	0.014
SODIUM	9.2	11.6	69.4	66.3	81.7	59.3	21.2	21.9	22.1	65.1	44.3	43.7
STRONTIUM	0.24	0.17	3.69	3.49	2.12	2.42	0.58	1.98	1.98	4.95	3.48	3.45
LEAD	0.007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.004	0.005	0.005	0.004	0.005
BN/A ORG. **												
VOL. ORG. **												
** ANALYSES PERFORMED ANNUALLY.												

TOTALS	PLANT:	WBSES									SAMPLE DATE:		9/19/95 - 9/20/95	
						SAMPLE NUMBERS								
PARAMETERS	9519933	9519934	9519935	9519936	9519937	9519938	9519939	9519940	DUP			MATRIX SPIKE		
*-- ALL DATA	L	L	L	L	L	L	L	L	L	L	L	L	L	
MG/L UNLESS	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L LOCATION	L INTRA	L			
NOTED.	D WELL24	D WELL26	D TRIP BLANK	D WELL15	D FIELD SPIKE + 1	D CLTWRSUMP	D SURGEPOND	D NRECYCLE	D NRECYCLE	D	D	A + I		B + I
pH (SU)	6.90	6.90		5.95		8.33	7.92	N						
COND. (uMHO)	2480	257		715		3630.0	750.0	O						
TURB. (NTU)	7.60	17.33		0.5		72.2	21.1							
W. TEMP. (C)	18.0	17.1		16.6		32.4	25.6	S						
ELEV. FT. MSL								A						
A. TEMP (C)	21.7	21.0		24.1		22.1	22.0	M						
TDS	2296.0	259.0	4.0	638.0	1385.0	2381.0	465.0	P		79.0				
SULFATE	1063.3	15.5	< 5.0	248.2	458.5	600.8	113.0	L		25.5				
CHLORIDE	36.0	3.0	< 1.0	21.0	207.0	402.0	66.0	E		10.2				
BORON					0.28									
NICKEL	0.038	0.007	< 0.005	< 0.005	0.097	0.014	0.005	DREDGING		0.020				
SODIUM	141.8	20.6	< 1.0	42.9	98.0	345.5	58.9	POND		67.5				
STRONTIUM	5.88	0.46	0.09	1.60	2.27	3.45	1.29			4.94				
LEAD	< 0.001	< 0.001	< 0.001	< 0.001	0.010	< 0.001	< 0.001			0.005				
BN/A ORG. **														
VOL. ORG. **														
** ANALYSES PERFORMED ANNUALLY.														

Appendix E

Listing of Data, 1991-1995

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL1	91035	03/20/91	1		2870	1883.0	710.9				0.20	0.65				
WELL1	91116	06/26/91	2		2514	798.0	172.6				0.20	0.71	0.00			
WELL1	91195	09/25/91	3		2731	1134.0	56.0				0.20	0.60	8.13			
WELL1	91234	11/21/91	4		2705	844.6	692.2				0.20	0.66	2.44			
WELL1	92003	03/12/92	5		2710	976.2	188.0	215.1	252.6	91.7	0.25	0.54	0.00		28.26	0.69
WELL1	92082	06/02-03/92	6		2978	1245.8	335.6	218.2	222.0	90.3	0.46	0.20	7.52	0	25.41	0.00
WELL1	92161	09/11-12/92	7		2664	976.8	516.8	230.4	128.2	107.0	0.20	0.20	3.65	0	23.14	32.90
WELL1	92301	12/7-8/92	8		3085	910.4	484.3	266.8	199.8	110.0	0.20	0.80	1.01	0	29.46	36.80
WELL1	93085	02/16/93	9		3109	1133.3	469.5	223.8	255.5	106.0	0.20	0.71	0.00		24.30	32.82
WELL1	93182	05/17-05/18/	10		2751	1091.0	513.0	228.0	234.0	95.5	0.30	0.66	0.00	0	32.40	28.50
WELL1	93268	08/17-18/93	11		2383	993.3	507.0	225.2	256.5	98.0	0.20	0.73	0.00	0	25.80	37.40
WELL1	93268	08/17-18/93	11	D	2363	996.3	504.0	225.2	256.0	94.8	0.20	0.73	0.00	0	27.20	37.00
WELL1	93357	11/16-17/93	12		2587	1079.7	495.0	207.6	73.7	96.8	< 0.2	0.87	< 0.00	0	26.56	33.00
WELL1	94073	02/22-23/94	13		2018	1400.0	603.9	217.2	221.9	81.1	< 0.2	0.67	0.70	0	25.00	26.32
WELL1	9519943	9/19-20/95	19		2637	1063.3	426.0	240.6			0.43					
WELL4	91046	03/20/91	1		217	70.5	21.4				0.20	0.20				
WELL4	91121	06/26/91	2		192	30.5	19.2				0.20	0.20	0.00			
WELL4	91198	09/25/91	3		217	40.9	16.9				0.20	0.20	0.00			
WELL4	91237	11/21/91	4		203	72.0	2.2				0.20	0.20	0.00			
WELL4	92006	03/12/92	5		216	104.8	32.0	18.5	6.1	2.5	0.20	0.20	0.69		1.24	0.50
WELL4	92085	06/02-03/92	6		217	61.1	29.0	17.3	6.9	3.2	0.04	0.20	6.52	0	1.33	0.70
WELL4	92164	09/11-12/92	7		238	837.1	52.0	17.7	11.5	3.6	0.20	0.20	3.99	0	3.38	4.36
WELL4	92262	12/7-8/92	8		238	28.9	19.4	22.0	7.2	3.7	0.20	0.20	1.46	0	3.08	1.50
WELL4	93088	02/16/93	9		216	38.4	28.2	26.0	8.4	3.5	0.20	0.20	0.57		3.70	1.57
WELL4	93088	02/16/93	9	D	233	42.4	28.5	24.1	7.4	3.1	0.20	0.20	0.57		3.80	1.73
WELL4	93185	05/17-05/18/	10		232	51.7	30.3	25.7	6.0	2.9	0.30	0.20	0.00	0	6.50	6.00
WELL4	93273	08/17-18/93	11		235	145.5	19.5	18.9	9.7	3.9	0.20	0.20	0.90	0	4.10	1.95
WELL4	93362	11/16-17/93	12													
WELL4	93362	11/16-17/93	12		255	106.7	20.7	21.6	16.0	3.6	< 0.2	< 0.2	1.24	0	8.32	8.80
WELL4	94076	02/22-23/94	13		209	35.2	31.2	28.1	6.8	2.9	< 0.2	< 0.2	0.62	0	7.76	10.10
WELL4	9519946	9/19-20/95	19		265	77.5	9.0	20.3								
WELL5	91051	03/20/91	1		336	382.0	891.7				0.20	0.68				
WELL5	91122	06/26/91	2		3152	795.0	85.2				0.20	0.73	0.50			
WELL5	91201	09/25/91	3		3378	942.0	13.8				0.20	0.87	37.20			
WELL5	91238	11/21/91	4		3490	251.3	447.0				0.20	0.67	2.46			
WELL5	92007	03/12/92	5		3056	434.2	119.8	306.6	283.8	141.2	0.22	0.20	0.00		2.07	0.12
WELL5	92086	06/02-03/92	6		3046	964.2	427.2	343.4	222.0	124.2	0.49	0.80	9.06	0	2.00	0.66
WELL5	92165	09/11-12/92	7		3321	1232.8	824.5	358.8	278.9	179.0	0.20	0.20	3.04	0	2.18	14.65
WELL5	92263	12/7-8/92	8		3332	409.0	711.7	384.0	288.4	145.0	0.40	1.10	0.00	0	3.15	13.00
WELL5	93091	02/16/93	9		3336	1053.1	798.0	324.6	301.0	147.6	0.20	0.61	0.06		1.30	8.05
WELL5	93186	05/17-05/18/	10		3216	989.6	417.0	342.0	242.0	129.0	0.20	0.20	0.92	0	1.10	6.20
WELL5	93274	08/17-18/93	11		5512	634.7	1080.0	330.5	317.0	162.0	0.20	0.75	2.93	0	0.40	10.00
WELL5	93363	11/16-17/93	12		3300	1174.7	1110.0	339.6	331.6	156.8	0.30	0.83	< 0.00	0	1.27	7.71
WELL5	94077	02/22-23/94	13		2424	1267.1	801.9	321.4	272.0	124.2	< 0.2	0.56	1.37	0	1.86	8.54
WELL5	9519947	9/19-20/95	19		3278	106.3	729.0	341.4								
WELL8	91063	03/20/91	1		399	196.7	45.8				0.20	0.20				
WELL8	91125	06/26/91	2		375	140.0	47.8				0.20	0.20	0.00			

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL8	91204	09/25/91	3		389	96.1	57.1				0.20	0.20	0.00			
WELL8	91243	11/21/91	4		386	319.7	56.8				0.20	0.20	0.00			
WELL8	92012	03/12/92	5		416	134.1	38.0	37.0	19.3	8.9	0.20	0.20	0.00		3.18	0.11
WELL8	92091	06/02-03/92	6		419	88.9	55.9	32.9	16.1	7.9	0.08	0.20	5.25	0	4.44	0.70
WELL8	92168	09/11-12/92	7	D	379	92.0	87.1	37.7	23.9	10.0	0.20	0.20	0.27	0	8.70	6.72
WELL8	92168	09/11-12/92	7		383	113.9	86.9	36.1	23.9	9.5	0.20	0.02	0.26	0	6.97	3.61
WELL8	92266	12/7-8/92	8		372	98.5	41.8	40.7	13.3	9.4	0.20	0.20	0.00	0	5.06	2.80
WELL8	93052	02/16/93	9		234	173.5	43.8	38.2	24.0	11.0	0.20	0.24	0.00		3.50	1.91
WELL8	93191	05/17-05/18/	10		429	229.5	48.0	41.4	20.0	9.6	0.20	0.20	0.00	0	5.00	2.20
WELL8	93277	08/17-18/93	11		343	229.7	54.3	36.8	21.1	9.2	0.20	0.20	0.00	0	4.80	1.62
WELL8	93366	11/16-17/93	12		411	206.4	50.1	41.2	23.9	8.9	< 0.2	< 0.2	< 0.00	0	7.94	5.90
WELL8	94082	02/22-23/94	13		377	148.4	52.0	42.8	23.3	10.0	< 0.2	< 0.2	0.51	0	6.70	4.91
WELL8	9519950	9/19-20/95	19		410	98.8	51.0	39.2								
WELL10	91065	03/20/91	1		434	179.9	37.8				0.20	0.20				
WELL10	91126	06/26/91	2		450	10.5	40.4				0.20	0.20	0.00			
WELL10	91206	09/25/91	3		496	180.6	44.3				0.20	0.20	0.00			
WELL10	91245	11/21/91	4		501	147.6	43.0				0.20	0.20	0.00			
WELL10	92014	03/12/92	5		567	438.8	46.0	66.2	27.1	13.1	0.20	0.20	0.00		2.60	0.20
WELL10	92093	06/02-03/92	6		506	144.4	49.0	54.1	18.0	9.8	0.09	0.20	4.23	0	11.10	0.56
WELL10	92172	09/11-12/92	7		493	137.8	56.1	59.2	25.5	12.4	0.20	0.20	0.00	0	11.56	8.68
WELL10	92268	12/7-8/92	8		577	193.4	47.4	83.9	16.7	14.7	0.11	0.23	0.00	0	12.76	9.10
WELL10	92268	12/7-8/92	8	D	565	200.8	56.0	78.6	14.9	14.0	0.10	0.21	0.00	0	15.24	9.50
WELL10	93054	02/16/93	9		606	252.2	43.2	73.4	32.5	15.5	0.20	0.28	3.32	0	24.80	10.68
WELL10	93152	05/17-05/18/	10		581	242.2	43.2	66.7	28.2	13.1	0.20	0.24	0.00	0	18.60	1.50
WELL10	93281	08/17-18/93	11		465	292.3	40.5	62.3	25.7	11.8	0.20	0.22	0.00	0	8.40	1.33
WELL10	93368	11/16-17/93	12		548	82.9	41.1	59.4	30.6	12.6	< 0.2	0.21	< 0.00	0	24.60	3.50
WELL10	93368	11/16-17/93	12	D	533	101.9	41.4	60.3	30.0	13.0	< 0.2	0.23	< 0.00	0	22.88	3.30
WELL10	94084	02/22-23/94	13		906	387.0	42.6	59.9	29.8	13.7	< 0.2	< 0.2	< 0.50	0	43.05	8.54
WELL10	9519952	9/19-20/95	19		591	351.8	42.0	64.0								
WELL11	91042	03/20/91	1		1043	663.9	40.0				0.20	0.62				
WELL11	91128A	06/26/91	2		993	417.0	34.6				0.20	0.80	0.00			
WELL11	91207	09/25/91	3		1087	548.0	42.0				0.24	0.63	0.00			
WELL11	91246	11/21/91	4		1177	449.3	39.2				0.25	0.87	0.00			
WELL11	92015	03/12/92	5		1189	998.1	34.0				0.34	0.39	0.00			
WELL11	92094	06/02-03/92	6		1119	423.7	30.8	133.7	39.2	27.1	0.43	0.80	4.90	0	3.38	0.24
WELL11	92173	09/11-12/92	7		1124	680.5	39.2	130.9	46.4	32.4	0.20	0.20	0.00	0	7.94	14.91
WELL11	92271	12/7-8/92	8		1000	221.1	32.0	162.8	21.5	36.8	0.40	0.90	0.00	0	2.83	13.00
WELL11	93055	02/16/93	9		1000	626.9	33.0	121.2	47.0	32.7	0.20	0.82	0.00	0	1.00	5.83
WELL11	93153	05/17-05/18/	10		1132	594.9	35.7	147.5	52.7	34.5	0.30	0.94	0.00	0	0.90	8.00
WELL11	93241	08/17-18/93	11		1146	671.2	36.0	154.0	54.1	35.1	0.27	0.89	0.00	0	4.80	19.48
WELL11	93371	11/16-17/93	12	D												
WELL11	93371	11/16-17/93	12		1160	889.7	37.8	144.0	58.8	41.6	0.31	1.09	1.83	0	0.98	9.10
WELL11	94085	02/22-23/94	13		1103	620.5	39.1	150.5	62.1	38.3	0.25	0.98	< 0.50	0	4.09	11.40
WELL11		02/22-23/94	13	D	1160	889.7	37.8	144.0	58.8	41.6	0.31	1.09	1.83	0	0.98	18.10
WELL11	9519953	9/19-20/95	19		1059	422.9	36.0	130.5								
WELL12	91043	03/20/91	1		413	877.7	53.3				0.20	0.20				
WELL12	91131	06/26/91	2		1115	691.0	48.4				0.20	0.53	0.00			

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL12	91208A	09/25/91	3		1046	446.0	61.4				0.20	0.69	0.00			
WELL12	91247	11/21/91	4		1195	456.7	64.9				0.20	0.82	0.00			
WELL12	92016	03/12/92	5		1174	529.3	44.0	93.2	82.5	37.9	0.20	0.35	4.60		5.08	0.00
WELL12	92095	06/02-03/92	6		1031	385.4	53.0	90.5	59.8	30.3	0.22	0.60	5.15	0	6.06	0.07
WELL12	92174	09/11-12/92	7		973	578.4	70.0	83.9	62.6	33.1	0.20	0.20	0.00	0	5.18	8.49
WELL12	92272	12/7-8/92	8		1148	492.6	70.6	109.8	39.2	44.2	0.20	0.80	0.00	0	4.73	13.20
WELL12	93056	02/16/93	9		1057	845.6	67.8	84.3	84.2	39.0	0.20	0.49	0.00		3.40	8.73
WELL12	93154	05/17-05/18/	10		1005	626.8	60.6	91.2	67.4	30.8	0.20	0.57	0.00	0	2.50	7.40
WELL12	93242	08/17-18/93	11		880	528.4	63.0	91.0	68.7	32.9	0.20	0.65	0.00	0	5.20	9.69
WELL12	93331	11/16-17/93	12		1165	694.2	66.9	105.5	97.2	43.8	< 0.2	0.74	6.66	0	11.74	13.60
WELL12	94086	02/22-23/94	13		542	593.2	67.3	92.8	69.8	31.0	< 0.2	0.57	< 0.50	0	5.48	8.35
WELL12	9519954	9/19-20/95	19		1316	529.7	54.0	118.5								
WELL13	91037	03/20/91	1		320	72.5	58.9				0.37	0.21				
WELL13	91132	06/26/91	2		357	65.0	56.0				0.40	0.25	0.00			
WELL13	91211	09/25/91	3		350	55.2	68.8				0.49	0.30	1.94			
WELL13	91248	11/21/91	4		330	58.1	65.5				0.57	0.30	0.00			
WELL13	92017	03/12/92	5		323	75.0	52.8	17.6	10.5	5.7	0.82	0.20	0.00		9.40	0.00
WELL13	92096	06/02-03/92	6		330	47.1	61.7	17.5	8.6	5.5	0.89	0.20	3.47	0	23.95	0.09
WELL13	92175	09/11-12/92	7		692	40.5	120.7	21.1	8.9	6.3	0.70	0.20	0.00	0	8.05	24.65
WELL13	92273	12/7-8/92	8		319	43.8	77.2	23.5	5.6	6.3	1.20	0.30	0.00	0	5.44	4.60
WELL13	93057	02/16/93	9		336	353.9	65.1	19.2	7.9	5.5	0.60	0.29	0.00		7.00	7.83
WELL13	93155	05/17-05/18/	10		338	89.8	60.0	17.4	8.2	5.0	0.80	0.26	0.00	0	4.40	7.40
WELL13	93243	08/17-18/93	11		288	87.8	65.4	18.1	8.3	5.5	0.88	0.28	0.00	0	6.10	8.82
WELL13	93332	11/16-17/93	12		245	84.2	4.5	21.7	12.9	4.6	0.74	0.25	4.31	0	6.46	10.00
WELL13	94087	02/22-23/94	13		240	82.3	61.4	20.0	7.3	4.9	0.91	< 0.2	0.60	0	6.16	9.34
WELL13	9519955	9/19-20/95	19		319	60.1	66.0	19.4								
WELL15	91031	03/20/91	1		682	393.0	24.8				0.20	0.20				
WELL15	91134	06/26/91	2		645	286.5	21.4				0.20	0.20	0.00			
WELL15	91213	09/25/91	3		629	294.0	33.9				0.20	0.20	0.00			
WELL15	91252	11/21/91	4		546	689.5	22.6				0.20	0.20	0.00			
WELL15	92021	03/12/92	5		625	36.8	8.8	41.0	50.8	18.5	0.20	0.20	0.74		9.10	0.18
WELL15	92021	03/12/92	5	D	624	35.8	8.6	40.7	50.1	18.1	0.20	0.20	0.67		9.10	0.19
WELL15	92098	06/02-03/92	6		651	235.0	31.3	37.0	46.2	17.2	0.24	0.20	3.62	33	9.41	0.28
WELL15	92098	06/02-03/92	6	D	667	238.0	30.2	39.9	51.6	18.9	0.21	0.20	3.01	32	9.76	0.20
WELL15	92177	09/11-12/92	7		634	328.0	70.3	43.2	58.3	22.9	0.20	0.20	0.00	21	8.64	0.22
WELL15	92275	12/7-8/92	8		628	226.9	14.9	45.9	37.2	23.5	0.22	0.20	0.00	36	9.32	0.40
WELL15	93061	02/16/93	9		704	392.7	21.9	40.4	74.4	26.4	0.20	0.20	1.49	40	4.50	0.45
WELL15	93157	05/17-05/18/	10		650	243.0	20.7	42.1	57.4	19.4	0.23	0.20	2.64	24	9.50	0.10
WELL15	93245	08/17-18/93	11		493	326.5	19.5	39.6	55.0	19.0	0.23	0.20	0.00	28	9.40	0.20
WELL15	93334	11/16-17/93	12		521	351.0	19.8	41.2	58.4	17.8	< 0.2	< 0.2	3.38	25	10.28	0.20
WELL15	94064	02/22-23/94	13		522	322.4	22.5	41.3	50.9	17.1	< 0.2	< 0.2	< 0.50	22	9.42	0.59
WELL15	9519936	9/19-20/95	19		638	248.2	21.0	42.9								
WELL17	91055	03/20/91	1		451	387.6	9.6				0.20	0.20				
WELL17	91136	06/26/91	2		242	190.6	0.2				0.20	0.20	0.00			
WELL17	91215	09/25/91	3		552	28.7	0.2				0.20	0.20	0.00			
WELL17	91254	11/21/91	4		292	177.3	21.0				0.21	0.20	0.00			
WELL17	92023	03/12/92	5		285	44.0	1.0	39.3	27.3	6.4	0.25	0.20	0.00		1.30	0.12

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL17	92102	06/02-03/92	6		290	23.2	18.3	43.6	29.1	6.8	0.28	0.20	4.05	173	3.25	0.07
WELL17	92181	09/11-12/92	7		280	17.1	26.6	45.4	36.8	8.5	0.30	0.77	0.00	182	6.99	9.72
WELL17	92277	12/7-8/92	8		277	11.7	3.5	46.9	28.0	8.9	0.30	0.20	0.00	176	9.44	20.70
WELL17	93063	02/16/93	9		303	30.6	6.6	39.2	36.1	8.0	0.20	0.20	0.00	187	2.10	0.96
WELL17	93161	05/17-05/18/	10		198	53.9	3.6	22.7	7.6	2.5	0.20	0.20	0.00	25	0.40	0.10
WELL17	93247	08/17-18/93	11		238	55.5	5.4	39.8	26.6	6.5	0.27	0.20	0.00	158	2.40	4.28
WELL17	93336	11/16-17/93	12		246	46.0	4.2	37.4	23.8	4.2	< 0.2	< 0.2	< 0.00	128	0.60	0.60
WELL17	94052	02/22-23/94	13		119	44.2	8.4	15.7	3.7	1.7	< 0.2	0.20	< 0.50	6	1.03	1.37
WELL17	9519926	9/19-20/95	19		152	24.5	21.0	11.6			0.36					
WELL19	91033	03/20/91	1		1502	1337.0	40.0				0.33	0.83				
WELL19	91138A	06/26/91	2		1479	325.0	38.0				0.39	0.76	0.00			
WELL19	91217	09/25/91	3		1467	541.5	64.9				0.43	0.62	0.00			
WELL19	91256	11/21/91	4		1674	1248.0	43.0				0.43	0.62	0.00			
WELL19	92025	03/12/92	5		1651	328.2	36.0	73.5	187.2	58.0	0.66	0.71	0.00		27.50	0.76
WELL19	92104	06/02-03/92	6		1493	381.5	50.3	68.7	143.0	50.2	0.67	0.70	3.36	0	24.98	0.45
WELL19	92183	09/11-12/92	7		1397	755.9	98.7	68.3	82.6	56.5	0.60	0.91	0.00	0	17.74	3.44
WELL19	92281	12/7-8/92	8		1409	309.0	33.6	78.7	153.6	56.0	0.60	0.90	0.00	0	25.31	3.80
WELL19	93065	02/16/93	9		1428	905.8	37.5	63.1	166.5	56.0	0.33	0.87	0.00		22.30	3.23
WELL19	93163	05/17-05/18/	10		1537	752.5	38.1	71.4	154.0	55.0	0.50	0.71	0.00	0	28.60	1.90
WELL19	93251	08/17-18/93	11		1058	838.3	36.3	63.2	134.4	48.5	0.60	0.83	0.00	0	17.60	2.85
WELL19	93338	11/16-17/93	12		988	652.2	36.3	63.7	185.2	32.8	0.41	0.86	< 0.00	0	26.48	8.60
WELL19	93338	11/16-17/93	12	D	998	661.7	36.3	66.7	183.6	29.5	0.36	0.86	< 0.00	0	27.56	7.00
WELL19	94054	02/22-23/94	13		1264	1145.9	37.2	66.6	148.9	49.0	0.55	0.77	< 0.50	0	24.65	3.82
WELL19	9519928	9/19-20/95	19		1434	600.8	39.0	66.3			0.64					
WELL21	91053	03/20/91	1		1282	75.9	37.6				0.20	0.68				
WELL21	91142	06/26/91	2		1312	698.4	54.0				0.20	0.68	0.00			
WELL21	91221	09/25/91	3		1273	540.5	45.1				0.31	0.67	0.71			
WELL21	91258A	11/21/91	4		1252	711.3	40.2				0.24	0.71	0.00			
WELL21	92027	03/12/92	5		1286	78.0	34.0	64.3	112.9	43.9	0.37	0.86	0.52		22.70	0.85
WELL21	92106	06/02-03/92	6		1295	415.8	52.2	64.5	108.0	41.2	0.40	0.60	3.15	0	20.54	0.00
WELL21	92185	09/11-12/92	7		1208	706.1	42.1	74.1	140.2	50.4	0.40	0.70	0.00	0	18.39	10.95
WELL21	92283	12/7-8/92	8		1207	148.7	89.0	76.6	65.0	46.6	0.40	0.60	0.00	0	17.66	6.00
WELL21	93067	02/16/93	9		1266	841.6	39.0	56.6	127.0	47.3	0.20	0.78	0.00		15.30	10.35
WELL21	93165	05/17-05/18/	10		1099	716.2	34.2	61.0	89.3	34.1	0.30	0.67	0.00	0	12.00	7.80
WELL21	93253	08/17-18/93	11		851	1081.4	34.5	61.9	110.1	41.9	0.39	0.70	0.00	0	16.40	8.30
WELL21	93342	11/16-17/93	12		1008	735.3	33.6	65.6	143.6	32.1	0.24	0.79	0.50	0	15.88	13.00
WELL21	94056	02/22-23/94	13		968	661.0	34.8	57.8	96.9	35.0	0.31	0.62	< 0.50	0	11.52	8.03
WELL21	9519930	9/19-20/95	19		1117	407.1	54.0	59.3			0.45					
WELL24	92188	09/11-12/92	7	D	4065	816.6	106.1	170.0	442.0	203.0	0.65	0.39	0.38	271	3.19	3.02
WELL24	92188	09/11-12/92	7		4076	854.0	120.5	171.0	478.0	227.0	0.66	0.39	0.39	228	2.92	3.26
WELL24	92286	12/7-8/92	8		3971	1806.6	105.5	196.8	602.0	222.0	0.70	0.30	0.00	233	7.78	2.30
WELL24	93072	02/16/93	9		3964	2650.5	82.5	153.4	552.0	188.8	0.70	0.32	0.00	189	7.60	3.10
WELL24	93167	05/17-05/18/	10		4210	2413.1	80.4	174.5	475.0	165.5	0.60	0.31	0.00	191	8.10	1.00
WELL24	93256	08/17-18/93	11		2524	2898.2	79.5	163.0	528.0	190.2	0.81	0.31	0.00	165	19.40	1.69
WELL24	93345	11/16-17/93	12		3507	2285.7	78.3	178.8	524.0	< 1.0	0.52	0.48	0.60	318	8.61	3.10
WELL24	94061	02/22-23/94	13		2748	1226.7	71.4	36.4	17.7	4.7	0.63	0.34	0.51	298	0.21	0.40
WELL24	9519933	9/19-20/95	19		2296	1063.3	36.0	141.8								

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WELL26	92192	09/11-12/92	7		293	55.3	42.3	25.2	48.5	12.7	0.20	0.20	0.00	203	2.65	5.38
WELL26	92288	12/7-8/92	8		308	23.3	14.0	27.9	41.2	9.9	0.07	0.11	0.00	187	1.70	1.90
WELL26	92288	12/7-8/92	8	D	309	24.7	13.5	27.0	39.9	9.6	0.08	0.10	0.00	188	1.69	1.80
WELL26	93074	02/16/93	9		301	25.4	7.2	31.2	32.3	6.8	0.20	0.20	0.00	163	0.40	0.80
WELL26	93171	05/17-05/18/	10		319	13.6	6.3	44.8	11.5	1.4	0.20	0.20	2.54	160	0.80	0.30
WELL26	93257	08/17-18/93	11		219	20.2	6.0	26.1	26.4	6.3	0.20	0.20	0.00	170	0.30	0.12
WELL26	93346	11/16-17/93	12		279	12.1	6.0	23.3	31.6	< 1.0	< 0.2	< 0.2	1.02	171	0.40	0.70
WELL26	94062	02/22-23/94	13		245	11.6	6.6	36.3	16.9	4.5	< 0.2	< 0.2	< 0.50	169	0.24	1.00
WELL26	9519934	9/19-20/95	19		259	15.5	3.0	20.6								
WELL2	91036	03/20/91	1		1318	635.0	123.8				0.20	0.20				
WELL2	91117	06/26/91	2		1258	546.0	41.0				0.30	0.20	0.00			
WELL2	91196	09/25/91	3		1213	574.8	50.4				0.29	0.20	0.00			
WELL2	91235	11/21/91	4		1244	608.5	72.6				0.26	0.20	0.00			
WELL2	92004	03/12/92	5		1245	745.1	76.0	58.6	144.0	11.9	0.33	0.20	0.52		29.25	0.68
WELL2	92083	06/02-03/92	6		1261	622.1	66.3	48.7	86.5	29.2	0.41	0.20	4.95	50	16.80	0.25
WELL2	92162	09/11-12/92	7		1211	678.1	99.8	62.2	91.7	47.1	0.30	0.20	3.36	37	19.35	1.04
WELL2	92302	12/7-8/92	8		1208	569.0	87.7	75.0	146.4	48.9	0.40	0.20	0.00	40	23.33	0.20
WELL2	93086	02/16/93	9		1277	527.3	81.3	60.7	159.5	47.7	0.20	0.20	0.00	16	20.50	0.93
WELL2	93183	05/17-05/18/	10		1296	697.4	90.6	65.2	144.0	40.1	0.20	0.20	0.00	18	25.00	0.60
WELL2	93271	08/17-18/93	11		1250	786.7	82.5	63.0	154.5	46.0	0.33	0.20	0.00	17	21.80	0.50
WELL2	93358	11/16-17/93	12		1221	699.7	82.5	65.7	157.5	44.1	0.26	< 0.2	0.85	30	23.12	1.10
WELL2	93358	11/16-17/93	12	D	1231	604.7	81.0	66.2	154.5	45.6	0.26	< 0.2	0.86	31	23.28	1.20
WELL2	94074	02/22-23/94	13		946	674.0	178.2	66.2	150.4	40.6	0.28	< 0.2	< 0.50	19	21.60	0.57
WELL2	9519944	9/19-20/95	19		1333	620.6	96.0	70.1								
WELL3	91047	03/20/91	1		232	74.2	11.2				0.20	0.20				
WELL3	91118A	06/26/91	2		215	56.0	12.0				0.20	0.20	0.00			
WELL3	91197A	09/25/91	3		247	17.0	7.8				0.20	0.20	0.00			
WELL3	91236	11/21/91	4		218	64.9	3.4				0.20	0.20	0.97			
WELL3	92005	03/12/92	5		210	256.3	12.0	15.0	10.3	3.3	0.20	0.20	0.00		5.04	0.87
WELL3	92084	06/02-03/92	6		225	34.6	16.2	15.1	8.0	3.3	0.04	0.20	3.62	12	4.25	0.31
WELL3	92163	09/11-12/92	7		204	370.0	37.5	18.0	13.1	3.7	0.20	0.20	4.42	11	3.51	2.84
WELL3	92261	12/7-8/92	8		209	33.9	7.5	21.1	11.7	4.8	0.20	0.20	0.00	12	4.18	1.40
WELL3	93087	02/16/93	9		229	151.9	9.3	15.9	10.5	3.6	0.20	0.20	0.00	9	3.00	0.75
WELL3	93184	05/17-05/18/	10		228	49.3	9.3	17.1	9.5	3.4	0.20	0.20	0.00	9	3.40	0.60
WELL3	93272	08/17-18/93	11		205	118.2	8.1	16.6	10.1	3.6	0.20	0.20	0.61	10	2.40	0.17
WELL3	93361	11/16-17/93	12		204	135.2	9.0	16.4	14.1	3.0	< 0.2	< 0.2	< 0.00	8	2.92	1.30
WELL3	94075	02/22-23/94	13		178	128.2	7.4	16.9	9.6	3.2	< 0.2	< 0.2	< 0.50	11	3.39	2.53
WELL3	9519945	9/19-20/95	19		212	56.5	6.0	16.8								
WELL6	91052	03/20/91	1		252	5.2	0.2				0.20	0.20	438.40			
WELL6	91123	06/26/91	2		143	35.0	5.8				0.20	0.20	0.00			
WELL6	91202	09/25/91	3		219	33.5	0.2				0.20	0.20	0.00			
WELL6	91241	11/21/91	4										0.00			
WELL6	92008	03/12/92	5										0.00			0.00
WELL6	92087	06/02-03/92	6										0.00			0.00
WELL6	92166	09/11-12/92	7													
WELL6	92264	12/7-8/92	8													

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WELL6	93092	02/16/93	9													
WELL6	93187	05/17-05/18/	10													
WELL6	93275	08/17-18/93	11													
WELL6	93364	11/16-17/93	12													
WELL7	91057	03/20/91	1		553	47.0	37.0				0.20	0.20				
WELL7	91124	06/26/91	2		487	36.0	35.8				0.20	0.20	0.00			
WELL7	91203	09/25/91	3		500	173.5	38.6				0.20	0.20	0.00			
WELL7	91242	11/21/91	4		494	87.7	39.4				0.20	0.20	0.00			
WELL7	92011	03/12/92	5		494	267.6	28.0	37.7	29.5	12.1	0.12	0.20	0.00		7.14	0.42
WELL7	92088	06/02-03/92	6	D	505	149.0	39.9	36.6	32.5	11.5	0.16	0.20	5.49	28	6.88	0.09
WELL7	92088	06/02-03/92	6		520	140.0	43.1	37.6	33.4	11.8	0.17	0.20	5.43	28	6.79	0.13
WELL7	92167	09/11-12/92	7		480	183.7	89.8	40.8	41.5	13.8	0.20	0.20	3.85	30	7.10	3.53
WELL7	92265	12/7-8/92	8		473	139.2	33.4	44.4	27.4	15.0	0.20	0.20	0.00	20	7.02	0.80
WELL7	93051	02/16/93	9		503	295.6	34.2	39.9	43.0	13.7	0.20	0.20	0.00	18	5.70	0.42
WELL7	93188	05/17-05/18/	10		484	190.2	34.5	40.6	35.7	12.0	0.20	0.20	0.00	17	5.40	0.30
WELL7	93188	05/17-05/18/	10	D	493	209.3	34.5	40.5	35.9	11.9	0.20	0.20	0.00	17	5.50	0.30
WELL7	93276	08/17-18/93	11		441	285.5	33.0	39.5	37.3	12.5	0.20	0.20	0.00	18	5.60	0.19
WELL7	93365	11/16-17/93	12		433	234.9	34.8	40.7	37.6	11.8	< 0.2	< 0.2	< 0.00	20	4.64	0.90
WELL7	94081	02/22-23/94	13		431	261.5	58.4	40.6	36.8	11.9	< 0.2	< 0.2	< 0.50	0	2.88	0.84
WELL7	9519949	9/19-20/95	19		478	113.0	30.0	39.7								
WELL9	91064	03/20/91	1		928	657.9	245.0				0.20	0.20				
WELL9	91127	06/26/91	2		953	433.0	66.0				0.20	0.20	0.00			
WELL9	91205	09/25/91	3		997	414.3	67.9				0.20	0.20	0.00			
WELL9	91244	11/21/91	4		970	302.6	73.3				0.20	0.20	0.00			
WELL9	92013	03/12/92	5		964	692.9	60.0	53.4	90.7	31.0	0.25	0.20	0.00		22.74	0.28
WELL9	92092	06/02-03/92	6		968	375.1	74.6	55.8	86.1	29.3	0.31	0.20	7.12	27	24.55	0.03
WELL9	92171	09/11-12/92	7		950	440.7	88.0	57.1	102.7	34.0	0.20	0.18	0.50	31	15.84	0.18
WELL9	92267	12/7-8/92	8		896	327.0	75.5	64.3	64.3	34.9	0.30	0.20	0.00	35	22.52	0.40
WELL9	93053	02/16/93	9		1033	490.4	79.2	52.4	107.8	33.7	0.20	0.20	0.00	6	23.20	0.66
WELL9	93151	05/17-05/18/	10		1012	368.0	69.6	32.8	56.3	17.4	0.30	0.20	0.00	8	11.70	0.10
WELL9	93278	08/17-18/93	11		846	405.5	77.4	57.1	106.0	32.9	0.20	0.20	0.00	9	18.90	0.30
WELL9	93278	08/17-18/93	11	D	862	391.8	78.0	55.0	101.0	31.4	0.20	0.20	0.00	11	17.40	0.27
WELL9	93367	11/16-17/93	12		766	314.2	76.8	59.0	107.2	30.9	0.26	< 0.2	1.00	8	18.92	0.70
WELL9	94083	02/22-23/94	13		820	431.5	81.7	55.7	94.9	28.2	0.22	< 0.2	0.78	26	20.25	0.25
WELL9	9519951	9/19-20/95	19		909	316.2	78.0	57.5								
WELL14	91032	03/20/91	1		644	208.0	48.1				0.20	0.20				
WELL14	91133	06/26/91	2										0.00			
WELL14	91212	09/25/91	3		700	223.1	20.4				0.20	0.20	0.00			
WELL14	91251	11/21/91	4		674	393.9	24.1				0.20	0.20	0.50			
WELL14	92018	03/12/92	5		678	255.9	18.6	43.2	65.3	21.5	0.24	0.20	0.00		11.64	0.00
WELL14	92097	06/02-03/92	6		713	290.0	27.0	39.7	74.4	21.5	0.26	0.20	3.37	54	109.05	0.39
WELL14	92176	09/11-12/92	7		681	337.0	68.3	47.5	72.1	28.1	0.20	0.20	0.00	34	2.53	0.30
WELL14	92274	12/7-8/92	8		668	279.4	21.1	48.6	46.6	26.9	0.20	0.20	0.00	50	5.82	0.90
WELL14	93058	02/16/93	9	D	643		19.5	37.9	61.4	21.8	0.20	0.20	0.00	22	9.20	0.36
WELL14	93058	02/16/93	9		647		21.3	38.3	61.6	22.4	0.20	0.20	0.00	22	9.30	0.33
WELL14	93156	05/17-05/18/	10		705	291.7	21.0	45.2	67.8	22.3	0.20	0.20	0.00	35	6.90	0.20
WELL14	93244	08/17-18/93	11		620	426.8	21.6	42.4	64.7	22.7	0.24	0.20	0.00	32	6.30	0.21

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium (mg/L)	Calcium (mg/L)	Mag-nesium (mg/L)	Boron (mg/L)	Fluoride (mg/L)	Nitrite+ Nitrate (mg/L)	Alka-linity (mg/L)	Iron (mg/L)	Alum-inum (mg/L)
WELL14	93333	11/16-17/93	12		506	354.6	21.3	42.7	63.8	21.5	< 0.2	< 0.2	3.45	23	1.19	0.40
WELL14	94088	02/22-23/94	13		667	290.1	22.8	43.6	64.0	19.8	< 0.2	< 0.2	< 0.50	24	9.84	0.46
WELL14	94088	02/22-23/94	13	D	674	310.3	22.5	42.5	62.5	19.3	< 0.2	< 0.2	< 0.50	23	9.74	0.67
WELL14	9519956	9/19-20/95	19	D	699	282.6	15.0	45.4								
WELL14	9519956	9/19-20/95	19		676	300.4	12.0	44.3								
WELL16	91056	03/20/91	1		141	387.6	9.6				0.20	0.20				
WELL16	91135	06/26/91	2		83	14.0	51.2				0.20	0.20	0.00			
WELL16	91214	09/25/91	3		113	16.3	18.7				0.20	0.20	0.00			
WELL16	91253	11/21/91	4		121	54.2	20.0				0.20	0.20	0.00			
WELL16	92022	03/12/92	5		113	25.0	1.0	7.9	4.9	1.2	0.20	0.20	0.00		3.80	0.66
WELL16	92101	06/02-03/92	6		111	7.1	11.5	7.9	2.6	0.4	0.20	0.20	3.68	0	0.50	0.85
WELL16	92178	09/11-12/92	7	D	63	8.0	11.8	8.6	2.2	0.5	0.20	0.11	0.00	7	1.06	1.91
WELL16	92178	09/11-12/92	7		89	10.3	14.8	8.1	2.4	0.5	0.20	0.12	0.00	7	1.24	2.29
WELL16	92276	12/7-8/92	8		108	6.8	1.0	8.7	1.6	0.6	0.20	0.20	0.00	10	2.23	3.50
WELL16	93062	02/16/93	9		100	10.0	4.2	7.8	3.0	1.0	0.20	0.20	0.00	9	4.30	1.26
WELL16	93158	05/17-05/18/	10	D	111	19.4	3.3	10.1	2.3	1.0	0.20	0.20	0.00	9	0.20	0.00
WELL16	93158	05/17-05/18/	10		109	19.4	3.3	10.1	2.1	1.0	0.20	0.20	0.00	8	0.20	0.00
WELL16	93246	08/17-18/93	11		95	12.1	3.0	7.7	1.2	1.0	0.20	0.20	0.00	9	1.10	1.56
WELL16	93335	11/16-17/93	12		115	13.0	3.0	8.2	2.3	< 1.0	< 0.2	< 0.2	4.78	8	1.02	0.90
WELL16	94051	02/22-23/94	13		115	50.4	3.6	10.4	1.7	< 1.0	< 0.2	0.20	< 0.50	7	2.37	1.13
WELL16	9519925	9/19-20/95	19		139	21.2	6.0	9.2			0.27					
WELL18	91034	03/20/91	1		1741	1217.0	48.7				0.37	0.79				
WELL18	91137	06/26/91	2		1722	324.0	11.4				0.50	1.00	0.00			
WELL18	91216	09/25/91	3		1740	480.9	13.6				0.46	0.35	0.60			
WELL18	91255	11/21/91	4		1350	829.1	42.9				0.44	0.31	0.00			
WELL18	92024	03/12/92	5		1560	374.9	40.0	74.4	185.4	53.8	0.62	0.37	0.00		19.50	0.83
WELL18	92103	06/02-03/92	6		1695	456.5	59.9	75.1	163.0	54.8	0.68	0.40	5.18	14	25.02	0.31
WELL18	92182	09/11-12/92	7		1558	772.0	71.7	78.3	116.6	66.5	0.70	0.56	0.00	21	22.70	1.71
WELL18	92278	12/7-8/92	8	D	1406	744.2	52.5	87.4	166.8	58.3	0.65	0.55	0.00	37	18.49	0.90
WELL18	92278	12/7-8/92	8		1397	722.5	57.5	87.8	167.4	58.3	0.66	0.57	0.00	37	18.49	1.10
WELL18	93064	02/16/93	9		1515	937.9	46.8	65.1	183.5	59.6	0.35	0.61	0.00		20.60	2.22
WELL18	93162	05/17-05/18/	10		1519	827.8	45.3	74.1	156.5	52.0	0.50	0.51	0.00	3	22.20	0.80
WELL18	93248	08/17-18/93	11	D	1050	871.8	45.9	73.2	175.2	55.5	0.64	0.59	0.00	0	24.00	1.17
WELL18	93248	08/17-18/93	11		1071	844.4	45.0	72.3	172.4	54.9	0.66	0.59	0.00	0	23.80	1.11
WELL18	93337	11/16-17/93	12		1183	781.8	39.9	72.8	172.4	41.7	0.42	0.56	4.10	20	21.52	1.00
WELL18	94053	02/22-23/94	13		1189	790.3	25.4	71.3	160.8	52.2	0.61	0.61	< 0.50	0	19.90	2.08
WELL18	9519927	9/19-20/95	19		1272	529.7	42.0	69.4								
WELL20	91054	03/20/91	1		1616	406.2	34.1				0.20	0.86				
WELL20	91141	06/26/91	2		1596	775.8	44.0				0.20	0.76	0.23			
WELL20	91218A	09/25/91	3		1585	406.0	46.0				0.26	0.77	0.00			
WELL20	91257	11/21/91	4		1548	686.0	34.4				0.20	0.72	2.45			
WELL20	92026	03/12/92	5		1627	100.7	28.0	85.3	125.3	58.5	0.30	0.86	0.50		5.90	0.37
WELL20	92105	06/02-03/92	6		1631	410.0	46.4	89.9	117.0	58.3	0.35	0.70	0.63	0	6.46	0.00
WELL20	92184	09/11-12/92	7		1562	868.1	31.8	85.7	51.2	71.5	0.40	0.83	0.00	0	3.90	23.20
WELL20	92282	12/7-8/92	8		1534	383.1	92.0	84.0	163.2	67.5	0.50	0.60	0.00	0	22.49	9.10
WELL20	93066	02/16/93	9		1418	972.0	43.8	64.5	144.5	59.0	0.20	0.80	0.00		12.10	9.35
WELL20	93164	05/17-05/18/	10		1626	874.8	78.9	88.0	126.5	59.5	0.30	0.81	0.00	0	3.30	23.60

WBSES Lab Data (since 1st qtr of 1991)

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WELL20	93252	08/17-18/93	11		1255	1382.3	33.2	82.3	30.4	58.8	0.21	0.84	0.00	0	1.60	30.55
WELL20	93341	11/16-17/93	12		1325	778.1	48.0	67.4	212.8	44.6	0.26	0.84	0.50	0	22.68	5.70
WELL20	94055	02/22-23/94	13		1369	1024.7	33.0	81.0	113.8	53.7	0.21	0.82	< 0.50	0	1.85	25.14
WELL20	9519929	9/19-20/95	19		1505	689.8	30.0	81.7			0.38					
WELL22	91041	03/20/91	1		278	115.5	19.3				0.20	0.23	0.50			
WELL22	91143	06/26/91	2		257	103.5	18.2				0.20	0.20	0.00			
WELL22	91222	09/25/91	3		238	43.0	18.4				0.20	0.20	4.92			
WELL22	91261	11/21/91	4		224	182.6	18.8				0.20	0.20	0.00			
WELL22	92028	03/12/92	5	D	288	55.0	5.0	19.2	15.4	4.9	0.20	0.20	0.50		6.90	0.80
WELL22	92028	03/12/92	5		331	50.0	5.0	18.6	15.2	4.6	0.20	0.20	0.57		6.00	0.77
WELL22	92107	06/02-03/92	6		232	41.9	32.3	14.4	9.6	2.8	0.06	0.20	4.25	0	2.88	0.26
WELL22	92186	09/11-12/92	7		211	51.9	62.1	17.3	14.5	4.1	0.20	0.20	0.00	0	3.76	1.69
WELL22	92284	12/7-8/92	8		241	32.1	15.2	18.4	11.4	4.8	0.20	0.20	0.00	0	4.61	5.30
WELL22	93068	02/16/93	9	D	257		20.4	19.4	15.2	4.9	0.20	0.20	0.00		3.10	1.53
WELL22	93068	02/16/93	9		262		20.1	19.2	15.6	4.8	0.20	0.20	0.00		3.20	1.30
WELL22	93166	05/17-05/18/	10		250	68.9	22.5	18.7	12.1	4.0	0.20	0.20	0.00	0	2.90	1.30
WELL22	93254	08/17-18/93	11		185	92.6	16.2	17.0	11.2	4.1	0.20	0.20	0.00	0	3.50	0.88
WELL22	93343	11/16-17/93	12		269	162.7	11.7	27.7	19.3	1.7	< 0.2	< 0.2	0.50	0	13.16	13.80
WELL22	93343	11/16-17/93	12													
WELL22	94057	02/22-23/94	13		297	107.9	19.8	25.5	13.9	5.1	< 0.2	0.20	< 0.50	0	3.78	2.01
WELL22	9519931	9/19-20/95	19		256	70.4	12.0	21.2			0.33					
WELL23	92187	09/11-12/92	7		902	299.9	143.2	75.6	94.8	34.1	0.70	0.20	0.00	200	0.60	1.39
WELL23	92285	12/7-8/92	8		860	229.6	77.0	104.5	108.0	28.5	0.70	0.20	0.00	194	0.11	0.00
WELL23	93071	02/16/93	9		837	364.0	80.5	78.8	106.4	26.7	0.40	0.20	0.00	187	0.10	0.23
WELL23	93168	05/17-05/18/	10		856	273.9	94.5	81.3	93.9	23.1	0.49	0.20	0.00	189	0.10	0.10
WELL23	93168	05/17-05/18/	10	D	853	273.9	94.5	83.8	93.7	22.9	0.48	0.20	0.00	188	0.10	0.20
WELL23	93255	08/17-18/93	11		764	326.5	105.3	70.7	110.4	30.3	0.59	0.20	0.00	216	0.10	0.37
WELL23	93344	11/16-17/93	12		572	459.1	77.4	80.4	84.6	< 1.0	0.31	< 0.2	0.50	141	0.13	1.20
WELL23	94058	02/22-23/94	13		100	290.1	3.0	8.0	14.3	1.6	< 0.2	0.20	< 0.50	43	1.01	1.03
WELL23	94058	02/22-23/94	13	D	109	290.1	2.7	8.1	14.2	1.6	< 0.2	0.20	< 0.50	42	1.02	2.26
WELL23	9519932	9/19-20/95	19	D	209	20.9	6.0	22.1								
WELL23	9519932	9/19-20/95	19		209	24.5	7.0	21.9								
WELL25	92191	09/11-12/92	7		768	50.3	16.3	120.7	129.0	1.1	0.20	0.32	0.78	701	7.10	8.81
WELL25	92287	12/7-8/92	8													
WELL25	93073	02/16/93	9		546	36.4	38.4	51.5	121.5	1.0	0.20	0.26	0.00	440	1.20	3.60
AR. RIVER	93267	08/17-18/93	11		283	216.9	75.0	43.6	38.7	8.6	0.20	0.26	0.00	97	0.20	0.32
AR. RIVER	93356	11/16-17/93	12		317	94.8	30.0	21.4	38.9	5.8	< 0.2	0.23	1.12	71	0.15	0.60
AR. RIVER	94072	02/22-23/94	13		195	116.0	31.9	24.1	30.2	5.7	0.23	< 0.2	< 0.50	44	0.55	0.75
AR. RIVER	9519942	9/19-20/95	19		366	49.4	78.0	58.2								
CLTWRSUMP	92002	03/12/92	5		344	105.5	74.0	55.4	42.4	8.6	0.36	0.43	< 0.00		0.14	0.24
CLTWRSUMP	92113	06/02-03/92	6		1842	416.5	435.1	231.0	218.0	36.2	1.76	0.90	8.96	62	1.19	0.21
CLTWRSUMP	92196	09/11-12/92	7		2735	627.6	96.2				2.40	1.80	1.28	63		
CLTWRSUMP	92294	12/7-8/92	8		2340	617.9	442.5	321.6	283.2	54.6	1.70	2.20	4.18	76	2.64	4.60
CLTWRSUMP	93078	3/2-3/93	9	D	2125	736.0	408.3	256.2	261.9	48.9	1.00	1.16	2.92	61	1.80	2.61
CLTWRSUMP	93078	3/2-3/93	9		2121	776.1	405.0	261.6	261.0	50.3	1.00	1.15	2.91	59	1.70	2.72

WBSES Lab Data (since 1st qtr of 1991)

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CLTWRSUMP	93175	5/17-18/93	10		2515	813.4	327.0	202.5	184.0	33.7	1.10	0.97	0.94	65	1.30	1.30
CLTWRSUMP	93263	08/17-18/93	11		2162	1485.6	486.0	332.0	296.5	63.6	0.94	1.36	0.90	88	1.20	2.00
CLTWRSUMP	93352	11/16-17/93	12		2010	1114.3	286.8	221.2	321.6	53.6	1.18	2.04	2.75	67	0.77	2.00
CLTWRSUMP	94066	02/22-23/94	13		1701	1226.7	410.9	197.0	285.4	41.0	1.18	1.40	3.14	60	1.79	3.35
CLTWRSUMP	9519938	9/19-20/95	19		2381	600.8	402.0	345.5								
NRECYCLE	92036	03/12/92	5		1113	650.0	76.0	86.0	135.9	12.7	1.38	0.84	< 0.00		0.50	0.86
NRECYCLE	92115	06/02-03/92	6		1142	399.4	128.7	92.1	190.0	13.9	2.02	0.80	5.17	31	0.33	2.04
NRECYCLE	92198	09/11-12/92	7	D	1219	500.1	239.3	91.1	151.9	14.9	2.00	0.66	0.93	14	0.19	1.86
NRECYCLE	92198	09/11-12/92	7		1200	479.2	238.9	73.4	124.5	16.8	2.00	0.68	0.93	14	0.18	1.41
NRECYCLE	92296	12/7-8/92	8		1103	459.2	79.5	95.6	192.0	11.5	1.50	0.80	0.82	35	0.44	1.50
NRECYCLE	93082	3/2-3/93	9		1090	665.0	78.0	78.5	202.0	13.4	1.00	0.60	< 0.00	21	0.50	2.18
NRECYCLE	93177	5/17-18/93	10		1740	453.7	52.5	59.9	128.0	8.7	1.20	1.26	< 0.00	35	0.20	0.70
NRECYCLE	93265	08/17-18/93	11		596	449.6	46.8	46.5	107.5	5.0	1.29	0.43	0.00	63	0.20	6.63
NRECYCLE	93354	11/16-17/93	12		606	397.3	33.6	46.0	129.2	8.9	0.55	0.78	1.03	3	0.28	1.30
NRECYCLE	94068	02/22-23/94	13	D	471	296.1	26.2	32.8	96.8	5.4	0.78	0.26	< 0.50	49	0.51	2.87
NRECYCLE	94068	02/22-23/94	13		463	316.3	26.7	33.1	97.5	5.3	0.74	0.26	< 0.50	51	0.54	2.80
NRECYCLE	9519940	9/19-20/95	19													
SRECYCLE	92001	03/12/92	5		1181	654.7	97.8	93.8	168.6	13.9	1.39	1.33	< 0.00		0.35	0.56
SRECYCLE	92116	06/02-03/92	6		1094	388.5	121.0	88.4	192.0	14.0	1.83	1.10	5.63	58	0.19	0.27
SRECYCLE	92201	09/11-12/92	7		1066	444.4	54.5	78.0	141.2	13.6	1.60	0.78	0.40	70	0.23	2.26
SRECYCLE	92297	12/7-8/92	8		1077	453.4	77.0	94.7	189.6	11.5	1.50	0.80	1.01	36	0.31	0.90
SRECYCLE	93083	3/2-3/93	9		1005	677.0	79.8	61.2	197.0	11.4	0.70	0.49	< 0.00	35	0.20	2.26
SRECYCLE	93178	5/17-18/93	10	D	858	402.0	54.6	60.4	140.5	9.0	0.90	1.30	< 0.00	52	0.20	1.40
SRECYCLE	93178	5/17-18/93	10		863	402.0	56.7	59.3	137.5	9.0	0.90	1.25	< 0.00	52	0.10	1.50
SRECYCLE	93266	08/17-18/93	11		615	404.0	45.6	45.7	108.5	5.5	1.21	0.45	0.00	59	0.30	7.06
SRECYCLE	93355	11/16-17/93	12		644	543.4	36.0	45.1	152.0	10.8	0.62	1.25	0.97	28	0.15	1.20
SRECYCLE	94071	02/22-23/94	13		452	271.9	26.7	30.8	92.6	5.5	0.78	0.27	0.56	57	0.32	2.01
SRECYCLE	9519941	9/19-20/95	19		444	124.1	69.0	57.2								
SURGEPOND	92035	03/12/92	5		499	425.0	53.0	53.9	52.1	8.7	0.79	0.32	< 0.00		< 0.1	0.15
SURGEPOND	92114	06/02-03/92	6		627	210.2	90.1	63.3	74.0	11.4	1.28	0.40	5.43	28	0.13	1.32
SURGEPOND	92197	09/11-12/92	7		563	306.4	95.5	65.1	73.4	12.1	0.90	0.49	0.69	15	0.07	0.44
SURGEPOND	92295	12/7-8/92	8		645	279.2	65.0	64.8	95.1	12.3	0.90	0.60	0.54	45	0.16	0.30
SURGEPOND	93081	3/2-3/93	9		419	261.6	33.9	39.5	68.3	9.8	0.50	0.34	0.52	39	2.50	3.08
SURGEPOND	93176	5/17-18/93	10		826	234.3	42.3	47.7	69.3	8.5	0.80	0.48	< 0.00	42	0.10	0.30
SURGEPOND	93264	08/17-18/93	11		827	240.6	61.8	55.9	80.1	10.5	0.91	0.58	0.00	40	0.10	0.60
SURGEPOND	93353	11/16-17/93	12		351	290.5	39.3	35.7	52.9	8.3	0.36	0.43	1.03	29	2.57	5.60
SURGEPOND	93353	11/16-17/93	12													
SURGEPOND	94067	02/22-23/94	13		358	233.5	22.8	29.0	47.1	7.0	0.53	0.29	0.76	34	3.14	6.00
SURGEPOND	9519939	9/19-20/95	19		465	113.0	66.0	58.9								

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Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL1	91035	03/20/91	1											
WELL1	91116	06/26/91	2											
WELL1	91195	09/25/91	3											
WELL1	91234	11/21/91	4											
WELL1	92003	03/12/92	5		3.91	0.025	0.113	0.010	0.005	0.002	0.012	0.001	0.001	0.002
WELL1	92082	06/02-03/92	6		4.33	0.016	0.123	0.010	0.005	0.002	0.007	0.001	0.001	0.001
WELL1	92161	09/11-12/92	7		5.48	0.114	0.205	0.008	0.005	0.002	0.005	0.001	0.001	0.004
WELL1	92301	12/7-8/92	8		4.19	0.025	0.149	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL1	93085	02/16/93	9		5.79	0.039	0.057	0.025			0.005		0.001	0.001
WELL1	93182	05/17-05/18/	10		5.15	0.025	0.005	0.025			0.005		0.001	0.001
WELL1	93268	08/17-18/93	11		5.76	0.101	0.134	0.025			0.014		0.001	0.001
WELL1	93268	08/17-18/93	11	D	5.95	0.101	0.134	0.025			0.018		0.001	0.001
WELL1	93357	11/16-17/93	12		4.49	0.166	0.016	< 0.025			0.010		< 0.0005	< 0.001
WELL1	94073	02/22-23/94	13		4.86	0.034	0.010	< 0.025			0.007		< 0.0005	< 0.001
WELL1	9519943	9/19-20/95	19		5.37		0.348							< 0.001
WELL4	91046	03/20/91	1											
WELL4	91121	06/26/91	2											
WELL4	91198	09/25/91	3											
WELL4	91237	11/21/91	4											
WELL4	92006	03/12/92	5		0.14	0.025	0.010	0.005	0.005	0.002	0.019	0.001	0.001	0.003
WELL4	92085	06/02-03/92	6		0.15	0.027	0.058	0.007	0.005	0.002	0.005	0.001	0.001	0.003
WELL4	92164	09/11-12/92	7		0.23	0.107	0.013	0.005	0.005	0.002	0.005	0.001	0.001	0.013
WELL4	92262	12/7-8/92	8		0.20	0.132	0.007	0.005	0.005	0.002	0.015	0.001	0.001	0.002
WELL4	93088	02/16/93	9		0.23	0.025	0.017	0.025			0.005		0.001	0.001
WELL4	93088	02/16/93	9	D	0.22	0.025	0.018	0.025			0.005		0.001	0.001
WELL4	93185	05/17-05/18/	10		0.19	0.025	0.022	0.025			0.005		0.001	0.003
WELL4	93273	08/17-18/93	11		0.18	0.058	0.012	0.025			0.005		0.001	0.003
WELL4	93362	11/16-17/93	12											
WELL4	93362	11/16-17/93	12		0.22	0.052	0.021	< 0.025			0.011		< 0.0005	0.004
WELL4	94076	02/22-23/94	13		0.15	0.063	0.010	< 0.025			0.007		< 0.0005	0.003
WELL4	9519946	9/19-20/95	19		0.35		0.031							< 0.001
WELL5	91051	03/20/91	1											
WELL5	91122	06/26/91	2											
WELL5	91201	09/25/91	3											
WELL5	91238	11/21/91	4											
WELL5	92007	03/12/92	5		5.97	0.025	0.091	0.005	0.005	0.002	0.018	0.001	0.001	0.004
WELL5	92086	06/02-03/92	6		4.61	0.024	0.081	0.005	0.005	0.002	0.005	0.001	0.001	0.011
WELL5	92165	09/11-12/92	7		8.31	0.088	0.118	0.005	0.005	0.002	0.011	0.001	0.001	0.001
WELL5	92263	12/7-8/92	8		6.23	0.025	0.083	0.005	0.005	0.002	0.021	0.001	0.001	0.001
WELL5	93091	02/16/93	9		6.86	0.029	0.033	0.025			0.006		0.001	0.001
WELL5	93186	05/17-05/18/	10		5.26	0.025	0.005	0.025			0.005		0.001	0.001
WELL5	93274	08/17-18/93	11		6.84	0.095	0.055	0.025			0.006		0.001	0.011
WELL5	93363	11/16-17/93	12		7.71	0.083	0.098	< 0.025			0.009		< 0.0005	< 0.001
WELL5	94077	02/22-23/94	13		5.81	0.070	0.008	< 0.025			0.009		0.001	< 0.001
WELL5	9519947	9/19-20/95	19		6.77		0.229							< 0.001
WELL8	91063	03/20/91	1											
WELL8	91125	06/26/91	2											

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Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL8	91204	09/25/91	3											
WELL8	91243	11/21/91	4											
WELL8	92012	03/12/92	5		0.28	0.025	0.029	0.009	0.005	0.002	0.011	0.001	0.001	0.005
WELL8	92091	06/02-03/92	6		0.28	0.025	0.029	0.005	0.005	0.002	0.011	0.004	0.001	0.020
WELL8	92168	09/11-12/92	7	D	0.46	0.025	0.028	0.005	0.005	0.002	0.005	0.001	0.001	0.006
WELL8	92168	09/11-12/92	7		0.44	0.025	0.025	0.005	0.005	0.002	0.005	0.001	0.001	0.006
WELL8	92266	12/7-8/92	8		0.38	0.154	0.014	0.005	0.005	0.002	0.014	0.001	0.001	0.003
WELL8	93052	02/16/93	9		0.41	0.025	0.022	0.025			0.005		0.001	0.001
WELL8	93191	05/17-05/18/	10		0.43	0.025	0.005	0.025			0.005		0.001	0.001
WELL8	93277	08/17-18/93	11		0.38	0.050	0.009	0.025			0.005		0.001	0.001
WELL8	93366	11/16-17/93	12		0.38	0.053	0.040	< 0.025			0.009		< 0.0005	0.002
WELL8	94082	02/22-23/94	13		0.38	0.058	0.031	< 0.025			0.008		< 0.0005	< 0.001
WELL8	9519950	9/19-20/95	19		0.56		0.026							< 0.001
WELL10	91065	03/20/91	1											
WELL10	91126	06/26/91	2											
WELL10	91206	09/25/91	3											
WELL10	91245	11/21/91	4											
WELL10	92014	03/12/92	5		0.44	0.107	0.011	0.005	0.005	0.002	0.019	0.001	0.001	0.001
WELL10	92093	06/02-03/92	6		0.47	0.025	0.005	0.005	0.005	0.002	0.009	0.004	0.001	0.012
WELL10	92172	09/11-12/92	7		0.57	0.025	0.010	0.005	0.005	0.002	0.005	0.001	0.001	0.006
WELL10	92268	12/7-8/92	8		0.89	0.140	0.005	0.005	0.005	0.002	0.017	0.001	0.001	0.001
WELL10	92268	12/7-8/92	8	D	0.90	0.120	0.007	0.005	0.005	0.002	0.019	0.001	0.001	0.001
WELL10	93054	02/16/93	9		0.39	0.025	0.017	0.025			0.005		0.001	0.001
WELL10	93152	05/17-05/18/	10		0.66	0.025	0.013	0.025			0.005		0.001	0.001
WELL10	93281	08/17-18/93	11		0.53	0.036	0.010	0.025			0.011		0.001	0.001
WELL10	93368	11/16-17/93	12		0.64	0.040	0.018	< 0.025			0.007		< 0.0005	< 0.001
WELL10	93368	11/16-17/93	12	D	0.64	0.039	0.018	< 0.025			0.006		< 0.0005	< 0.001
WELL10	94084	02/22-23/94	13		0.67	0.045	< 0.005	< 0.025			0.012		< 0.0005	< 0.001
WELL10	9519952	9/19-20/95	19		0.85		0.020							< 0.001
WELL11	91042	03/20/91	1											
WELL11	91128A	06/26/91	2											
WELL11	91207	09/25/91	3											
WELL11	91246	11/21/91	4											
WELL11	92015	03/12/92	5										0.004	
WELL11	92094	06/02-03/92	6		0.84	0.033	0.017	0.005	0.005	0.002	0.009	0.004	0.001	0.004
WELL11	92173	09/11-12/92	7		0.97	0.030	0.057	0.005	0.005	0.002	0.005	0.001	0.006	0.001
WELL11	92271	12/7-8/92	8		1.17	0.098	0.039	0.005	0.005	0.002	0.015	0.001	0.004	0.001
WELL11	93055	02/16/93	9		1.02	0.025	0.031	0.025			0.007		0.002	0.001
WELL11	93153	05/17-05/18/	10		1.12	0.025	0.056	0.025			0.005		0.002	0.001
WELL11	93241	08/17-18/93	11		1.05	0.107	0.042	0.025			0.007		0.001	0.001
WELL11	93371	11/16-17/93	12	D										
WELL11	93371	11/16-17/93	12		1.19	0.079	0.072	< 0.025			0.005		0.001	< 0.001
WELL11	94085	02/22-23/94	13		1.24	0.065	< 0.081	< 0.025			0.008		0.002	< 0.001
WELL11		02/22-23/94	13	D	1.19	0.079	0.072	< 0.025			0.005		0.001	< 0.001
WELL11	9519953	9/19-20/95	19		0.92		0.058							< 0.001
WELL12	91043	03/20/91	1											
WELL12	91131	06/26/91	2											

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL12	91208A	09/25/91	3											
WELL12	91247	11/21/91	4											
WELL12	92016	03/12/92	5		1.39	0.155	0.156	0.005	0.005	0.002	0.020	0.001	0.001	0.001
WELL12	92095	06/02-03/92	6		1.24	0.025	0.025	0.005	0.005	0.002	0.015	0.010	0.001	0.019
WELL12	92174	09/11-12/92	7		1.26	0.025	0.079	0.005	0.005	0.002	0.006	0.003	0.001	0.001
WELL12	92272	12/7-8/92	8		1.84	0.086	0.063	0.005	0.005	0.002	0.018	0.001	0.001	0.001
WELL12	93056	02/16/93	9		1.71	0.025	0.005	0.025			0.005		0.001	0.001
WELL12	93154	05/17-05/18/	10		1.34	0.025	0.067	0.025			0.006		0.001	0.001
WELL12	93242	08/17-18/93	11		1.39	0.063	0.049	0.025			0.009		0.001	0.001
WELL12	93331	11/16-17/93	12		1.92	< 0.025	0.089	< 0.025			0.024		< 0.0005	< 0.001
WELL12	94086	02/22-23/94	13		1.33	< 0.025	0.083	< 0.025			0.009		0.001	< 0.001
WELL12	9519954	9/19-20/95	19		2.46		0.066							< 0.001
WELL13	91037	03/20/91	1											
WELL13	91132	06/26/91	2											
WELL13	91211	09/25/91	3											
WELL13	91248	11/21/91	4											
WELL13	92017	03/12/92	5		0.28	0.206	0.061	0.005	0.005	0.002	0.020	0.001	0.001	0.007
WELL13	92096	06/02-03/92	6		0.39	0.045	0.151	0.005	0.008	0.002	0.011	0.007	0.001	0.010
WELL13	92175	09/11-12/92	7		0.42	0.025	0.049	0.005	0.005	0.002	0.007	0.002	0.001	0.001
WELL13	92273	12/7-8/92	8		0.44	0.085	0.022	0.005	0.005	0.002	0.015	0.003	0.001	0.001
WELL13	93057	02/16/93	9		0.41	0.051	0.028	0.025			0.006		0.001	0.001
WELL13	93155	05/17-05/18/	10		0.37	0.025	0.024	0.025			0.006		0.001	0.001
WELL13	93243	08/17-18/93	11		0.38	0.047	0.024	0.025			0.006		0.001	0.001
WELL13	93332	11/16-17/93	12		0.41	< 0.025	0.036	< 0.025			0.009		< 0.0005	< 0.001
WELL13	94087	02/22-23/94	13		0.30	< 0.025	0.037	< 0.025			0.005		< 0.0005	< 0.001
WELL13	9519955	9/19-20/95	19		0.49		0.035							< 0.001
WELL15	91031	03/20/91	1											
WELL15	91134	06/26/91	2											
WELL15	91213	09/25/91	3											
WELL15	91252	11/21/91	4											
WELL15	92021	03/12/92	5		1.21	0.025	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL15	92021	03/12/92	5	D	1.18	0.025	0.005	0.005	0.005	0.002	0.018	0.001	0.001	0.001
WELL15	92098	06/02-03/92	6		1.27	0.025	0.005	0.005	0.005	0.002	0.009	0.001	0.001	0.001
WELL15	92098	06/02-03/92	6	D	1.27	0.025	0.005	0.005	0.005	0.002	0.007	0.001	0.001	0.001
WELL15	92177	09/11-12/92	7		1.55	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL15	92275	12/7-8/92	8		1.54	0.025	0.005	0.005	0.005	0.002	0.015	0.001	0.001	0.001
WELL15	93061	02/16/93	9		1.86	0.025	0.005	0.025			0.005		0.001	0.001
WELL15	93157	05/17-05/18/	10		1.42	0.025	0.005	0.025			0.005		0.001	0.001
WELL15	93245	08/17-18/93	11		1.31	0.025	0.005	0.025			0.005		0.001	0.001
WELL15	93334	11/16-17/93	12		1.45	0.081	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL15	94064	02/22-23/94	13		1.25	< 0.025	< 0.005	< 0.025			< 0.006		< 0.0005	< 0.001
WELL15	9519936	9/19-20/95	19		1.60		< 0.005							< 0.001
WELL17	91055	03/20/91	1											
WELL17	91136	06/26/91	2											
WELL17	91215	09/25/91	3											
WELL17	91254	11/21/91	4											
WELL17	92023	03/12/92	5		0.63	0.040	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.003

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL17	92102	06/02-03/92	6		0.78	0.033	0.005	0.007	0.005	0.002	0.005	0.001	0.001	0.005
WELL17	92181	09/11-12/92	7		0.87	0.025	0.013	0.010	0.005	0.002	0.010	0.002	0.001	0.001
WELL17	92277	12/7-8/92	8		1.00	0.025	0.005	0.005	0.006	0.002	0.017	0.001	0.001	0.001
WELL17	93063	02/16/93	9		1.00	0.025	0.005	0.025			0.005		0.001	0.001
WELL17	93161	05/17-05/18/	10		0.25	0.025	0.005	0.025			0.005		0.001	0.001
WELL17	93247	08/17-18/93	11		0.68	0.025	0.005	0.025			0.005		0.001	0.002
WELL17	93336	11/16-17/93	12		0.66	0.058	< 0.005	< 0.025			0.005		< 0.0005	0.002
WELL17	94052	02/22-23/94	13		0.11	0.047	0.006	< 0.025			0.008		< 0.0005	< 0.001
WELL17	9519926	9/19-20/95	19		0.17		0.009							< 0.001
WELL19	91033	03/20/91	1											
WELL19	91138A	06/26/91	2											
WELL19	91217	09/25/91	3											
WELL19	91256	11/21/91	4											
WELL19	92025	03/12/92	5		3.79	0.063	0.006	0.005	0.005	0.002	0.020	0.001	0.001	0.002
WELL19	92104	06/02-03/92	6		3.28	0.035	0.005	0.008	0.005	0.002	0.005	0.001	0.001	0.004
WELL19	92183	09/11-12/92	7		3.15	0.025	0.028	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL19	92281	12/7-8/92	8		3.89	0.141	0.008	0.005	0.005	0.002	0.013	0.001	0.001	0.002
WELL19	93065	02/16/93	9		3.96	0.025	0.005	0.025			0.005		0.001	0.001
WELL19	93163	05/17-05/18/	10		3.70	0.030	0.005	0.025			0.005		0.001	0.001
WELL19	93251	08/17-18/93	11		3.11	0.063	0.007	0.025			0.005		0.001	0.001
WELL19	93338	11/16-17/93	12		3.27	< 0.025	0.014	< 0.025			0.008		< 0.0005	< 0.001
WELL19	93338	11/16-17/93	12	D	3.32	< 0.025	0.013	< 0.025			0.007		< 0.0005	< 0.001
WELL19	94054	02/22-23/94	13		3.27	0.053	0.008	< 0.025			0.007		< 0.0005	< 0.001
WELL19	9519928	9/19-20/95	19		3.49		0.005							< 0.001
WELL21	91053	03/20/91	1											
WELL21	91142	06/26/91	2											
WELL21	91221	09/25/91	3											
WELL21	91258A	11/21/91	4											
WELL21	92027	03/12/92	5		2.05	0.036	0.159	0.005	0.005	0.002	0.021	0.001	0.001	0.014
WELL21	92106	06/02-03/92	6		2.29	0.015	0.028	0.007	0.005	0.002	0.005	0.001	0.001	0.002
WELL21	92185	09/11-12/92	7		2.84	0.138	0.087	0.011	0.007	0.009	0.006	0.001	0.001	0.001
WELL21	92283	12/7-8/92	8		3.11	0.092	0.054	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL21	93067	02/16/93	9		2.93	0.025	0.048	0.025			0.005		0.001	0.001
WELL21	93165	05/17-05/18/	10		2.13	0.025	0.005	0.025			0.005		0.001	0.001
WELL21	93253	08/17-18/93	11		2.39	0.053	0.062	0.025			0.005		0.001	0.001
WELL21	93342	11/16-17/93	12		2.35	< 0.025	0.073	< 0.025			< 0.005		< 0.0005	< 0.001
WELL21	94056	02/22-23/94	13		2.00	0.069	0.039	0.025			0.008		< 0.0005	< 0.001
WELL21	9519930	9/19-20/95	19		2.42		0.047							< 0.001
WELL24	92188	09/11-12/92	7	D	8.04	0.025	0.152	0.009	0.005	0.002	0.005	0.001	0.001	0.001
WELL24	92188	09/11-12/92	7		8.26	0.025	0.170	0.009	0.005	0.002	0.005	0.001	0.001	0.001
WELL24	92286	12/7-8/92	8		9.88	0.025	0.088	0.005	0.005	0.002	0.006	0.001	0.001	0.001
WELL24	93072	02/16/93	9		8.79	0.031	0.048	0.025			0.005		0.001	0.001
WELL24	93167	05/17-05/18/	10		7.84	0.028	0.005	0.025			0.005		0.001	0.001
WELL24	93256	08/17-18/93	11		8.61	0.065	0.081	0.025			0.005		0.001	0.001
WELL24	93345	11/16-17/93	12		8.27	< 0.025	0.101	< 0.025			< 0.005		< 0.0005	< 0.001
WELL24	94061	02/22-23/94	13		0.28	< 0.047	< 0.005	< 0.025			0.006		< 0.0005	< 0.001
WELL24	9519933	9/19-20/95	19		5.88		0.038							< 0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL26	92192	09/11-12/92	7		0.58	0.025	0.008	0.005	0.005	0.002	0.006	0.001	0.001	0.001
WELL26	92288	12/7-8/92	8		0.49	0.181	0.005	0.005	0.005	0.002	0.014	0.001	0.001	0.001
WELL26	92288	12/7-8/92	8	D	0.40	0.197	0.006	0.005	0.005	0.002	0.014	0.001	0.001	0.001
WELL26	93074	02/16/93	9		0.40	0.025	0.005	0.025			0.005		0.001	0.001
WELL26	93171	05/17-05/18/	10		0.31	0.025	0.005	0.025			0.005		0.001	0.001
WELL26	93257	08/17-18/93	11		0.38	0.030	0.005	0.025			0.005		0.001	0.002
WELL26	93346	11/16-17/93	12		0.37	< 0.025	0.008	< 0.025			0.009		< 0.0005	< 0.001
WELL26	94062	02/22-23/94	13		0.28	< 0.045	< 0.005	< 0.025			< 0.006		< 0.0005	< 0.001
WELL26	9519934	9/19-20/95	19		0.46		0.007							< 0.001
WELL2	91036	03/20/91	1											
WELL2	91117	06/26/91	2											
WELL2	91196	09/25/91	3											
WELL2	91235	11/21/91	4											
WELL2	92004	03/12/92	5		2.64	0.025	0.046	0.005	0.005	0.002	0.015	0.001	0.001	0.002
WELL2	92083	06/02-03/92	6		2.15	0.007	0.068	0.008	0.005	0.002	0.005	0.001	0.001	0.001
WELL2	92162	09/11-12/92	7		3.86	0.064	0.015	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL2	92302	12/7-8/92	8		3.07	0.025	0.005	0.005	0.005	0.002	0.015	0.001	0.001	0.001
WELL2	93086	02/16/93	9		4.00	0.025	0.021	0.025			0.005		0.001	0.001
WELL2	93183	05/17-05/18/	10		3.57	0.025	0.005	0.025			0.005		0.001	0.001
WELL2	93271	08/17-18/93	11		3.66	0.077	0.005	0.025			0.005		0.001	0.001
WELL2	93358	11/16-17/93	12		3.81	0.070	0.007	< 0.025			0.005		< 0.0005	< 0.001
WELL2	93358	11/16-17/93	12	D	3.75	0.072	0.009	< 0.025			0.005		< 0.0005	< 0.001
WELL2	94074	02/22-23/94	13		3.35	0.036	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL2	9519944	9/19-20/95	19		3.80		0.019							< 0.001
WELL3	91047	03/20/91	1											
WELL3	91118A	06/26/91	2											
WELL3	91197A	09/25/91	3											
WELL3	91236	11/21/91	4											
WELL3	92005	03/12/92	5		0.24	0.025	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.010
WELL3	92084	06/02-03/92	6		0.22	0.104	0.069	0.007	0.005	0.002	0.005	0.001	0.001	0.006
WELL3	92163	09/11-12/92	7		0.31	0.236	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.018
WELL3	92261	12/7-8/92	8		0.40	0.087	0.005	0.005	0.006	0.003	0.005	0.001	0.001	0.004
WELL3	93087	02/16/93	9		0.29	0.025	0.005	0.025			0.005		0.001	0.001
WELL3	93184	05/17-05/18/	10		0.30	0.025	0.005	0.025			0.005		0.001	0.001
WELL3	93272	08/17-18/93	11		0.24	0.057	0.005	0.025			0.005		0.001	0.001
WELL3	93361	11/16-17/93	12		0.26	0.050	0.011	< 0.025			< 0.005		< 0.0005	0.002
WELL3	94075	02/22-23/94	13		0.25	0.053	< 0.005	< 0.025			0.008		< 0.0005	0.005
WELL3	9519945	9/19-20/95	19		0.34		0.012							< 0.001
WELL6	91052	03/20/91	1											
WELL6	91123	06/26/91	2											
WELL6	91202	09/25/91	3											
WELL6	91241	11/21/91	4											
WELL6	92008	03/12/92	5											
WELL6	92087	06/02-03/92	6											
WELL6	92166	09/11-12/92	7											
WELL6	92264	12/7-8/92	8											

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL6	93092	02/16/93	9											
WELL6	93187	05/17-05/18/	10											
WELL6	93275	08/17-18/93	11											
WELL6	93364	11/16-17/93	12											
WELL7	91057	03/20/91	1											
WELL7	91124	06/26/91	2											
WELL7	91203	09/25/91	3											
WELL7	91242	11/21/91	4											
WELL7	92011	03/12/92	5		0.86	0.025	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.003
WELL7	92088	06/02-03/92	6	D	0.91	0.006	0.034	0.005	0.005	0.002	0.005	0.001	0.001	0.002
WELL7	92088	06/02-03/92	6		0.93	0.009	0.034	0.005	0.005	0.002	0.005	0.001	0.001	0.002
WELL7	92167	09/11-12/92	7		1.04	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL7	92265	12/7-8/92	8		1.43	0.176	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL7	93051	02/16/93	9		1.08	0.025	0.005	0.025			0.005		0.001	0.001
WELL7	93188	05/17-05/18/	10		1.05	0.025	0.005	0.025			0.005		0.001	0.001
WELL7	93188	05/17-05/18/	10	D	1.04	0.025	0.005	0.025			0.005		0.001	0.001
WELL7	93276	08/17-18/93	11		0.86	0.052	0.005	0.025			0.005		0.001	0.001
WELL7	93365	11/16-17/93	12		0.93	0.050	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
WELL7	94081	02/22-23/94	13		0.86	0.070	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL7	9519949	9/19-20/95	19		1.01		< 0.005							< 0.001
WELL9	91064	03/20/91	1											
WELL9	91127	06/26/91	2											
WELL9	91205	09/25/91	3											
WELL9	91244	11/21/91	4											
WELL9	92013	03/12/92	5		1.81	0.184	0.005	0.005	0.005	0.002	0.017	0.001	0.001	0.001
WELL9	92092	06/02-03/92	6		2.45	0.025	0.005	0.005	0.005	0.002	0.007	0.001	0.001	0.005
WELL9	92171	09/11-12/92	7		2.91	0.025	0.025	0.005	0.005	0.002	0.005	0.003	0.001	0.004
WELL9	92267	12/7-8/92	8		3.01	0.128	0.005	0.005	0.005	0.002	0.013	0.001	0.001	0.001
WELL9	93053	02/16/93	9		3.01	0.025	0.005	0.025			0.005		0.001	0.001
WELL9	93151	05/17-05/18/	10		1.63	0.025	< 0.005	0.025			0.005		0.001	0.001
WELL9	93278	08/17-18/93	11		2.77	0.059	0.005	0.025			0.005		0.001	0.001
WELL9	93278	08/17-18/93	11	D	2.82	0.052	0.005	0.025			0.005		0.001	0.001
WELL9	93367	11/16-17/93	12		2.71	0.071	0.006	< 0.025			0.008		< 0.0005	< 0.001
WELL9	94083	02/22-23/94	13		2.40	0.050	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
WELL9	9519951	9/19-20/95	19		4.51		0.008							< 0.001
WELL14	91032	03/20/91	1											
WELL14	91133	06/26/91	2											
WELL14	91212	09/25/91	3											
WELL14	91251	11/21/91	4											
WELL14	92018	03/12/92	5		1.06	0.179	0.006	0.005	0.005	0.002	0.019	0.001		0.002
WELL14	92097	06/02-03/92	6		2.19	0.039	0.062	0.006	0.007	0.002	0.010	0.006	0.001	0.008
WELL14	92176	09/11-12/92	7		1.96	0.025	0.013	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL14	92274	12/7-8/92	8		2.02	0.093	0.005	0.009	0.005	0.002	0.014	0.001	0.001	0.001
WELL14	93058	02/16/93	9	D	1.60	0.025	0.005	0.025			0.005		0.001	0.001
WELL14	93058	02/16/93	9		1.57	0.025	0.005	0.025			0.005		0.001	0.001
WELL14	93156	05/17-05/18/	10		1.68	0.025	0.006	0.025			0.005		0.001	0.001
WELL14	93244	08/17-18/93	11		1.60	0.025	0.005	0.025			0.006		0.001	0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL14	93333	11/16-17/93	12		1.66	0.065	0.008	< 0.025			0.005		< 0.0005	< 0.001
WELL14	94088	02/22-23/94	13		1.43		0.014	< 0.025			0.008		< 0.0005	< 0.001
WELL14	94088	02/22-23/94	13	D	1.38	< 0.025	0.018	< 0.025			0.009		< 0.0005	< 0.001
WELL14	9519956	9/19-20/95	19	D	1.95		< 0.005							< 0.001
WELL14	9519956	9/19-20/95	19		1.98		< 0.005							< 0.001
WELL16	91056	03/20/91	1											
WELL16	91135	06/26/91	2											
WELL16	91214	09/25/91	3											
WELL16	91253	11/21/91	4											
WELL16	92022	03/12/92	5		0.10	0.062	0.005	0.005	0.005	0.002	0.018	0.001	0.001	0.010
WELL16	92101	06/02-03/92	6		0.02	0.018	0.005	0.010	0.005	0.002	0.005	0.001	0.001	0.001
WELL16	92178	09/11-12/92	7	D	0.05	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL16	92178	09/11-12/92	7		0.06	0.025	0.005	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL16	92276	12/7-8/92	8		0.01	0.213	0.005	0.005	0.005	0.002	0.015	0.001	0.001	0.001
WELL16	93062	02/16/93	9		0.11	0.025	0.005	0.025			0.005		0.001	0.001
WELL16	93158	05/17-05/18/	10	D	0.06	0.025	0.005	0.025			0.005		0.001	0.001
WELL16	93158	05/17-05/18/	10		0.07	0.025	0.005	0.025			0.005		0.001	0.001
WELL16	93246	08/17-18/93	11		0.03	0.025	0.005	0.025			0.006		0.001	0.002
WELL16	93335	11/16-17/93	12		0.07	0.071	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL16	94051	02/22-23/94	13		0.05	0.054	0.007	< 0.025			< 0.005		< 0.0005	0.001
WELL16	9519925	9/19-20/95	19		0.24		0.017							0.007
WELL18	91034	03/20/91	1											
WELL18	91137	06/26/91	2											
WELL18	91216	09/25/91	3											
WELL18	91255	11/21/91	4											
WELL18	92024	03/12/92	5		3.62	0.057	0.005	0.005	0.005	0.002	0.020	0.001	0.001	0.002
WELL18	92103	06/02-03/92	6		3.77	0.025	0.005	0.006	0.005	0.002	0.005	0.001	0.001	0.001
WELL18	92182	09/11-12/92	7		4.03	0.036	0.005	0.037	0.005	0.002	0.005	0.001	0.001	0.001
WELL18	92278	12/7-8/92	8	D	4.56	0.120	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL18	92278	12/7-8/92	8		4.53	0.122	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.001
WELL18	93064	02/16/93	9		4.62	0.025	0.005	0.025			0.005		0.001	0.001
WELL18	93162	05/17-05/18/	10		3.94	0.025	0.005	0.025			0.005		0.001	0.001
WELL18	93248	08/17-18/93	11	D	4.24	0.080	0.005	0.025			0.005		0.001	0.001
WELL18	93248	08/17-18/93	11		4.28	0.082	0.005	0.025			0.005		0.001	0.001
WELL18	93337	11/16-17/93	12		3.97	0.094	0.005	< 0.025			< 0.005		< 0.0005	< 0.001
WELL18	94053	02/22-23/94	13		3.54	0.060	< 0.005	< 0.025			0.006		< 0.0005	< 0.001
WELL18	9519927	9/19-20/95	19		3.69		< 0.005							< 0.001
WELL20	91054	03/20/91	1											
WELL20	91141	06/26/91	2											
WELL20	91218A	09/25/91	3											
WELL20	91257	11/21/91	4											
WELL20	92026	03/12/92	5		1.94	0.059	0.076	0.005	0.005	0.002	0.021	0.001	0.001	0.004
WELL20	92105	06/02-03/92	6		2.04	0.017	0.032	0.006	0.005	0.002	0.006	0.001	0.001	0.001
WELL20	92184	09/11-12/92	7		2.26	0.025	0.005	0.015	0.005	0.002	0.006	0.001	0.001	0.001
WELL20	92282	12/7-8/92	8		4.56	0.285	0.040	0.009	0.005	0.002	0.015	0.001	0.001	0.001
WELL20	93066	02/16/93	9		3.50	0.025	0.041	0.025			0.006		0.001	0.001
WELL20	93164	05/17-05/18/	10		2.26	0.025	0.005	0.025			0.005		0.001	0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
WELL20	93252	08/17-18/93	11		2.06	0.064	0.124	0.025			0.006		0.001	0.001
WELL20	93341	11/16-17/93	12		3.85	< 0.025	0.049	0.077			< 0.005		< 0.0005	< 0.001
WELL20	94055	02/22-23/94	13		1.87	0.043	0.083	< 0.025			0.007		< 0.0005	< 0.001
WELL20	9519929	9/19-20/95	19		2.12		0.208							< 0.001
WELL22	91041	03/20/91	1											
WELL22	91143	06/26/91	2											
WELL22	91222	09/25/91	3											
WELL22	91261	11/21/91	4											
WELL22	92028	03/12/92	5	D	0.33	0.022	0.005	0.005	0.005	0.002	0.012	0.001	0.001	0.002
WELL22	92028	03/12/92	5		0.31	0.016	0.005	0.005	0.005	0.002	0.016	0.001	0.001	0.003
WELL22	92107	06/02-03/92	6		0.24	0.025	0.066	0.007	0.005	0.002	0.011	0.009	0.001	0.019
WELL22	92186	09/11-12/92	7		0.31	0.100	0.011	0.013	0.005	0.002	0.005	0.001	0.001	0.001
WELL22	92284	12/7-8/92	8		0.67	0.088	0.008	0.005	0.005	0.002	0.014	0.001	0.001	0.001
WELL22	93068	02/16/93	9	D	0.46	0.025	0.008	0.025			0.005		0.001	0.001
WELL22	93068	02/16/93	9		0.45	0.025	0.009	0.025			0.005		0.001	0.001
WELL22	93166	05/17-05/18/	10		0.41	0.025	0.008	0.025			0.005		0.001	0.001
WELL22	93254	08/17-18/93	11		0.32	0.049	0.007	0.025			0.005		0.001	0.001
WELL22	93343	11/16-17/93	12		0.54	< 0.025	0.017	< 0.025			0.008		< 0.0005	< 0.001
WELL22	93343	11/16-17/93	12											
WELL22	94057	02/22-23/94	13		0.43	0.054	0.010	< 0.025			0.006		< 0.0005	< 0.001
WELL22	9519931	9/19-20/95	19		0.58		< 0.005							< 0.001
WELL23	92187	09/11-12/92	7		2.52	0.069	0.010	0.005	0.005	0.002	0.005	0.001	0.001	0.001
WELL23	92285	12/7-8/92	8		3.63	0.057	0.008	0.005	0.005	0.002	0.013	0.001	0.001	0.001
WELL23	93071	02/16/93	9		3.01	0.025	0.005	0.025			0.005		0.001	0.001
WELL23	93168	05/17-05/18/	10		3.17	0.025	0.006	0.025			0.005		0.001	0.001
WELL23	93168	05/17-05/18/	10	D	3.18	0.025	0.005	0.025			0.005		0.001	0.001
WELL23	93255	08/17-18/93	11		3.27	0.041	0.005	0.025			0.006		0.001	0.001
WELL23	93344	11/16-17/93	12		3.08	< 0.025	0.008	< 0.025			< 0.005		< 0.0005	< 0.001
WELL23	94058	02/22-23/94	13		0.30	0.030	0.011	< 0.025			0.005		< 0.0005	< 0.001
WELL23	94058	02/22-23/94	13	D	0.30	0.033	0.010	< 0.025			0.005		< 0.0005	< 0.001
WELL23	9519932	9/19-20/95	19	D	1.98		0.008							0.005
WELL23	9519932	9/19-20/95	19		1.98		0.008							0.004
WELL25	92191	09/11-12/92	7		7.18	0.183	0.010	0.021	0.005	0.002	0.012	0.001	0.001	0.001
WELL25	92287	12/7-8/92	8											
WELL25	93073	02/16/93	9		6.55	0.035	0.008	0.025			0.005		0.001	0.001
AR. RIVER	93267	08/17-18/93	11		0.36	0.058	0.005	0.025			0.005		0.001	0.002
AR. RIVER	93356	11/16-17/93	12		0.37	0.085	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
AR. RIVER	94072	02/22-23/94	13		0.34	0.042	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
AR. RIVER	9519942	9/19-20/95	19		0.61		< 0.005							< 0.001
CLTWRSUMP	92002	03/12/92	5		0.42	< 0.025	< 0.005	0.010	< 0.005	< 0.002	0.008	< 0.001	< 0.0005	< 0.001
CLTWRSUMP	92113	06/02-03/92	6		1.85	< 0.025	0.017	0.012	< 0.005	< 0.002	0.009	< 0.001	< 0.0005	0.002
CLTWRSUMP	92196	09/11-12/92	7						< 0.005	< 0.002		0.021		0.005
CLTWRSUMP	92294	12/7-8/92	8		3.20	0.301	0.019	0.031	< 0.005	< 0.002	0.020	0.002	< 0.0005	< 0.001
CLTWRSUMP	93078	3/2-3/93	9	D	3.37	< 0.025	0.007	< 0.025			< 0.005		< 0.0005	< 0.001
CLTWRSUMP	93078	3/2-3/93	9		3.41	< 0.025	0.007	< 0.025			< 0.005		< 0.0005	< 0.001

WBSES Lab Data (since 1st qtr of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	Stron-tium (mg/L)	Titanium (mg/L)	Nickel (mg/L)	Molyb-denum (mg/L)	Arsenic (mg/L)	Sele-nium (mg/L)	Chro-mium (mg/L)	Cad-mium (mg/L)	Mercury (mg/L)	Lead (mg/L)
CLTWRSUMP	93175	5/17-18/93	10		2.33	< 0.025	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
CLTWRSUMP	93263	08/17-18/93	11		2.70	0.195	0.005	0.029			0.009		0.001	0.001
CLTWRSUMP	93352	11/16-17/93	12		3.89	0.177	0.020	0.045			0.010		< 0.0005	< 0.001
CLTWRSUMP	94066	02/22-23/94	13		3.13	< 0.062	0.010	< 0.032			0.010		< 0.0005	< 0.001
CLTWRSUMP	9519938	9/19-20/95	19		3.45		0.014							< 0.001
NRECYCLE	92036	03/12/92	5		2.17	0.179	< 0.005	0.036	< 0.005	0.012	0.022	< 0.001	< 0.0005	< 0.001
NRECYCLE	92115	06/02-03/92	6		2.28	0.044	0.015	0.048	< 0.005	< 0.002	0.026	< 0.001	< 0.0005	0.001
NRECYCLE	92198	09/11-12/92	7	D	3.84	0.076	0.005	0.020	< 0.005	< 0.002	< 0.005	< 0.001	< 0.0005	< 0.001
NRECYCLE	92198	09/11-12/92	7		3.05	0.066	< 0.005	0.026	< 0.005	< 0.002	< 0.005	< 0.001	< 0.0005	< 0.001
NRECYCLE	92296	12/7-8/92	8		2.86	0.106	< 0.005	0.053	< 0.005	< 0.002	0.029	< 0.001	< 0.0005	< 0.001
NRECYCLE	93082	3/2-3/93	9		3.51	0.110	< 0.005	0.127			< 0.005		< 0.0005	< 0.001
NRECYCLE	93177	5/17-18/93	10		2.23	< 0.025	0.006	< 0.025			< 0.005		< 0.0005	< 0.001
NRECYCLE	93265	08/17-18/93	11		2.06	0.025	0.005	0.055			0.015		0.001	0.001
NRECYCLE	93354	11/16-17/93	12		2.02	0.123	0.009	0.031			0.014		< 0.0005	< 0.001
NRECYCLE	94068	02/22-23/94	13	D	1.61	< 0.108	0.010	< 0.027			< 0.023		< 0.0005	< 0.001
NRECYCLE	94068	02/22-23/94	13		1.61	< 0.113	0.010	< 0.030			< 0.023		< 0.0005	< 0.001
NRECYCLE	9519940	9/19-20/95	19											
SRECYCLE	92001	03/12/92	5		2.35	< 0.025	0.005	0.051	< 0.005	0.025	0.022	< 0.001	< 0.0005	< 0.001
SRECYCLE	92116	06/02-03/92	6		2.28	0.044	0.012	0.056	< 0.005	< 0.002	0.260	< 0.001	< 0.0005	< 0.001
SRECYCLE	92201	09/11-12/92	7		3.62	0.074	0.005	0.102	< 0.005	< 0.002	0.006	0.002	< 0.0005	0.036
SRECYCLE	92297	12/7-8/92	8		2.74	0.063	< 0.005	0.050	< 0.005	< 0.002	0.026	< 0.001	< 0.0005	< 0.001
SRECYCLE	93083	3/2-3/93	9		3.30	0.058	< 0.005	0.115			< 0.005		< 0.0005	< 0.001
SRECYCLE	93178	5/17-18/93	10	D	2.43	< 0.025	0.015	< 0.025			0.014		< 0.0005	< 0.001
SRECYCLE	93178	5/17-18/93	10		2.44	< 0.025	0.015	< 0.025			0.014		< 0.0005	< 0.001
SRECYCLE	93266	08/17-18/93	11		2.16	0.025	0.005	0.051			0.013		0.001	0.001
SRECYCLE	93355	11/16-17/93	12		2.14	0.123	0.011	0.032			0.013		< 0.0005	< 0.001
SRECYCLE	94071	02/22-23/94	13		1.57	0.113	< 0.005	0.027			0.021		< 0.0005	< 0.001
SRECYCLE	9519941	9/19-20/95	19		1.46		< 0.005							< 0.001
SURGEPOND	92035	03/12/92	5		0.74	< 0.025	0.008	0.015	< 0.005	0.004	0.023	< 0.001	< 0.0005	< 0.001
SURGEPOND	92114	06/02-03/92	6		1.06	< 0.025	0.013	0.028	< 0.005	< 0.002	0.007	< 0.001	< 0.0005	0.003
SURGEPOND	92197	09/11-12/92	7		1.68	< 0.025	< 0.005	0.043	< 0.005	< 0.002	< 0.005	0.012	< 0.0005	0.039
SURGEPOND	92295	12/7-8/92	8		1.59	0.076	< 0.005	0.032	< 0.005	< 0.002	0.018	< 0.001	< 0.0005	< 0.001
SURGEPOND	93081	3/2-3/93	9		1.12	0.043	< 0.005	< 0.025			0.007		< 0.0005	< 0.001
SURGEPOND	93176	5/17-18/93	10		1.09	< 0.025	< 0.005	< 0.025			< 0.005		< 0.0005	< 0.001
SURGEPOND	93264	08/17-18/93	11		1.34	0.074	0.005	0.044			0.010		0.001	0.001
SURGEPOND	93353	11/16-17/93	12		0.87	0.087	0.013	< 0.025			0.014		< 0.0005	< 0.001
SURGEPOND	93353	11/16-17/93	12											
SURGEPOND	94067	02/22-23/94	13		0.77	< 0.041	< 0.005	< 0.025			< 0.010		< 0.0005	< 0.001
SURGEPOND	9519939	9/19-20/95	19		1.29		0.005							< 0.001

WBSES Field Data (since first quarter of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL1	91035	03/20/91	1						
WELL1	91116	06/26/91	2						
WELL1	91195	09/25/91	3						
WELL1	91234	11/21/91	4						
WELL1	92003	03/12/92	5		4.0	3200	11.0	17.1	8.2
WELL1	92082	06/02-03/92	6		3.6	3140	3.4	19.3	21.8
WELL1	92161	09/11-12/92	7		3.8	3340	2.2	24.1	28.9
WELL1	92301	12/7-8/92	8		3.4	3320	0.3	17.9	5.8
WELL1	93085	02/16/93	9		3.7	3490	0.3	18.4	15.6
WELL1	93182	05/17-05/18/	10		3.6	3340	0.2	14.5	22.9
WELL1	93268	08/17-18/93	11		3.8	3120	0.2	18.1	35.7
WELL1	93268	08/17-18/93	11	D	3.8	3110	0.2	18.1	35.7
WELL1	93357	11/16-17/93	12		3.7	3670	3.1	17.8	10.2
WELL1	94073	02/22-23/94	13		3.8	3560	0.3	19.2	14.8
WELL1	9519943	9/19-20/95	19		4.0	3016	0.9	18.1	23.6
WELL4	91046	03/20/91	1						
WELL4	91121	06/26/91	2						
WELL4	91198	09/25/91	3						
WELL4	91237	11/21/91	4						
WELL4	92006	03/12/92	5		4.4	150	12.0	14.9	8.2
WELL4	92085	06/02-03/92	6		4.2	188	200.0	18.6	21.8
WELL4	92164	09/11-12/92	7		4.1	265	132.0	23.5	18.8
WELL4	92262	12/7-8/92	8		4.4	315	260.0	6.6	5.6
WELL4	93088	02/16/93	9	D	4.3	260	138.0	11.1	12.2
WELL4	93088	02/16/93	9		4.3	260	138.0	11.1	12.2
WELL4	93185	05/17-05/18/	10		4.7	218	215.0	21.0	26.2
WELL4	93273	08/17-18/93	11		4.1	280	113.8	24.4	27.2
WELL4	93362	11/16-17/93	12		4.6	344	89.7	19.5	11.0
WELL4	94076	02/22-23/94	13		4.8	274	210.0	12.0	8.0
WELL4	9519946	9/19-20/95	19		4.3	265	116.5	19.2	22.2
WELL5	91051	03/20/91	1						
WELL5	91122	06/26/91	2						
WELL5	91201	09/25/91	3						
WELL5	91238	11/21/91	4						
WELL5	92007	03/12/92	5		4.1	2800	32.0	17.7	8.2
WELL5	92086	06/02-03/92	6		4.0	3400	53.0	17.7	21.8
WELL5	92165	09/11-12/92	7		3.8	4750	44.0	23.3	18.9
WELL5	92263	12/7-8/92	8		4.1	3560	144.0	7.7	6.1
WELL5	93186	05/17-05/18/	10		4.0	3520	90.0	21.6	25.8
WELL5	93274	08/17-18/93	11		4.0	4320	40.4	25.6	28.8
WELL5	93363	11/16-17/93	12		4.2	4990	47.6	17.0	11.0
WELL5	94077	02/22-23/94	13		4.2	4410	76.9	13.0	9.0
WELL5	9519947	9/19-20/95	19		3.8	4340	261.0	19.2	23.6
WELL8	91063	03/20/91	1						
WELL8	91125	06/26/91	2						
WELL8	91204	09/25/91	3						
WELL8	91243	11/21/91	4						
WELL8	92012	03/12/92	5		4.1	478	76.0	18.5	8.2
WELL8	92091	06/02-03/92	6		4.1	446	66.0	18.8	21.8
WELL8	92168	09/11-12/92	7	D	4.2	496	160.0	21.6	19.0
WELL8	92168	09/11-12/92	7		4.1	490	60.0	21.1	19.0
WELL8	92266	12/7-8/92	8		4.6	635	43.0	8.2	6.7
WELL8	93052	02/16/93	9		4.5	380	28.0	13.3	13.3
WELL8	93191	05/17-05/18/	10		4.1	457	40.0	20.5	25.1
WELL8	93277	08/17-18/93	11		3.9	525	36.8	25.6	32.8
WELL8	93366	11/16-17/93	12		4.8	595	88.8	17.8	11.0
WELL8	94082	02/22-23/94	13		4.2	625	67.6	16.0	9.0
WELL8	9519950	9/19-20/95	19		4.1	515	32.1	19.1	21.2

WBSES Field Data (since first quarter of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL10	91065	03/20/91	1						
WELL10	91126	06/26/91	2						
WELL10	91206	09/25/91	3						
WELL10	91245	11/21/91	4						
WELL10	92014	03/12/92	5		4.3	566	22.0	16.4	8.2
WELL10	92093	06/02-03/92	6		4.2	490	160.0	19.4	23.0
WELL10	92172	09/11-12/92	7		4.2	634	300.0	23.8	28.9
WELL10	92268	12/7-8/92	8		4.4	950	260.0	7.8	7.2
WELL10	92268	12/7-8/92	8	D	4.4	950	260.0	7.8	7.2
WELL10	93054	02/16/93	9		4.5	1220	80.0	12.8	12.8
WELL10	93152	05/17-05/18/	10		4.0	603	173.0	21.1	26.9
WELL10	93281	08/17-18/93	11		3.9	649	184.2	26.1	35.0
WELL10	93368	11/16-17/93	12	D	4.8	778	191.6	18.0	12.0
WELL10	93368	11/16-17/93	12		4.8	778	191.6	18.0	12.0
WELL10	94084	02/22-23/94	13		4.4	744	186.3	13.0	8.0
WELL10	9519952	9/19-20/95	19		6.1	746	391.0	20.8	21.0
WELL11	91042	03/20/91	1						
WELL11	91128A	06/26/91	2						
WELL11	91207	09/25/91	3						
WELL11	91246	11/21/91	4						
WELL11	92015	03/12/92	5		4.1	1250	420.0	18.8	8.2
WELL11	92094	06/02-03/92	6		4.1	1310	176.0	19.1	23.0
WELL11	92173	09/11-12/92	7		4.0	1488	460.0	23.3	18.9
WELL11	92271	12/7-8/92	8		4.3	1845	220.0	7.7	8.9
WELL11	93055	02/16/93	9		3.8	953	108.0	15.6	12.2
WELL11	93153	05/17-05/18/	10		4.0	1206	213.0		27.6
WELL11	93241	08/17-18/93	11		4.0	1284	164.4	23.3	31.7
WELL11	93371	11/16-17/93	12		4.3	1675	217.0	19.0	12.0
WELL11		02/22-23/94	13		4.3	1675	217.0	19.0	12.0
WELL11	94085	02/22-23/94	13		4.1	174	165.7	14.0	6.0
WELL11	9519953	9/19-20/95	19		3.9	1551	176.0	19.6	21.7
WELL12	91043	03/20/91	1						
WELL12	91131	06/26/91	2						
WELL12	91208A	09/25/91	3						
WELL12	91247	11/21/91	4						
WELL12	92016	03/12/92	5		3.8	1280	104.0	17.9	8.2
WELL12	92095	06/02-03/92	6		3.7	1500	94.0	18.2	21.8
WELL12	92174	09/11-12/92	7		3.5	1172	60.0	21.6	18.9
WELL12	92272	12/7-8/92	8		3.6	1216	58.0	7.8	6.7
WELL12	93056	02/16/93	9		3.2	969	44.0	12.8	11.1
WELL12	93154	05/17-05/18/	10		4.0	1058	45.0		26.8
WELL12	93242	08/17-18/93	11		3.6	1259	21.7	24.4	32.2
WELL12	93331	11/16-17/93	12		3.9	1789	65.6	19.0	11.0
WELL12	94086	02/22-23/94	13		3.8	145	22.2	13.0	6.0
WELL12	9519954	9/19-20/95	19		3.5	1627	98.8	23.1	21.3
WELL13	91037	03/20/91	1						
WELL13	91132	06/26/91	2						
WELL13	91211	09/25/91	3						
WELL13	91248	11/21/91	4						
WELL13	92017	03/12/92	5		4.0	525	72.0	16.2	8.2
WELL13	92096	06/02-03/92	6		3.6	363	102.0	18.3	21.8
WELL13	92175	09/11-12/92	7		3.9	488	140.0	20.4	18.9
WELL13	92273	12/7-8/92	8		3.3	441	54.0	12.5	6.0
WELL13	93057	02/16/93	9		3.8	446	73.0	16.1	15.8
WELL13	93155	05/17-05/18/	10		3.8	439	92.0	12.0	24.0
WELL13	93243	08/17-18/93	11		3.5	417	52.0	17.8	29.5
WELL13	93332	11/16-17/93	12		3.7	524	73.0	15.5	9.0
WELL13	94087	02/22-23/94	13		3.7	480	34.0	15.5	13.1
WELL13	9519955	9/19-20/95	19		4.1	427	66.6	18.8	24.2

WBSES Field Data (since first quarter of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL15	91031	03/20/91	1						
WELL15	91134	06/26/91	2						
WELL15	91213	09/25/91	3						
WELL15	91252	11/21/91	4						
WELL15	92021	03/12/92	5		6.6	850	20.0	15.3	8.2
WELL15	92021	03/12/92	5	D	6.6	850	20.0	15.3	8.2
WELL15	92098	06/02-03/92	6		5.8	701	3.0	19.4	21.8
WELL15	92098	06/02-03/92	6	D	5.8	701	3.0	19.4	21.8
WELL15	92177	09/11-12/92	7		5.7	784	3.5	21.8	18.9
WELL15	92275	12/7-8/92	8		5.0	769	1.5	14.3	6.2
WELL15	93061	02/16/93	9		6.2	825	20.0	15.6	13.6
WELL15	93157	05/17-05/18/	10		6.2	741	0.8	13.0	20.0
WELL15	93245	08/17-18/93	11		5.6	719	0.6	17.3	28.5
WELL15	93334	11/16-17/93	12		5.6	826	0.1	16.5	8.5
WELL15	94064	02/22-23/94	13		5.8	737	17.0	16.0	13.1
WELL15	9519936	9/19-20/95	19		6.0	715	0.5	16.6	24.1
WELL17	91055	03/20/91	1						
WELL17	91136	06/26/91	2						
WELL17	91215	09/25/91	3						
WELL17	91254	11/21/91	4						
WELL17	92023	03/12/92	5						8.2
WELL17	92102	06/02-03/92	6		7.4	471	105.0	24.8	21.8
WELL17	92181	09/11-12/92	7		6.6	412	250.0	21.2	28.9
WELL17	92277	12/7-8/92	8		6.8	492	0.4	16.9	7.9
WELL17	93063	02/16/93	9		7.2	453	40.0	17.0	23.1
WELL17	93161	05/17-05/18/	10		6.0	175	25.5	13.3	27.0
WELL17	93247	08/17-18/93	11		6.8	401	43.0	18.3	31.0
WELL17	93336	11/16-17/93	12		6.5	251	15.6	17.5	12.0
WELL17	94052	02/22-23/94	13		5.6	1380	11.0	17.3	10.1
WELL17	9519926	9/19-20/95	19		6.1	955	50.0	17.6	26.9
WELL19	91033	03/20/91	1						
WELL19	91138A	06/26/91	2						
WELL19	91217	09/25/91	3						
WELL19	91256	11/21/91	4						
WELL19	92025	03/12/92	5						8.2
WELL19	92104	06/02-03/92	6		4.2	1648	90.0	20.7	21.8
WELL19	92183	09/11-12/92	7		4.2	1747	9.6	24.8	28.9
WELL19	92281	12/7-8/92	8		4.4	1558	24.0	18.1	9.1
WELL19	93065	02/16/93	9		4.3	1615	14.0	18.4	20.1
WELL19	93163	05/17-05/18/	10		4.1	1568	9.6	14.2	24.0
WELL19	93251	08/17-18/93	11		3.8	1683	2.0	19.0	35.5
WELL19	93338	11/16-17/93	12	D	4.7	1085	83.6	17.6	14.6
WELL19	93338	11/16-17/93	12		4.6	1087	83.6	17.6	14.6
WELL19	94054	02/22-23/94	13		4.3	1520	34.0	19.5	10.6
WELL19	9519928	9/19-20/95	19		4.7	1448	5.4	18.2	27.5
WELL21	91053	03/20/91	1						
WELL21	91142	06/26/91	2						
WELL21	91221	09/25/91	3						
WELL21	91258A	11/21/91	4						
WELL21	92027	03/12/92	5						8.2
WELL21	92106	06/02-03/92	6		4.2	1247	42.0	20.8	21.8
WELL21	92185	09/11-12/92	7		3.8	1445	74.0	22.6	
WELL21	92283	12/7-8/92	8		4.1	1386	39.0	14.8	8.5
WELL21	93067	02/16/93	9		3.7	1542	16.0	16.2	13.7
WELL21	93165	05/17-05/18/	10		4.4	1055	55.0	22.4	26.7
WELL21	93253	08/17-18/93	11		3.7	1228	7.5	19.5	36.5
WELL21	93342	11/16-17/93	12		4.0	1570	13.3	16.5	9.0
WELL21	94056	02/22-23/94	13		3.9	1403	5.4	17.3	13.7
WELL21	9519930	9/19-20/95	19		4.2	126	6.4	16.8	26.1

WBSES Field Data (since first quarter of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL24	92188	09/11-12/92	7	D	7.3	3840	25.0	24.8	28.9
WELL24	92188	09/11-12/92	7		7.3	3840	25.0	24.8	28.9
WELL24	92286	12/7-8/92	8		9.3	5480	8.8	16.0	8.0
WELL24	93072	02/16/93	9		6.8	4180	12.0	15.6	11.4
WELL24	93167	05/17-05/18/	10		6.4	4160	15.0	14.2	23.0
WELL24	93256	08/17-18/93	11		6.3	3140	8.6	18.2	38.9
WELL24	93345	11/16-17/93	12		6.8	4580	26.7	17.1	11.5
WELL24	94061	02/22-23/94	13		5.8	4270	3.5	18.4	7.6
WELL24	9519933	9/19-20/95	19		6.9	2480	7.6	18.0	21.7
WELL26	92192	09/11-12/92	7		6.3	464	47.5	21.2	31.1
WELL26	92288	12/7-8/92	8		7.0	670	1.3	13.9	7.2
WELL26	92288	12/7-8/92	8	D	7.0	670	1.3	13.9	7.2
WELL26	93074	02/16/93	9		7.5	405	25.0	16.7	16.0
WELL26	93171	05/17-05/18/	10		9.4	388	57.1	14.0	27.5
WELL26	93257	08/17-18/93	11		6.9	260	13.7	17.7	39.5
WELL26	93346	11/16-17/93	12		6.9	413	16.7	17.0	11.5
WELL26	94062	02/22-23/94	13		8.9	459	4.5	18.1	11.6
WELL26	9519934	9/19-20/95	19		6.9	257	17.3	17.1	21.0
WELL2	91036	03/20/91	1						
WELL2	91117	06/26/91	2						
WELL2	91196	09/25/91	3						
WELL2	91235	11/21/91	4						
WELL2	92004	03/12/92	5		6.8	1390	5.0	16.7	8.2
WELL2	92083	06/02-03/92	6		6.0	1381	8.3	20.1	21.8
WELL2	92162	09/11-12/92	7		5.6	1420	3.8	22.2	28.9
WELL2	92302	12/7-8/92	8		5.1	1468	3.0	17.7	5.8
WELL2	93086	02/16/93	9		6.0	1557	0.6	18.0	15.6
WELL2	93183	05/17-05/18/	10		5.8	1574	10.7	14.5	22.9
WELL2	93271	08/17-18/93	11		5.9	1383	2.2	18.2	35.7
WELL2	93358	11/16-17/93	12	D	5.6	720	8.6	17.6	10.2
WELL2	93358	11/16-17/93	12		5.6	720	8.6	17.6	10.2
WELL2	94074	02/22-23/94	13		5.7	1631	2.5	18.8	14.8
WELL2	9519944	9/19-20/95	19		5.8	1620	43.2	18.2	23.6
WELL3	91047	03/20/91	1						
WELL3	91118A	06/26/91	2						
WELL3	91197A	09/25/91	3						
WELL3	91236	11/21/91	4						
WELL3	92005	03/12/92	5		5.3	180	200.0	17.1	8.2
WELL3	92084	06/02-03/92	6		5.1	186	72.0	18.1	21.8
WELL3	92163	09/11-12/92	7		5.4	196	58.0	20.3	18.8
WELL3	92261	12/7-8/92	8		5.4	275	60.0	10.1	5.6
WELL3	93087	02/16/93	9		5.1	232	64.0	13.9	12.2
WELL3	93184	05/17-05/18/	10		5.3	204	251.0	21.6	26.2
WELL3	93272	08/17-18/93	11		5.6	200	22.7	18.9	25.6
WELL3	93361	11/16-17/93	12		6.1	234	72.9	17.0	11.0
WELL3	94075	02/22-23/94	13		5.6	231	86.8	16.0	8.0
WELL3	9519945	9/19-20/95	19		5.4	183	17.5	18.0	22.2
WELL6	91052	03/20/91	1						
WELL6	91123	06/26/91	2						
WELL6	91202	09/25/91	3						
WELL6	91241	11/21/91	4						
WELL6	92008	03/12/92	5						
WELL6	92087	06/02-03/92	6						21.8
WELL6	92166	09/11-12/92	7						
WELL6	92264	12/7-8/92	8						
WELL6	93187	05/17-05/18/	10						
WELL6	93275	08/17-18/93	11						
WELL6	93364	11/16-17/93	12						

WBSES Field Data (since first quarter of 1991)

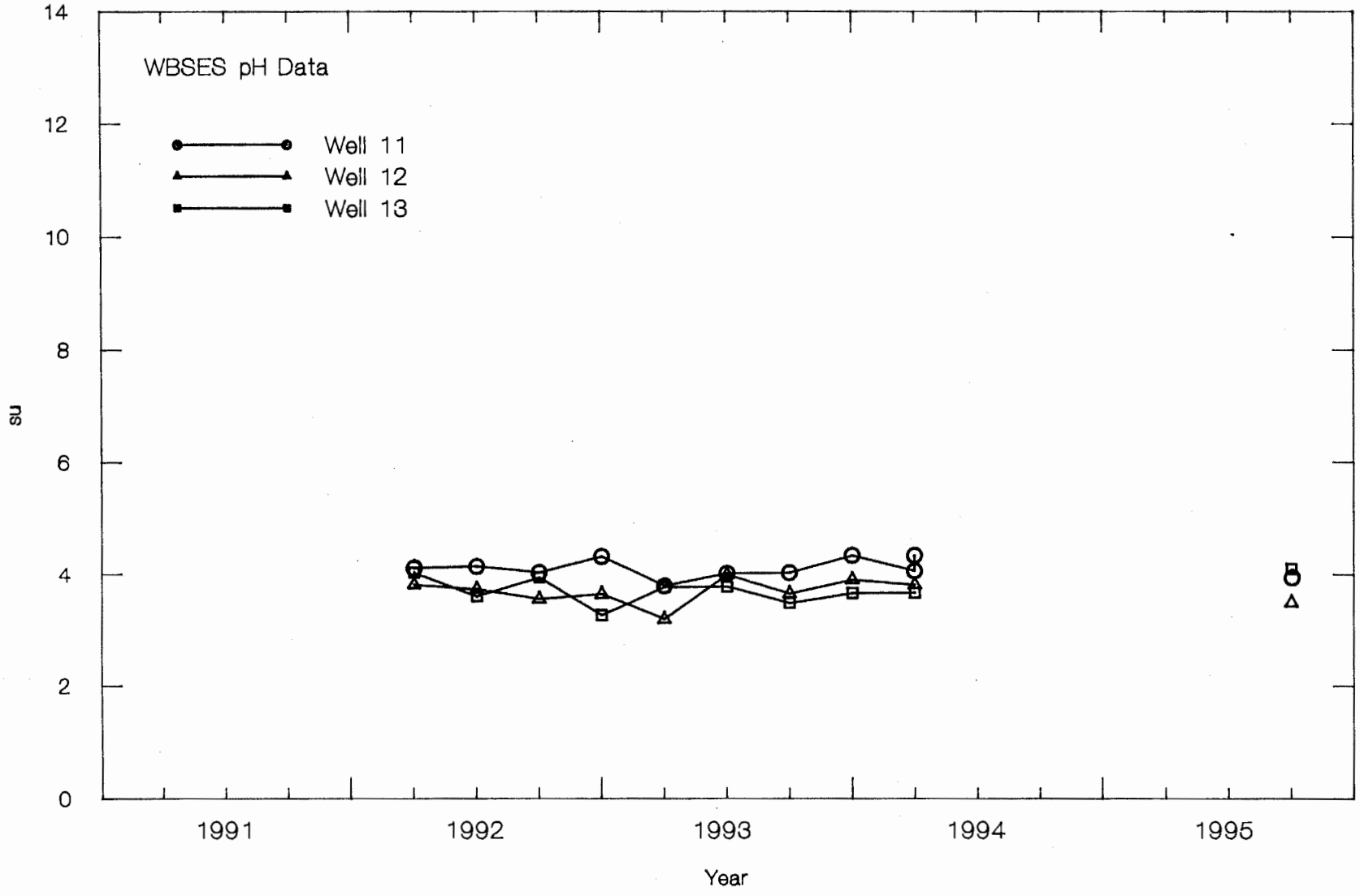
Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL7	91057	03/20/91	1						
WELL7	91124	06/26/91	2						
WELL7	91203	09/25/91	3						
WELL7	91242	11/21/91	4						
WELL7	92011	03/12/92	5		5.5	519	32.0	17.7	8.2
WELL7	92088	06/02-03/92	6		5.4	570	18.0	18.4	21.8
WELL7	92088	06/02-03/92	6	D	5.4	570	18.0	18.4	21.8
WELL7	92167	09/11-12/92	7		5.6	564	87.0	20.3	18.9
WELL7	92265	12/7-8/92	8		5.8	862	37.0	11.6	6.7
WELL7	93051	02/16/93	9		5.5	454	36.0	13.9	13.3
WELL7	93188	05/17-05/18/	10	D	5.7	512	29.1	21.4	25.1
WELL7	93188	05/17-05/18/	10		5.7	512	29.1	21.4	25.1
WELL7	93276	08/17-18/93	11		5.7	543	19.7	20.0	32.2
WELL7	93365	11/16-17/93	12		5.3	559	37.6	17.0	11.0
WELL7	94081	02/22-23/94	13		5.7	686	10.7	16.0	9.0
WELL7	9519949	9/19-20/95	19		5.7	531	38.9	18.3	21.1
WELL9	91064	03/20/91	1						
WELL9	91127	06/26/91	2						
WELL9	91205	09/25/91	3						
WELL9	91244	11/21/91	4						
WELL9	92013	03/12/92	5		5.9	958	18.0	17.5	8.2
WELL9	92092	06/02-03/92	6		5.5	1090	30.0	18.8	23.0
WELL9	92171	09/11-12/92	7		5.7	1183	30.0	22.2	28.9
WELL9	92267	12/7-8/92	8		5.6	1602	20.0	8.9	7.2
WELL9	93053	02/16/93	9		6.3	2080	14.0	15.6	12.8
WELL9	93151	05/17-05/18/	10		5.6	997	30.0		26.9
WELL9	93278	08/17-18/93	11	D	6.3	1078	47.3	20.6	35.0
WELL9	93278	08/17-18/93	11		6.3	1078	47.3	20.6	35.0
WELL9	93367	11/16-17/93	12		5.8	1319	22.6	17.0	12.0
WELL9	94083	02/22-23/94	13		5.7	1306	9.2	14.0	8.0
WELL9	9519951	9/19-20/95	19		7.8	1044	49.7	18.3	21.0
WELL14	91032	03/20/91	1						
WELL14	91133	06/26/91	2						
WELL14	91212	09/25/91	3						
WELL14	91251	11/21/91	4						
WELL14	92018	03/12/92	5						8.2
WELL14	92097	06/02-03/92	6		6.7	815	260.0	21.8	21.8
WELL14	92176	09/11-12/92	7		5.7	815	28.0	20.1	18.9
WELL14	92274	12/7-8/92	8		7.1	996	0.3	13.9	7.1
WELL14	93058	02/16/93	9	D	6.0	738	0.4	16.1	13.6
WELL14	93058	02/16/93	9		6.0	738	0.4	16.1	13.6
WELL14	93156	05/17-05/18/	10		6.0	775	82.0	13.5	20.0
WELL14	93244	08/17-18/93	11		7.5	736	37.6	17.3	32.5
WELL14	93333	11/16-17/93	12		5.6	922	13.7	14.5	8.5
WELL14	94088	02/22-23/94	13	D	5.5	835	44.0	15.6	13.1
WELL14	94088	02/22-23/94	13		5.5	835	44.0	15.6	13.1
WELL14	9519956	9/19-20/95	19	D	5.1	866	111.4	16.6	24.1
WELL14	9519956	9/19-20/95	19		5.1	866	111.4	16.6	24.1
WELL16	91056	03/20/91	1						
WELL16	91135	06/26/91	2						
WELL16	91214	09/25/91	3						
WELL16	91253	11/21/91	4						
WELL16	92022	03/12/92	5						8.2
WELL16	92101	06/02-03/92	6		5.3	68	9.0	20.2	21.8
WELL16	92178	09/11-12/92	7	D	5.1	52	50.0	22.1	18.9
WELL16	92178	09/11-12/92	7		5.1	52	50.0	22.1	18.9
WELL16	92276	12/7-8/92	8		5.3	64	0.6	16.8	7.9
WELL16	93062	02/16/93	9		5.6	78	45.0	17.2	23.1
WELL16	93158	05/17-05/18/	10		5.2	68	10.1	13.2	27.0
WELL16	93158	05/17-05/18/	10	D	5.3	69	11.5	13.2	27.0

WBSES Field Data (since first quarter of 1991)

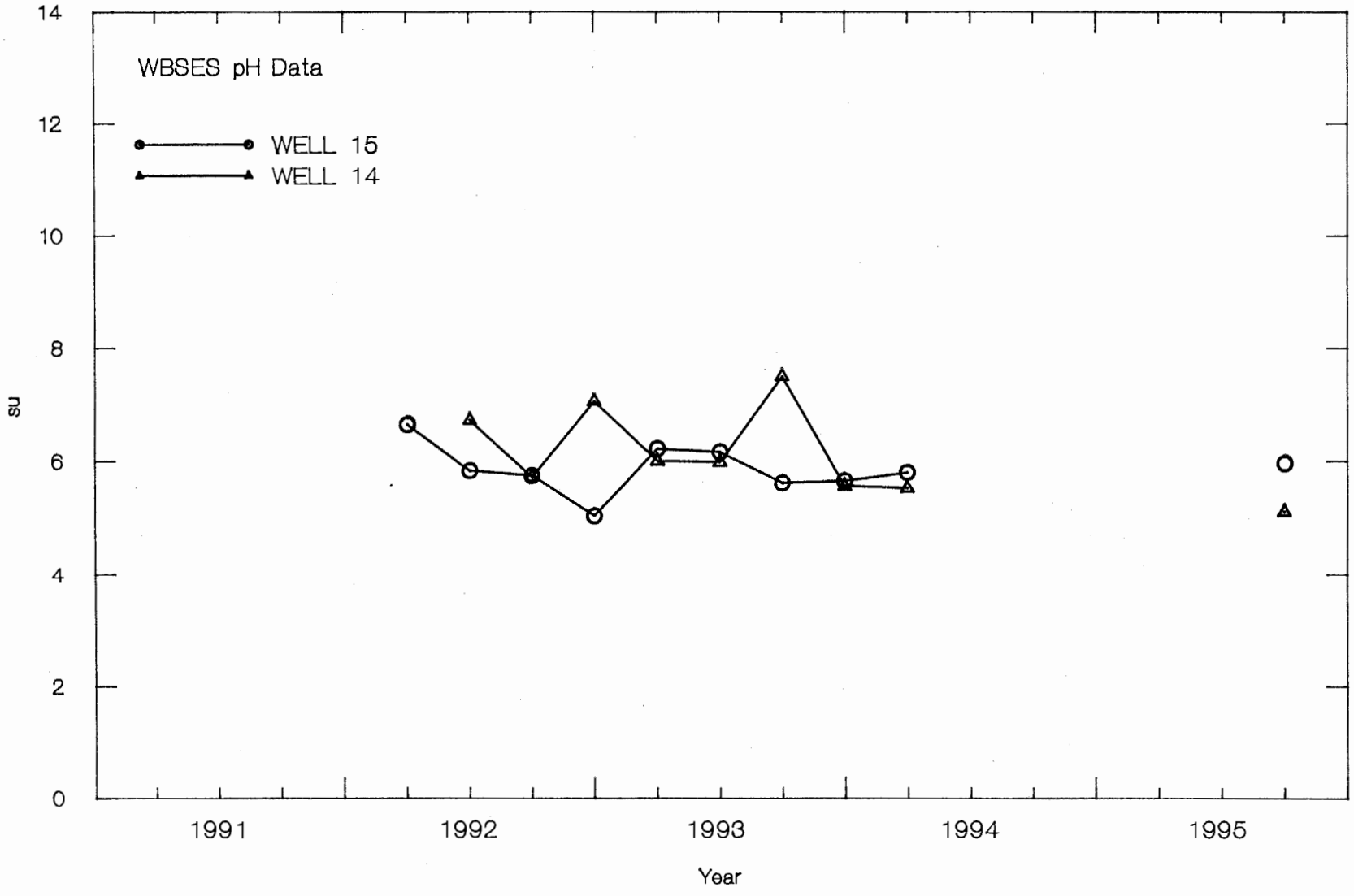
Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL16	93246	08/17-18/93	11		5.2	56	24.5	17.6	31.0
WELL16	93335	11/16-17/93	12		5.5	67	30.0	17.2	12.0
WELL16	94051	02/22-23/94	13		5.1	779	35.0	17.1	10.1
WELL16	9519925	9/19-20/95	19		5.7	72	120.0	17.6	26.9
WELL18	91034	03/20/91	1						
WELL18	91137	06/26/91	2						
WELL18	91216	09/25/91	3						
WELL18	91255	11/21/91	4						
WELL18	92024	03/12/92	5						8.2
WELL18	92103	06/02-03/92	6		5.3	1791	44.0	19.2	21.8
WELL18	92182	09/11-12/92	7		5.8	1795	26.0	23.1	28.9
WELL18	92278	12/7-8/92	8	D	5.4	1607	23.0	17.8	9.1
WELL18	92278	12/7-8/92	8		5.4	1607	23.0	17.8	9.1
WELL18	93064	02/16/93	9		5.7	1691	6.4	18.9	20.1
WELL18	93162	05/17-05/18/	10		5.7	1607	22.1	14.2	22.5
WELL18	93248	08/17-18/93	11	D	5.3	1623	10.7	19.2	35.5
WELL18	93248	08/17-18/93	11		5.3	1623	10.7	19.2	35.5
WELL18	93337	11/16-17/93	12		5.7	702	16.8	17.2	14.5
WELL18	94053	02/22-23/94	13		5.6	1905	4.8	18.3	10.6
WELL18	9519927	9/19-20/95	19		6.0	1367	46.8	17.6	27.5
WELL20	91054	03/20/91	1						
WELL20	91141	06/26/91	2						
WELL20	91218A	09/25/91	3						
WELL20	91257	11/21/91	4						
WELL20	92026	03/12/92	5						8.2
WELL20	92105	06/02-03/92	6		3.6	1795	8.6	19.6	21.8
WELL20	92184	09/11-12/92	7		3.4	1730	10.0	19.5	
WELL20	92282	12/7-8/92	8		4.2	1683	3.4	15.2	8.5
WELL20	93066	02/16/93	9		3.7	1704	1.3	16.4	13.7
WELL20	93164	05/17-05/18/	10		3.6	1523	8.0	21.9	26.7
WELL20	93252	08/17-18/93	11		3.3	1462	2.2	19.8	36.5
WELL20	93341	11/16-17/93	12		4.3	1875	1.2	16.4	9.0
WELL20	94055	02/22-23/94	13		3.6	1870	0.5	17.4	13.7
WELL20	9519929	9/19-20/95	19		3.8	1623	31.8	16.1	26.1
WELL22	91041	03/20/91	1						
WELL22	91143	06/26/91	2						
WELL22	91222	09/25/91	3						
WELL22	91261	11/21/91	4						
WELL22	92028	03/12/92	5						8.2
WELL22	92028	03/12/92	5	D					8.2
WELL22	92107	06/02-03/92	6		4.3	240	400.0	19.4	21.8
WELL22	92186	09/11-12/92	7		4.0	257	100.0	20.1	28.9
WELL22	92284	12/7-8/92	8		4.1	331	0.3	17.4	8.1
WELL22	93068	02/16/93	9		4.2	567	36.0	12.8	13.3
WELL22	93068	02/16/93	9	D	4.2	567	36.0	12.8	13.3
WELL22	93166	05/17-05/18/	10		3.9	288	85.0		27.8
WELL22	93254	08/17-18/93	11		3.7	257	58.0	20.5	37.0
WELL22	93343	11/16-17/93	12		3.9	520	145.0	17.0	9.0
WELL22	94057	02/22-23/94	13		4.0	417	41.0	16.1	15.1
WELL22	9519931	9/19-20/95	19		4.0	319	10.6	20.9	22.8
WELL23	92187	09/11-12/92	7		7.4	1190	16.0	21.2	24.9
WELL23	92285	12/7-8/92	8		6.4	1220	0.2	16.5	8.0
WELL23	93071	02/16/93	9		7.4	1225	1.1	15.0	11.4
WELL23	93168	05/17-05/18/	10	D	7.2	1179	1.0	14.2	23.0
WELL23	93168	05/17-05/18/	10		7.2	1179	1.0	14.2	23.0
WELL23	93255	08/17-18/93	11		8.5	1003	3.2	17.8	38.9
WELL23	93344	11/16-17/93	12		6.7	1240	10.5	16.6	11.5
WELL23	94058	02/22-23/94	13		7.9	153	38.0	17.4	7.7
WELL23	94058	02/22-23/94	13	D	7.9	153	38.0	17.4	7.7

WBSES Field Data (since first quarter of 1991)

Well Name	Sample Number	Date	Quarter Number	Dup	pH (su)	Conduc. (umho)	Turbidity (NTU)	Water Temp. (C)	Air Temp. (C)
WELL23	9519932	9/19-20/95	19		7.5	497	303.0	20.0	21.7
WELL23	9519932	9/19-20/95	19	D	7.5	497	303.0	20.0	21.7
WELL25	92191	09/11-12/92	7		11.7	3150	73.0	20.7	31.1
WELL25	92287	12/7-8/92	8						
WELL25	93073	02/16/93	9		12.3	2240	16.0	15.0	16.0
AR. RIVER	93267	08/17-18/93	11		7.5	601	14.6	31.1	33.3
AR. RIVER	93356	11/16-17/93	12		6.6	396	11.3	13.0	12.0
AR. RIVER	94072	02/22-23/94	13		6.6	370	15.1	9.0	8.0
AR. RIVER	9519942	9/19-20/95	19		7.7	635	12.3	25.5	22.1
CLTWRSUMP	92002	03/12/92	5		7.6	500	1.8	13.6	8.2
CLTWRSUMP	92113	06/2-3/92	6		7.7	2500	30.0	26.8	21.8
CLTWRSUMP	92196	9/11-12/92	7		8.0	4300	40.0	29.7	28.9
CLTWRSUMP	92294	12/7-8/92	8		6.7	4008	65.0	6.3	7.8
CLTWRSUMP	93078	3/2-3/93	9	D	6.9	546	78.0	16.1	12.2
CLTWRSUMP	93078	3/2-3/93	9		6.9	546	78.0	16.1	12.2
CLTWRSUMP	93175	5/17-18/93	10		6.8	2350	77.0	29.1	26.9
CLTWRSUMP	93263	08/17-18/93	11		8.2	3870	73.3	35.6	35.6
CLTWRSUMP	93352	11/16-17/93	12		6.3	3620	43.3	20.0	11.0
CLTWRSUMP	94066	02/22-23/94	13		6.9	3320	46.4	20.0	7.5
CLTWRSUMP	9519938	9/19-20/95	19		8.3	3630	72.2	32.4	22.1
NRECYCLE	92036	03/12/92	5		7.6	1290	52.0	17.0	17.0
NRECYCLE	92115	06/2-3/92	6		7.7	1632	6.5	26.6	21.8
NRECYCLE	92198	9/11-12/92	7		7.7	1850	10.0	30.4	28.9
NRECYCLE	92198	9/11-12/92	7	D	7.7	1850	10.0	30.4	28.9
NRECYCLE	92296	12/7-8/92	8		8.0	1802	14.0	11.8	6.7
NRECYCLE	93082	3/2-3/93	9		7.8	2560	14.0	14.4	13.9
NRECYCLE	93177	5/17-18/93	10		7.9	1127	8.0	27.7	26.8
NRECYCLE	93265	08/17-18/93	11		10.0	973	7.6	34.4	35.0
NRECYCLE	93354	11/16-17/93	12		6.0	1060	7.4	15.0	11.0
NRECYCLE	94068	02/22-23/94	13		6.6	765	23.8	13.0	9.0
NRECYCLE	94068	02/22-23/94	13	D	6.6	765	23.8	13.0	9.0
NRECYCLE	9519940	9/19-20/95	19						
SRECYCLE	92001	03/12/92	5		8.2	560	13.0	15.3	8.2
SRECYCLE	92116	06/2-3/92	6		8.5	1400	4.6	24.4	
SRECYCLE	92201	9/11-12/92	7		9.1	1610	12.0	28.9	
SRECYCLE	92297	12/7-8/92	8		7.7	1612	10.0	8.8	6.7
SRECYCLE	93083	3/2-3/93	9		8.9	2240	8.0	12.8	13.9
SRECYCLE	93178	5/17-18/93	10		8.7	1155	12.0	27.6	26.8
SRECYCLE	93178	5/17-18/93	10	D	8.7	1155	12.0	27.6	26.8
SRECYCLE	93266	08/17-18/93	11		9.6	987	21.6	33.9	35.0
SRECYCLE	93355	11/16-17/93	12		6.3	1131	3.5	15.0	11.0
SRECYCLE	94071	02/22-23/94	13		8.0	754	9.9	13.0	9.0
SRECYCLE	9519941	9/19-20/95	19		9.1	735	15.8	26.4	23.0
SURGEPOND	92035	03/12/92	5		7.8	740	42.0	15.3	17.0
SURGEPOND	92114	06/2-3/92	6		7.6	760	140.0	24.0	21.8
SURGEPOND	92197	9/11-12/92	7		7.9	976	41.0	28.1	28.9
SURGEPOND	92295	12/7-8/92	8		7.6	1049	12.0	7.2	7.8
SURGEPOND	93081	3/2-3/93	9		8.4	1020	90.0	11.1	13.3
SURGEPOND	93176	5/17-18/93	10		8.7	720	11.0	28.0	26.9
SURGEPOND	93264	08/17-18/93	11		8.2	960	11.8	32.8	35.6
SURGEPOND	93353	11/16-17/93	12		6.5	619	163.9	13.0	11.0
SURGEPOND	94067	02/22-23/94	13		6.3	514	178.6	11.0	10.0
SURGEPOND	9519939	9/19-20/95	19		7.9	750	21.1	25.6	22.0



2:28 pm, 1/25/96
WBFIELD



12:31 pm 1/25/96
WBFIELD

Appendix F

Summary Statistics by Well

Period of record summary statistics by well - White Bluff

WELL1

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	14
MINIMUM	2018.000	798.000	56.000	207.600	0.200
MAXIMUM	3109.000	1883.000	710.900	266.800	0.460
MEAN	2695.857	1109.243	440.771	227.290	0.245
C.V.	0.105	0.245	0.435	0.073	0.361

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	3.910	0.001	0.005
MAXIMUM	5.790	0.004	0.348
MEAN	4.933	0.001	0.116
C.V.	0.137	0.690	0.910

WELL2

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	946.000	527.300	41.000	48.700	0.200
MAXIMUM	1333.000	786.700	178.200	75.000	0.410
MEAN	1234.357	641.736	87.764	63.540	0.289
C.V.	0.074	0.118	0.377	0.110	0.236

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	2.150	0.001	0.005
MAXIMUM	4.000	0.002	0.068
MEAN	3.391	0.001	0.020
C.V.	0.177	0.287	1.086

WELL3

AL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	13	14	10	13
MINIMUM	178.000	17.000	3.380	15.000	0.040
MAXIMUM	247.000	256.300	37.500	21.100	0.200
MEAN	215.429	90.477	11.191	16.890	0.188
C.V.	0.077	0.729	0.730	0.103	0.236

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.220	0.001	0.005
MAXIMUM	0.400	0.018	0.069
MEAN	0.285	0.005	0.013
C.V.	0.195	1.116	1.572

WELL4

TOTAL OBSERVATIONS: 15

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	192.000	28.900	2.160	17.300	0.040
MAXIMUM	265.000	837.100	52.000	28.100	0.300
MEAN	225.000	121.486	23.643	21.610	0.195
C.V.	0.089	1.718	0.500	0.176	0.278

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.137	0.001	0.007
MAXIMUM	0.350	0.013	0.058
MEAN	0.204	0.004	0.020
C.V.	0.302	0.955	0.753

WELL5

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	13	14	14	10	13
MINIMUM	336.000	106.300	13.800	306.600	0.200
MAXIMUM	3490.000	1267.100	1110.000	384.000	0.490
MEAN	2974.231	759.714	604.057	339.230	0.247
C.V.	0.281	0.509	0.592	0.063	0.380

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	4.610	0.001	0.005
MAXIMUM	8.310	0.011	0.229
MEAN	6.437	0.003	0.080
C.V.	0.171	1.262	0.808

WELL6

TOTAL OBSERVATIONS: 12

	TDS	SO4	CL	NATOT	B
N OF CASES	3	3	3	0	3
MINIMUM	143.000	5.200	0.200	.	0.200
MAXIMUM	252.000	35.000	5.800	.	0.200
MEAN	204.667	24.567	2.067	.	0.200
C.V.	0.273	0.683	1.564	.	0.000

	STTOT	PBTOT	NITOT
N OF CASES	0	0	0
MINIMUM	.	.	.
MAXIMUM	.	.	.
MEAN	.	.	.
C.V.	.	.	.

WELL7

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	431.000	36.000	28.000	37.600	0.120
MAXIMUM	553.000	295.600	89.800	44.400	0.200
MEAN	483.643	175.386	40.719	40.150	0.192
C.V.	0.069	0.491	0.390	0.047	0.120

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.860	0.001	0.005
MAXIMUM	1.430	0.003	0.034
MEAN	1.005	0.001	0.008
C.V.	0.170	0.519	1.161

WELL8

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	234.000	88.900	38.000	32.900	0.080
MAXIMUM	429.000	319.700	86.900	42.800	0.200
MEAN	381.643	162.443	52.096	38.630	0.191
C.V.	0.127	0.414	0.222	0.078	0.174

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.280	0.001	0.005
MAXIMUM	0.560	0.020	0.040
MEAN	0.392	0.004	0.023
C.V.	0.203	1.434	0.467

WELL9

TAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	766.000	302.600	60.000	32.800	0.200
MAXIMUM	1033.000	692.900	245.000	64.300	0.310
MEAN	929.429	426.379	86.646	54.510	0.234
C.V.	0.082	0.280	0.532	0.152	0.190

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	1.630	0.001	0.005
MAXIMUM	4.510	0.005	0.025
MEAN	2.721	0.002	0.007
C.V.	0.290	0.879	0.846

WELL10

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	434.000	10.500	37.800	54.100	0.090
MAXIMUM	906.000	438.800	56.100	83.900	0.200
MEAN	551.500	217.243	44.047	64.910	0.185
C.V.	0.210	0.548	0.103	0.131	0.205

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.390	0.001	0.005
MAXIMUM	0.890	0.012	0.020
MEAN	0.611	0.003	0.011
C.V.	0.272	1.407	0.488

WELL11

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	9	13
MINIMUM	993.000	221.100	30.750	121.200	0.200
MAXIMUM	1189.000	998.100	42.000	162.800	0.430
MEAN	1095.143	587.693	36.385	141.678	0.276
C.V.	0.061	0.341	0.091	0.095	0.278

	STTOT	PBTOT	NITOT
N OF CASES	9	9	9
MINIMUM	0.840	0.001	0.017
MAXIMUM	1.240	0.004	0.081
MEAN	1.058	0.001	0.050
C.V.	0.126	0.750	0.399

WELL12

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	413.000	385.400	44.000	83.900	0.200
MAXIMUM	1316.000	877.700	70.600	118.500	0.220
MEAN	1004.286	591.071	60.374	96.070	0.202
C.V.	0.248	0.245	0.140	0.119	0.028

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	1.240	0.001	0.005
MAXIMUM	2.460	0.019	0.156
MEAN	1.588	0.003	0.068
C.V.	0.247	2.033	0.593

WELL13

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	13	13	14	10	13
MINIMUM	240.000	40.500	4.500	17.400	0.370
MAXIMUM	357.000	89.800	120.700	23.500	1.200
MEAN	315.000	66.262	63.143	19.550	0.721
C.V.	0.115	0.257	0.373	0.105	0.324

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.281	0.001	0.022
MAXIMUM	0.490	0.010	0.151
MEAN	0.389	0.003	0.047
C.V.	0.160	1.296	0.827

WELL14

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	13	12	13	10	12
MINIMUM	506.000	208.000	12.000	38.300	0.200
MAXIMUM	713.000	426.800	68.300	48.600	0.260
MEAN	659.923	304.238	26.741	43.550	0.212
C.V.	0.080	0.213	0.559	0.072	0.102

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	1.060	0.001	0.005
MAXIMUM	2.190	0.008	0.062
MEAN	1.715	0.002	0.013
C.V.	0.194	1.223	1.363

WELL15

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	493.000	36.800	8.800	37.000	0.200
MAXIMUM	704.000	689.500	70.300	45.900	0.240
MEAN	612.000	312.393	25.242	41.460	0.209
C.V.	0.105	0.450	0.567	0.057	0.072

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	1.210	0.001	0.005
MAXIMUM	1.860	0.001	0.005
MEAN	1.446	0.001	0.005
C.V.	0.138	0.000	0.000

WELL16

AL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	14
MINIMUM	83.000	6.800	1.000	7.700	0.200
MAXIMUM	141.000	387.600	51.200	10.400	0.268
MEAN	110.857	46.240	10.776	8.600	0.205
C.V.	0.148	2.149	1.230	0.114	0.089

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.010	0.001	0.005
MAXIMUM	0.240	0.010	0.017
MEAN	0.076	0.003	0.006
C.V.	0.869	1.232	0.590

WELL17

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	14
MINIMUM	119.000	11.700	0.200	11.600	0.200
MAXIMUM	552.000	387.600	26.600	46.900	0.362
MEAN	280.357	81.064	9.258	34.160	0.241
C.V.	0.393	1.286	0.949	0.372	0.221

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.110	0.001	0.005
MAXIMUM	1.000	0.005	0.013
MEAN	0.615	0.002	0.006
C.V.	0.537	0.731	0.424

WELL18

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	13
MINIMUM	1071.000	324.000	11.400	65.100	0.350
MAXIMUM	1741.000	1217.000	71.700	87.800	0.700
MEAN	1465.143	706.343	42.150	74.060	0.536
C.V.	0.154	0.347	0.392	0.081	0.231

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	3.540	0.001	0.005
MAXIMUM	4.620	0.002	0.005
MEAN	3.999	0.001	0.005
C.V.	0.093	0.287	0.000

WELL19

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	14
MINIMUM	988.000	309.000	33.600	63.100	0.330
MAXIMUM	1674.000	1337.000	98.700	78.700	0.670
MEAN	1412.929	722.971	44.921	68.350	0.510
C.V.	0.138	0.475	0.388	0.073	0.239

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	3.110	0.001	0.005
MAXIMUM	3.960	0.004	0.028
MEAN	3.491	0.002	0.009
C.V.	0.091	0.648	0.790

WELL20

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	14
MINIMUM	1255.000	100.700	28.000	64.500	0.200
MAXIMUM	1631.000	1382.300	92.000	89.900	0.500
MEAN	1514.071	696.971	44.544	80.980	0.283
C.V.	0.082	0.476	0.421	0.104	0.330

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	1.870	0.001	0.005
MAXIMUM	4.560	0.004	0.208
MEAN	2.646	0.001	0.066
C.V.	0.361	0.730	0.928

WELL21

TOTAL OBSERVATIONS: 14

	TDS	SO4	CL	NATOT	B
N OF CASES	14	14	14	10	14
MINIMUM	851.000	75.900	33.630	56.600	0.200
MAXIMUM	1312.000	1081.400	89.000	76.600	0.451
MEAN	1173.143	558.380	44.596	64.170	0.315
C.V.	0.122	0.535	0.332	0.103	0.278

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	2.000	0.001	0.005
MAXIMUM	3.110	0.014	0.159
MEAN	2.451	0.002	0.060
C.V.	0.156	1.703	0.690

WELL22

TOTAL OBSERVATIONS: 15

	TDS	SO4	CL	NATOT	B
N OF CASES	14	13	14	10	14
MINIMUM	185.000	32.100	5.000	14.400	0.060
MAXIMUM	331.000	182.600	62.100	27.700	0.327
MEAN	252.214	86.385	20.831	19.800	0.199
C.V.	0.144	0.545	0.642	0.203	0.263

	STTOT	PBTOT	NITOT
N OF CASES	10	10	10
MINIMUM	0.240	0.001	0.005
MAXIMUM	0.670	0.019	0.066
MEAN	0.426	0.003	0.015
C.V.	0.321	1.886	1.259

WELL23

TOTAL OBSERVATIONS: 8

	TDS	SO4	CL	NATOT	B
N OF CASES	8	8	8	8	7
MINIMUM	100.000	24.500	3.000	8.000	0.200
MAXIMUM	902.000	459.100	143.200	104.500	0.700
MEAN	637.500	283.450	73.488	65.150	0.484
C.V.	0.496	0.441	0.646	0.503	0.398

	STTOT	PBTOT	NITOT
N OF CASES	8	8	8
MINIMUM	0.300	0.001	0.005
MAXIMUM	3.630	0.004	0.011
MEAN	2.620	0.001	0.008
C.V.	0.406	0.771	0.289

WELL24

TOTAL OBSERVATIONS: 8

	TDS	SO4	CL	NATOT	B
N OF CASES	8	8	8	7	7
MINIMUM	2296.000	854.000	36.000	141.800	0.520
MAXIMUM	4210.000	2898.200	120.500	196.800	0.810
MEAN	3412.000	1899.763	81.763	168.471	0.660
C.V.	0.226	0.409	0.303	0.106	0.138

	STTOT	PBTOT	NITOT
N OF CASES	8	8	8
MINIMUM	0.280	0.001	0.005
MAXIMUM	9.880	0.001	0.170
MEAN	7.226	0.001	0.067
C.V.	0.418	0.000	0.823

WELL25

TOTAL OBSERVATIONS: 3

	TDS	SO4	CL	NATOT	B
N OF CASES	2	2	2	2	2
MINIMUM	546.000	36.400	16.300	51.500	0.200
MAXIMUM	768.000	50.300	38.400	120.700	0.200
MEAN	657.000	43.350	27.350	86.100	0.200
C.V.	0.239	0.227	0.571	0.568	0.000

	STTOT	PBTOT	NITOT
N OF CASES	2	2	2
MINIMUM	6.550	0.001	0.008
MAXIMUM	7.180	0.001	0.010
MEAN	6.865	0.001	0.009
C.V.	0.065	0.000	0.157

WELL26

TOTAL OBSERVATIONS: 8

	TDS	SO4	CL	NATOT	B
N OF CASES	8	8	8	8	7
MINIMUM	219.000	11.600	3.000	20.600	0.070
MAXIMUM	319.000	55.300	42.300	44.800	0.200
MEAN	277.875	22.125	11.425	29.425	0.181
C.V.	0.124	0.649	1.125	0.267	0.271

	STTOT	PBTOT	NITOT
N OF CASES	8	8	8
MINIMUM	0.280	0.001	0.005
MAXIMUM	0.580	0.002	0.008
MEAN	0.409	0.001	0.006
C.V.	0.240	0.314	0.236

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PROCESSING JUNKFLD1.CMD

Period of record summary statistics by well - White Bluff

WELL1

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	3.430	3016.000	0.200	14.500
MAXIMUM	3.970	3670.000	11.000	24.100
MEAN	3.735	3319.600	2.185	18.450
C.V.	0.044	0.063	1.529	0.130

WELL2

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	5.080	720.000	0.600	14.500
MAXIMUM	6.810	1631.000	43.200	22.200
MEAN	5.827	1414.400	8.790	18.200
C.V.	0.076	0.186	1.424	0.111

WELL3

TAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	5.100	180.000	17.500	10.100
MAXIMUM	6.120	275.000	251.000	21.600
MEAN	5.428	212.100	90.490	17.100
C.V.	0.054	0.142	0.832	0.191

WELL4

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	4.130	150.000	12.000	6.600
MAXIMUM	4.790	344.000	260.000	24.400
MEAN	4.382	255.900	148.700	17.080
C.V.	0.056	0.224	0.491	0.337

WELL5

TOTAL OBSERVATIONS: 13

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	3.780	2800.000	32.000	7.700
MAXIMUM	4.200	4990.000	261.000	25.600
MEAN	4.019	4010.000	87.656	18.089
C.V.	0.037	0.180	0.840	0.298

WELL6

TOTAL OBSERVATIONS: 11

	PH	COND	TURB	H2OTEMP
OF CASES	0	0	0	0
MINIMUM	.	.	.	.
MAXIMUM	.	.	.	.
MEAN	.	.	.	.
C.V.	.	.	.	.

WELL7

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	5.330	454.000	10.650	11.600
MAXIMUM	5.830	862.000	87.000	21.400
MEAN	5.612	580.000	34.595	17.459
C.V.	0.029	0.199	0.601	0.172

WELL8

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	3.920	380.000	28.000	8.200
MAXIMUM	4.810	635.000	88.800	25.600
MEAN	4.246	514.600	53.830	17.890
C.V.	0.067	0.160	0.383	0.262

WELL9

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	9
MINIMUM	5.500	958.000	9.230	8.900
MAXIMUM	7.830	2080.000	49.700	22.200
MEAN	6.019	1265.700	27.083	16.989
C.V.	0.115	0.272	0.491	0.230

WELL10

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	3.940	490.000	22.000	7.800
MAXIMUM	6.110	1220.000	391.000	26.100
MEAN	4.493	738.000	194.810	17.920
C.V.	0.138	0.288	0.538	0.310

WELL11

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	9
MINIMUM	3.780	174.000	108.000	7.700
MAXIMUM	4.330	1845.000	460.000	23.300
MEAN	4.068	1273.600	232.010	17.822
C.V.	0.040	0.364	0.495	0.273

WELL12

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
OF CASES	10	10	10	9
MINIMUM	3.180	145.000	21.700	7.800
MAXIMUM	3.980	1789.000	104.000	24.400
MEAN	3.666	1201.500	61.330	17.533
C.V.	0.063	0.374	0.486	0.309

WELL13

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	3.250	363.000	34.000	12.000
MAXIMUM	4.090	525.000	140.000	20.400
MEAN	3.719	455.000	75.860	16.310
C.V.	0.068	0.110	0.392	0.163

WELL14

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	5.100	736.000	0.300	13.500
MAXIMUM	7.490	996.000	260.000	21.800
MEAN	6.121	833.111	64.156	16.600
C.V.	0.130	0.102	1.281	0.168

WELL15

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	10	10	10	10
MINIMUM	5.020	701.000	0.100	13.000
MAXIMUM	6.640	850.000	20.000	21.800
MEAN	5.855	766.700	6.704	16.580
C.V.	0.074	0.069	1.282	0.151

WELL16

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	5.110	52.100	0.600	13.200
MAXIMUM	5.720	779.000	120.000	22.100
MEAN	5.330	144.778	36.022	17.669
C.V.	0.043	1.644	0.989	0.138

WELL17

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	5.560	175.000	0.400	13.300
MAXIMUM	7.350	1380.000	250.000	24.800
MEAN	6.539	554.444	60.056	18.211
C.V.	0.088	0.682	1.290	0.175

WELL18

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
; OF CASES	9	9	9	9
MINIMUM	5.250	702.000	4.750	14.200
MAXIMUM	6.020	1905.000	46.800	23.100
MEAN	5.602	1565.333	22.283	18.389
C.V.	0.046	0.229	0.675	0.127

WELL19

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	3.830	1087.000	2.000	14.200
MAXIMUM	4.700	1747.000	90.000	24.800
MEAN	4.276	1541.556	30.244	18.944
C.V.	0.062	0.125	1.109	0.149

WELL20

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	3.310	1462.000	0.500	15.200
MAXIMUM	4.270	1875.000	31.800	21.900
MEAN	3.706	1696.111	7.444	18.033
C.V.	0.092	0.084	1.318	0.124

WELL21

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	9
MINIMUM	3.700	126.000	5.400	14.800
MAXIMUM	4.390	1570.000	74.000	22.600
MEAN	3.992	1222.444	28.729	18.544
C.V.	0.059	0.362	0.863	0.154

WELL22

TOTAL OBSERVATIONS: 14

	PH	COND	TURB	H2OTEMP
N OF CASES	9	9	9	8
MINIMUM	3.720	240.000	0.300	12.800
MAXIMUM	4.300	567.000	400.000	20.900
MEAN	4.011	355.111	97.317	18.025
C.V.	0.041	0.337	1.256	0.153

WELL23

TOTAL OBSERVATIONS: 8

	PH	COND	TURB	H2OTEMP
N OF CASES	8	8	8	8
MINIMUM	6.390	153.000	0.200	14.200
MAXIMUM	8.530	1240.000	303.000	21.200
MEAN	7.369	963.375	46.625	17.338
C.V.	0.089	0.427	2.238	0.136

WELL24

TOTAL OBSERVATIONS: 8

	PH	COND	TURB	H2OTEMP
N OF CASES	8	8	8	8
MINIMUM	5.800	2480.000	3.500	14.200
MAXIMUM	9.340	5480.000	26.700	24.800
MEAN	6.971	4016.250	13.400	17.788
C.V.	0.152	0.225	0.626	0.179

WELL25

TOTAL OBSERVATIONS: 3

	PH	COND	TURB	H2OTEMP
N OF CASES	2	2	2	2
MINIMUM	11.720	2240.000	16.000	15.000
MAXIMUM	12.300	3150.000	73.000	20.700
MEAN	12.010	2695.000	44.500	17.850
C.V.	0.034	0.239	0.906	0.226

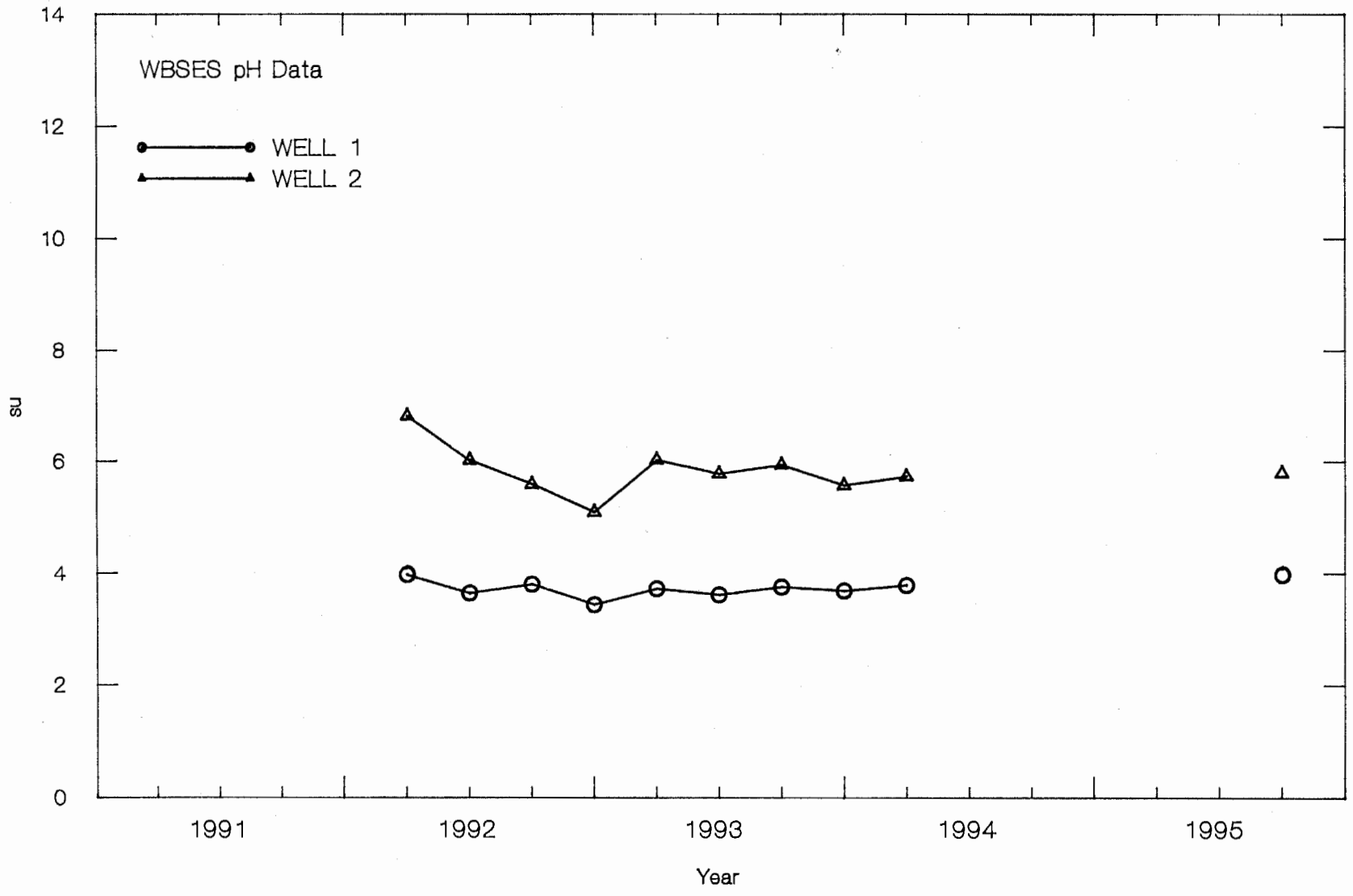
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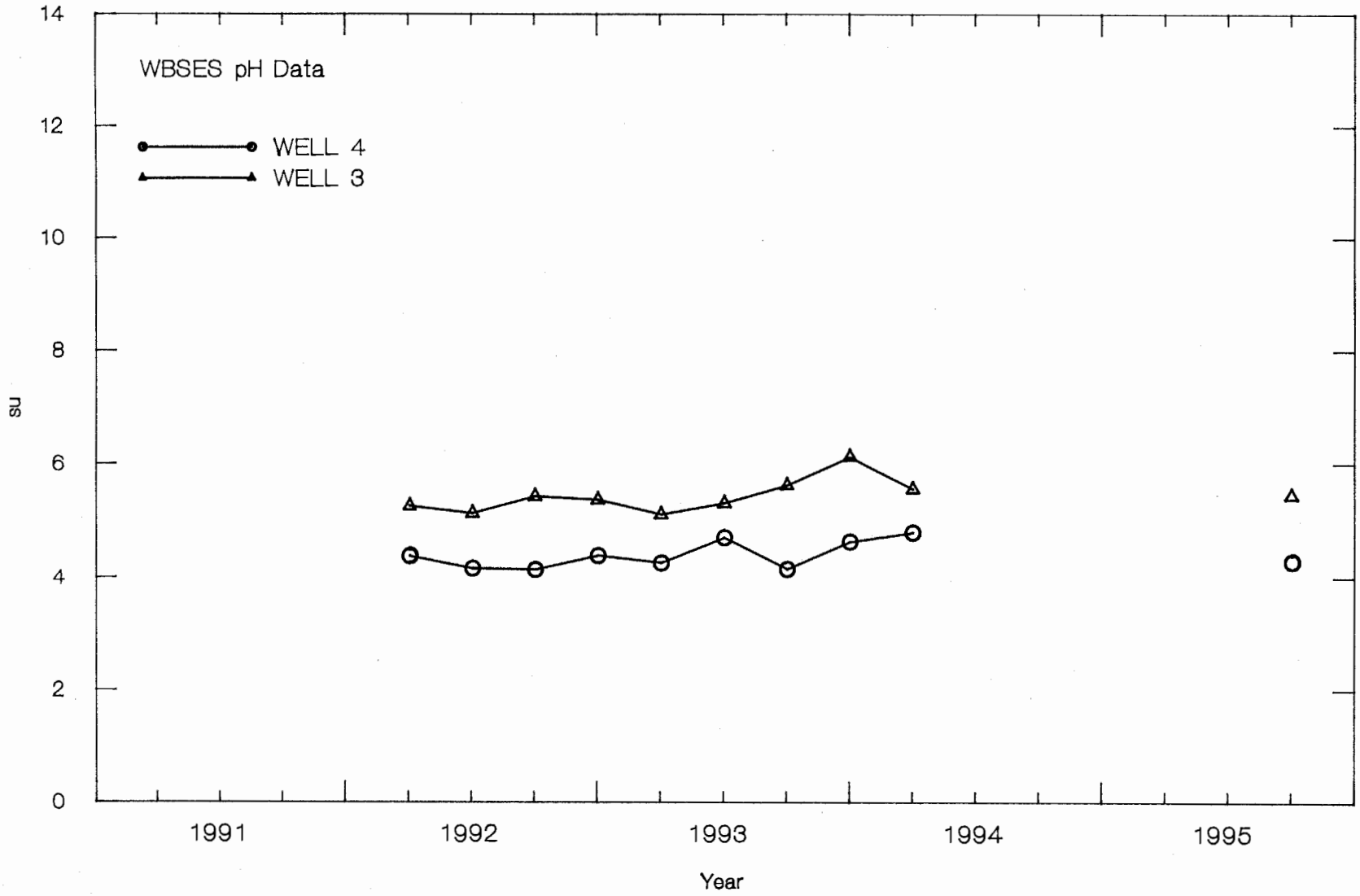
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N OF CASES	8	8	8	8
MINIMUM	6.310	257.000	1.300	13.900
MAXIMUM	9.360	670.000	57.100	21.200
MEAN	7.473	414.500	22.891	16.963
C.V.	0.144	0.315	0.864	0.137

Appendix G

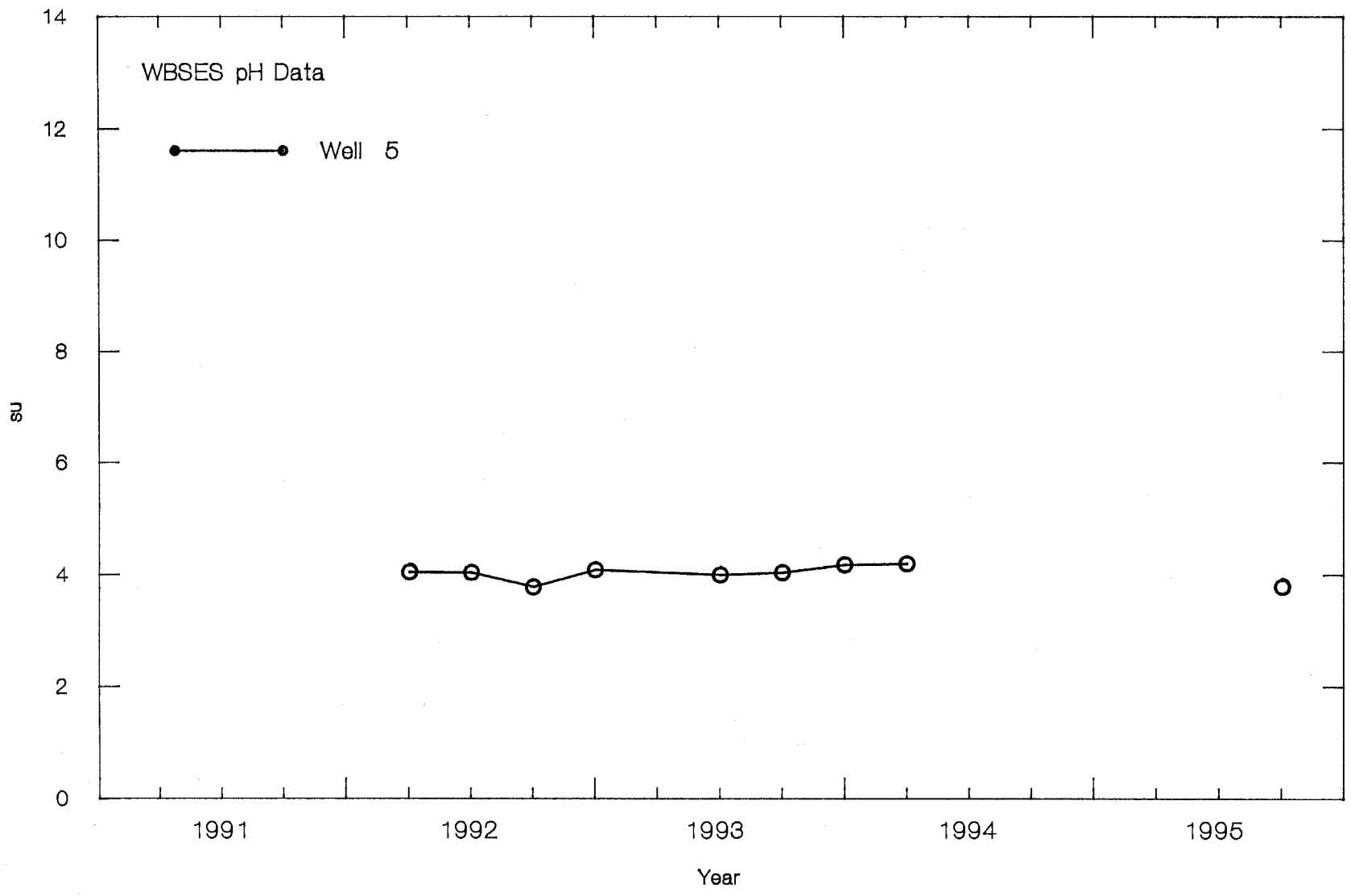
Time Series Graphs



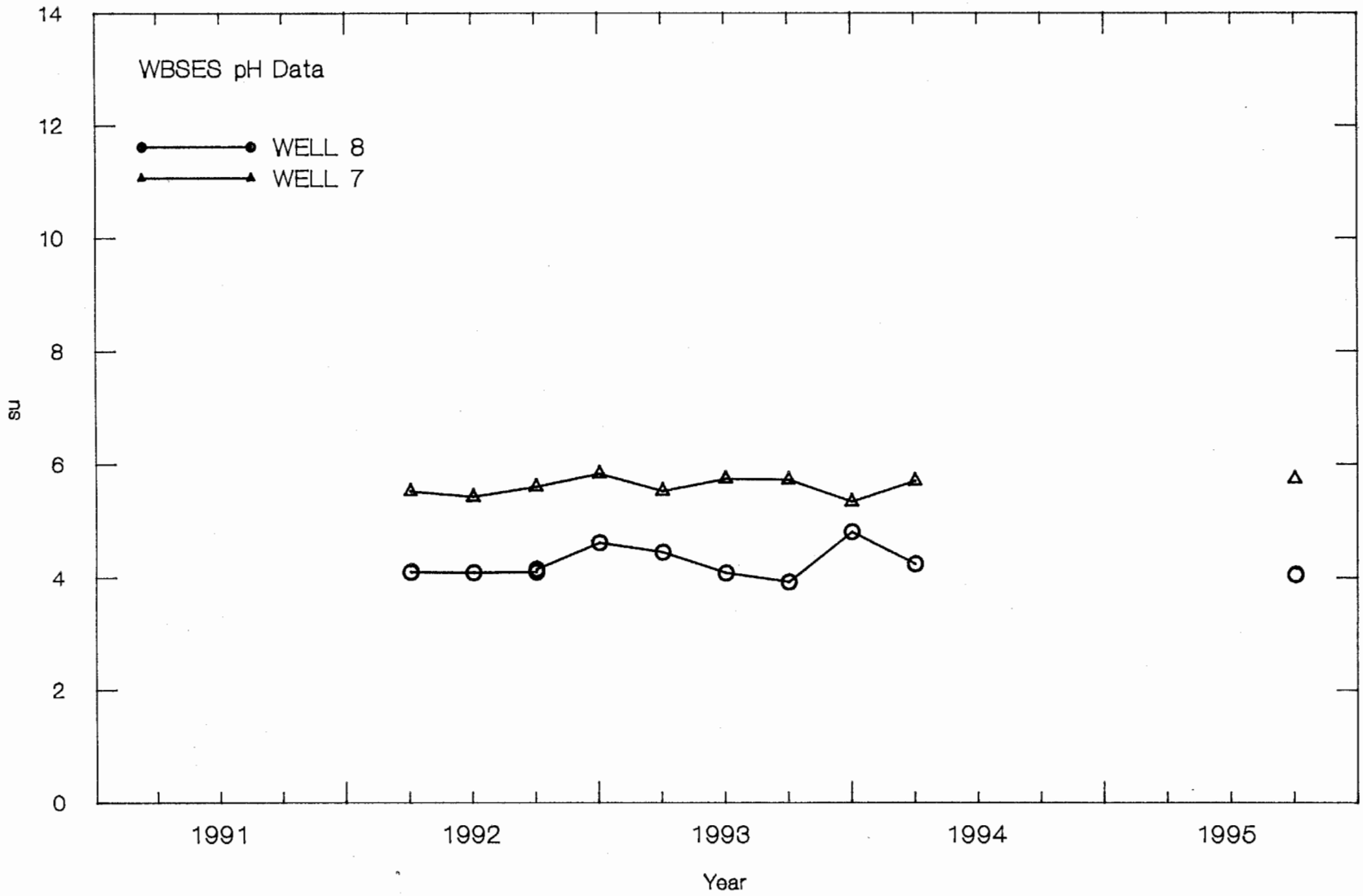
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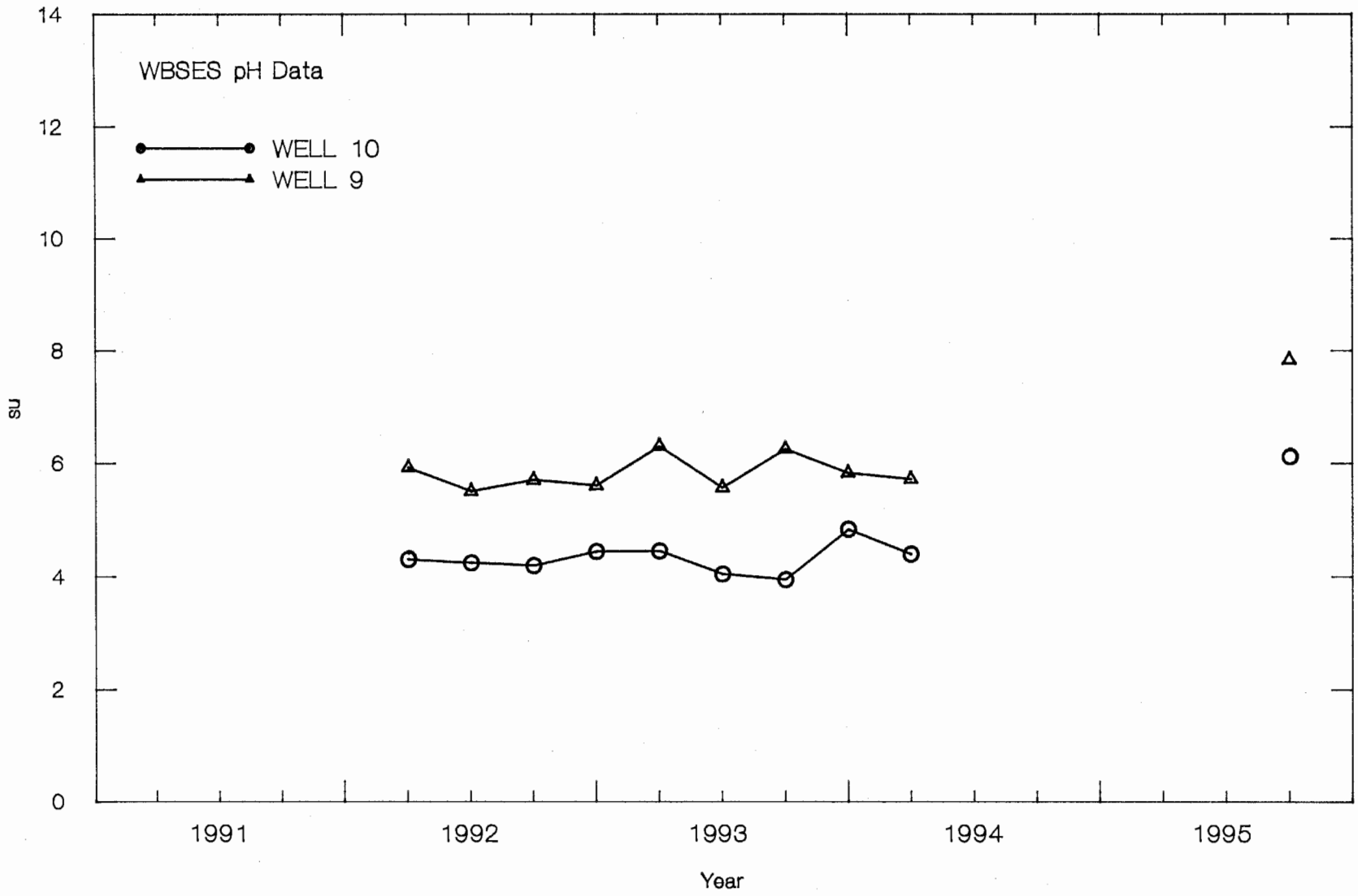
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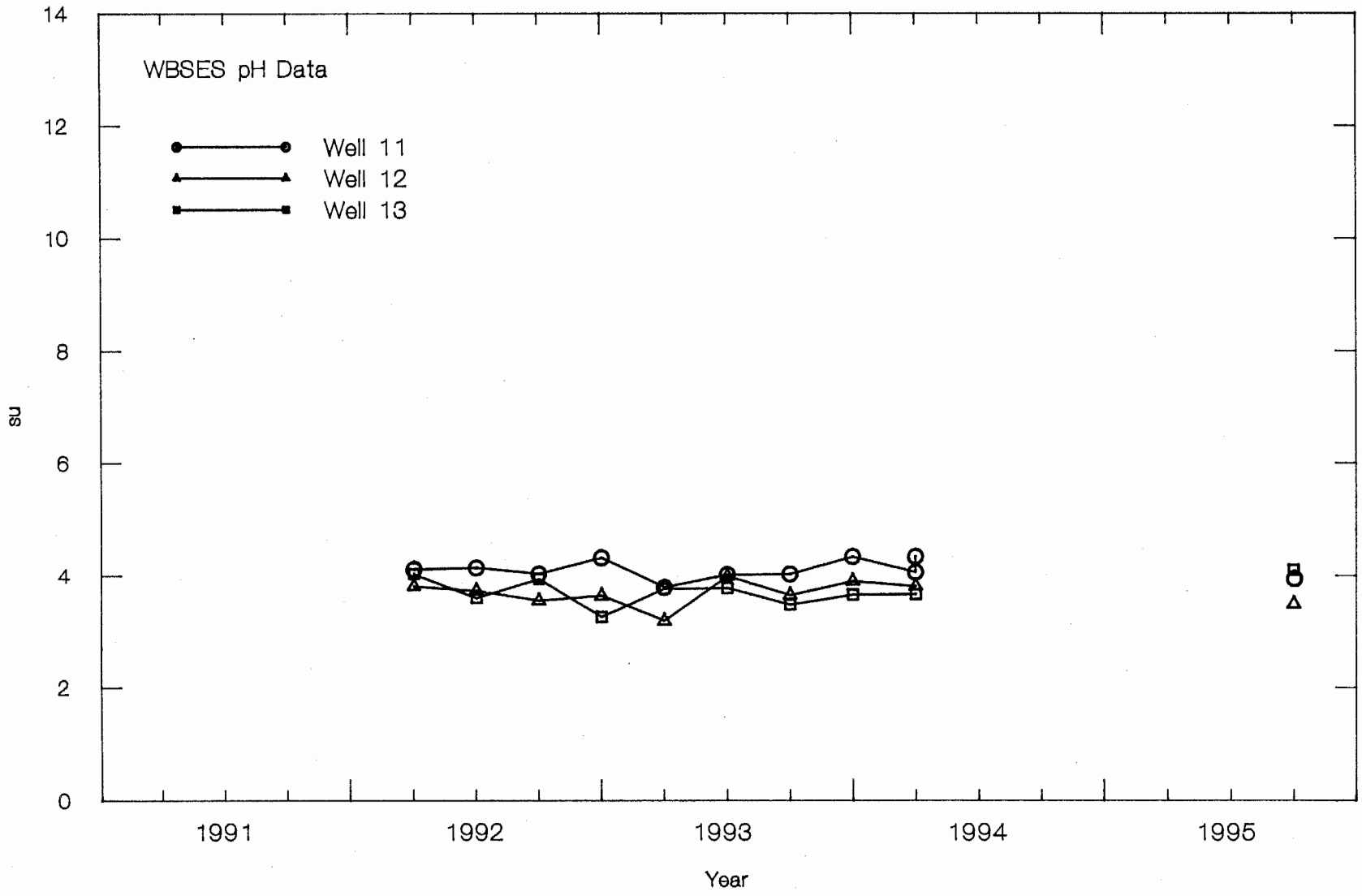
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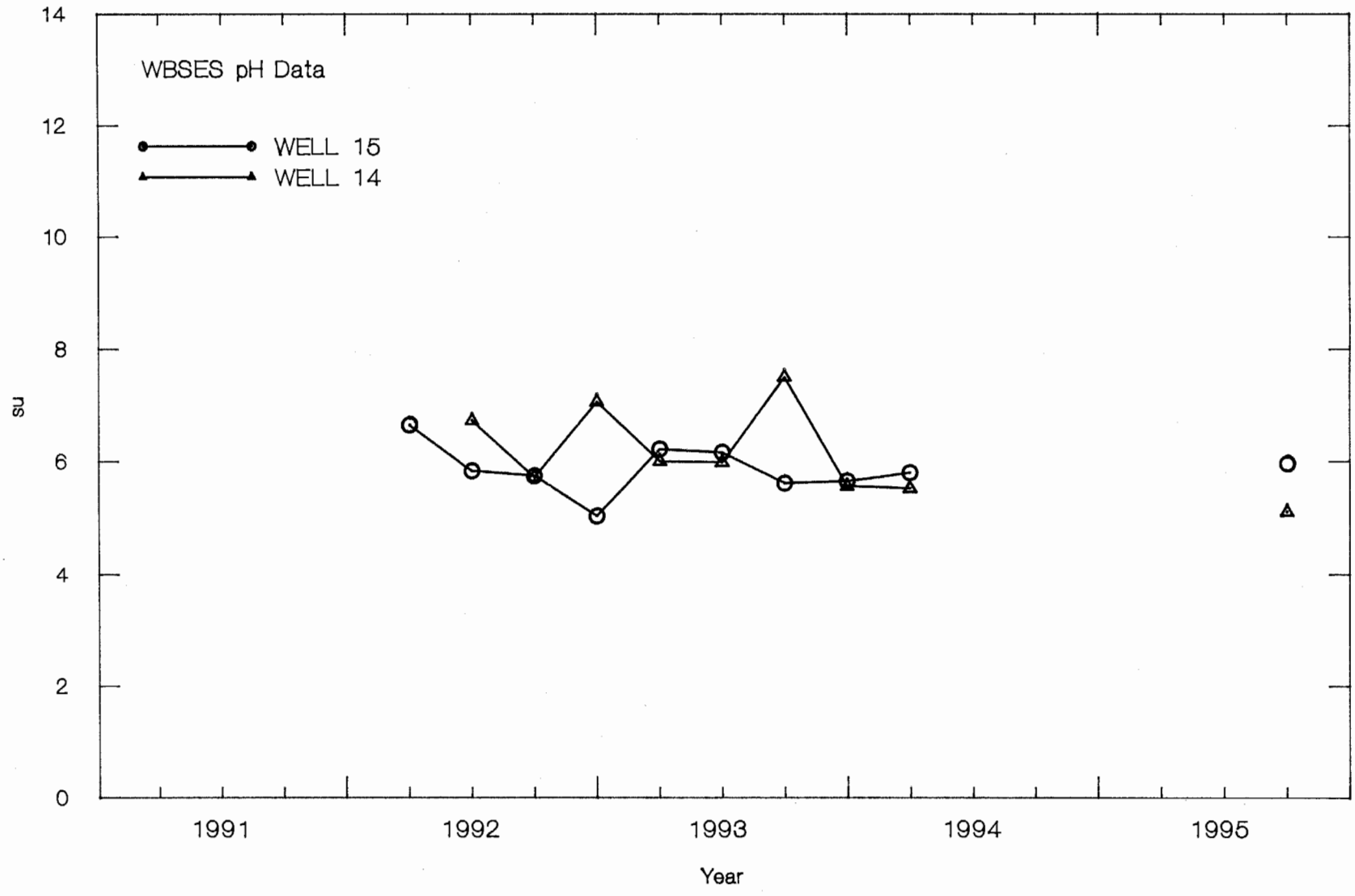
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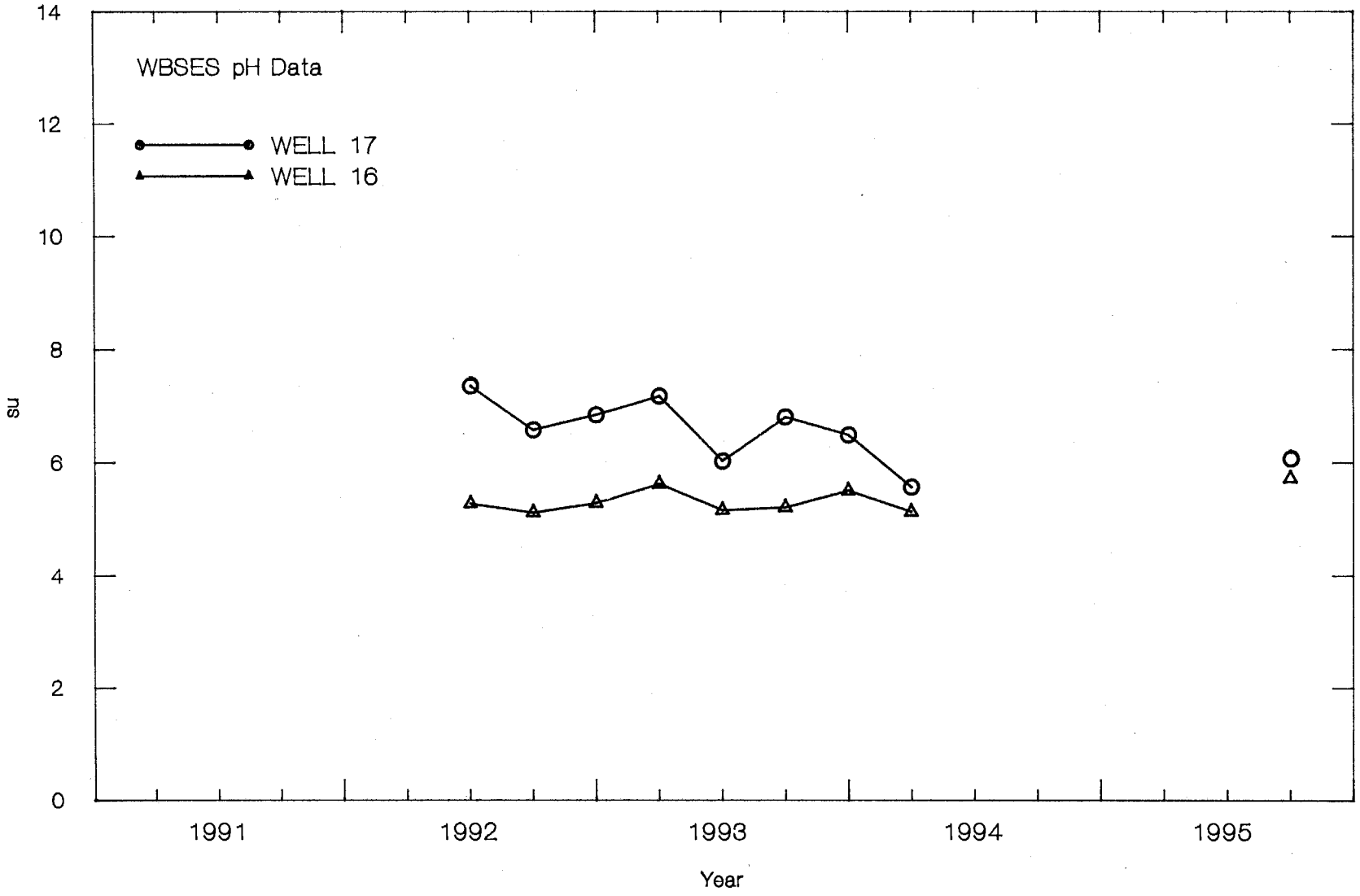
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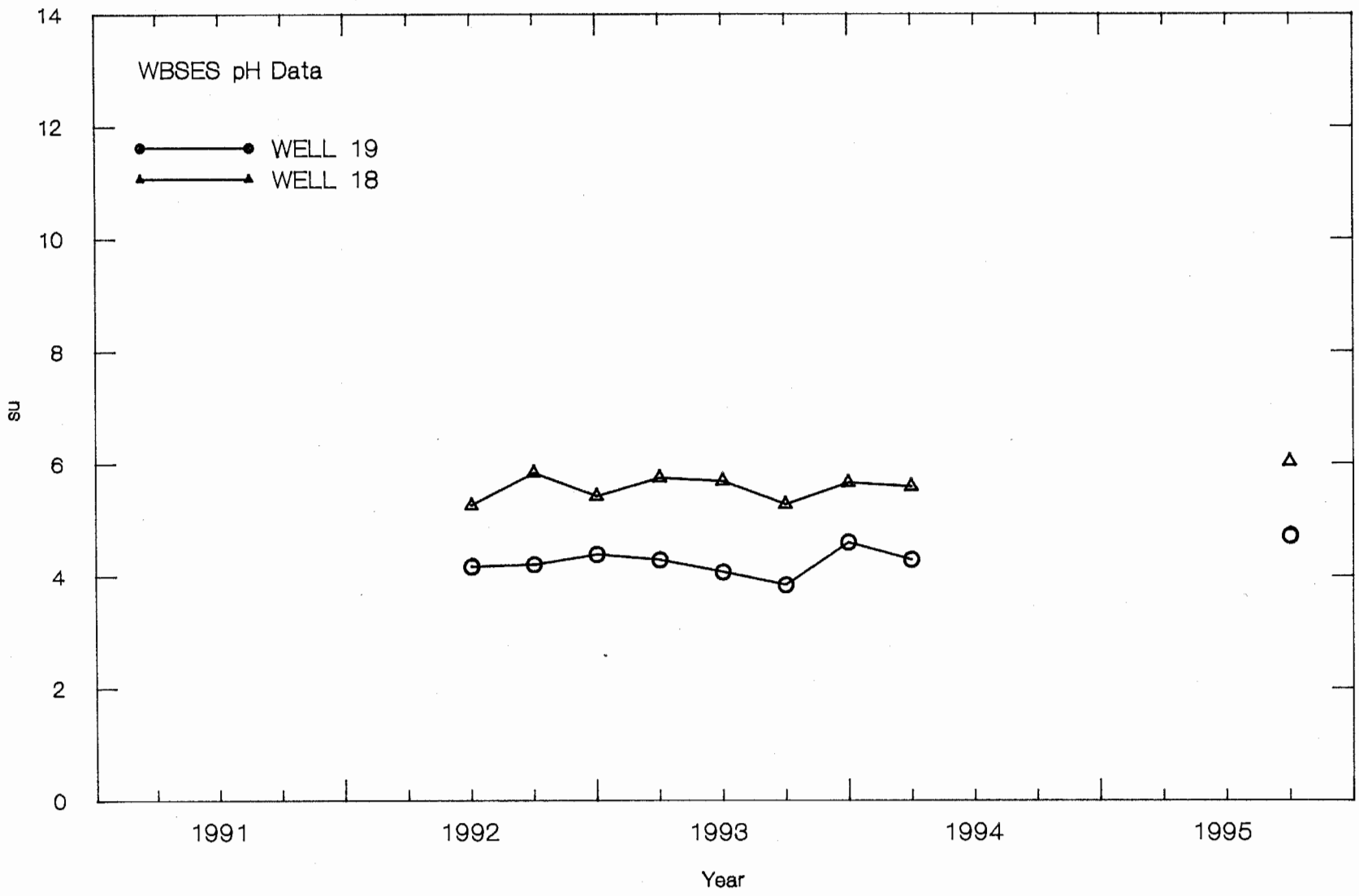
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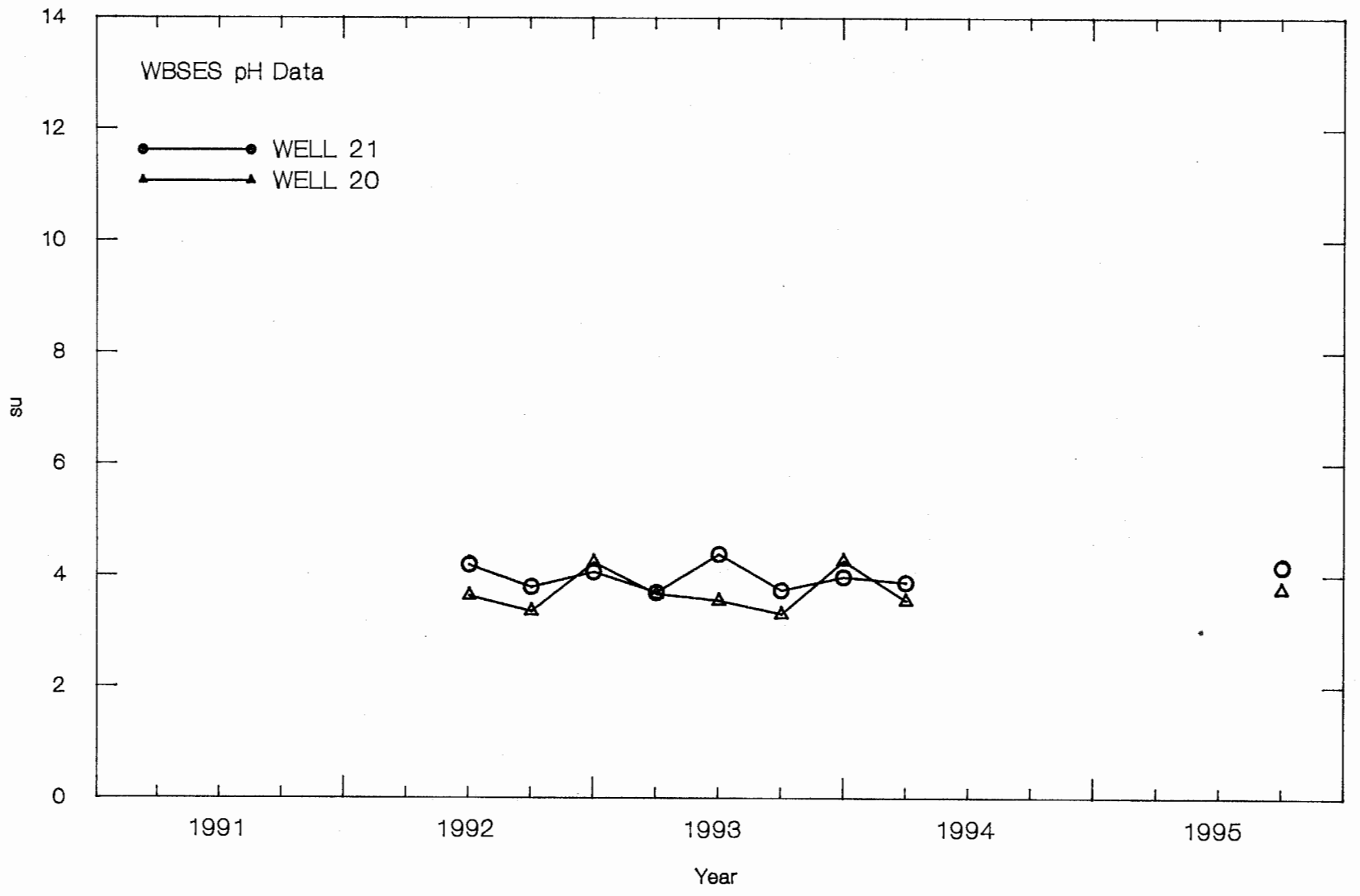
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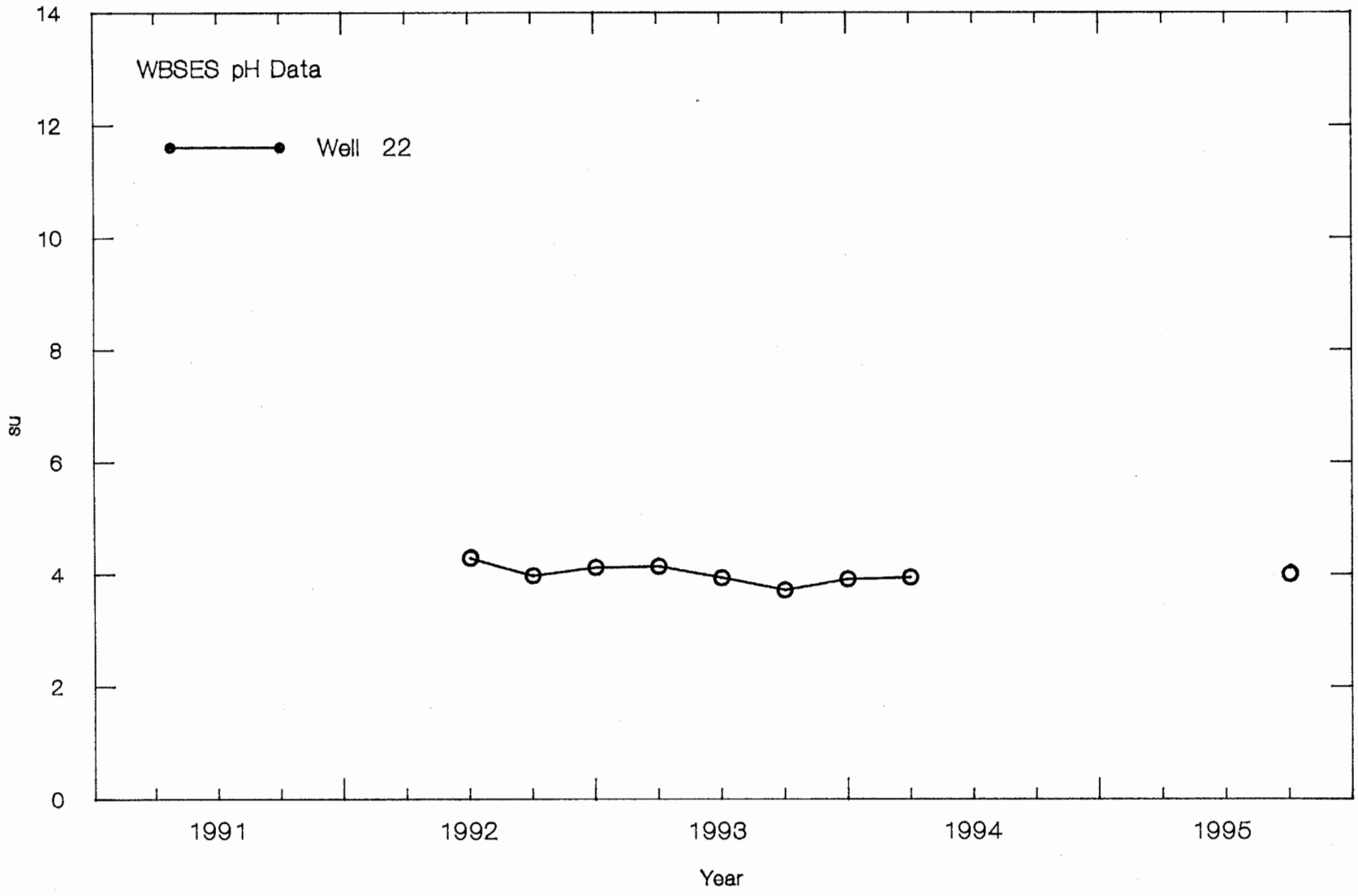
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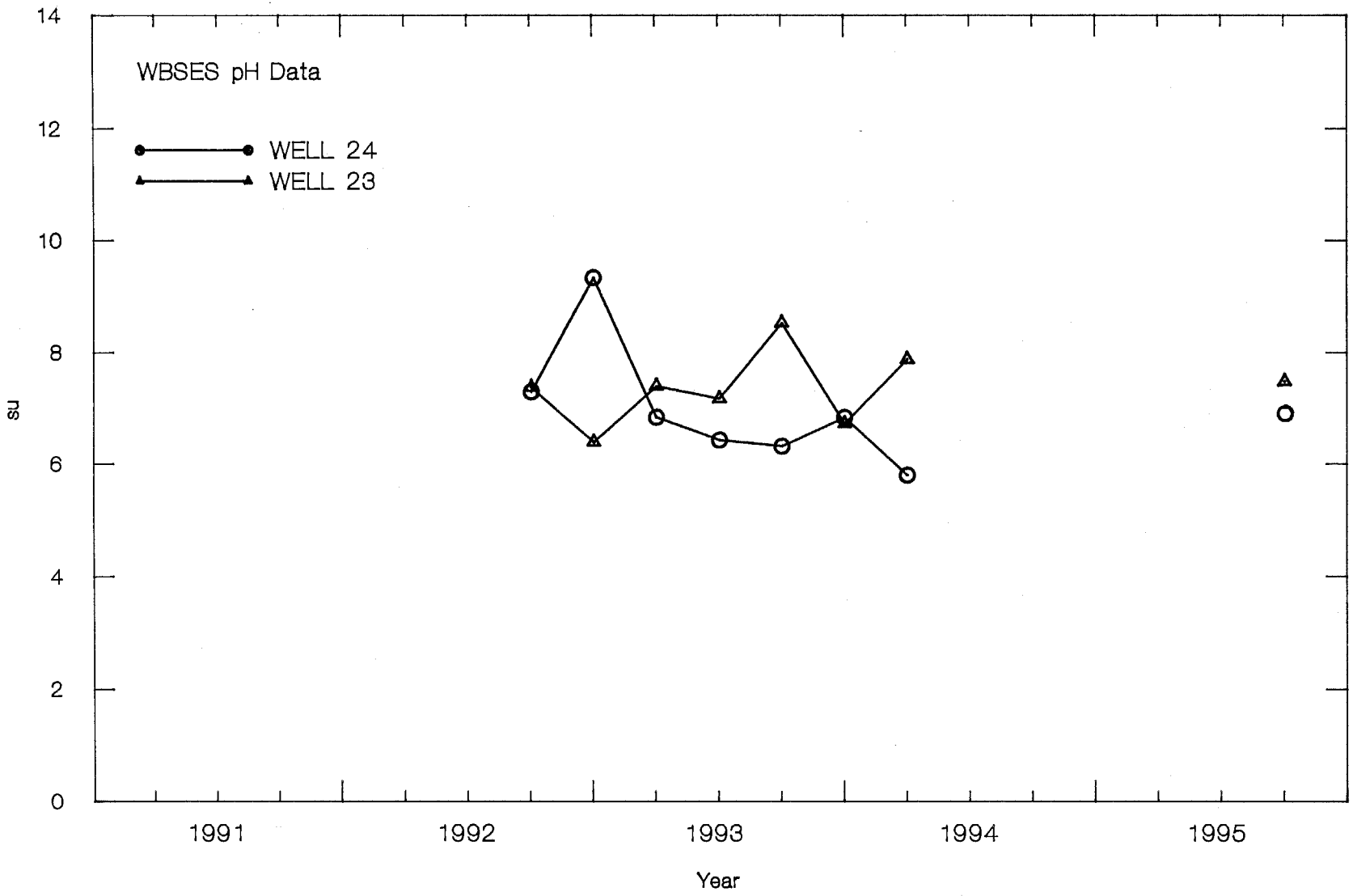
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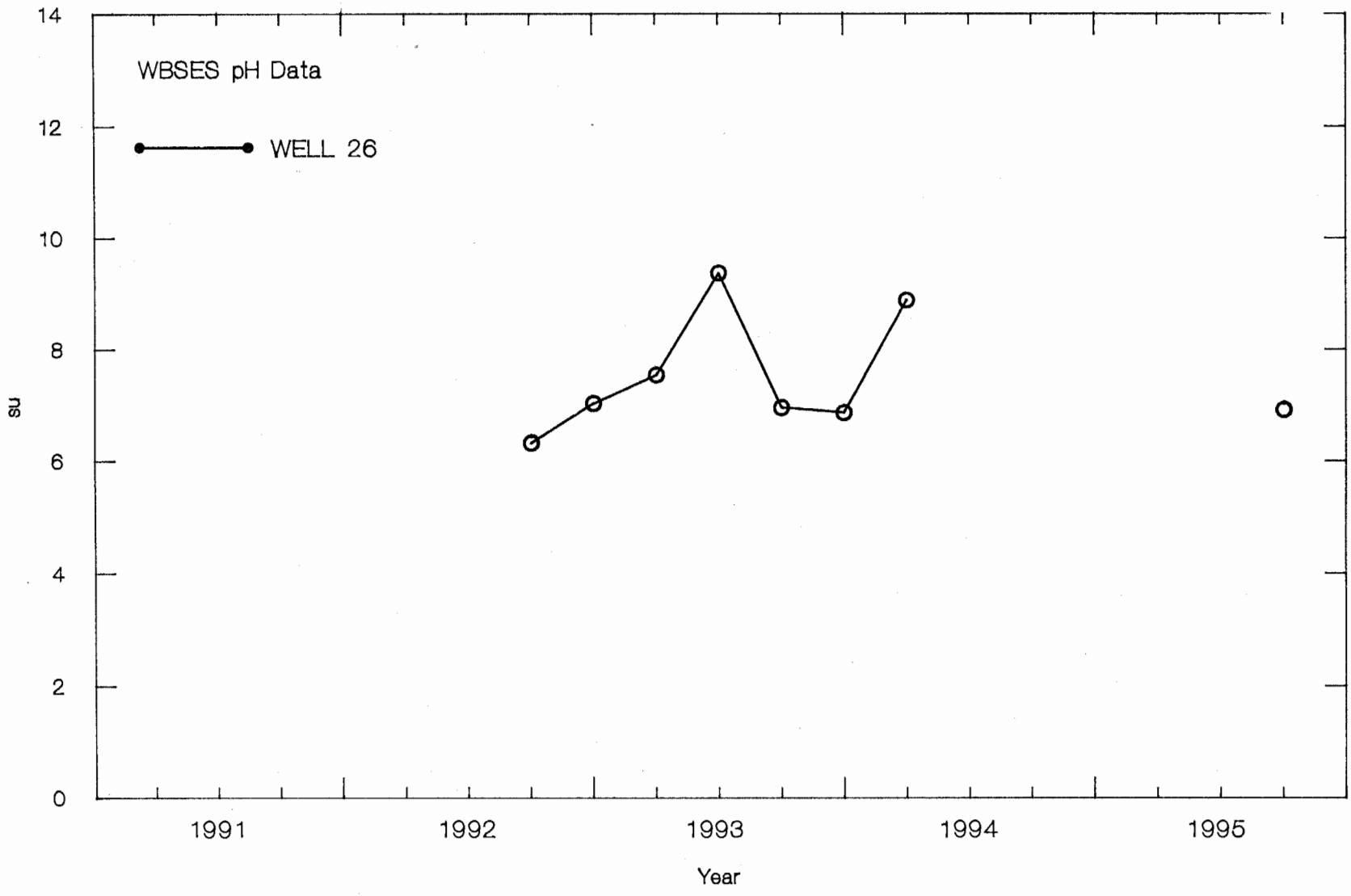
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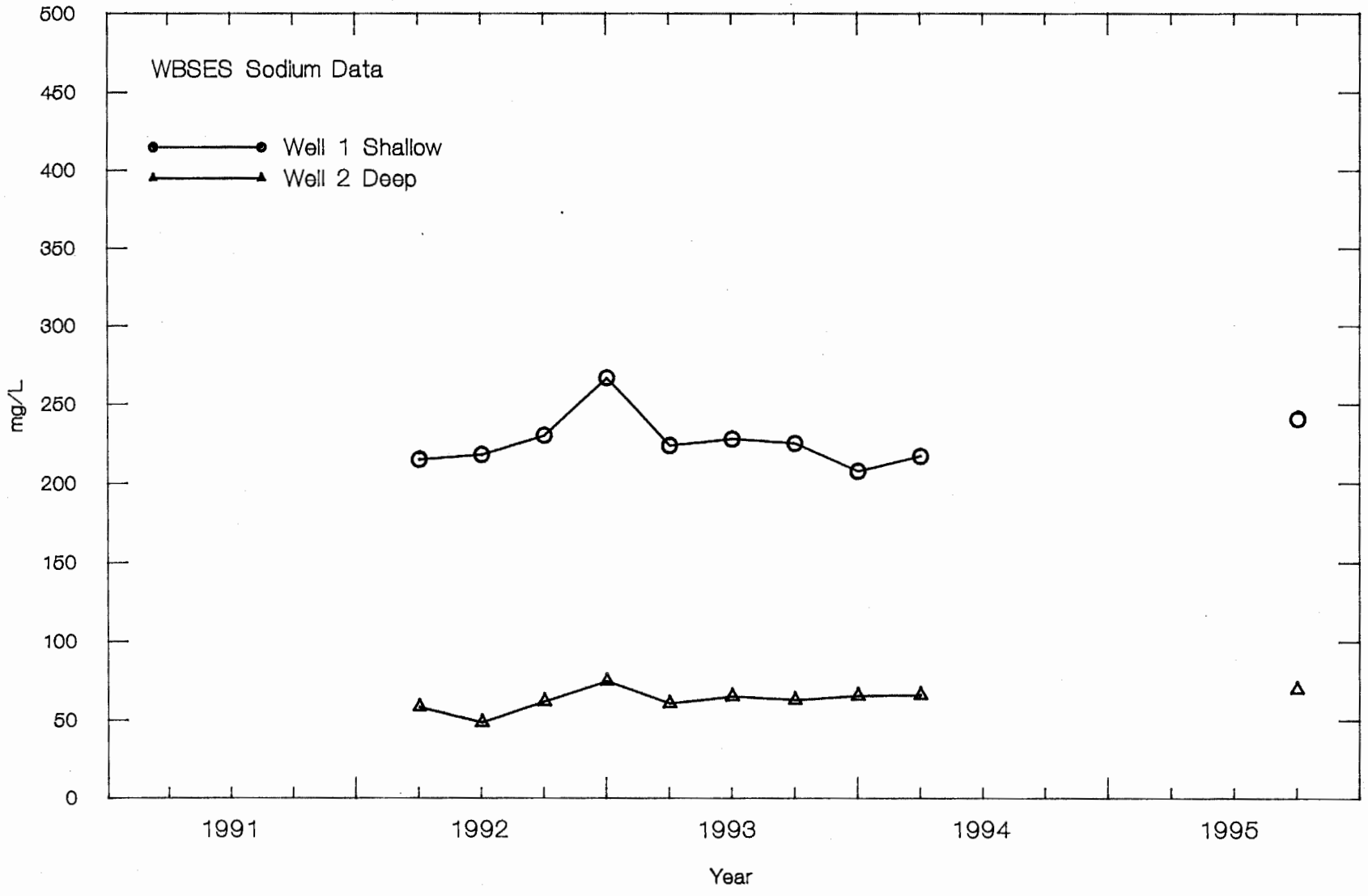
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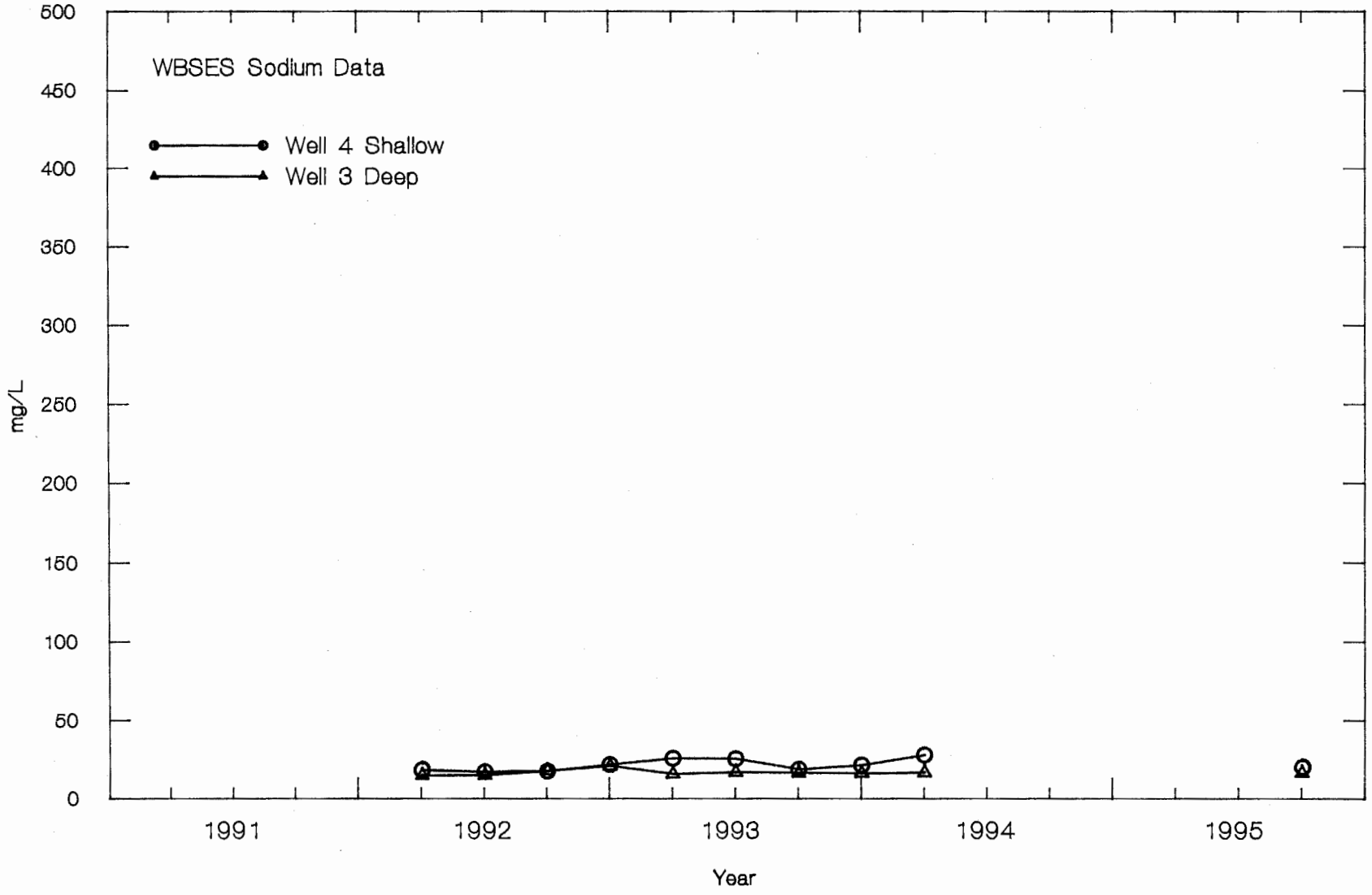
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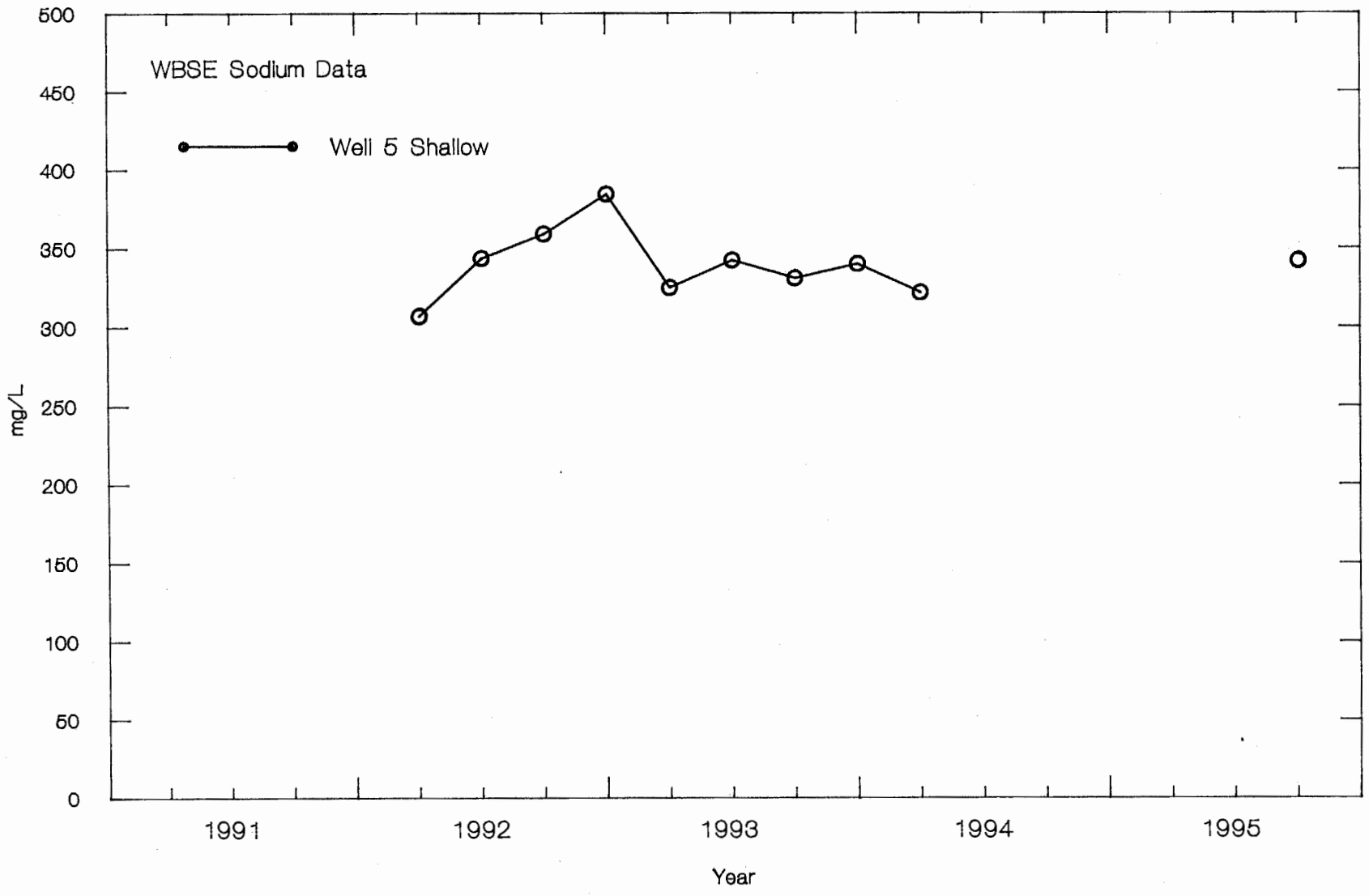
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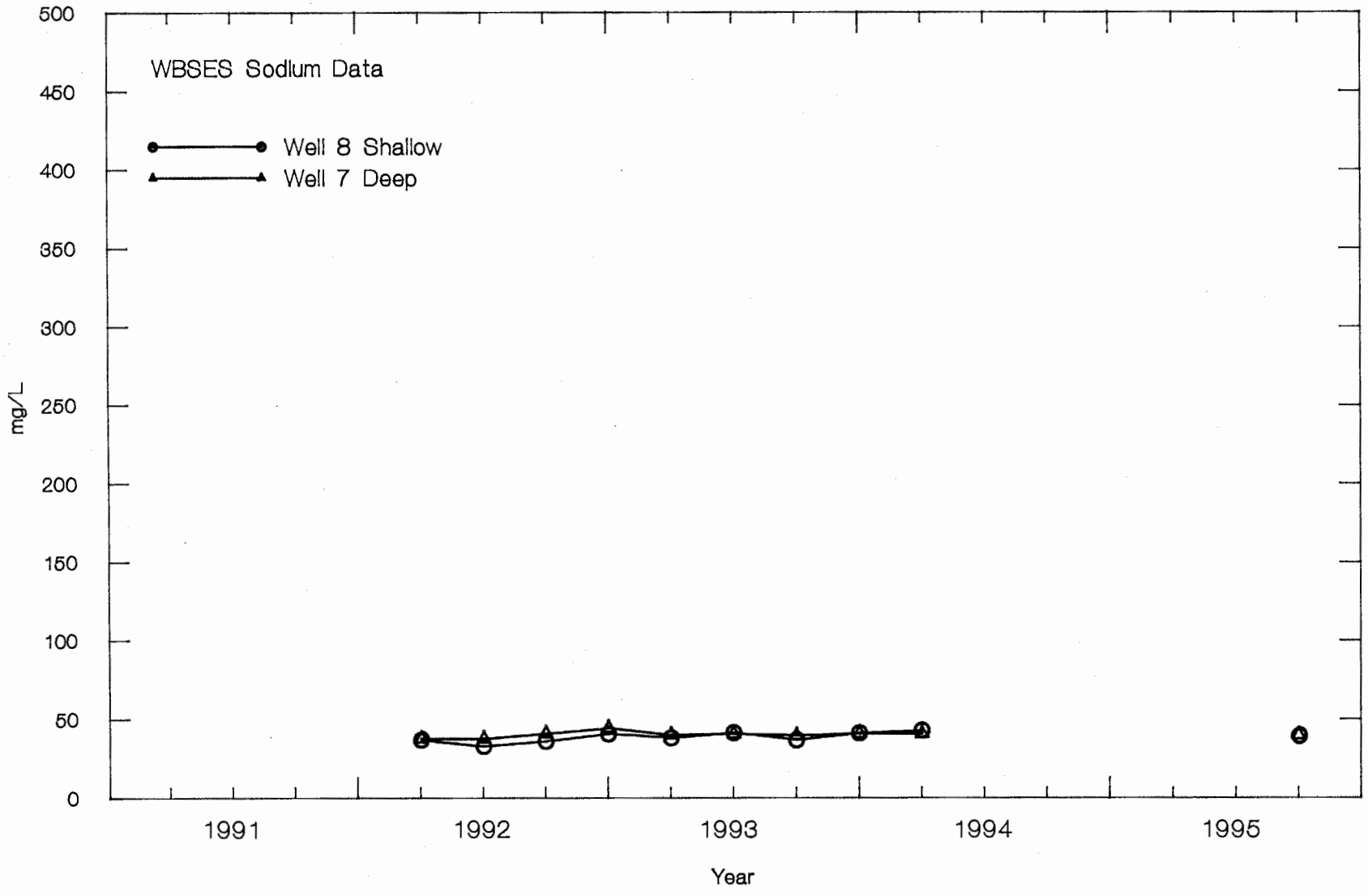
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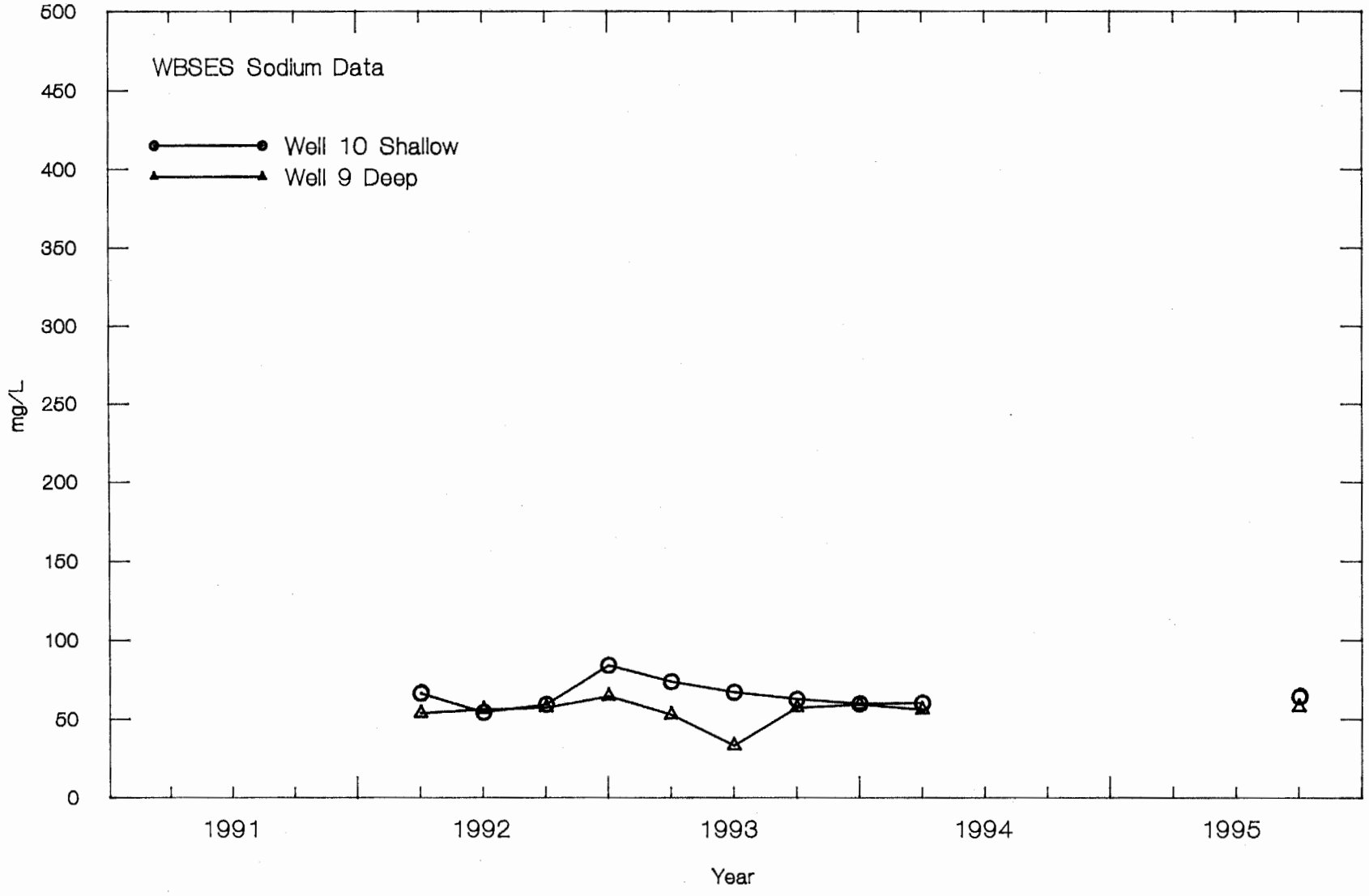
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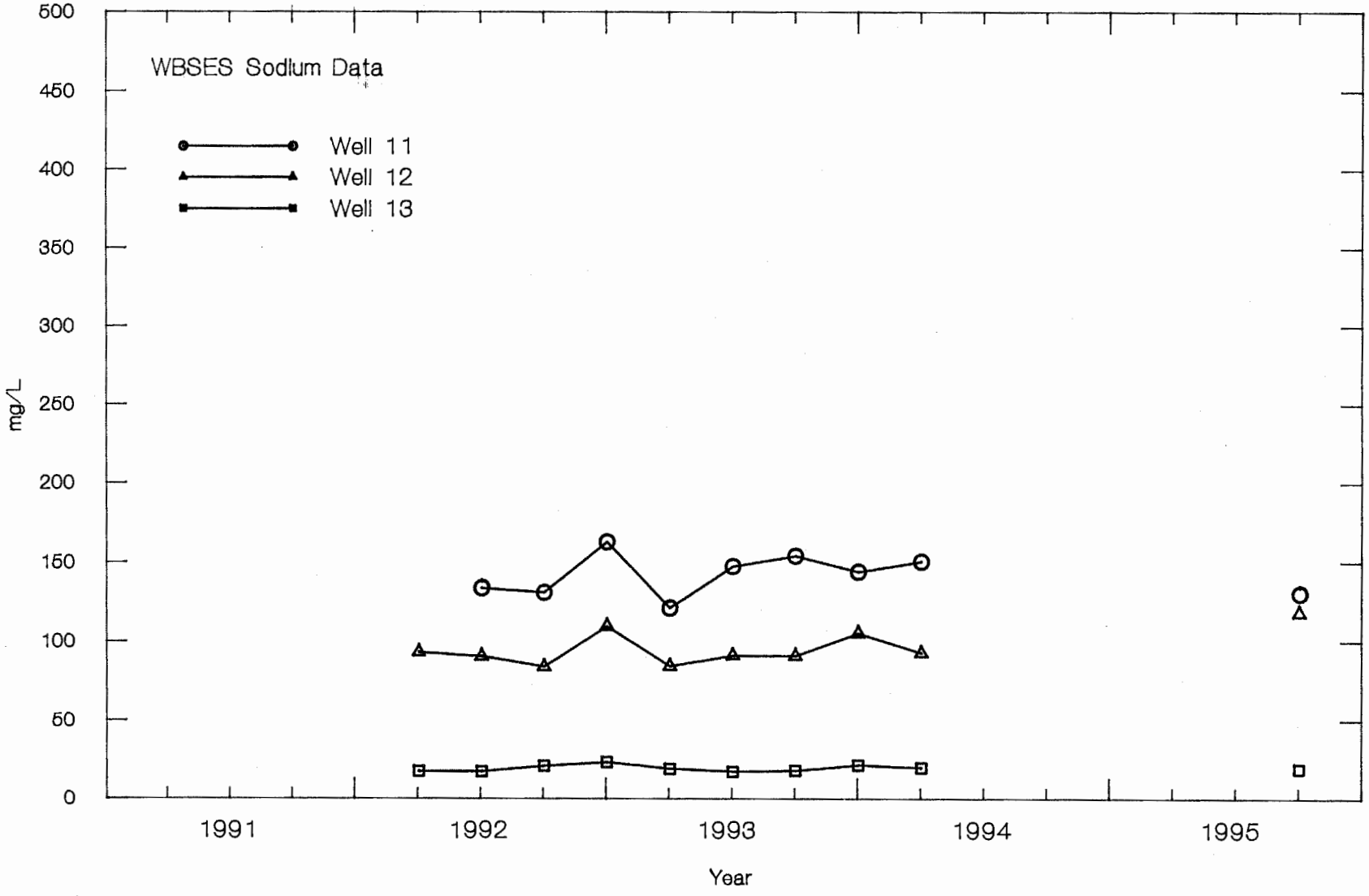
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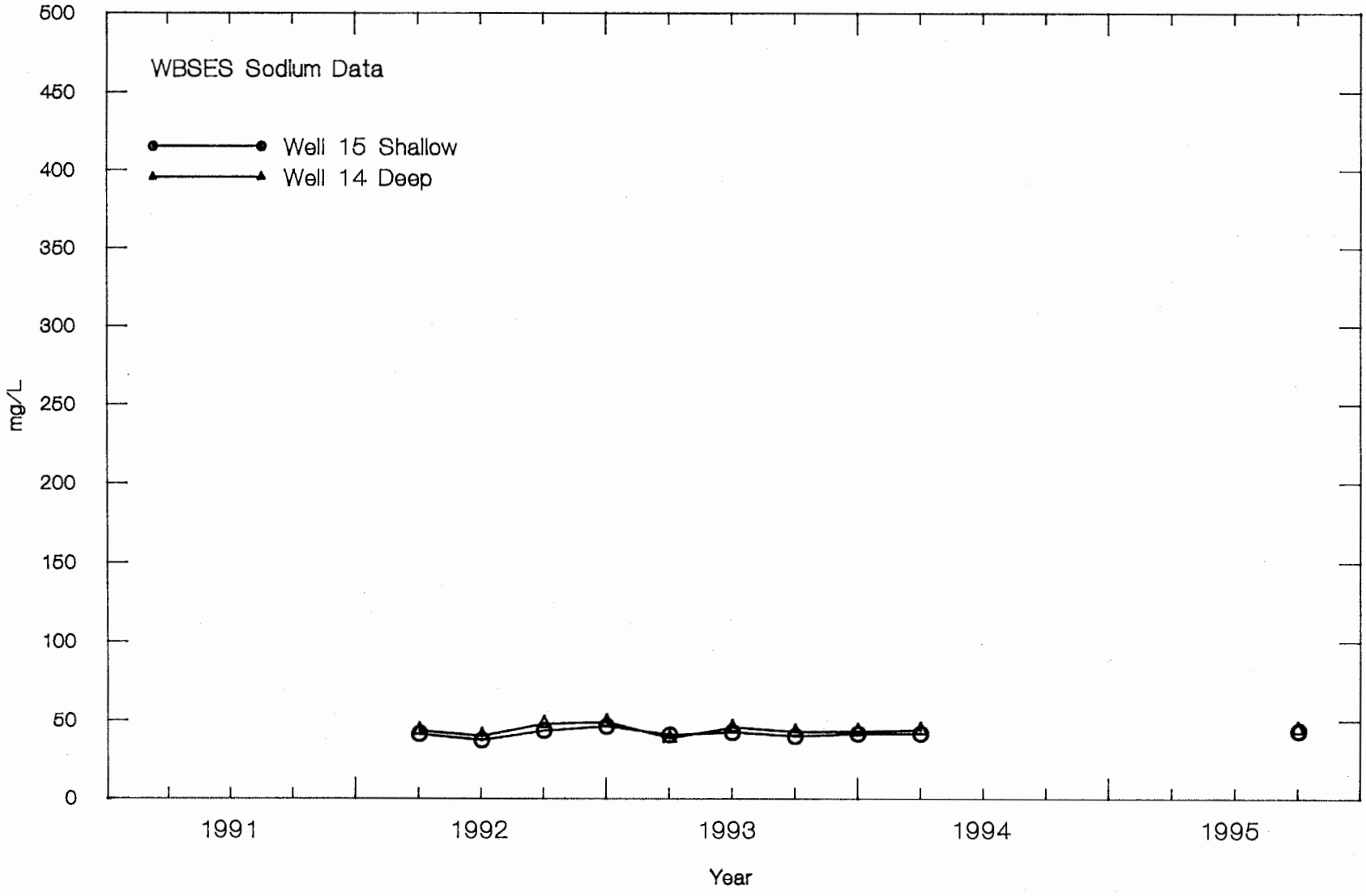
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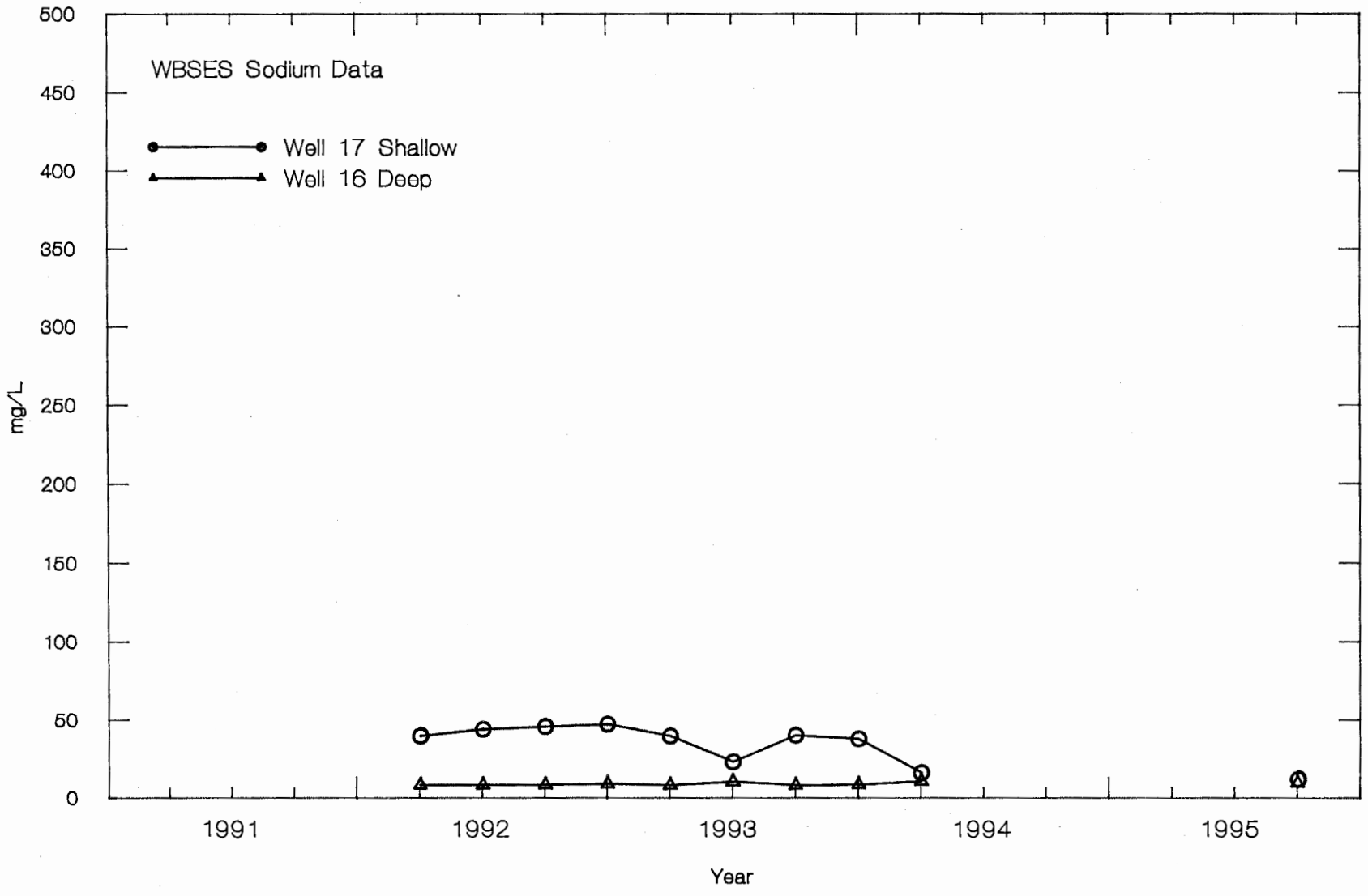
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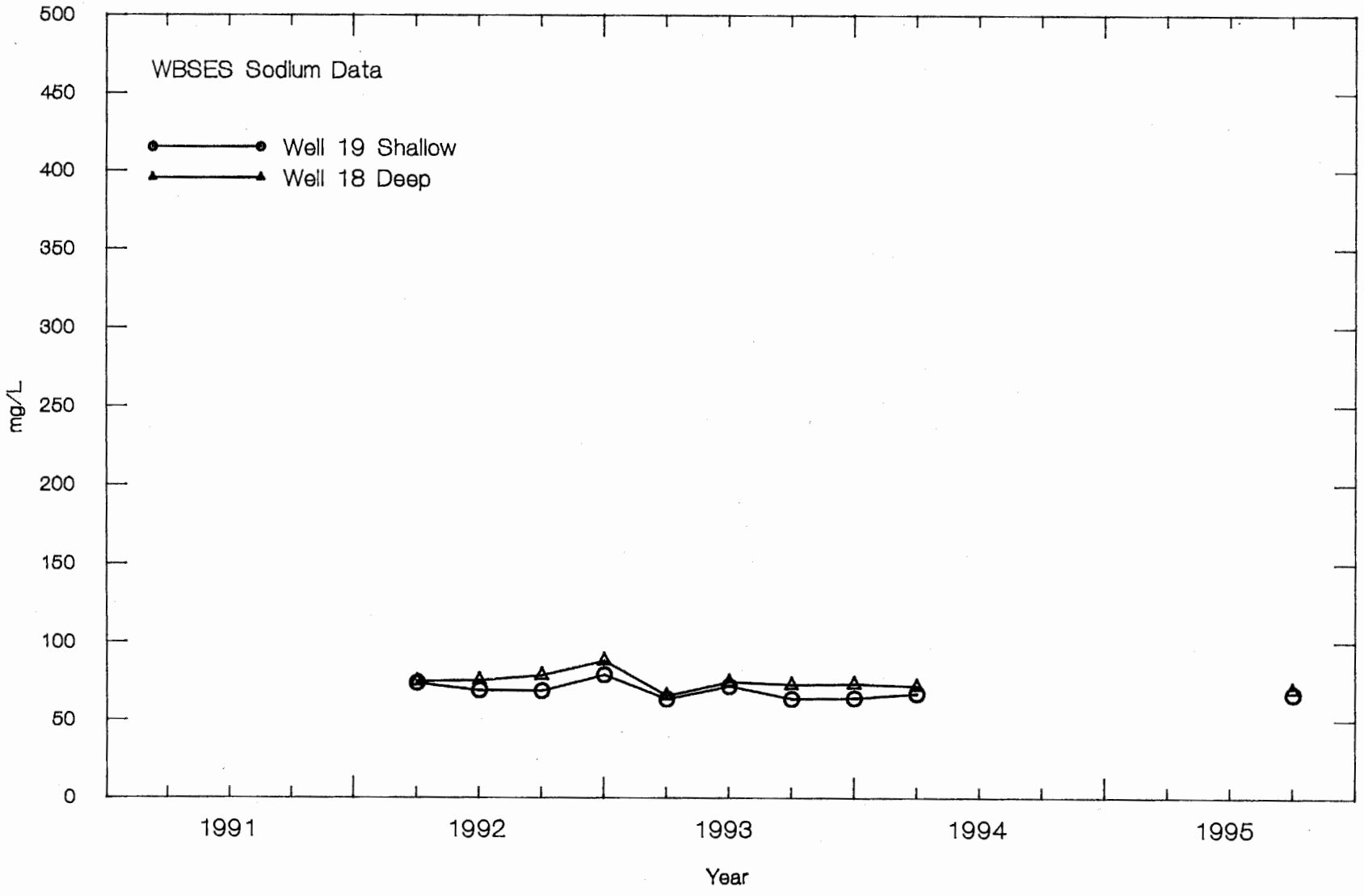
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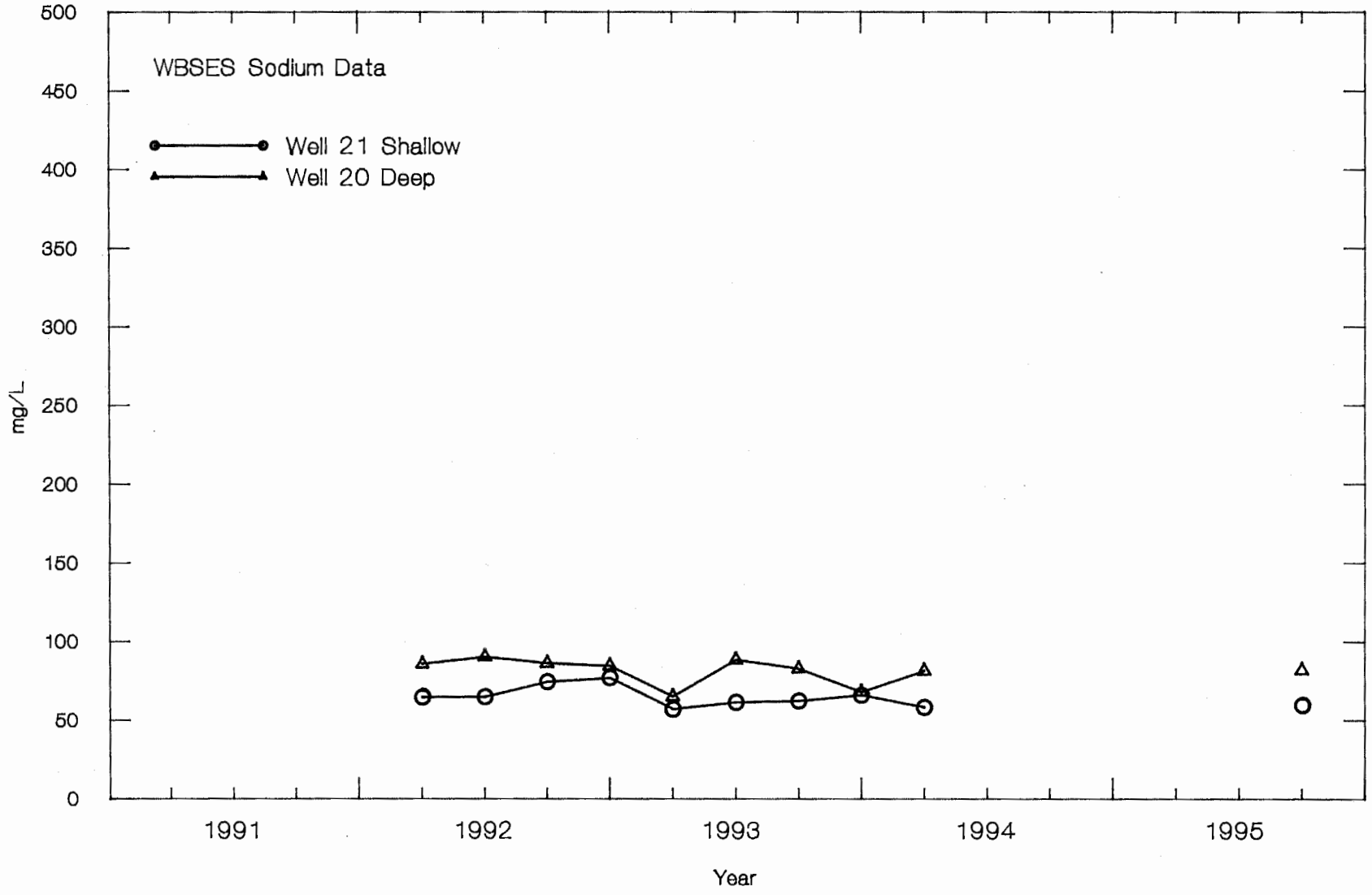
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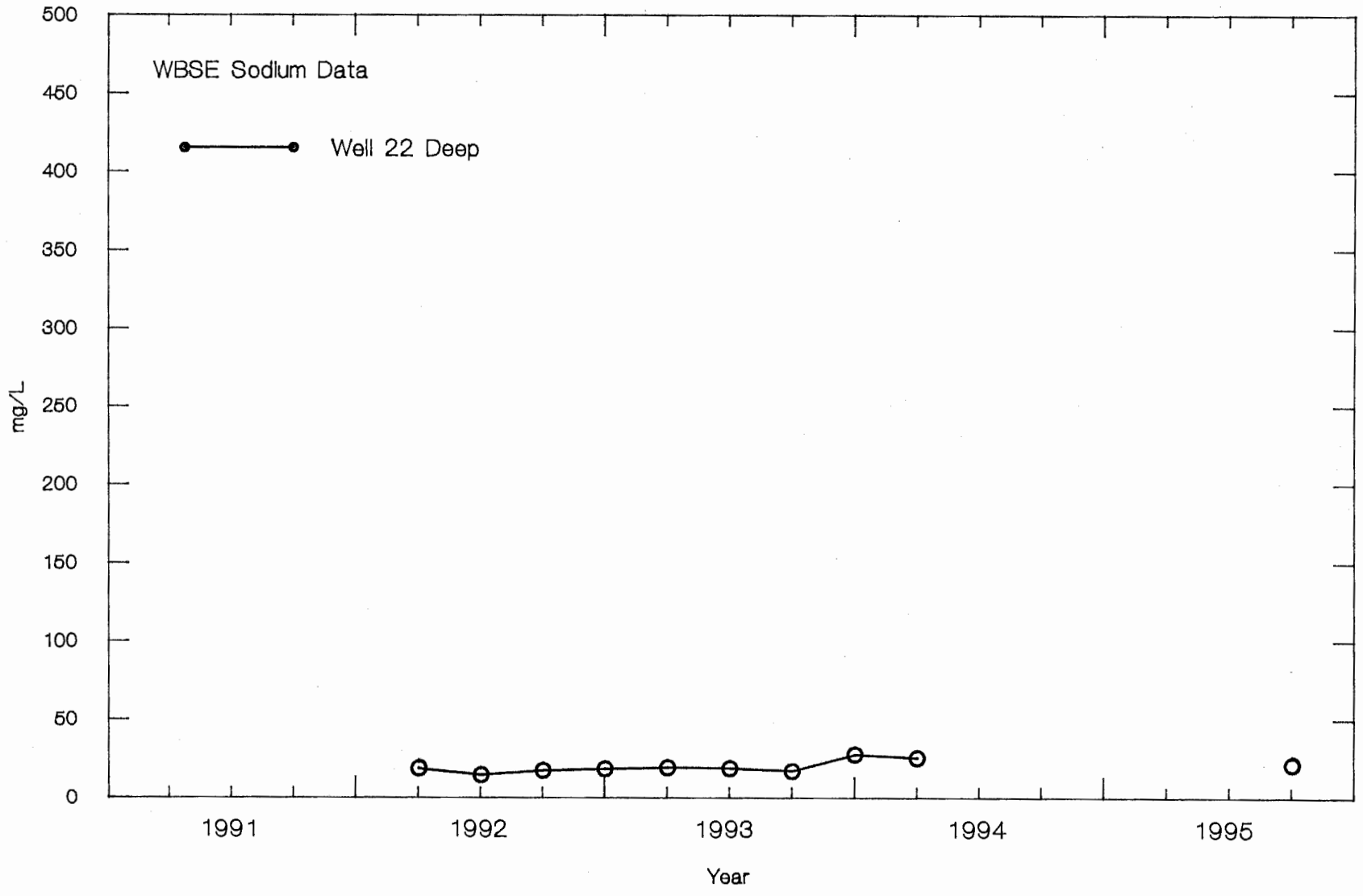
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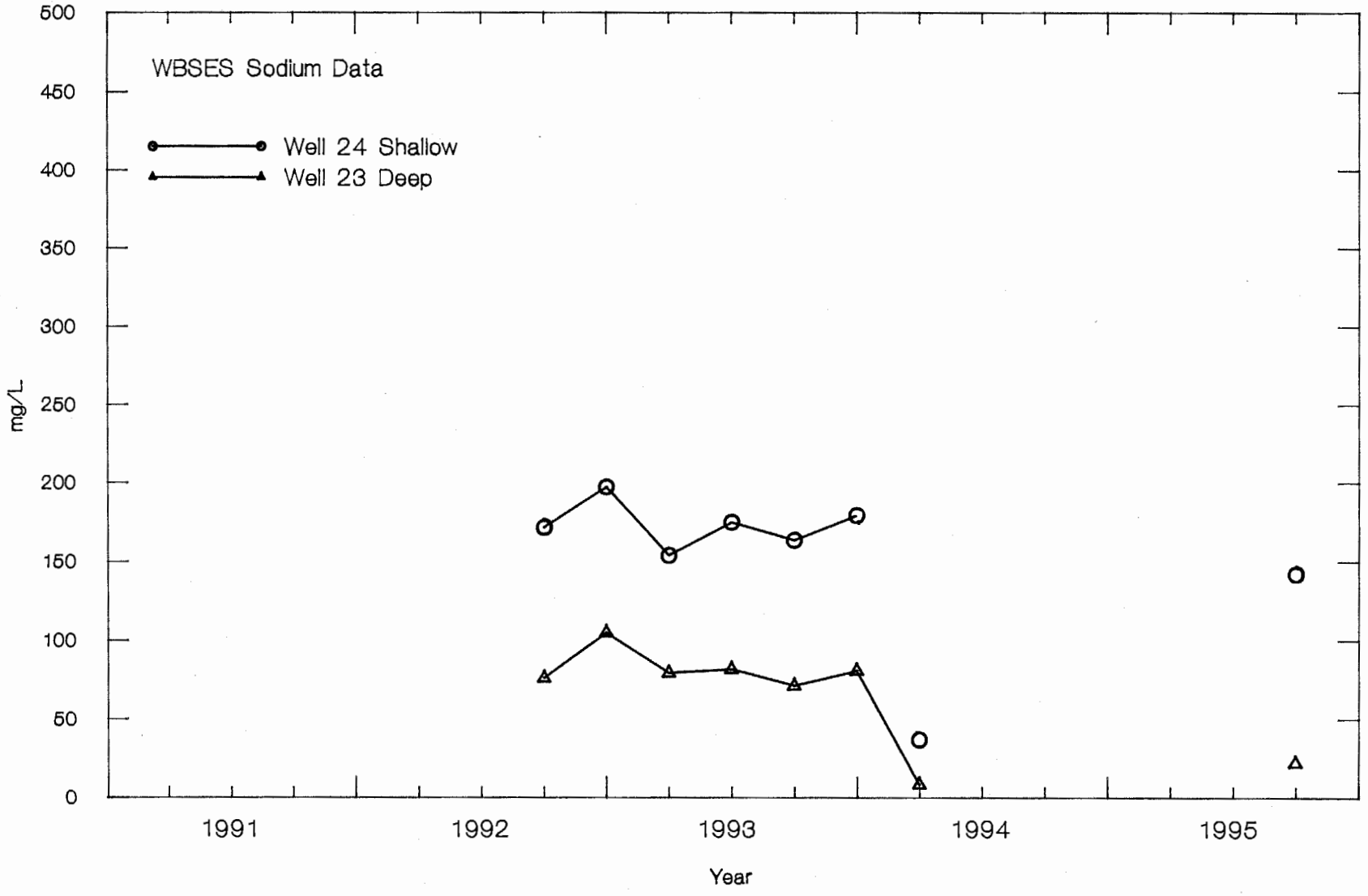
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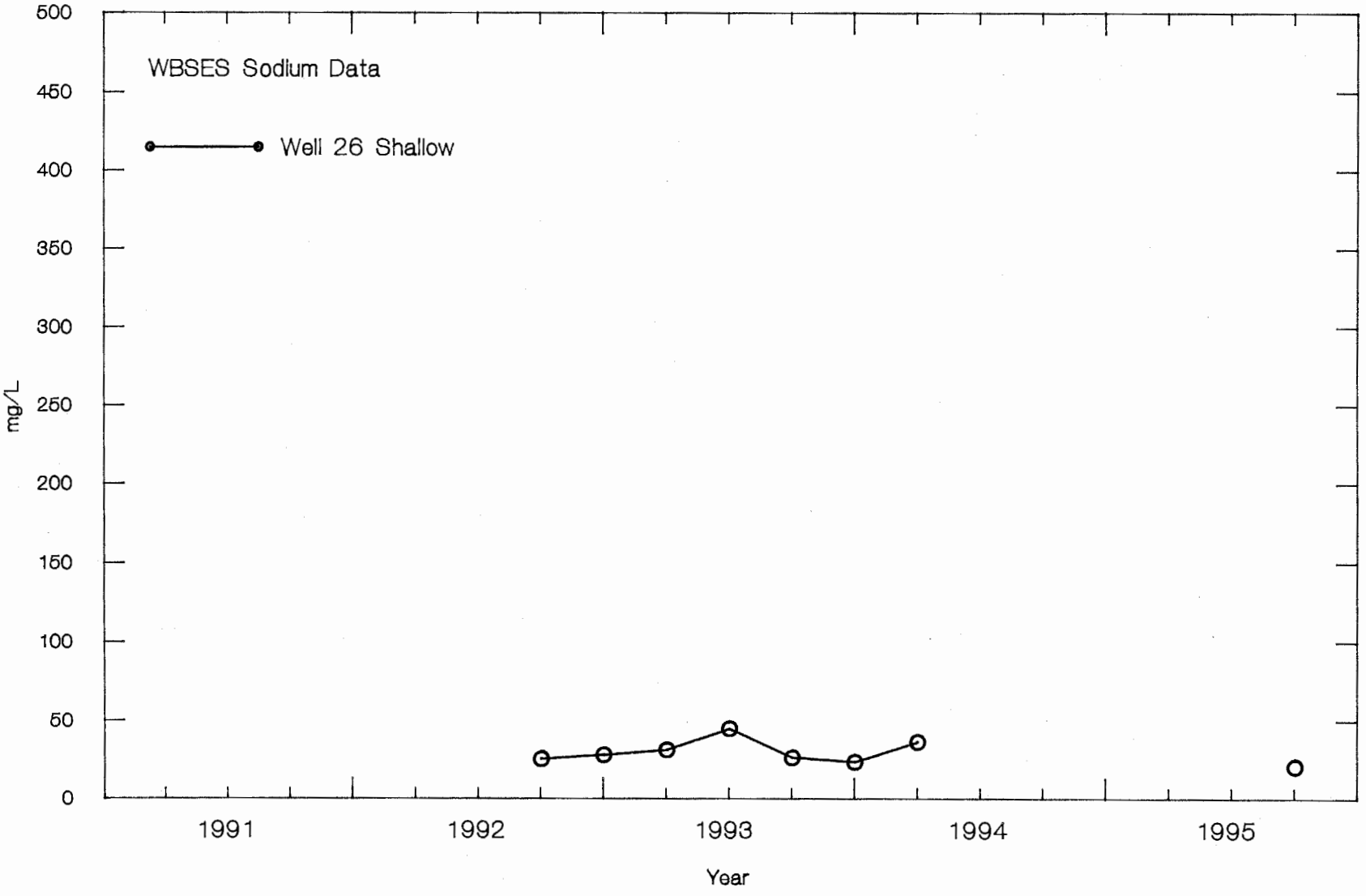
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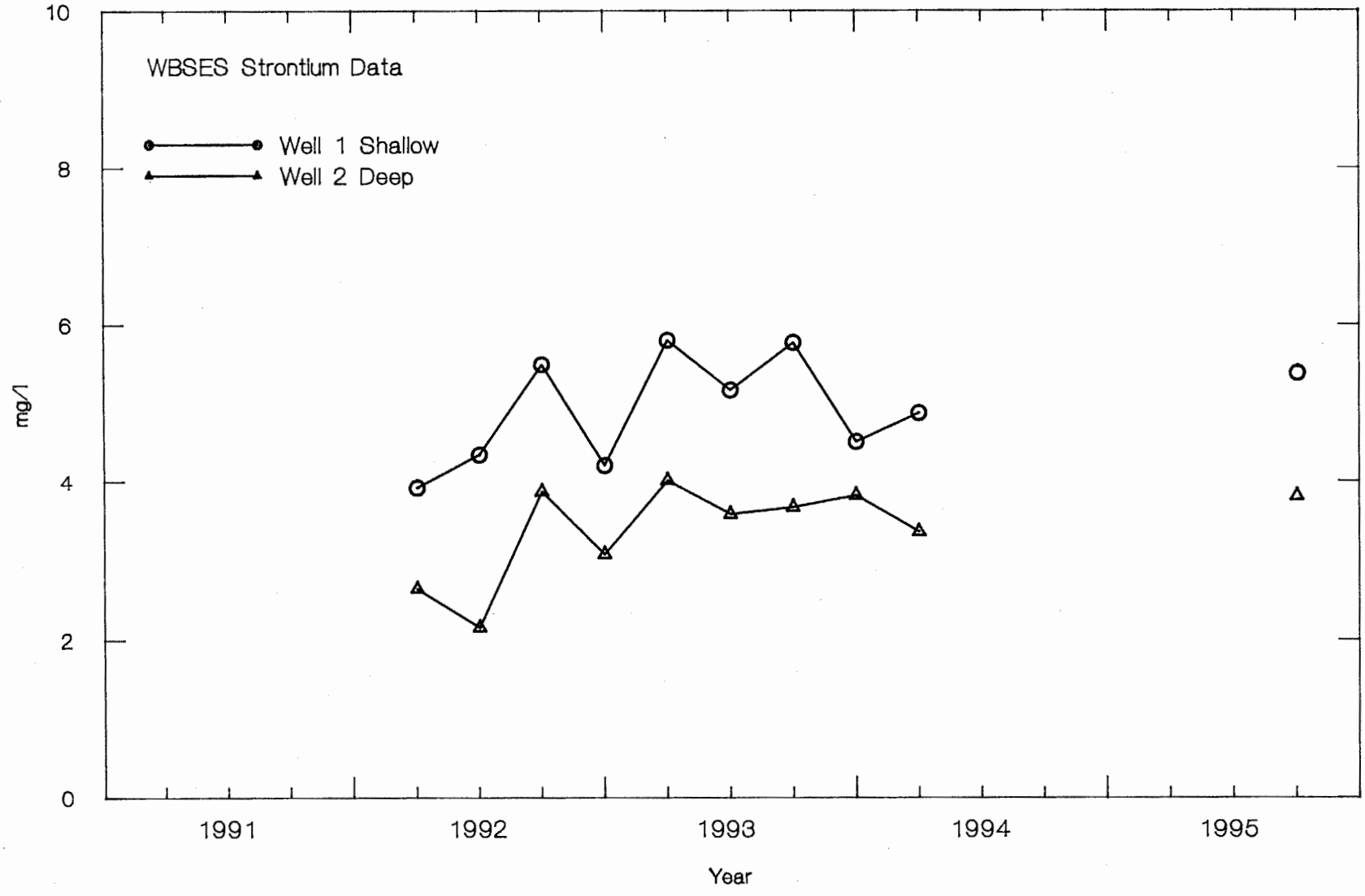
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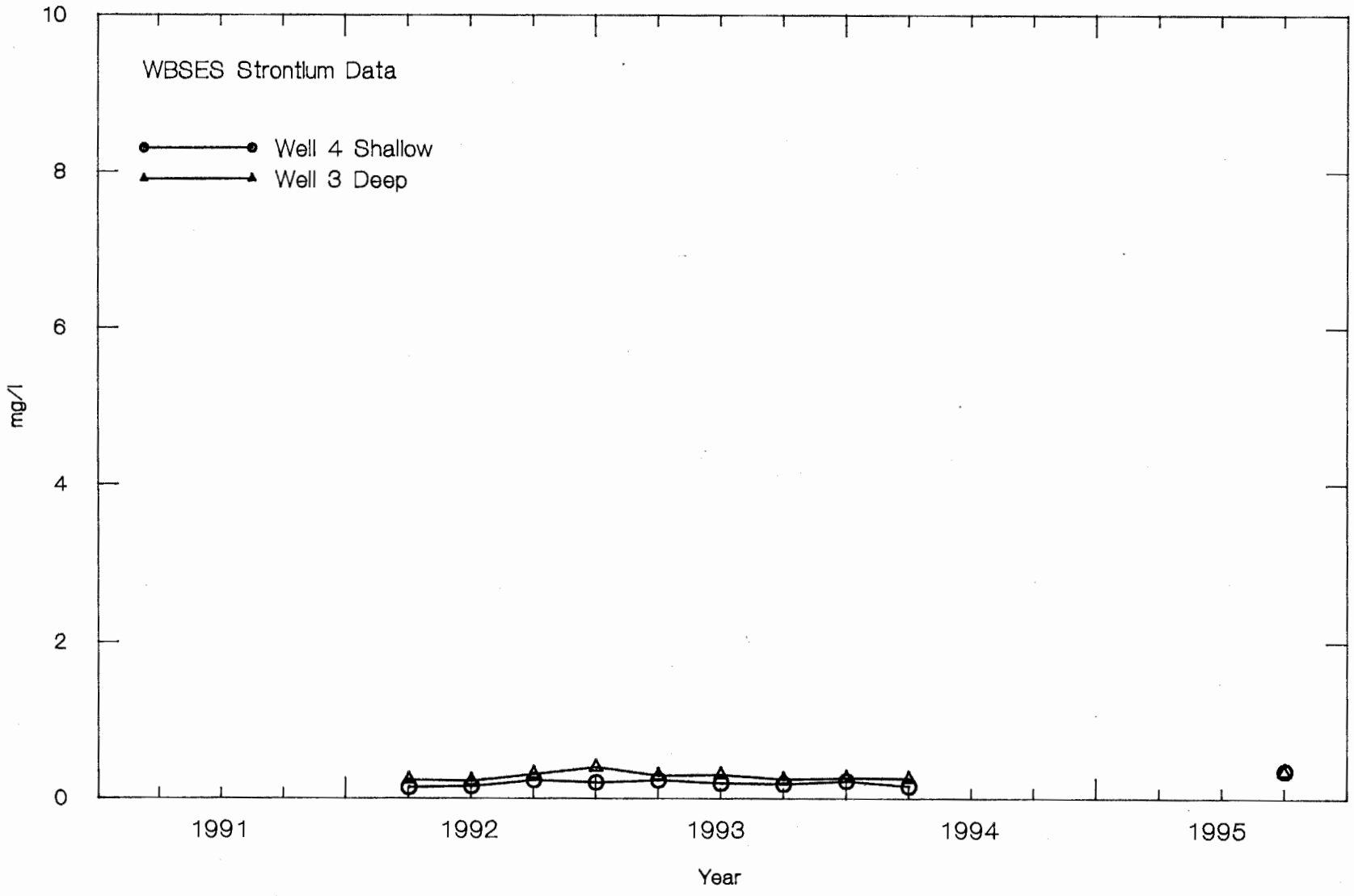
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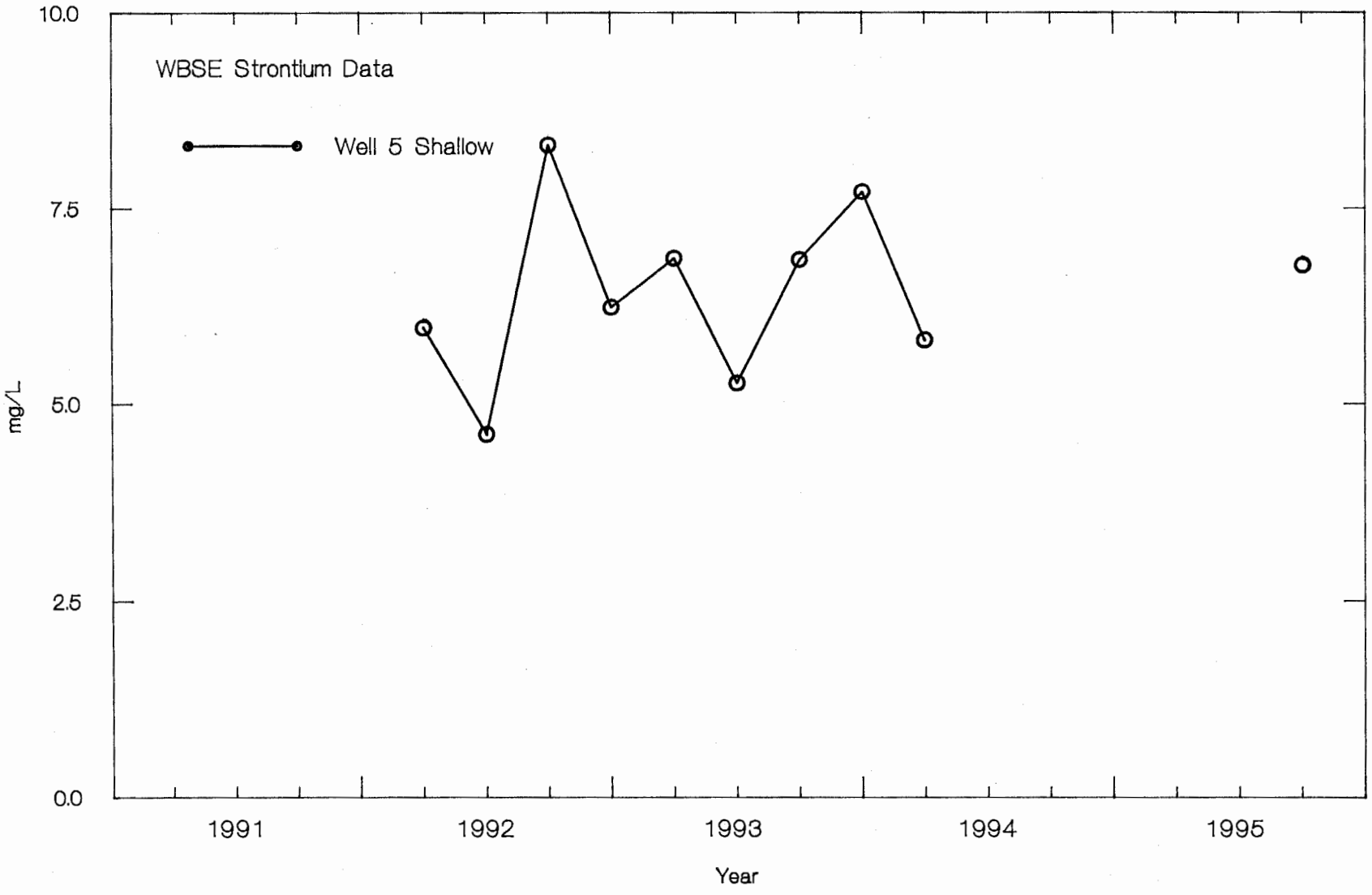
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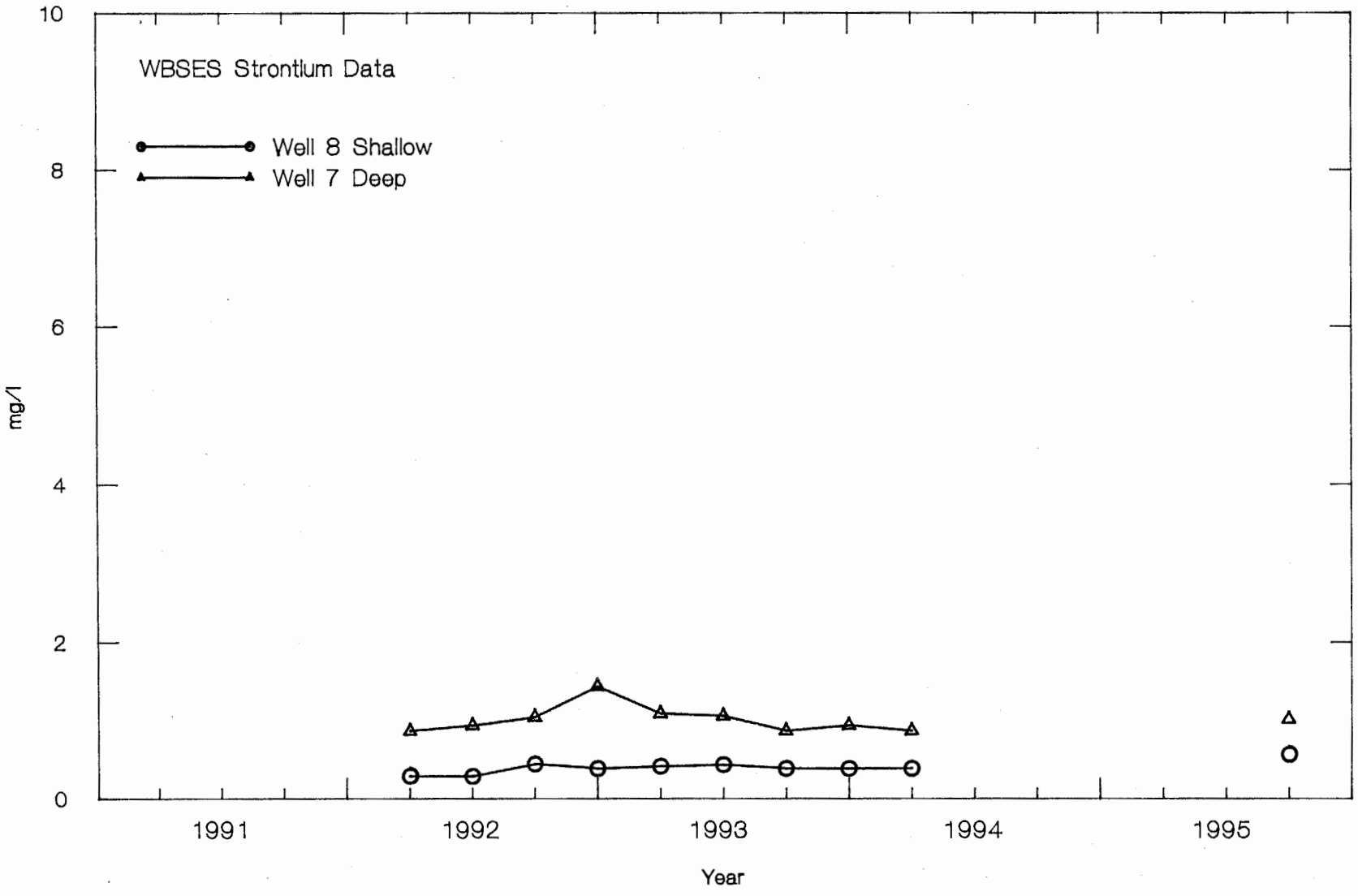
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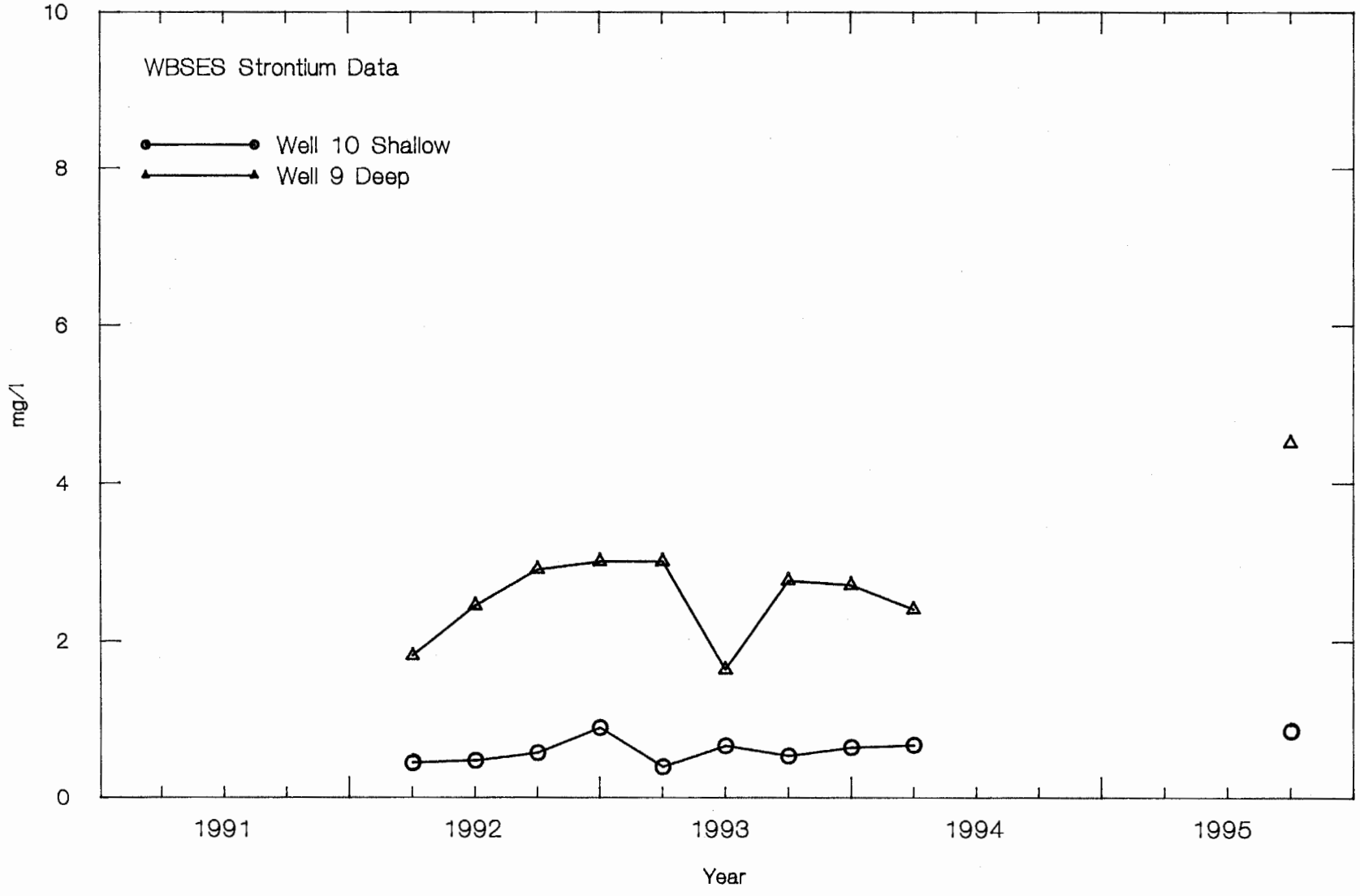
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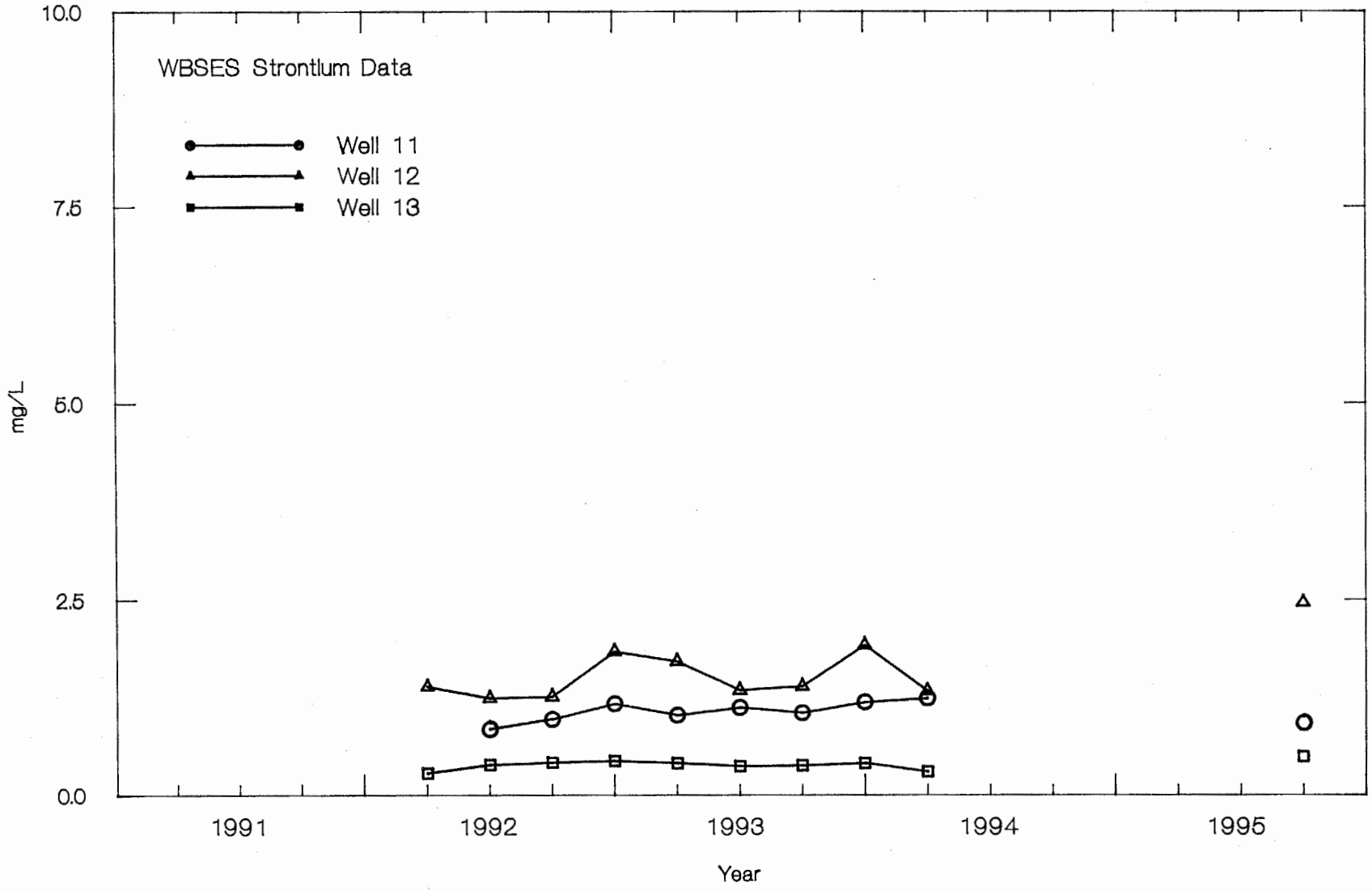
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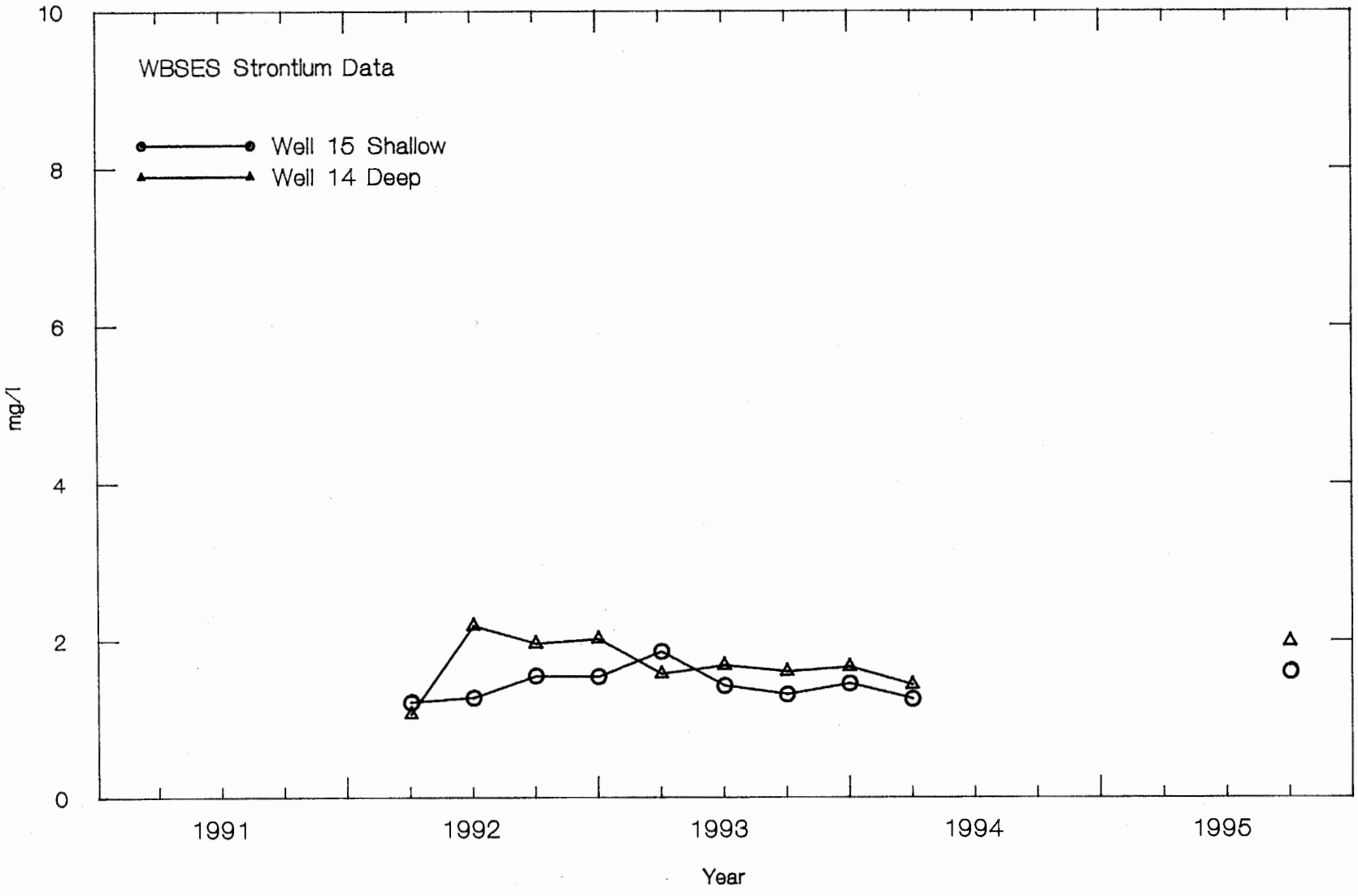
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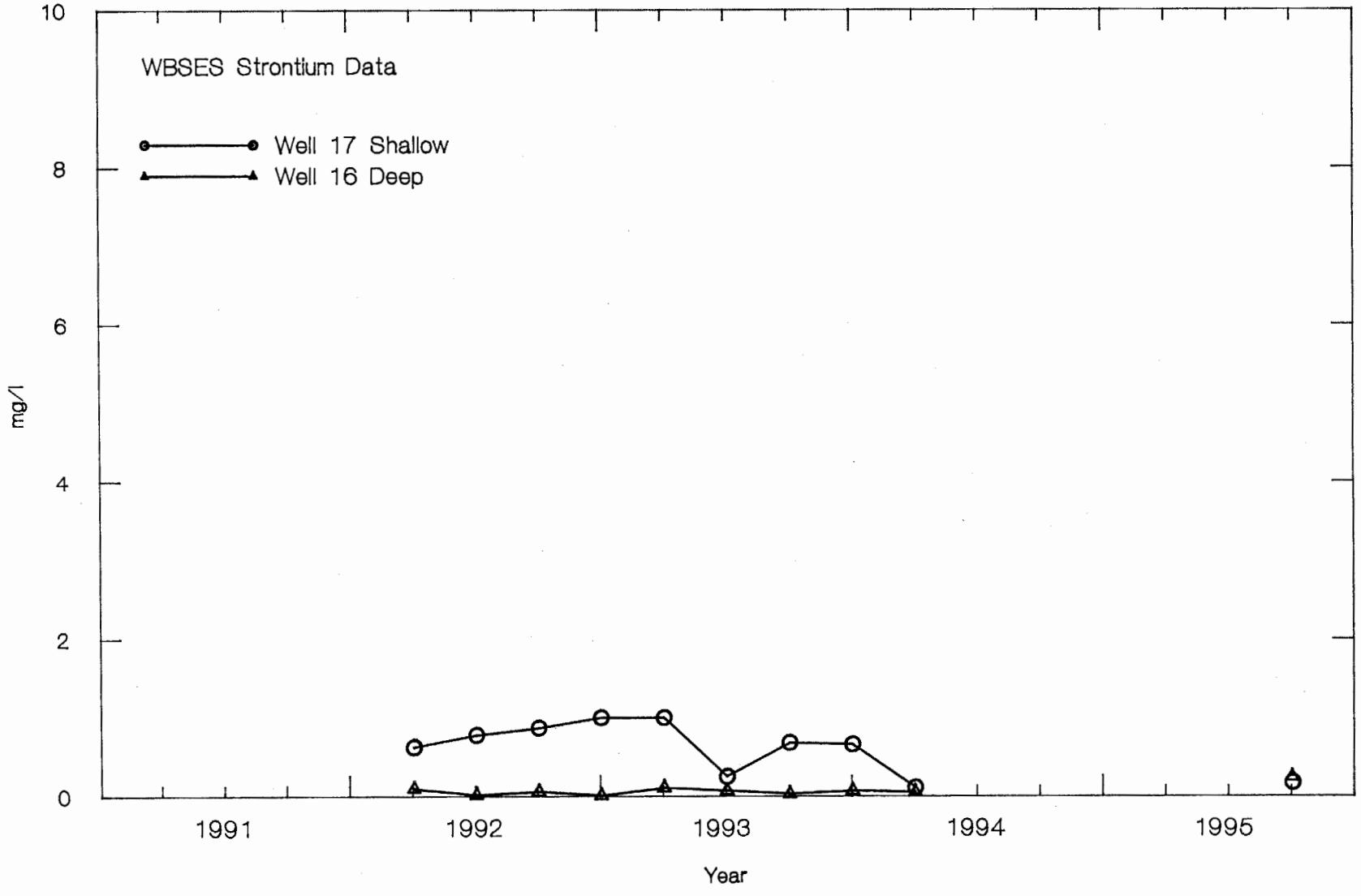
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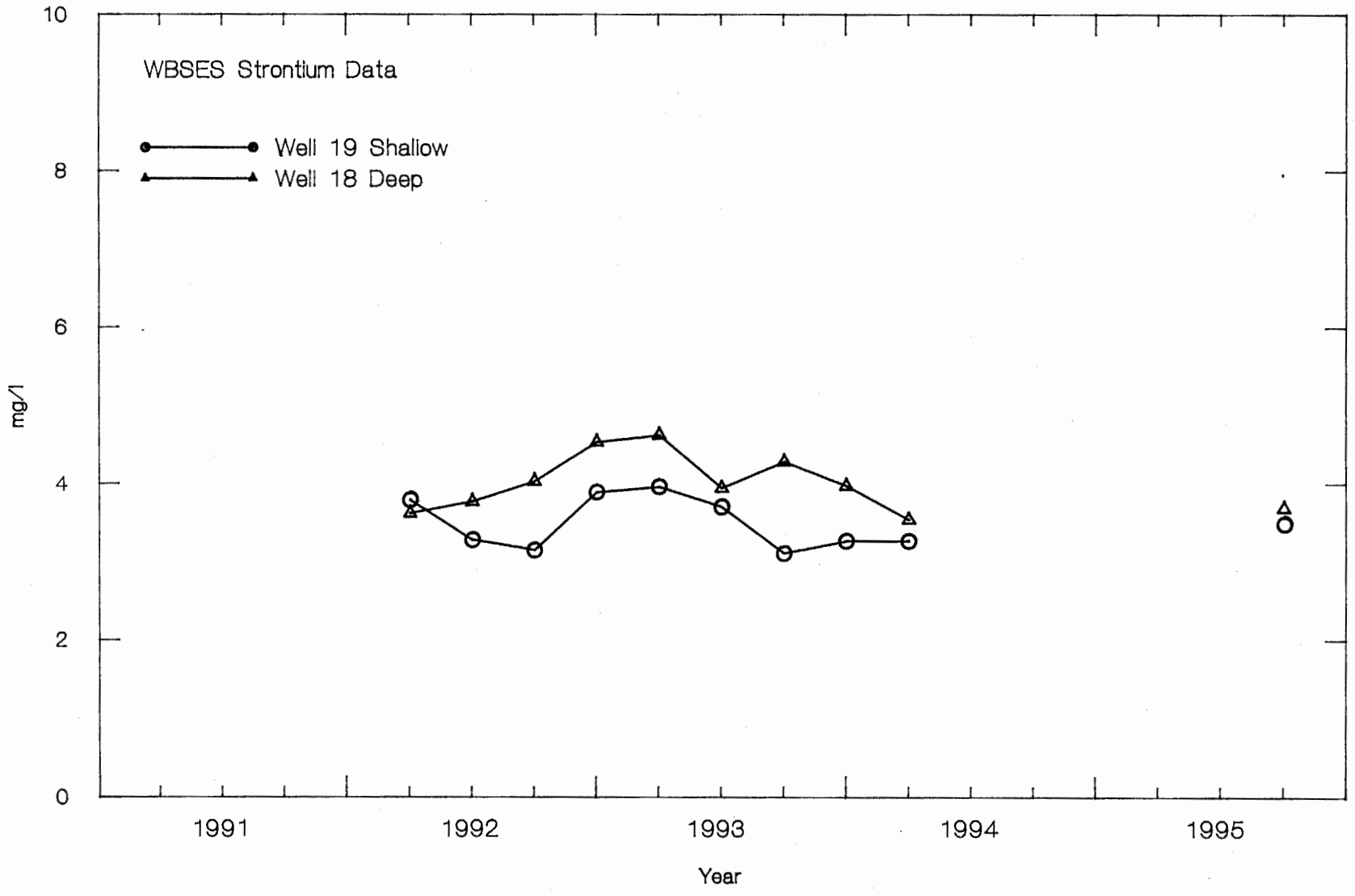
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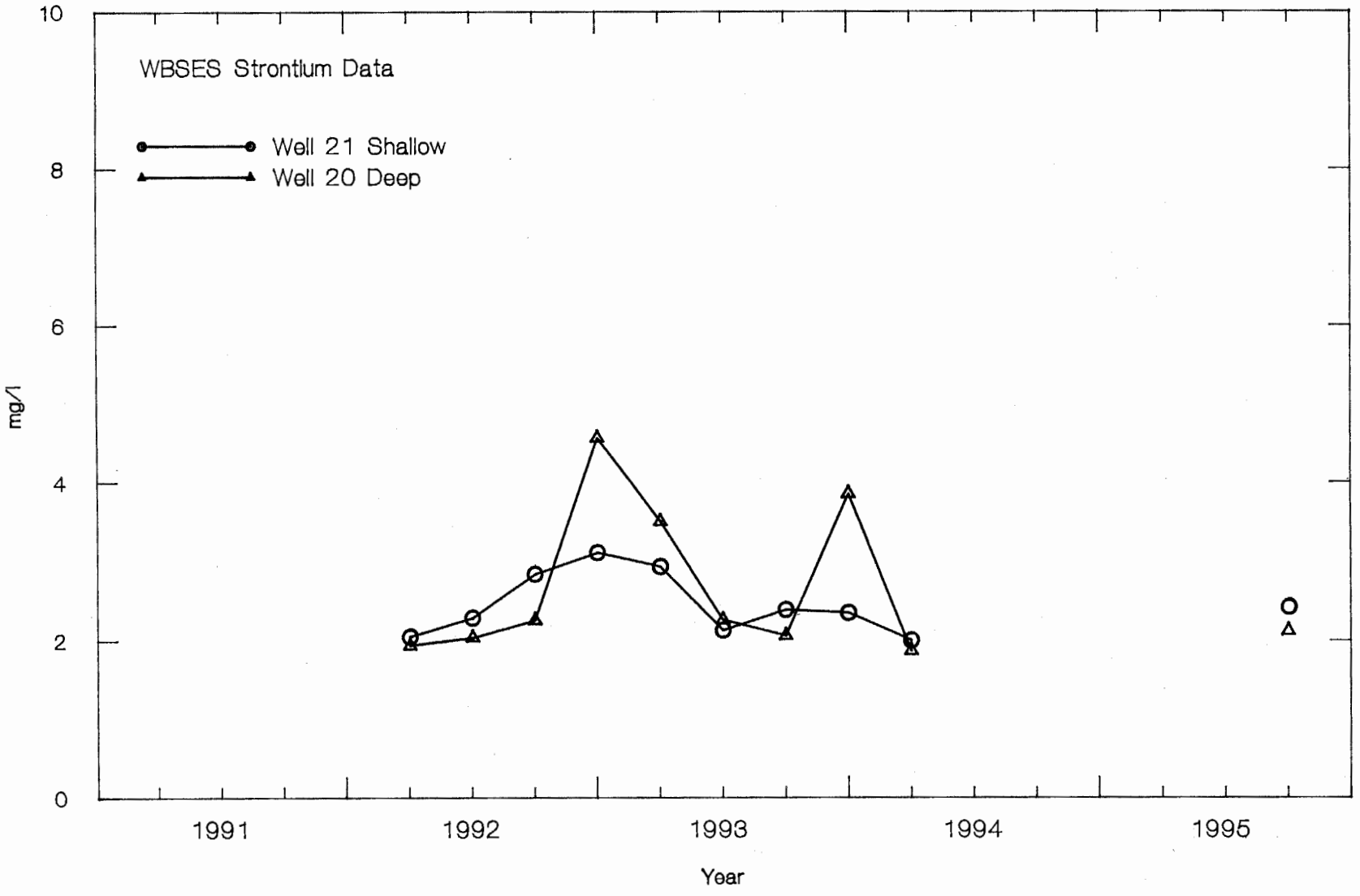
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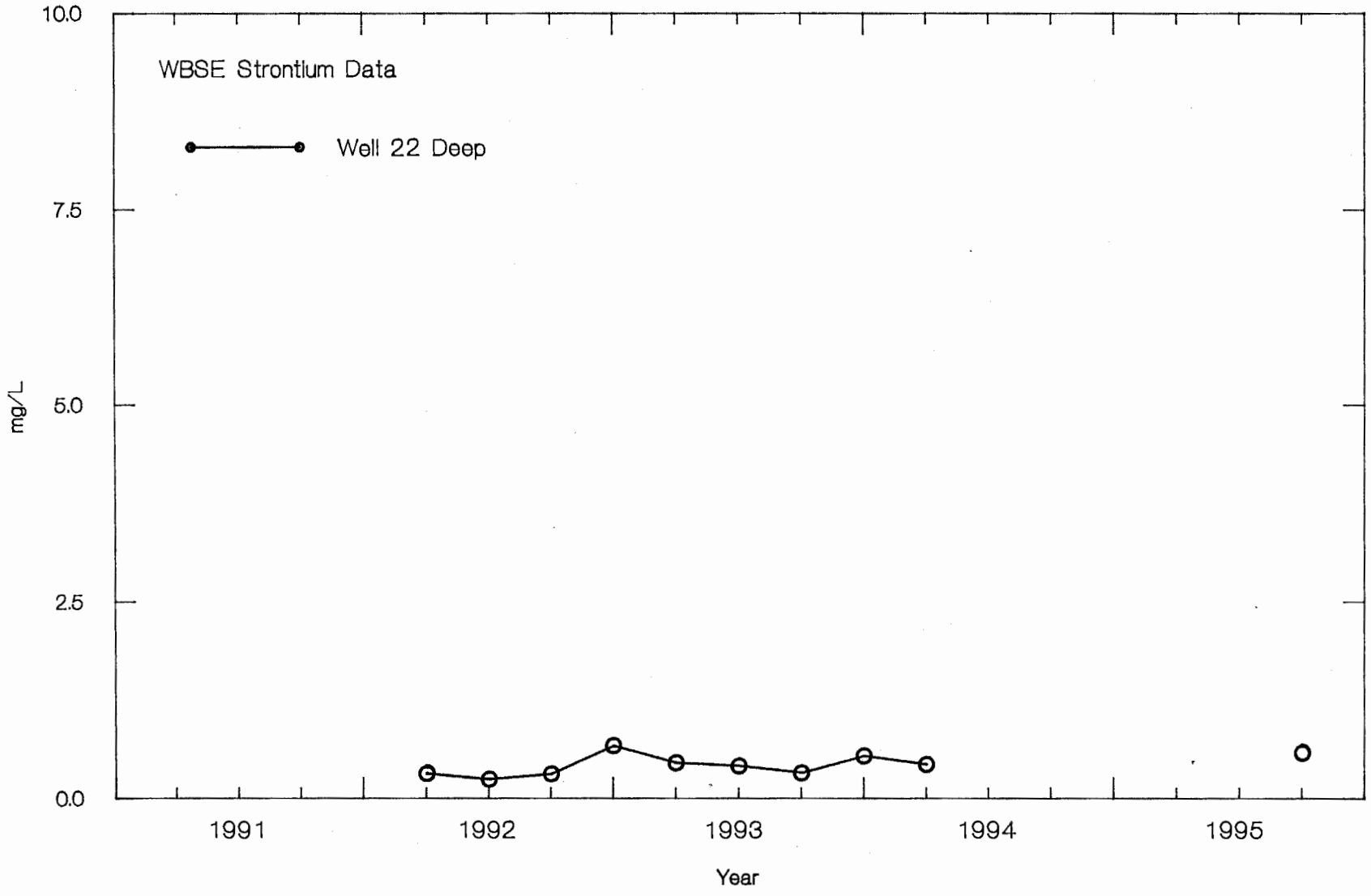
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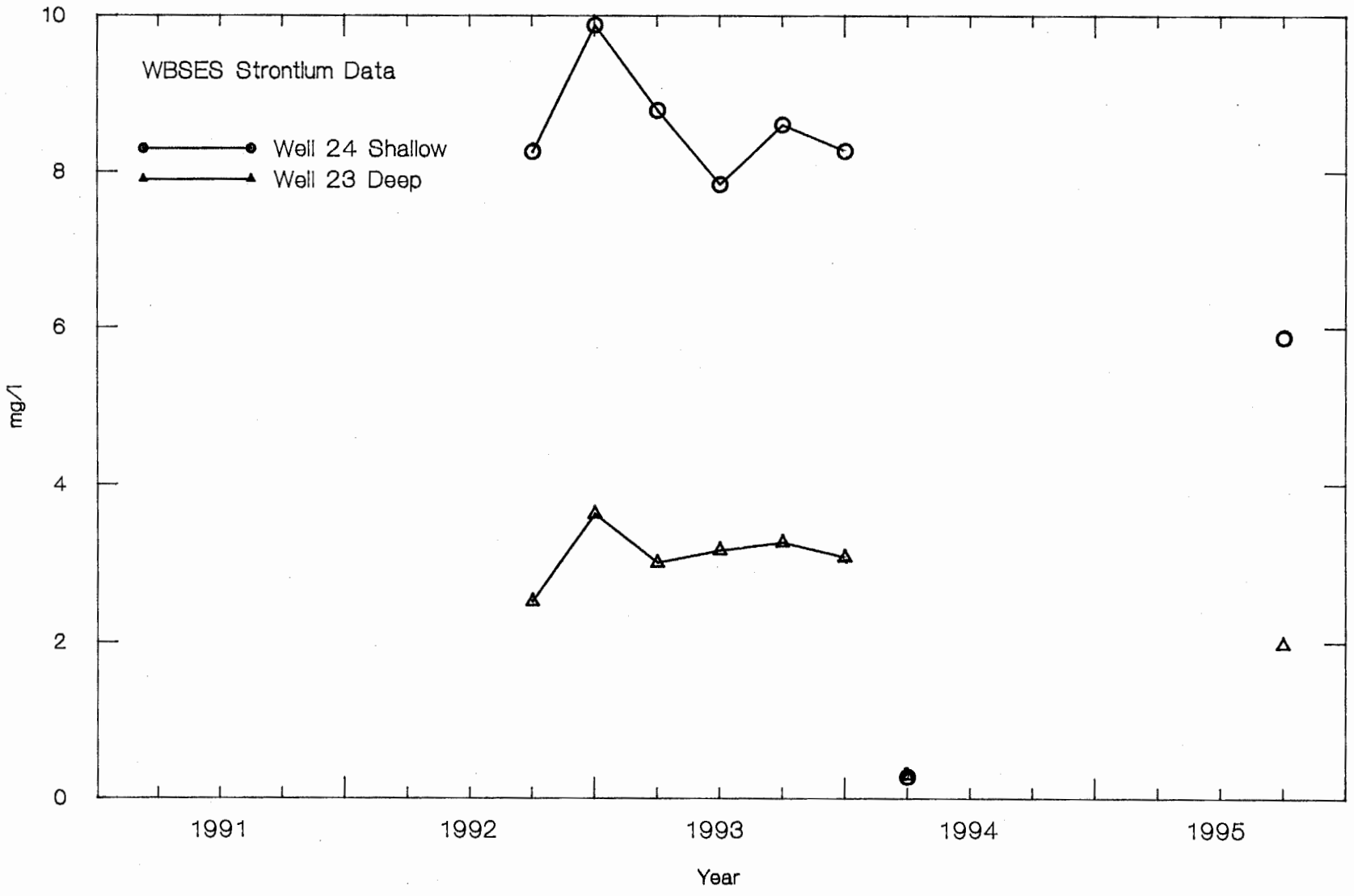
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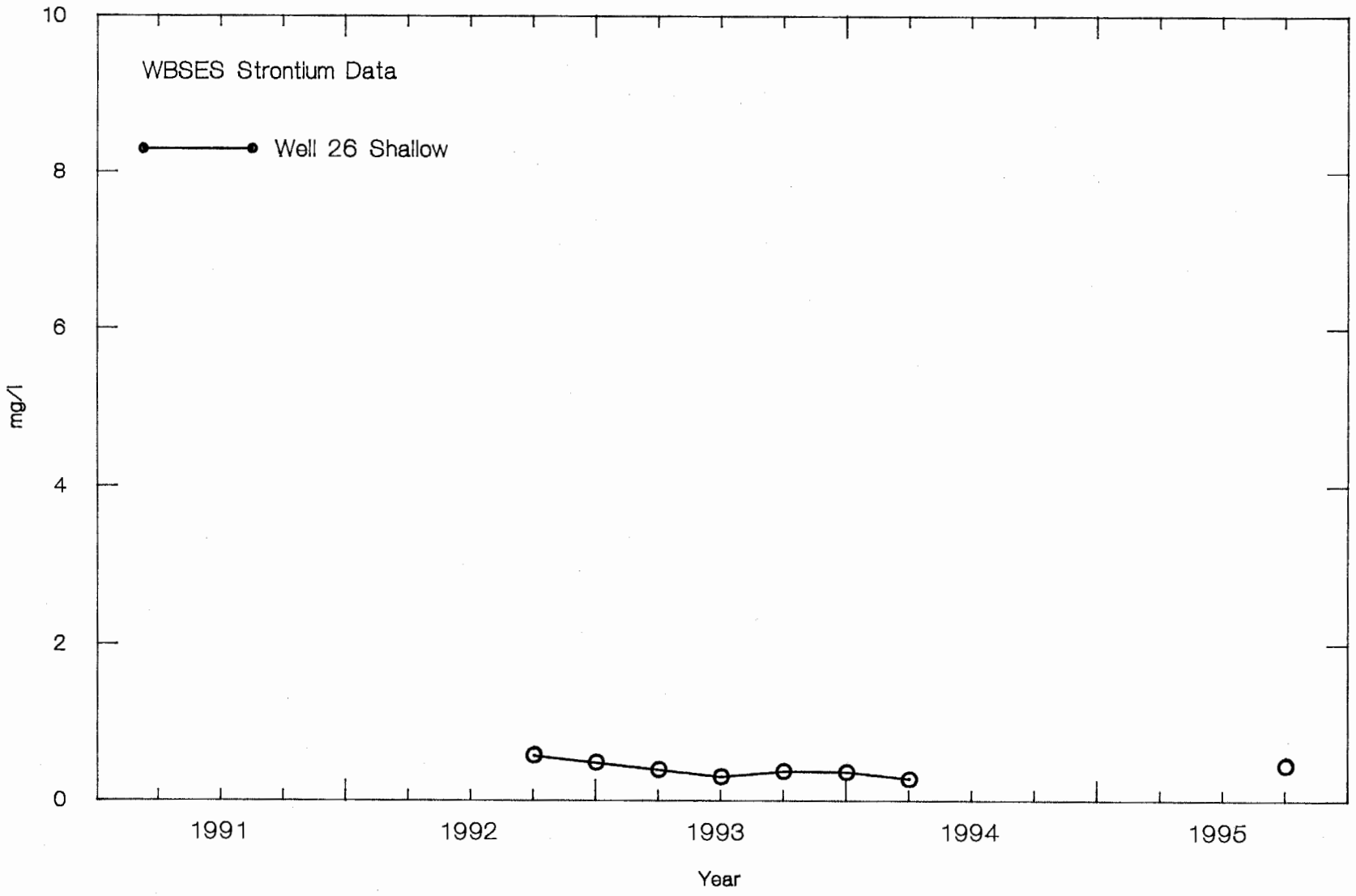
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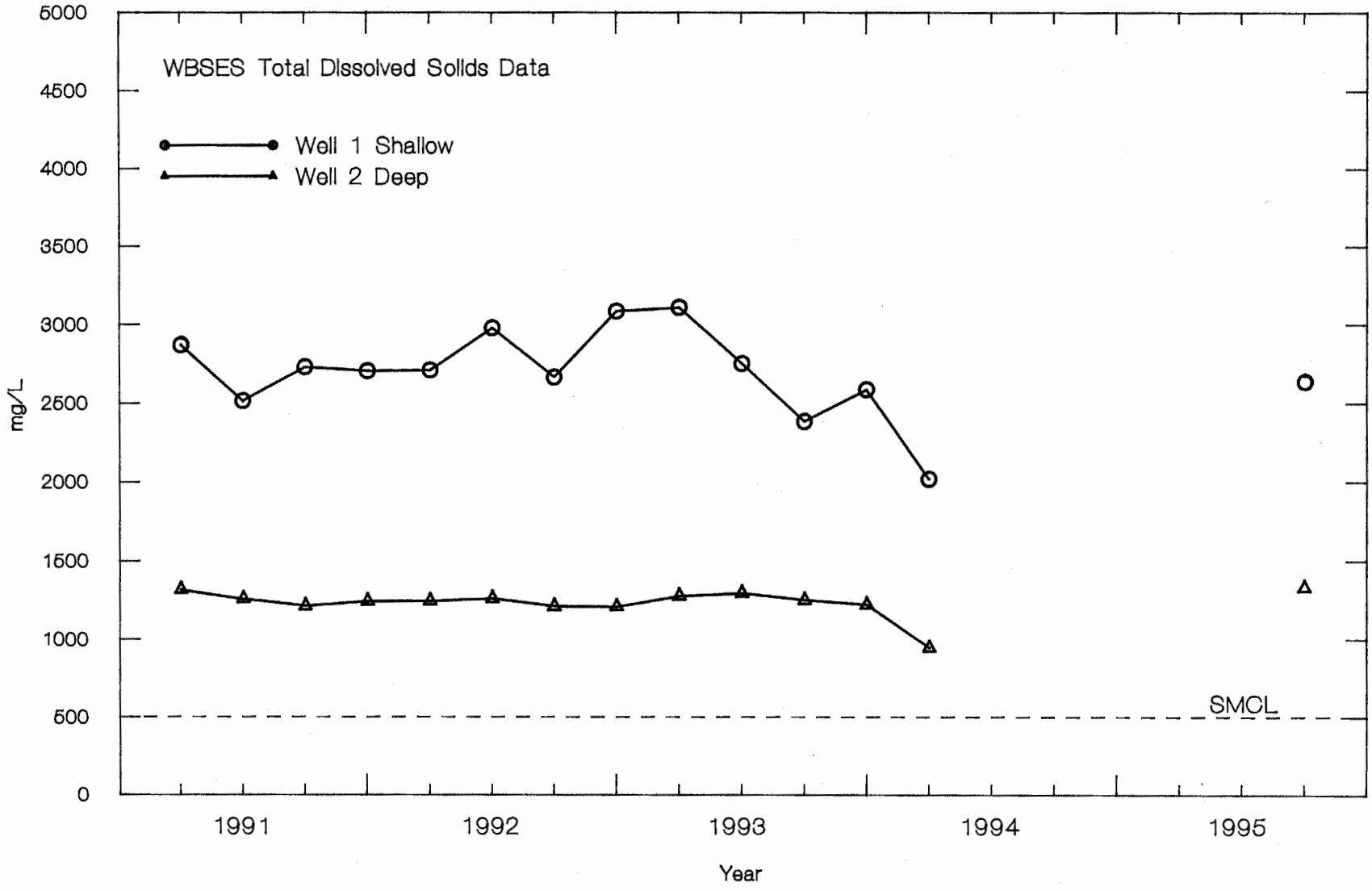
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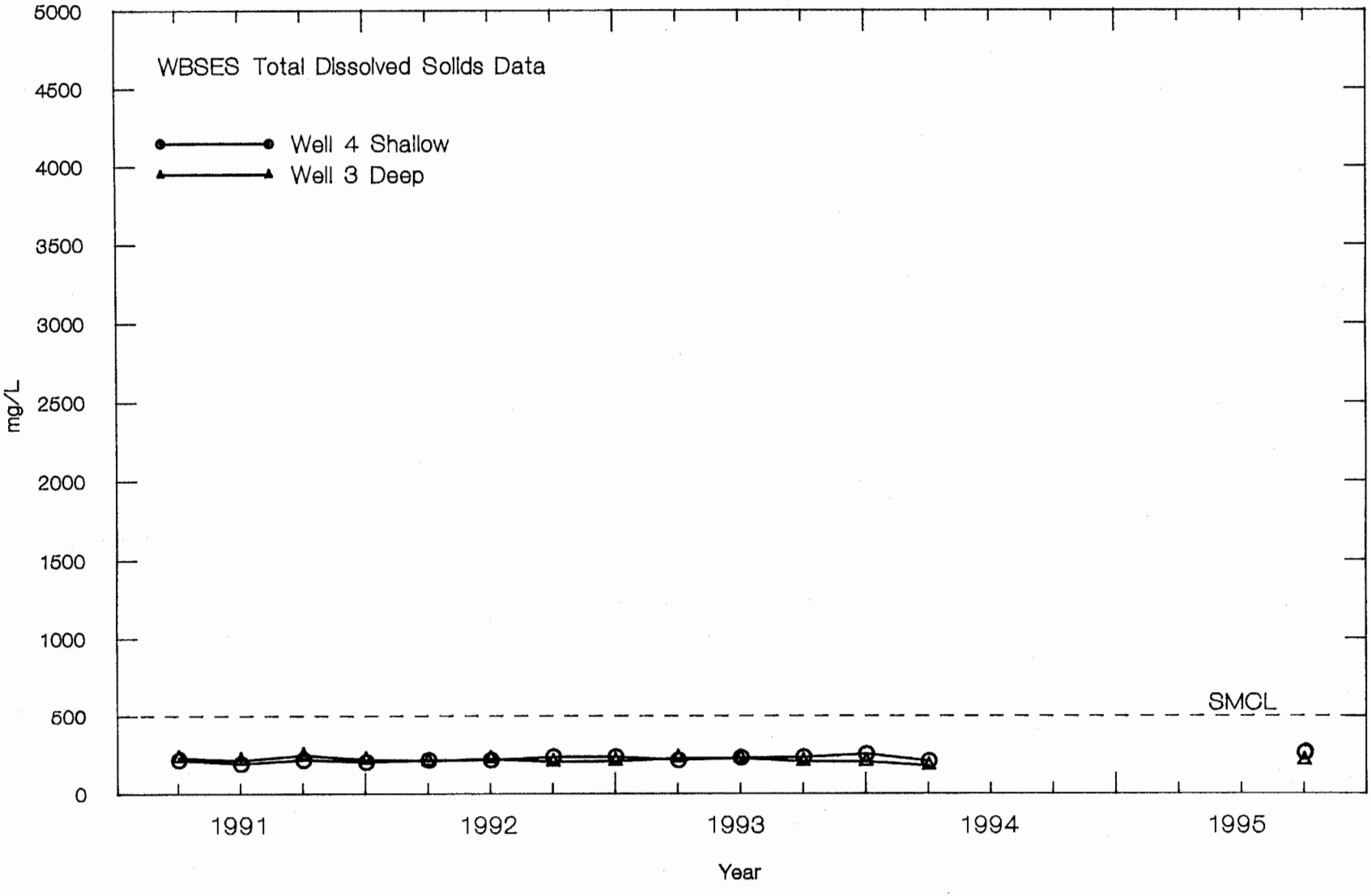
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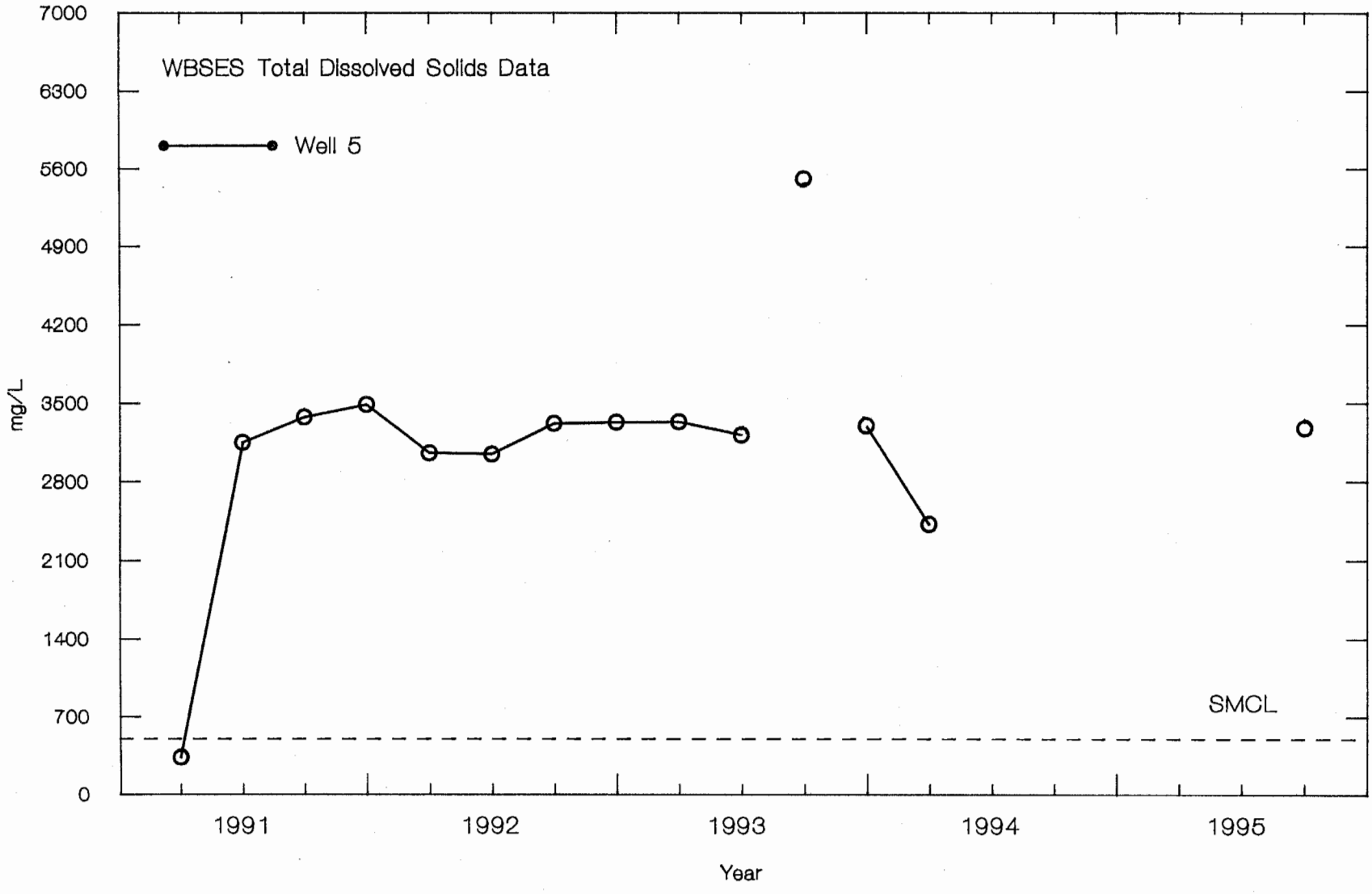
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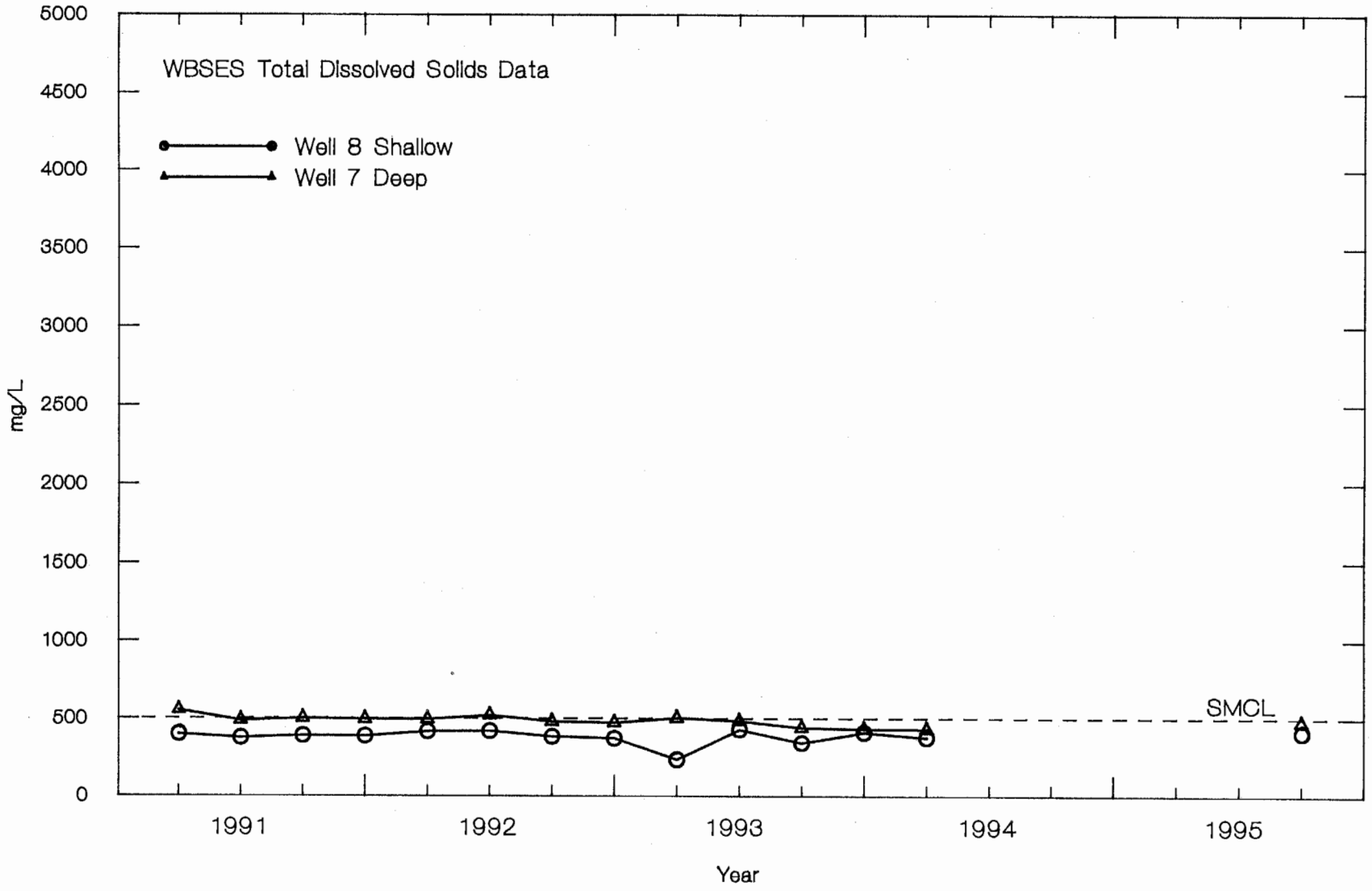
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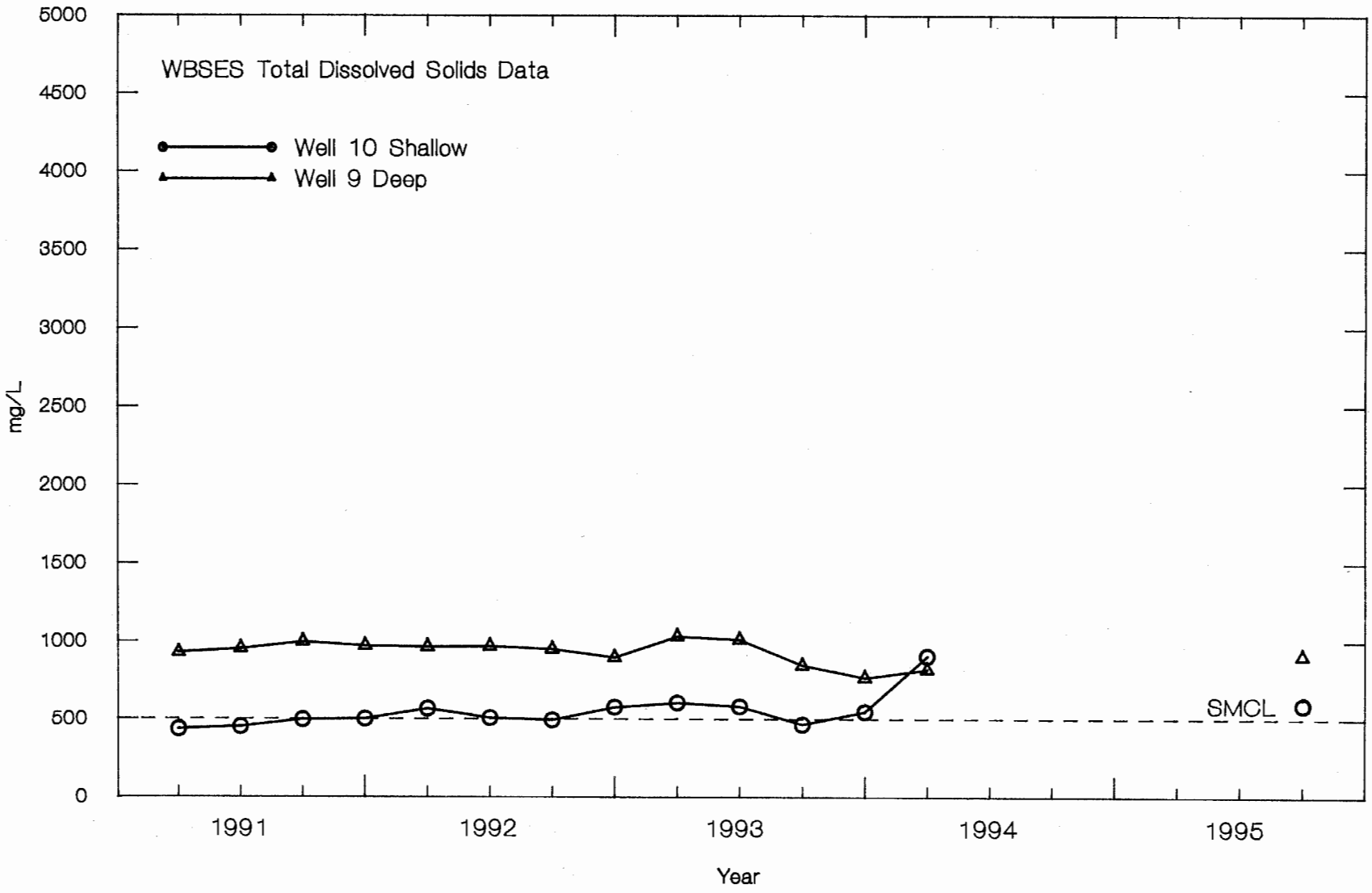
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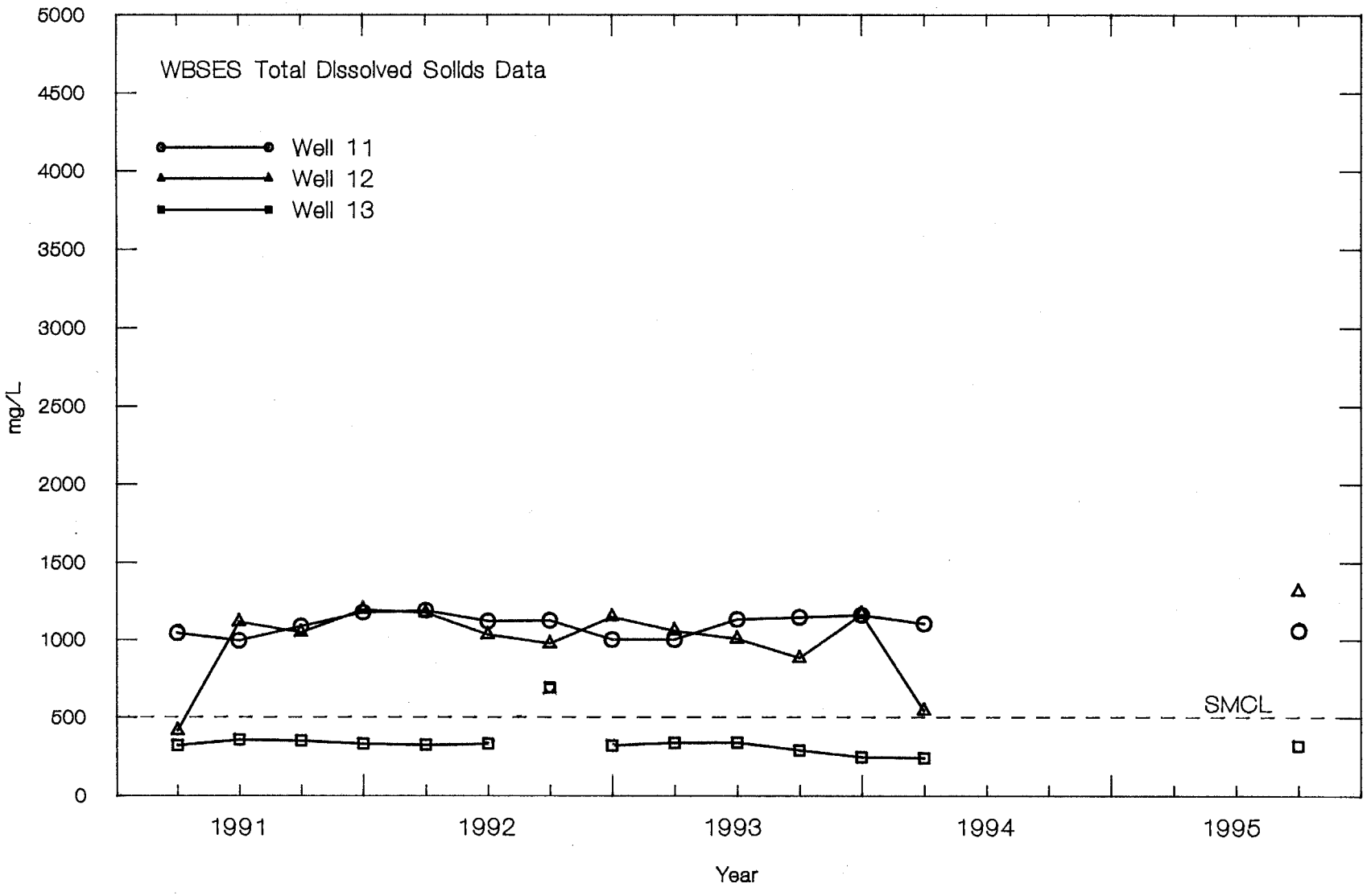
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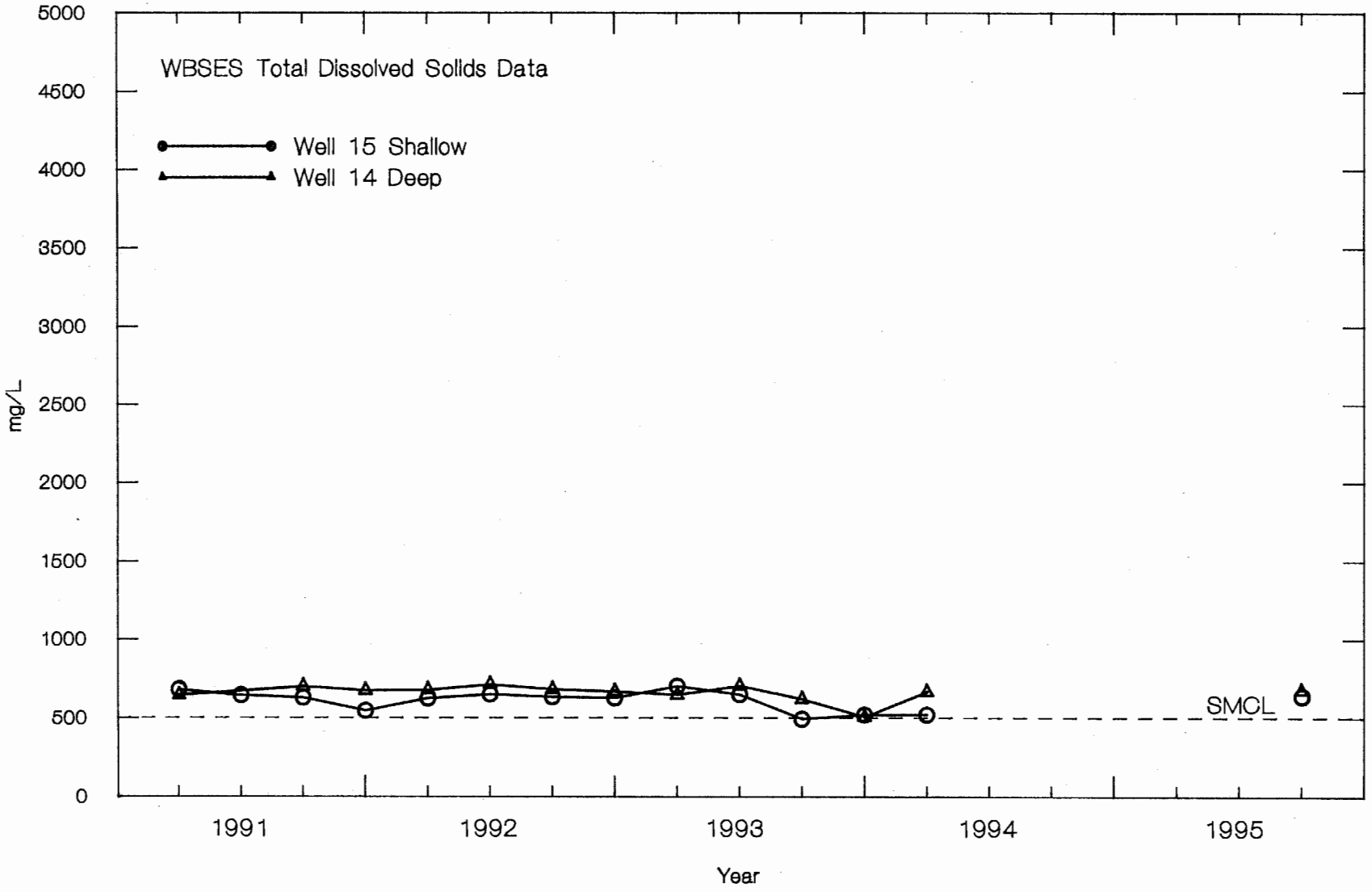
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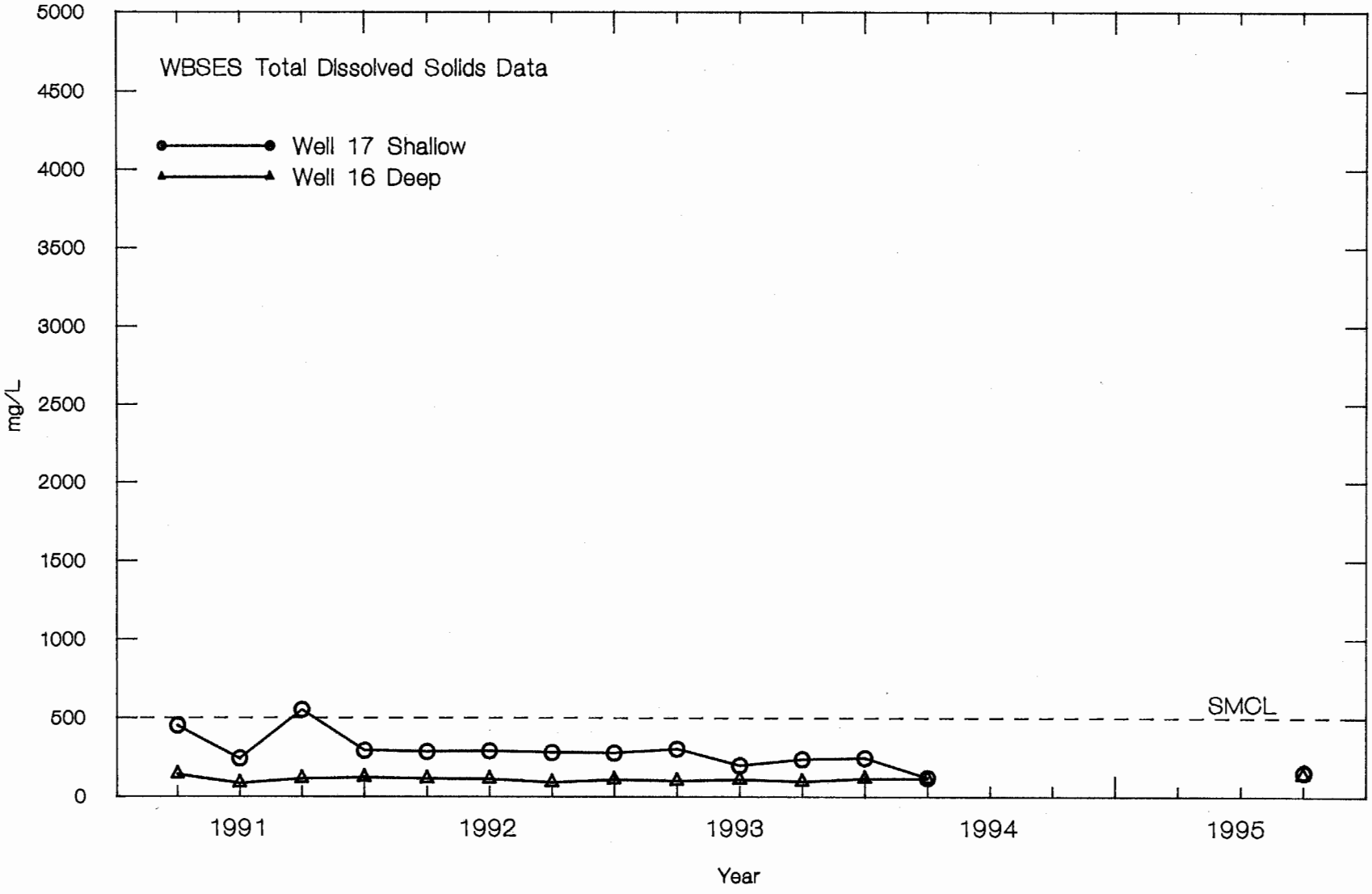
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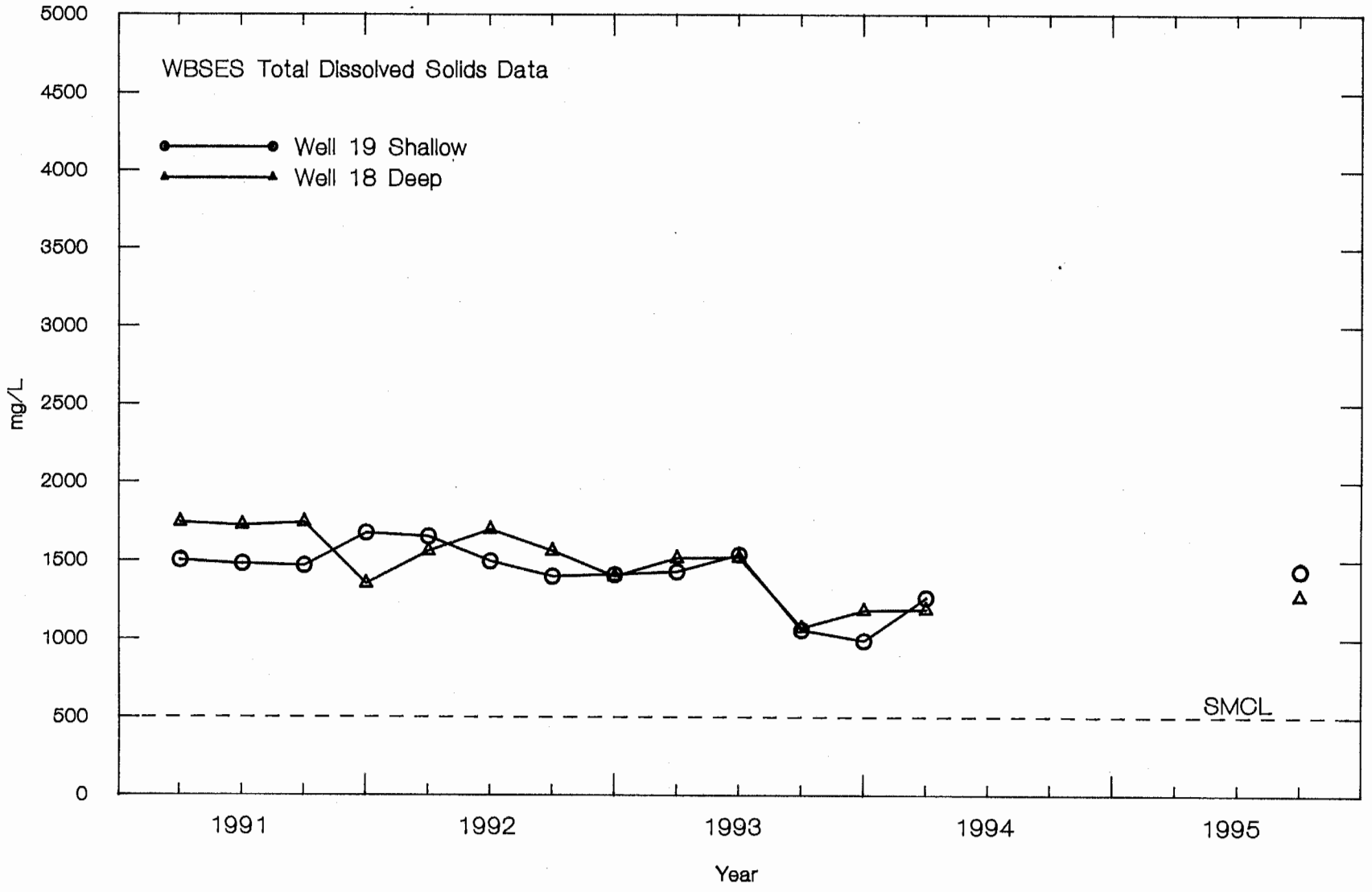
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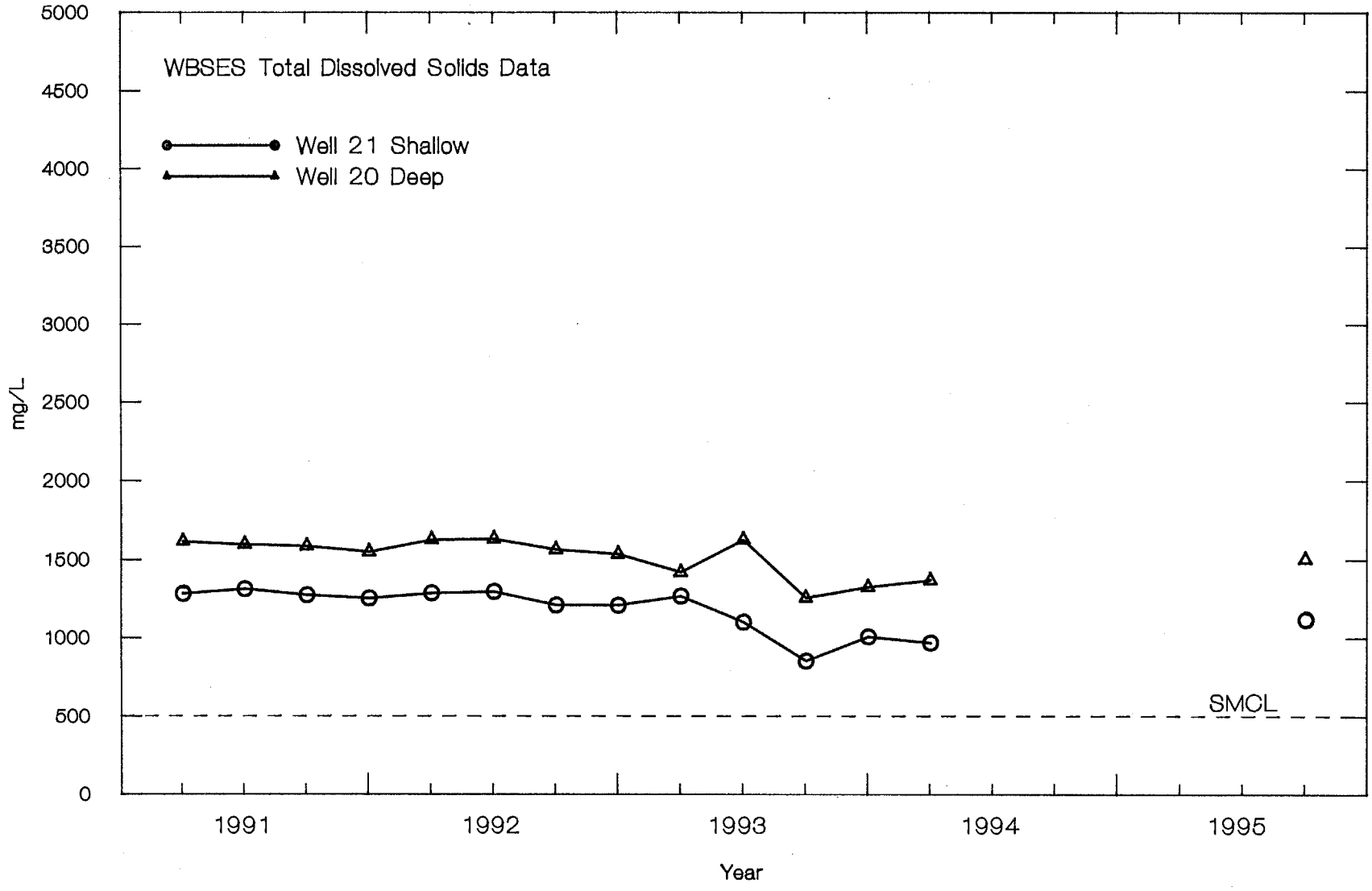
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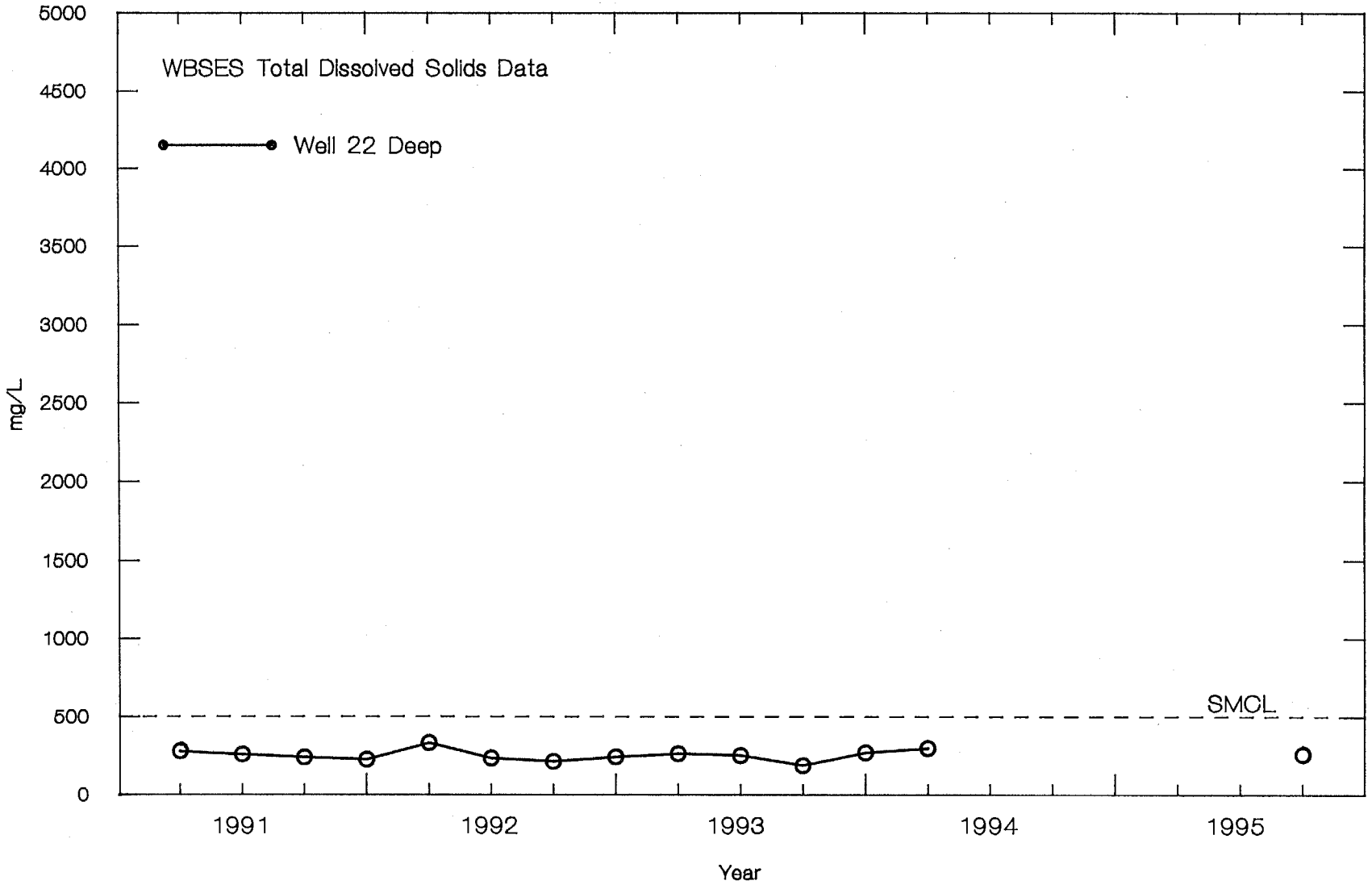
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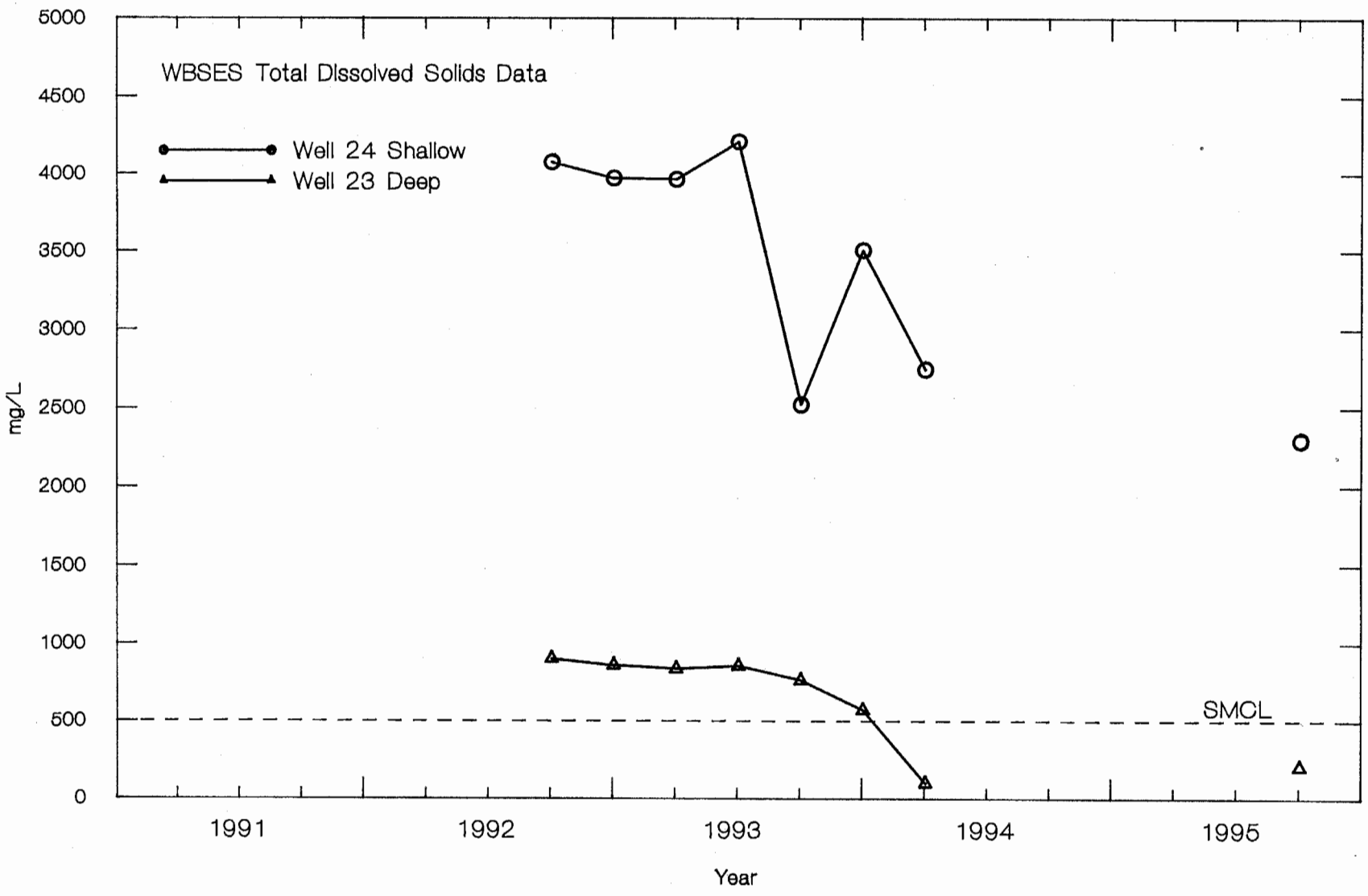
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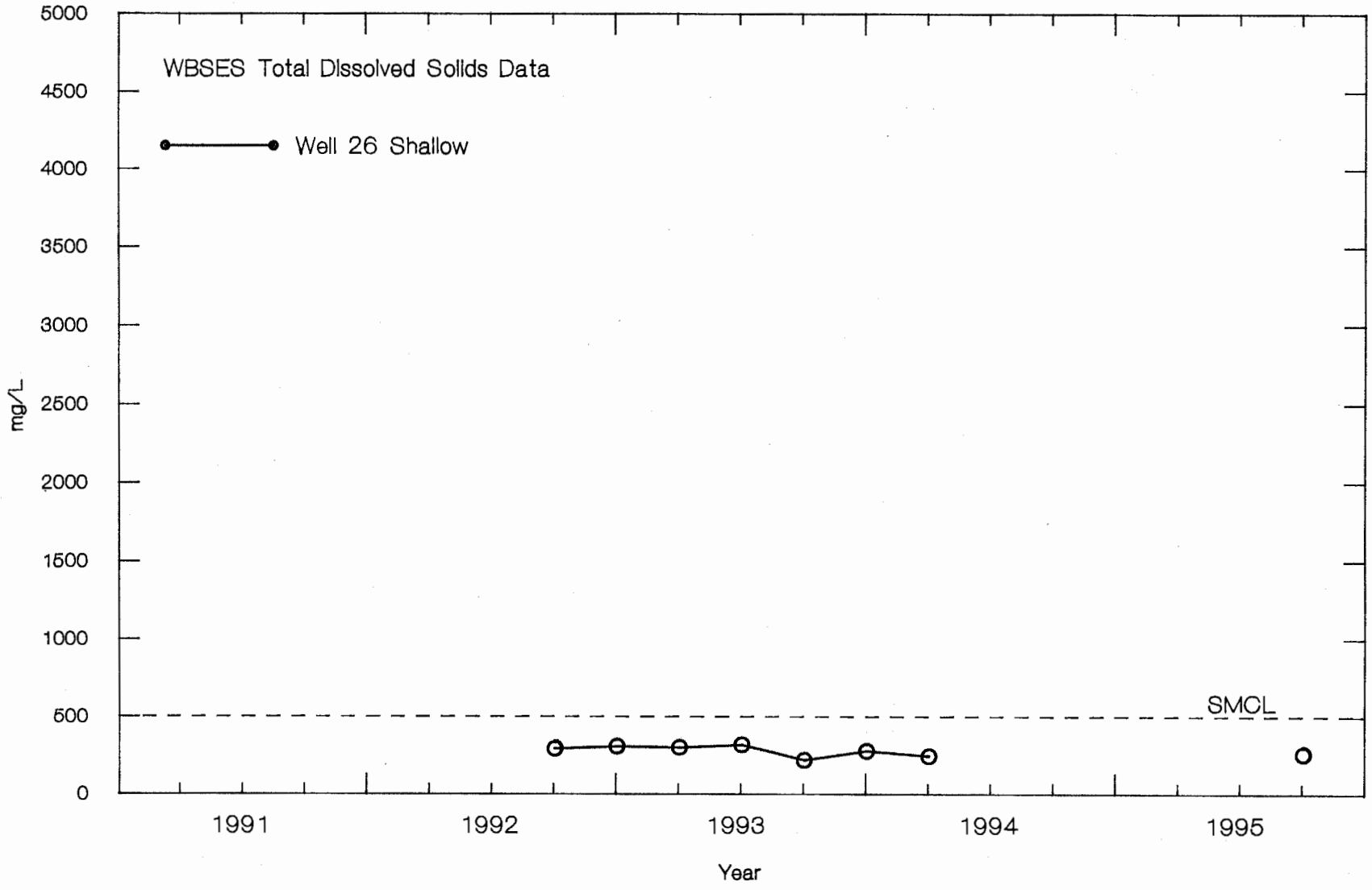
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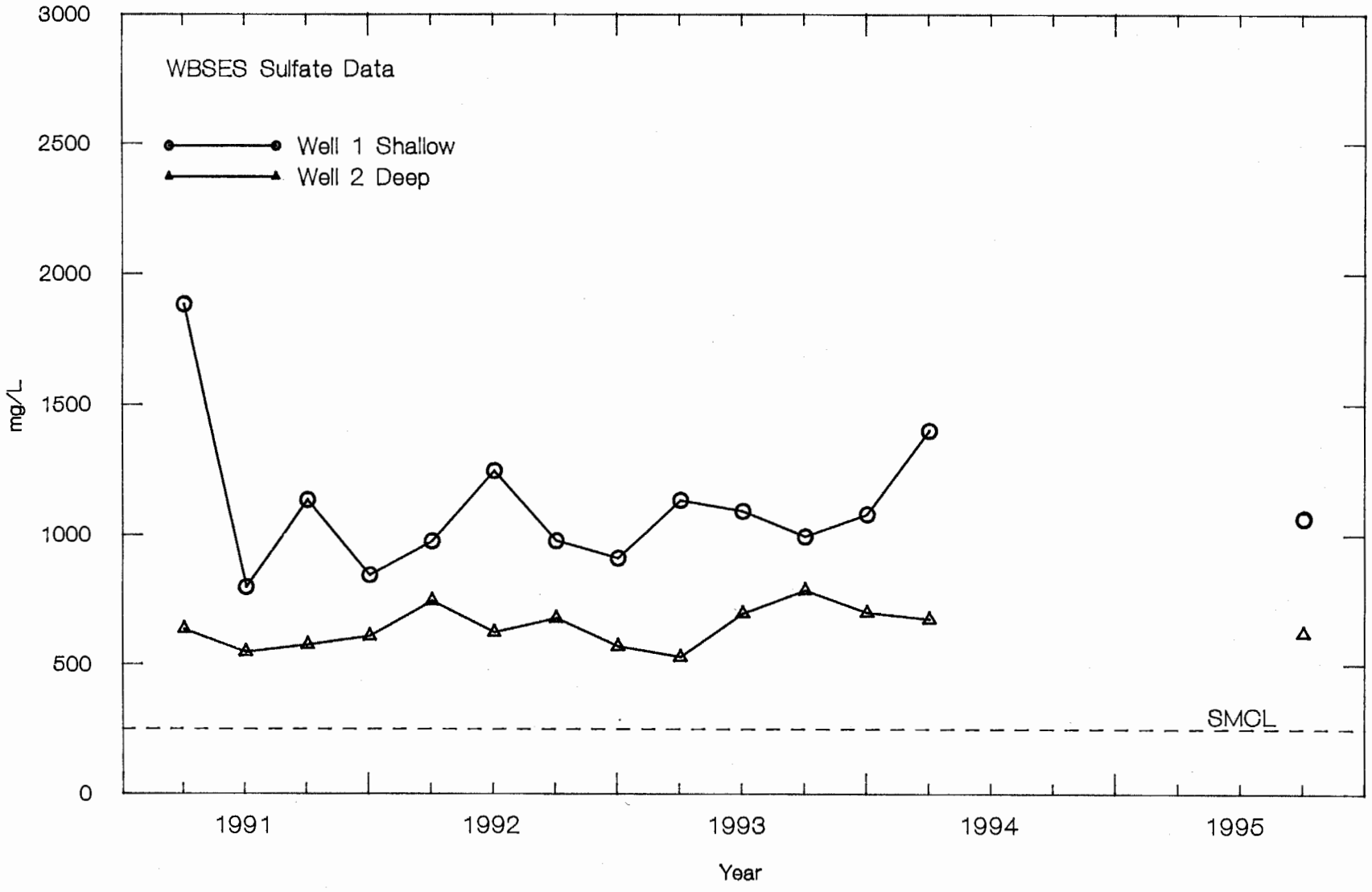
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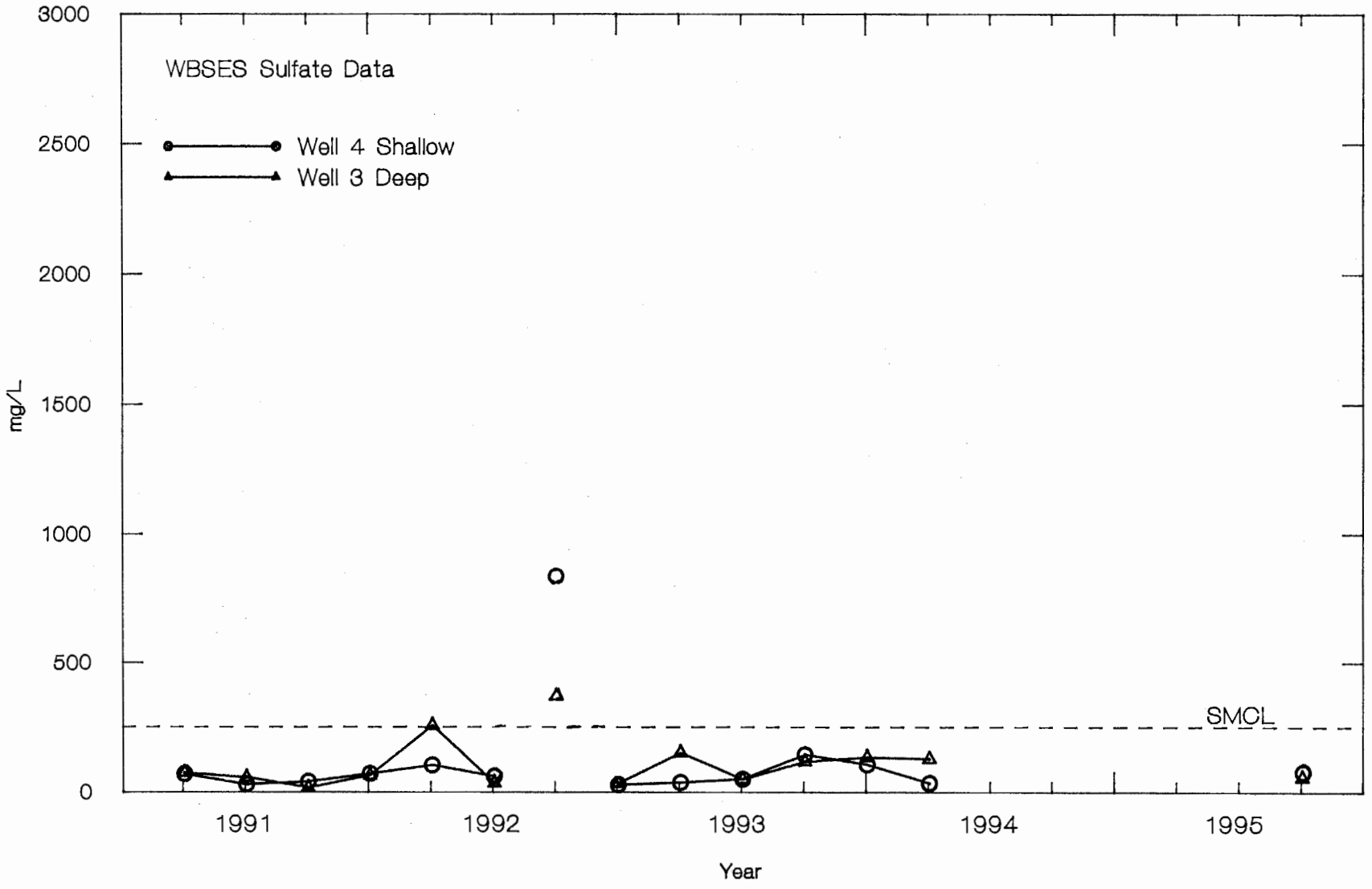
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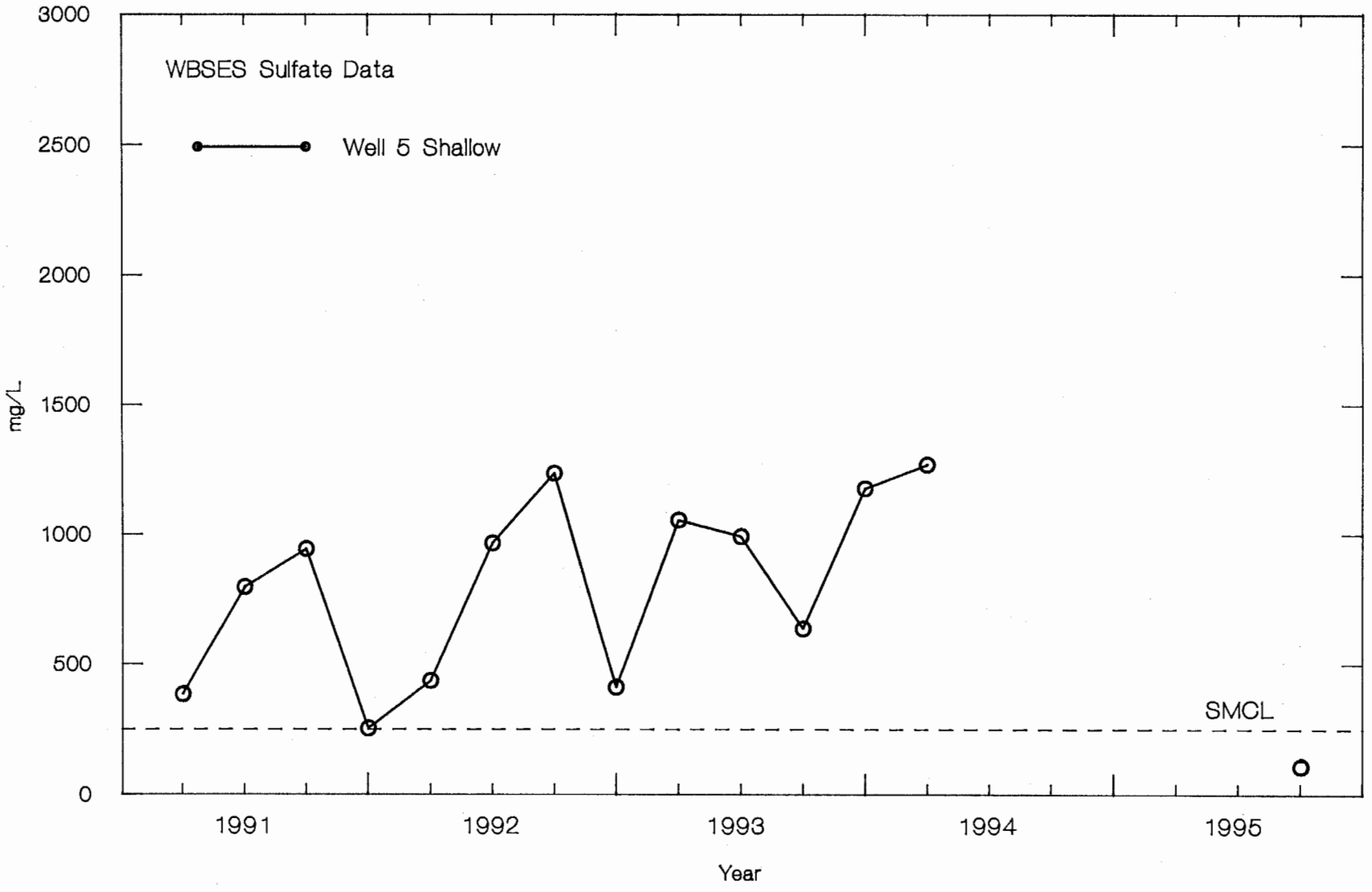
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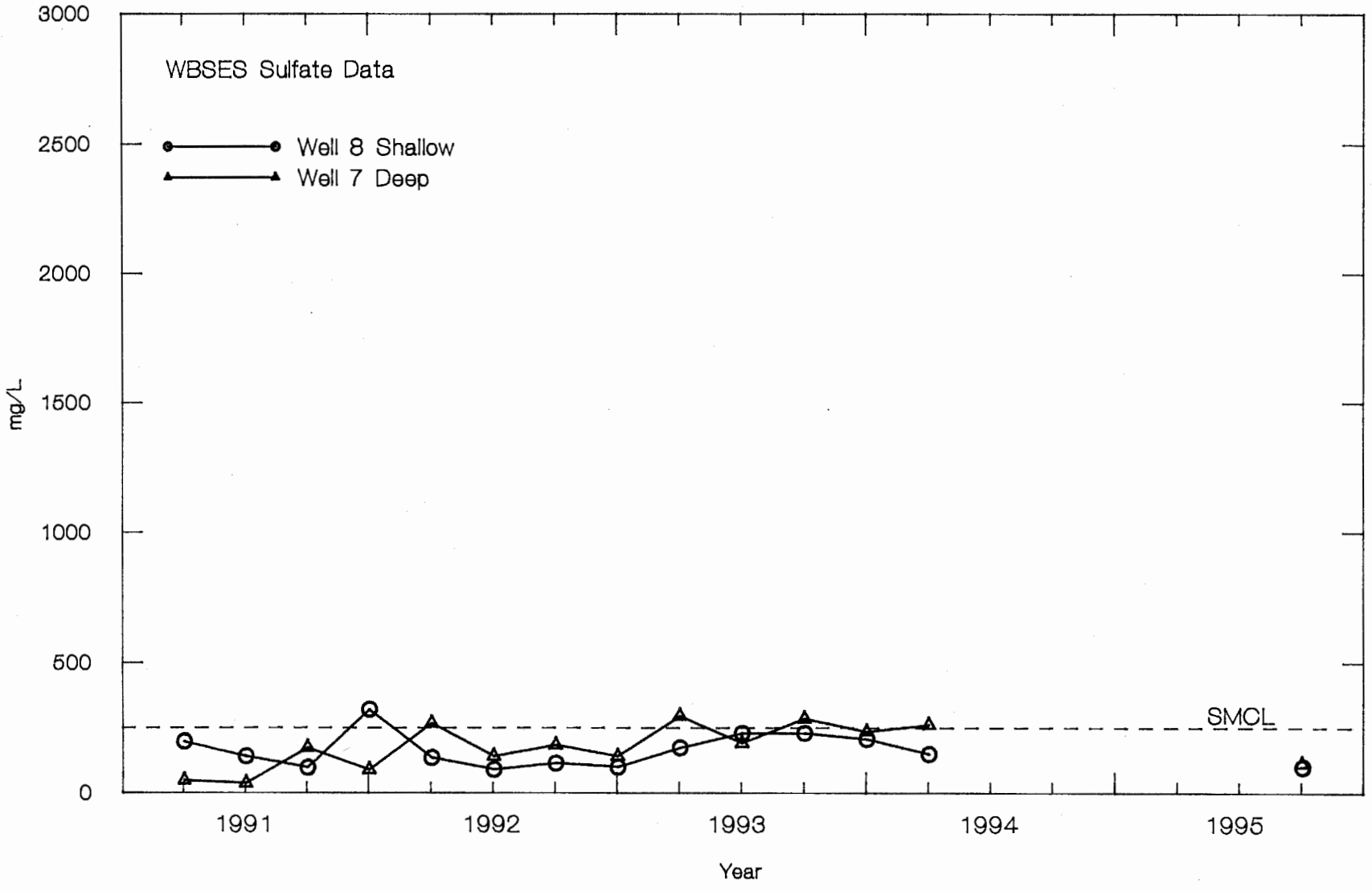
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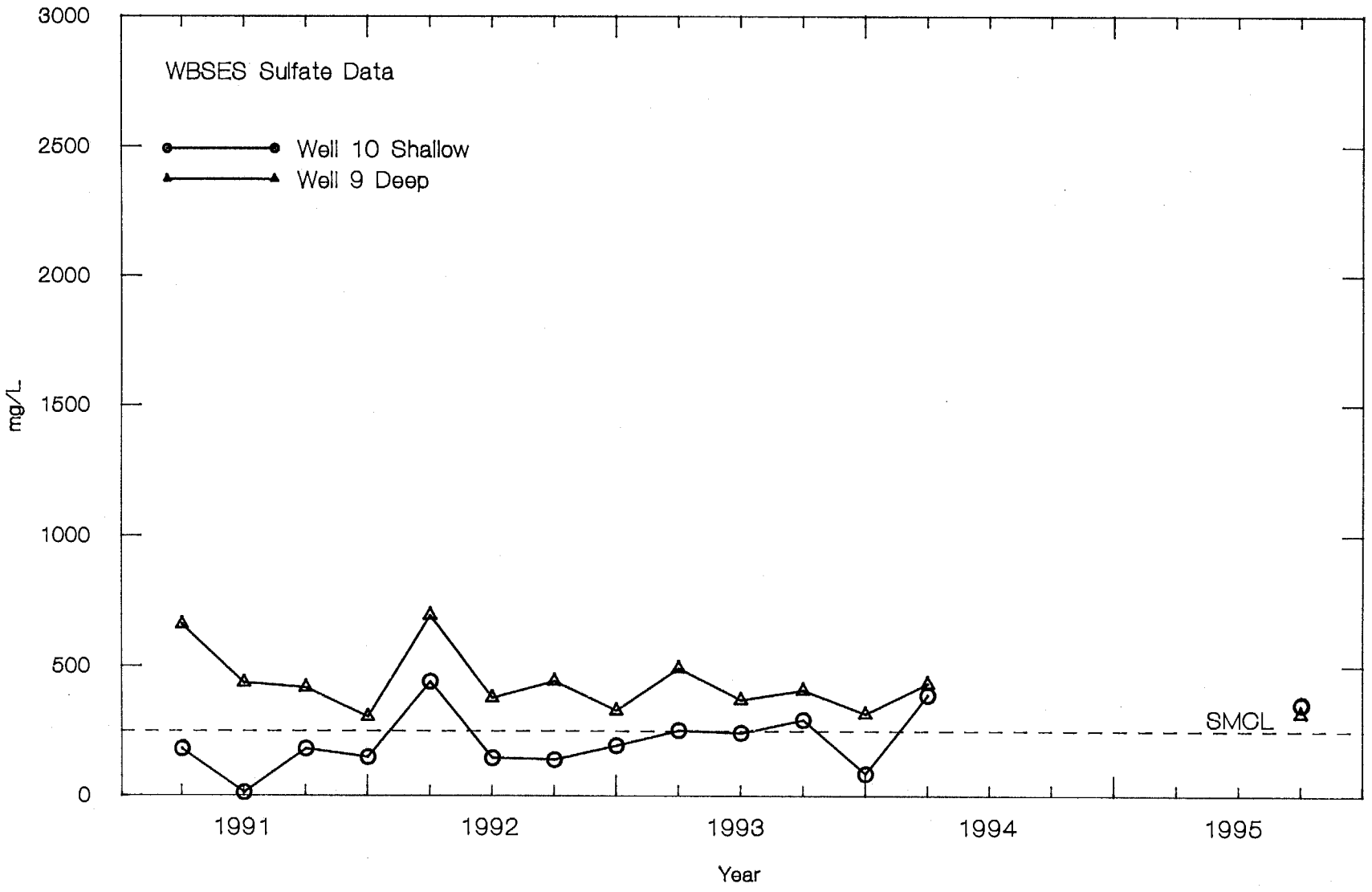
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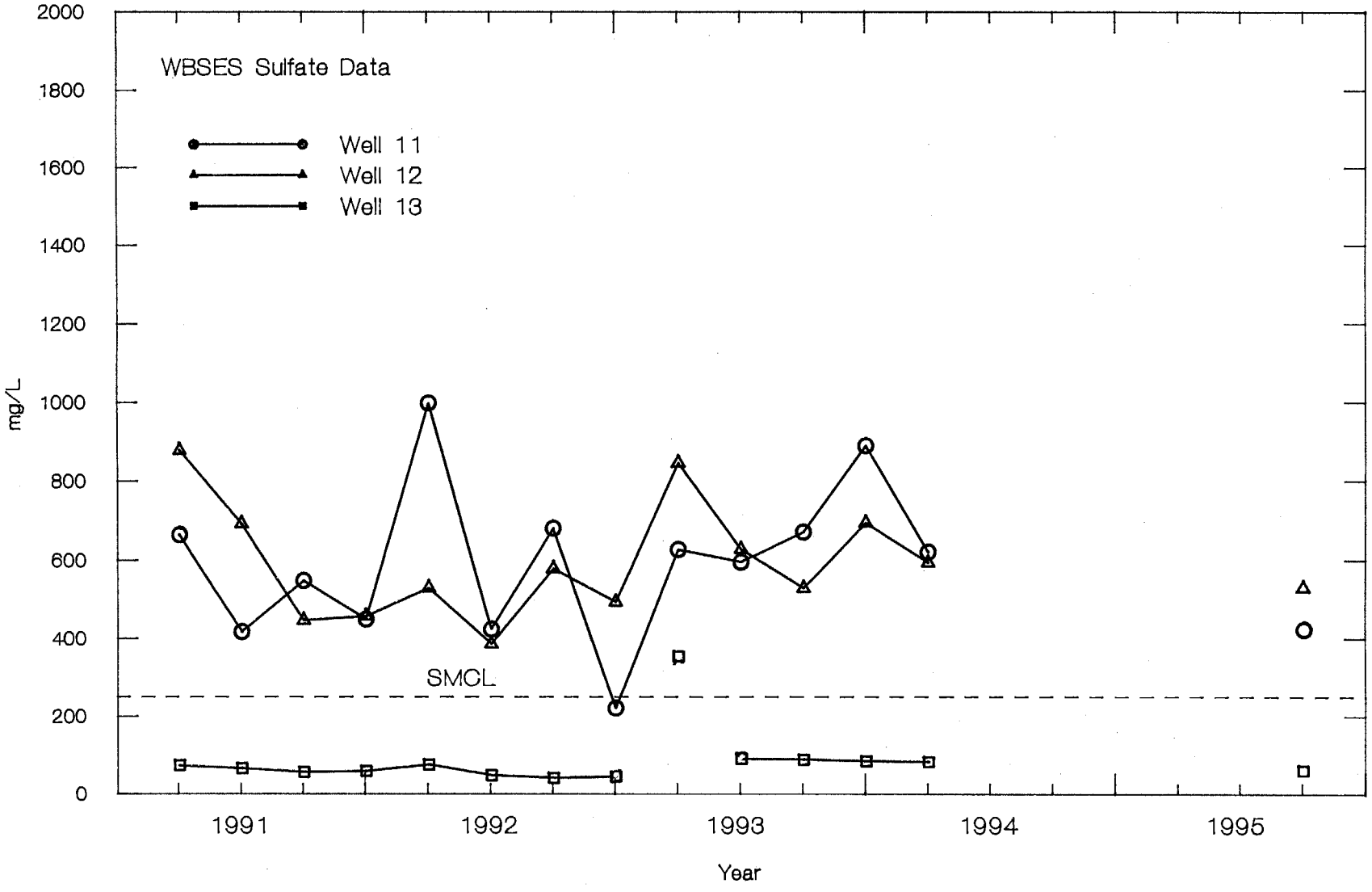
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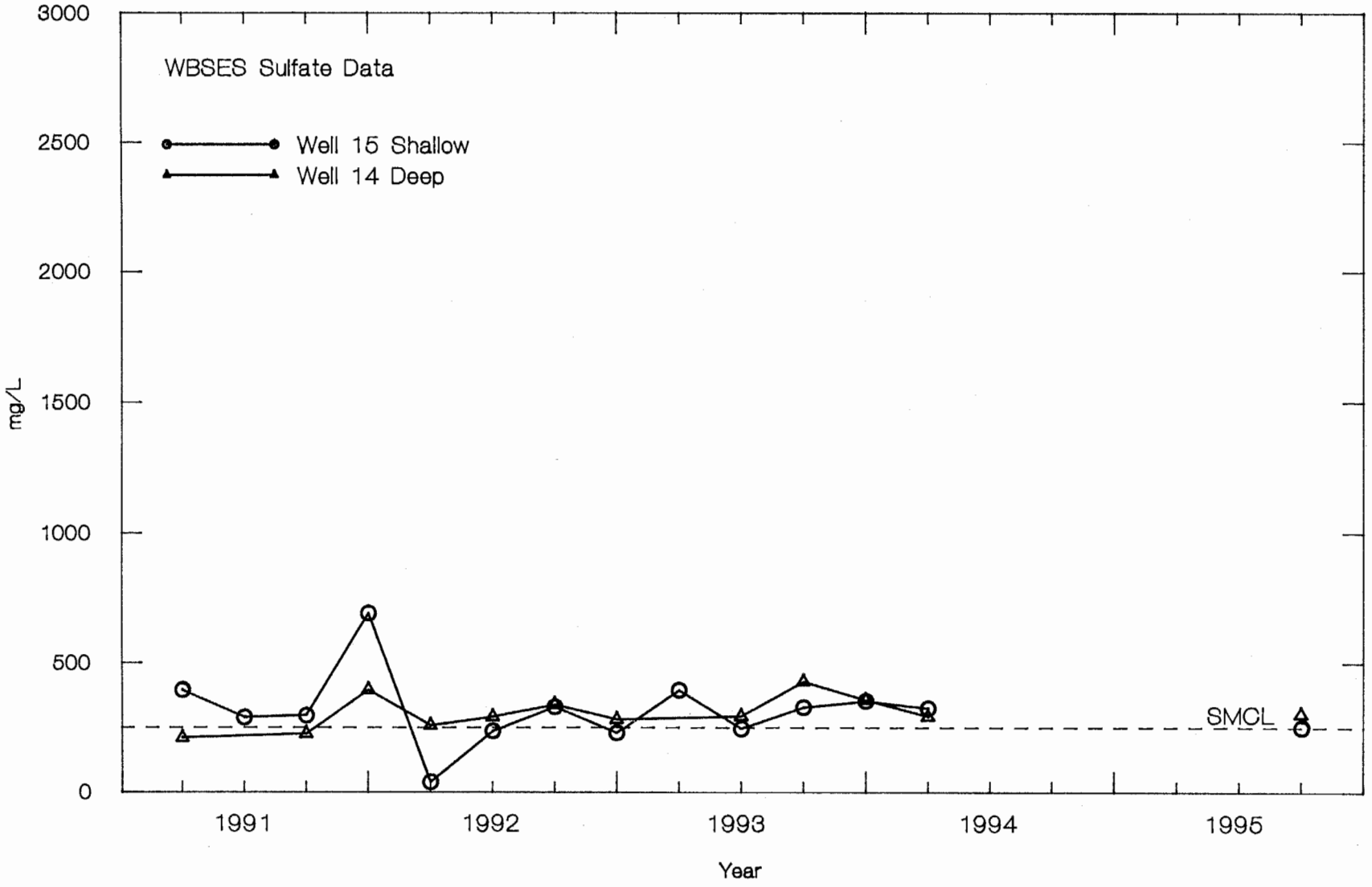
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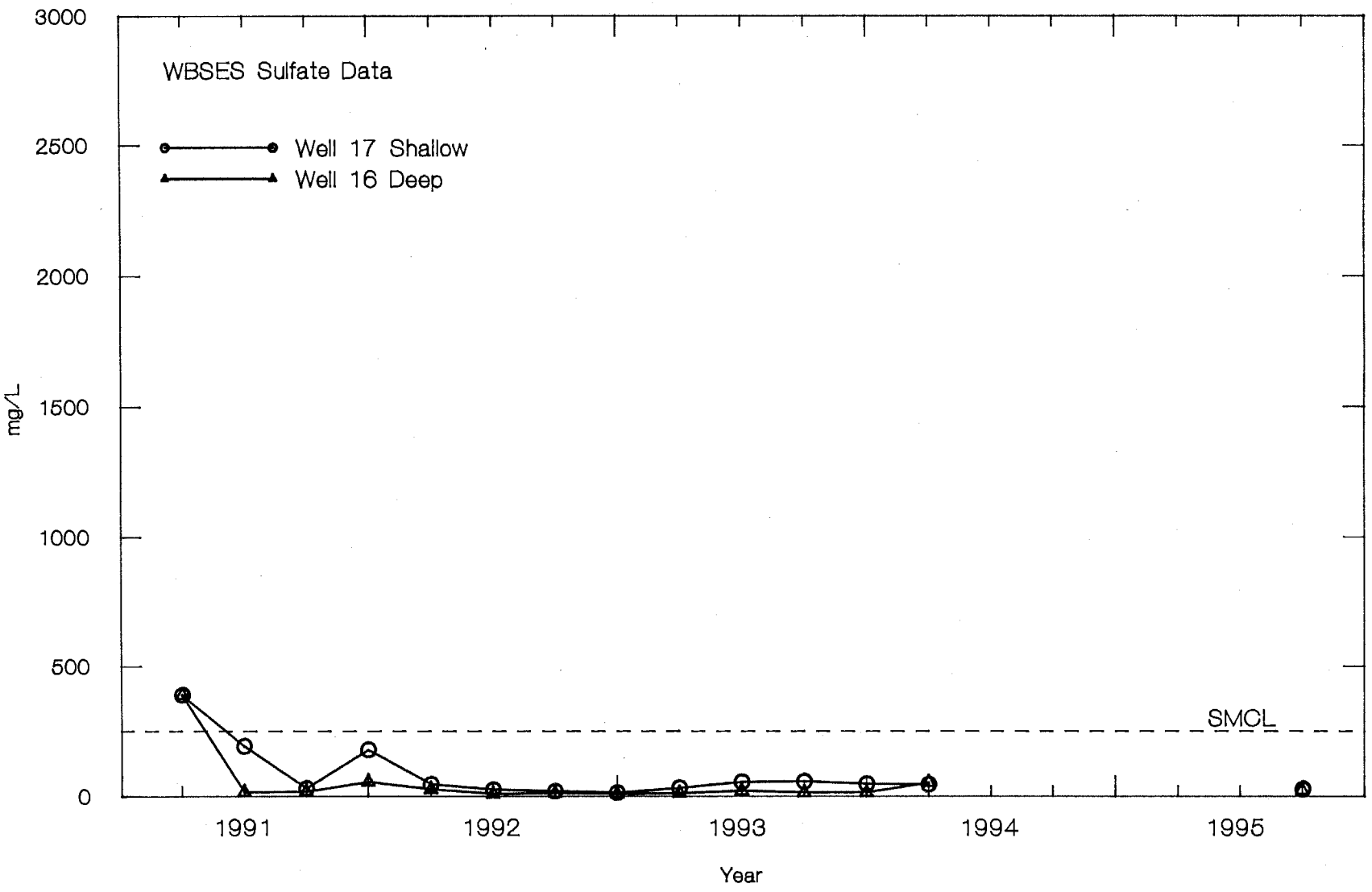
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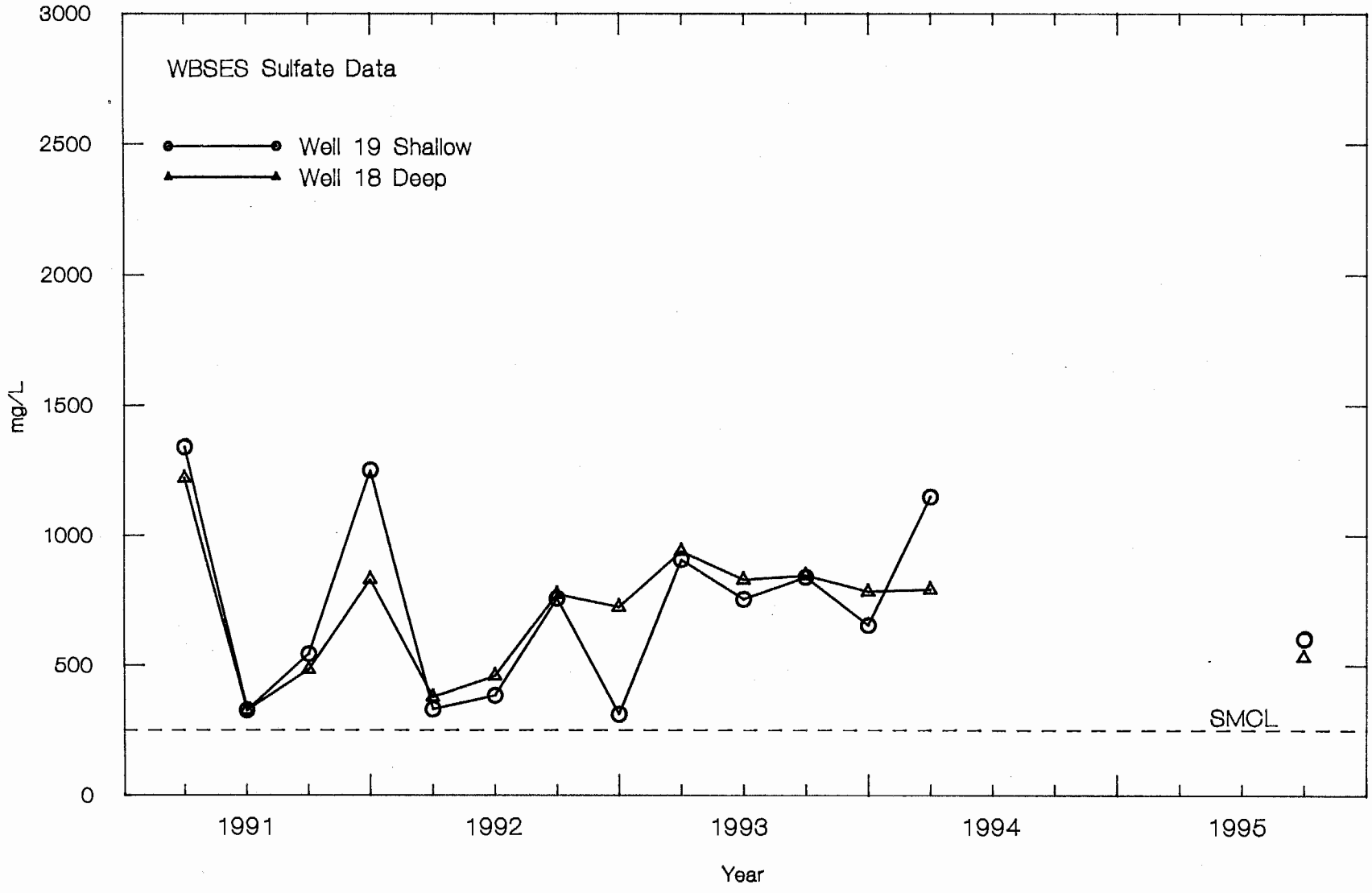
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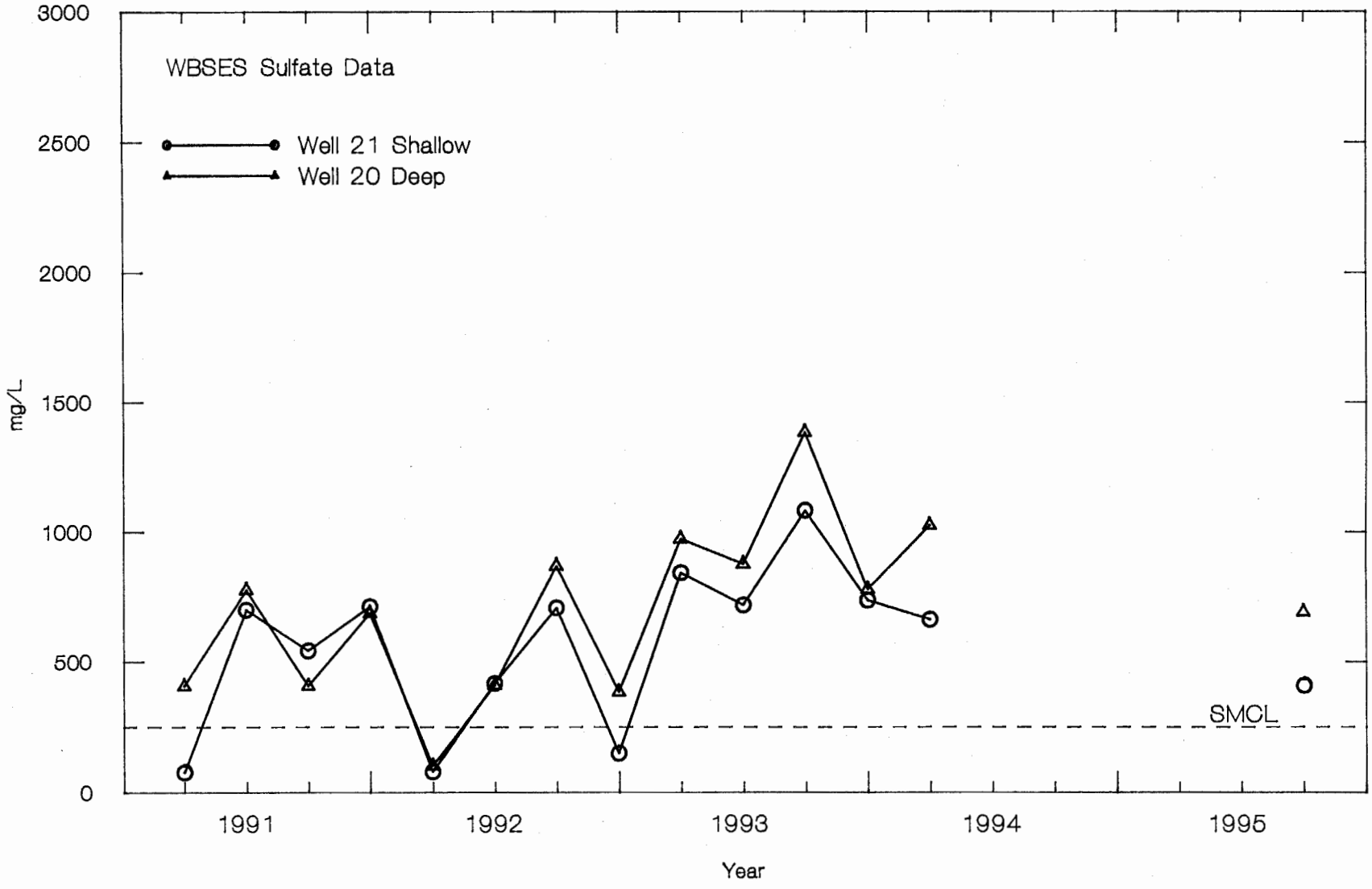
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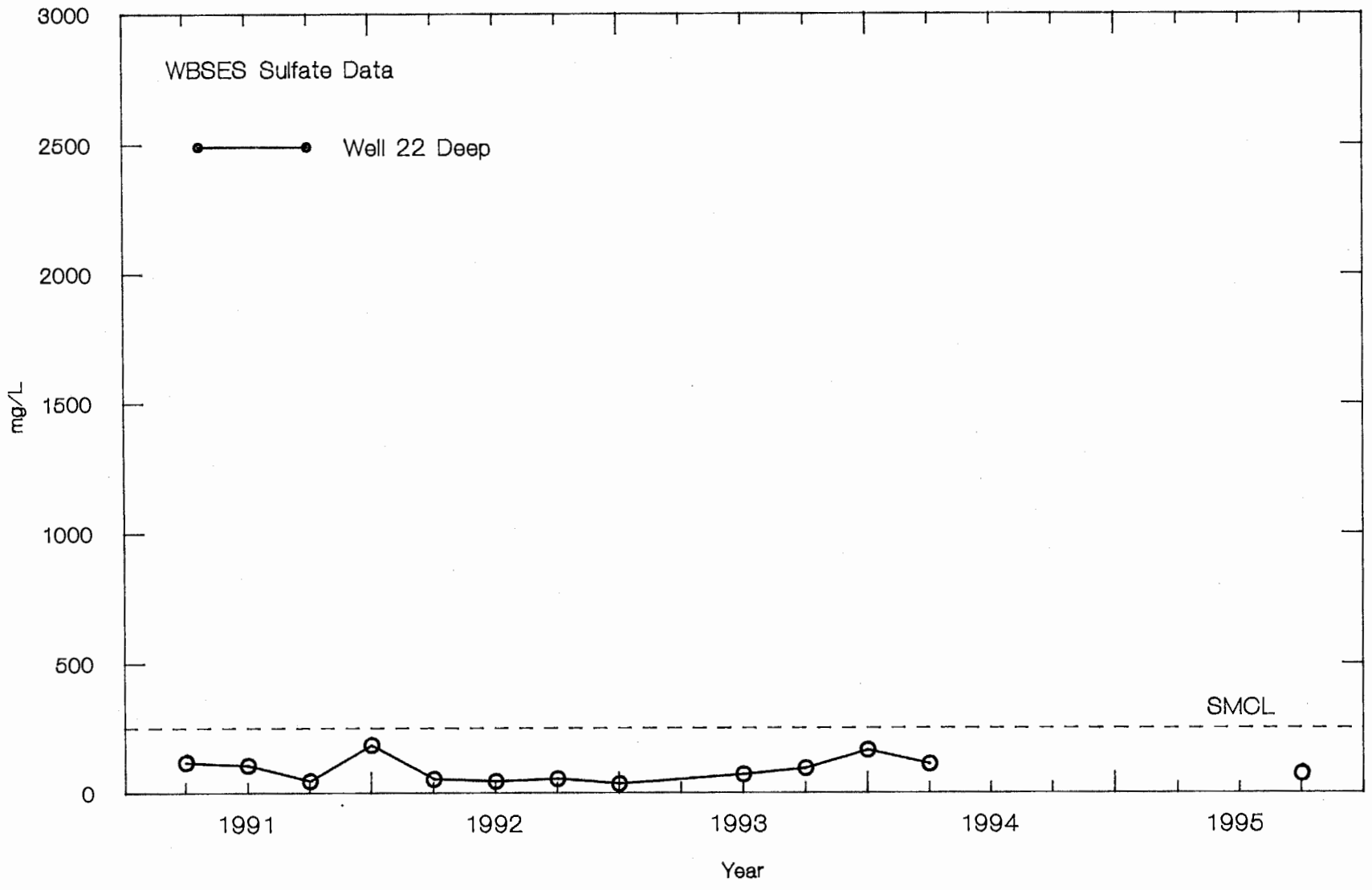
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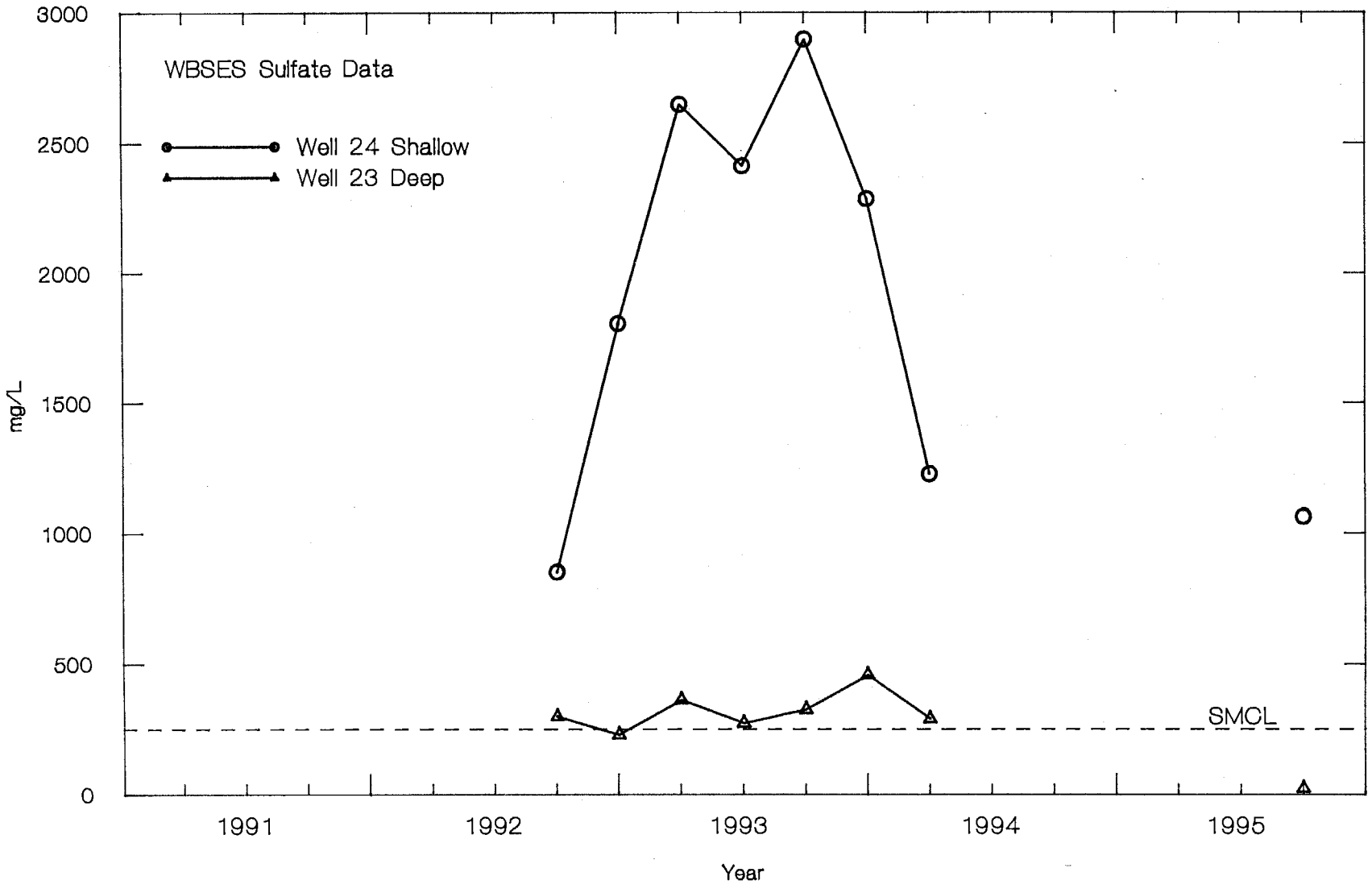
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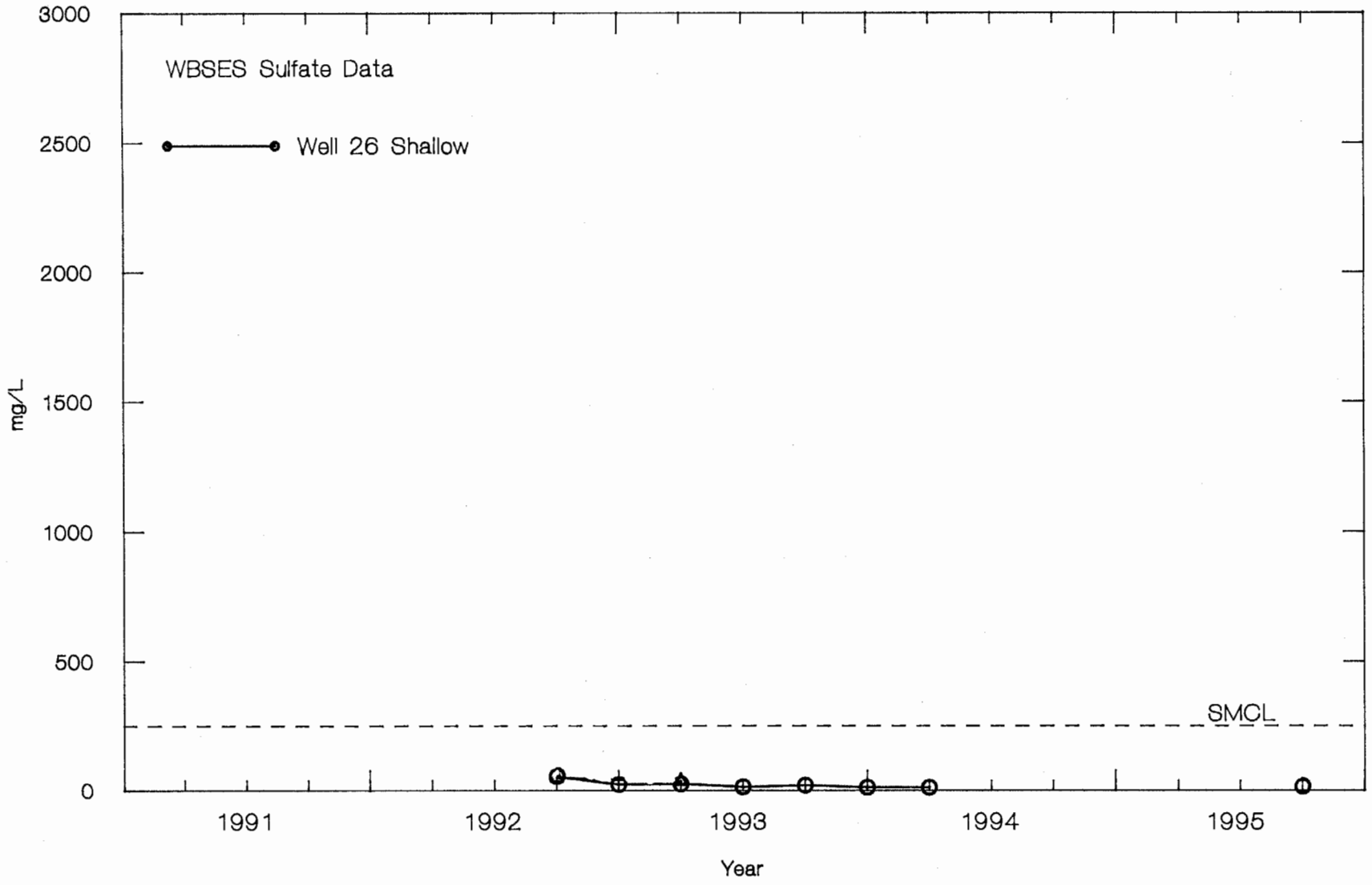
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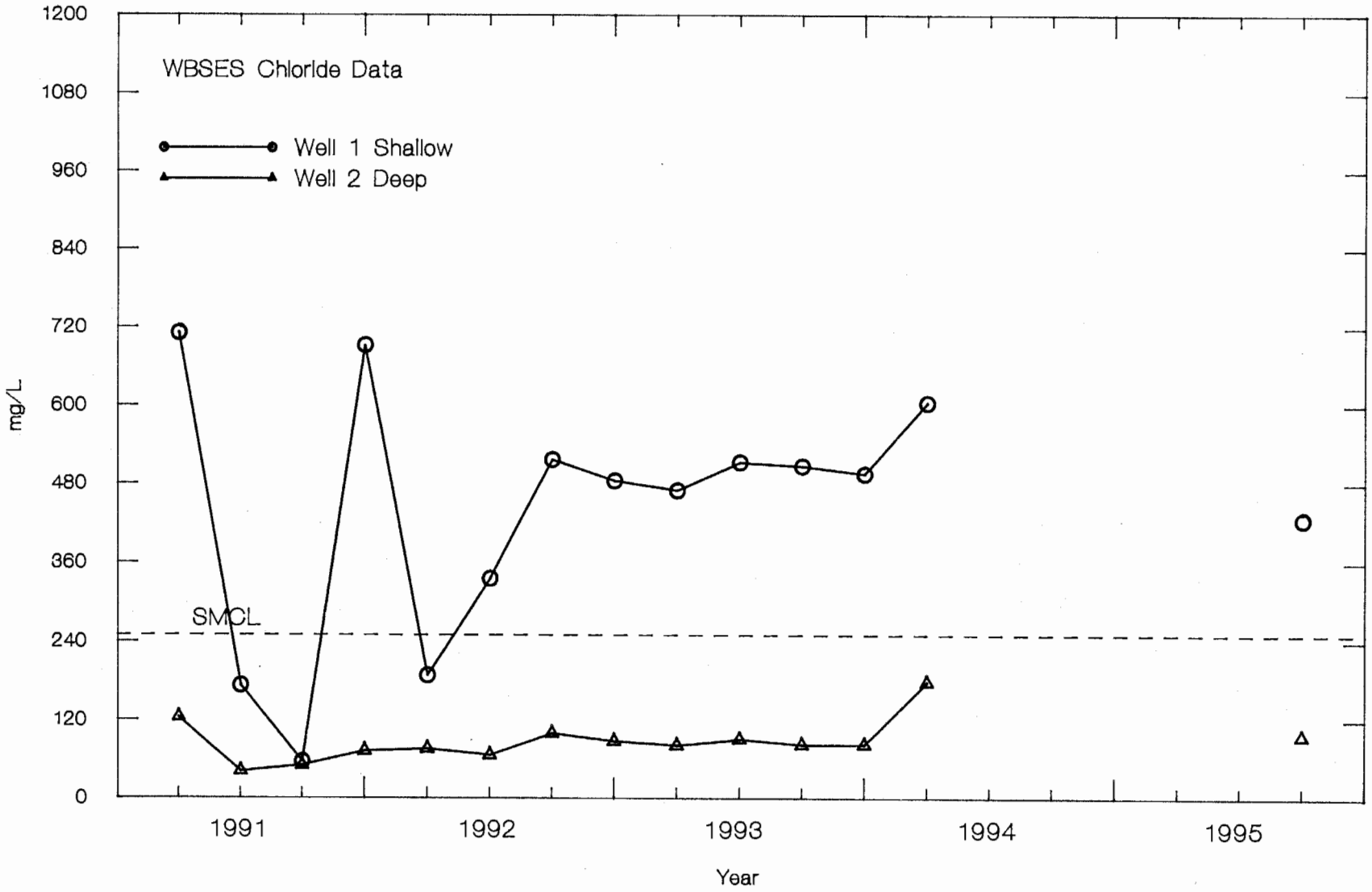
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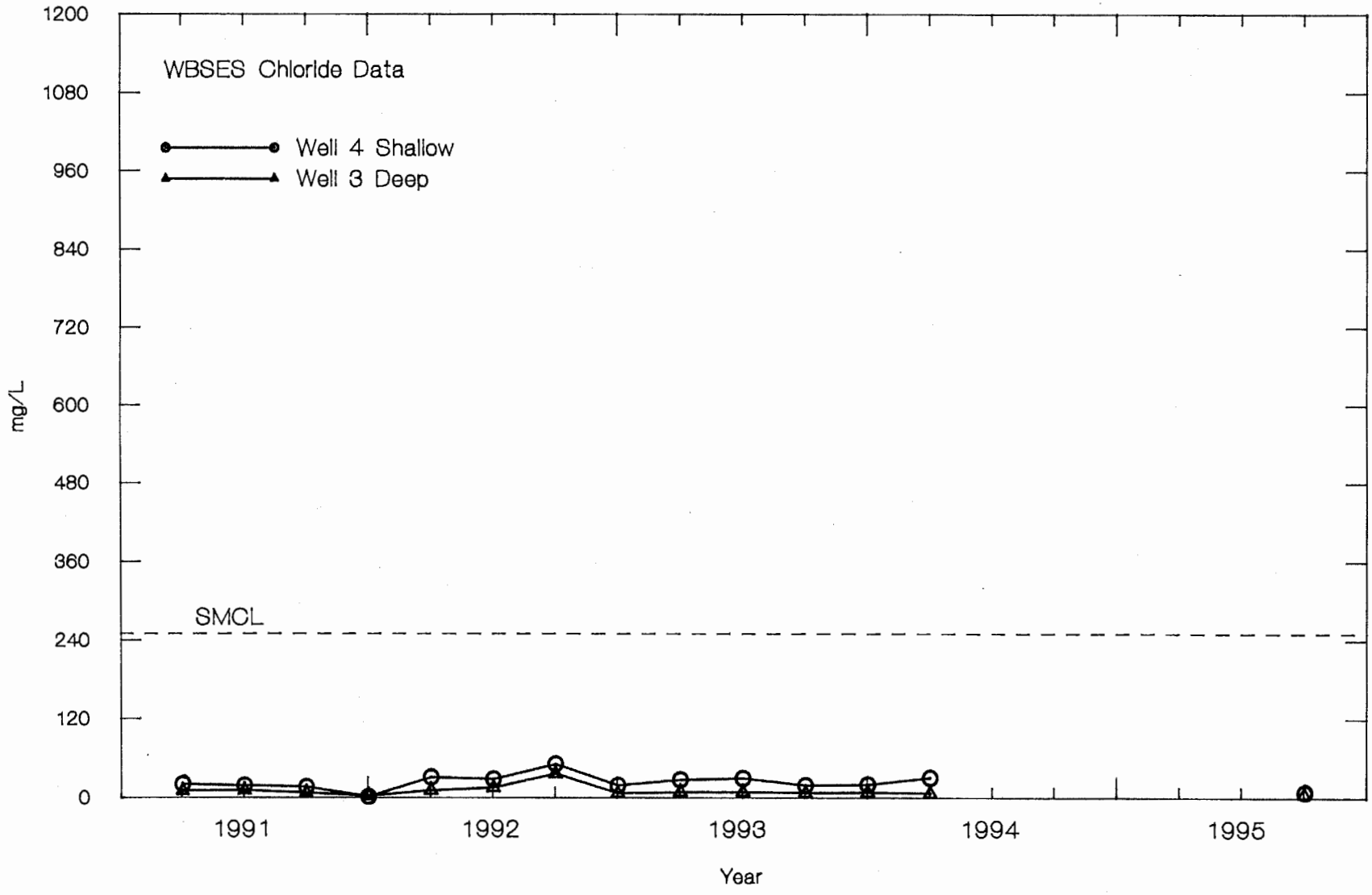
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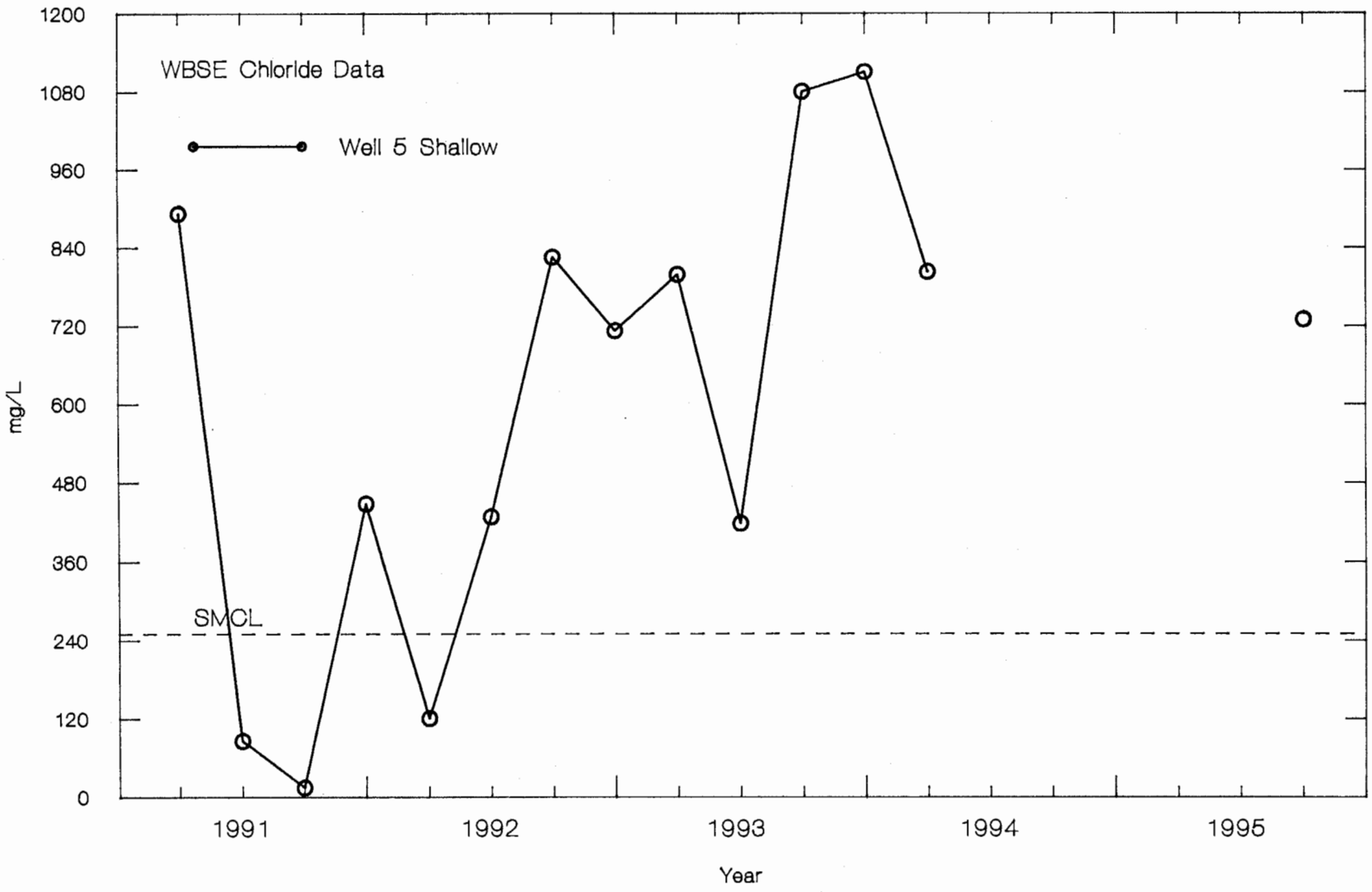
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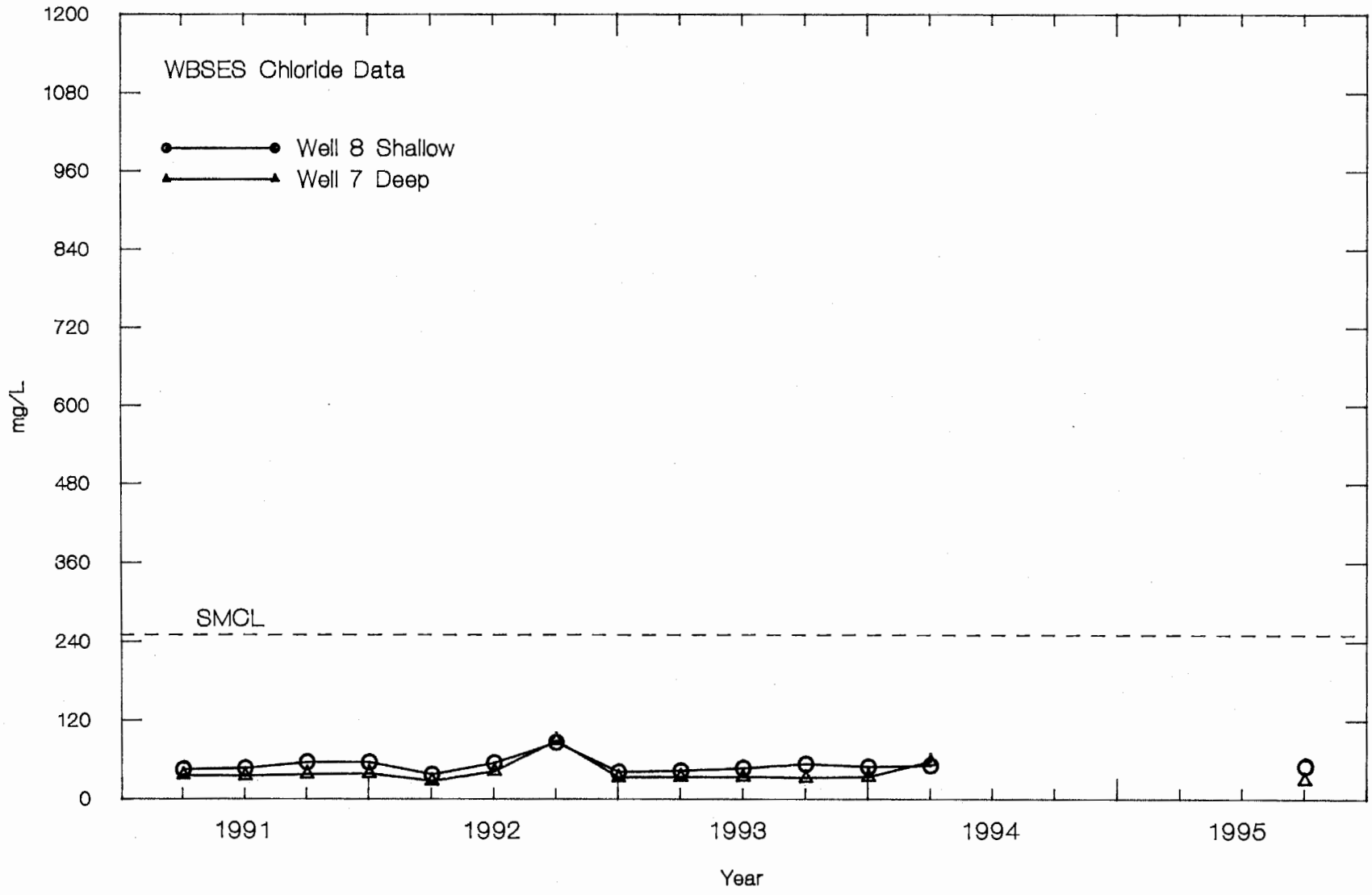
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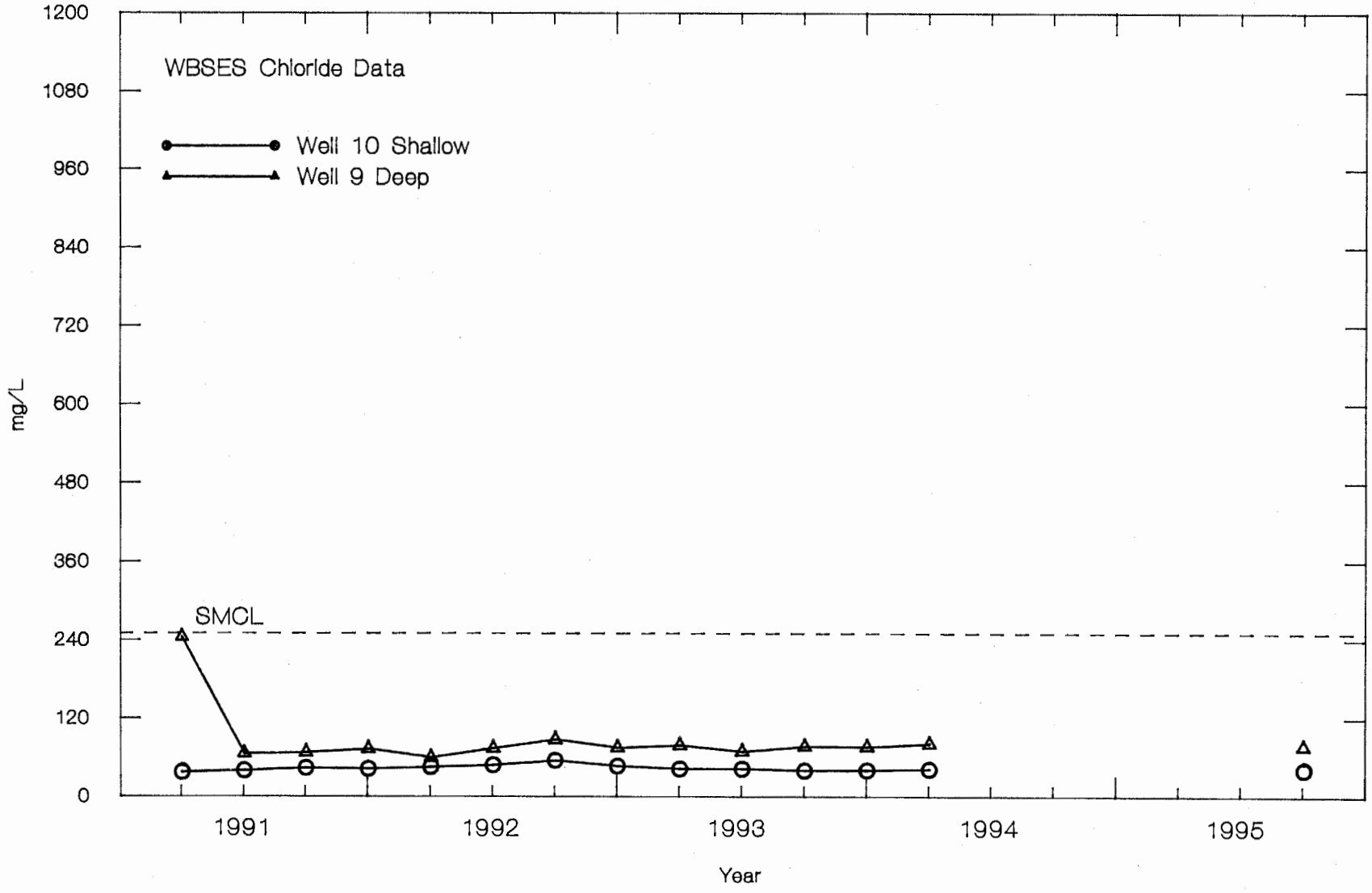
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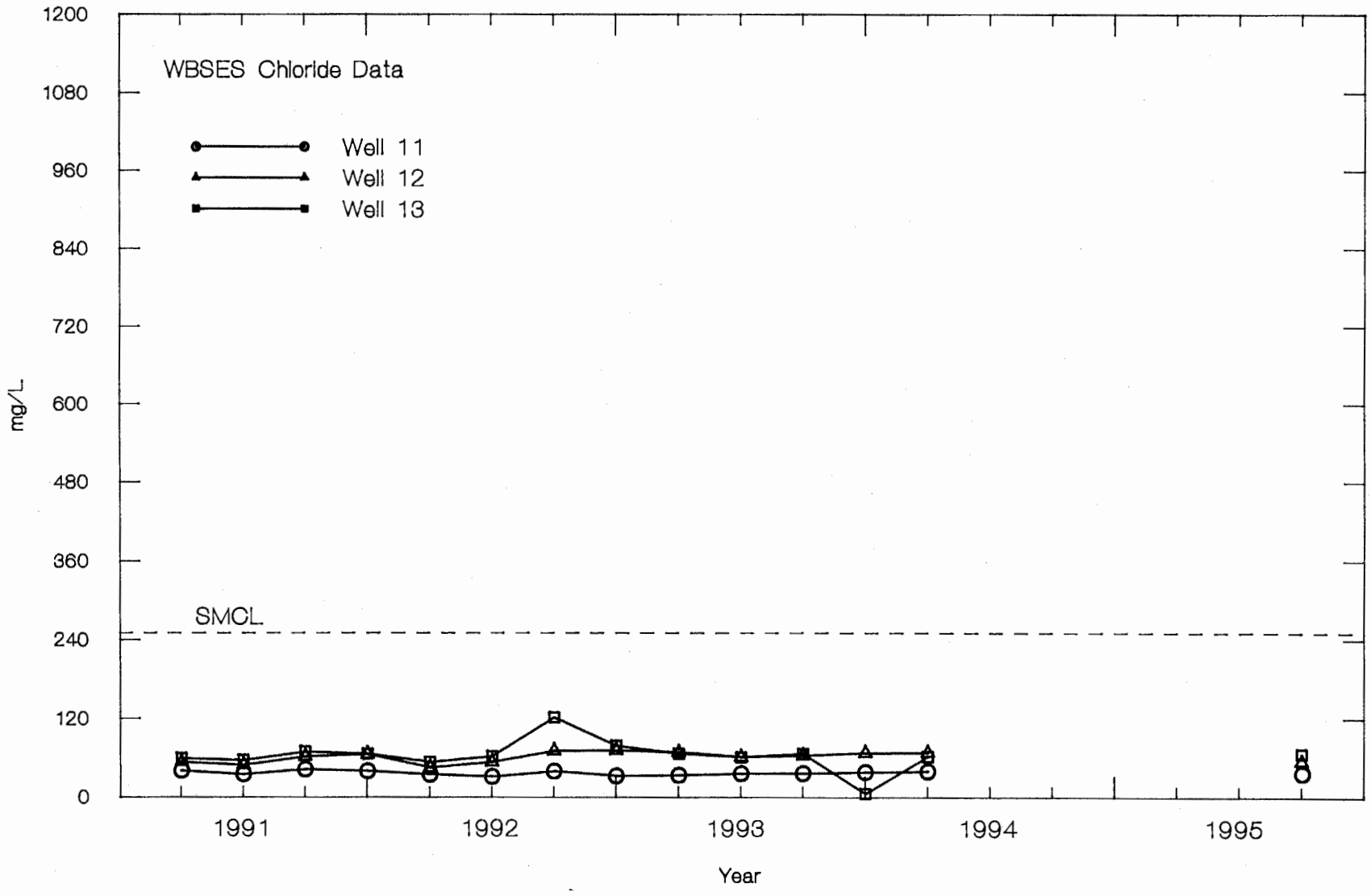
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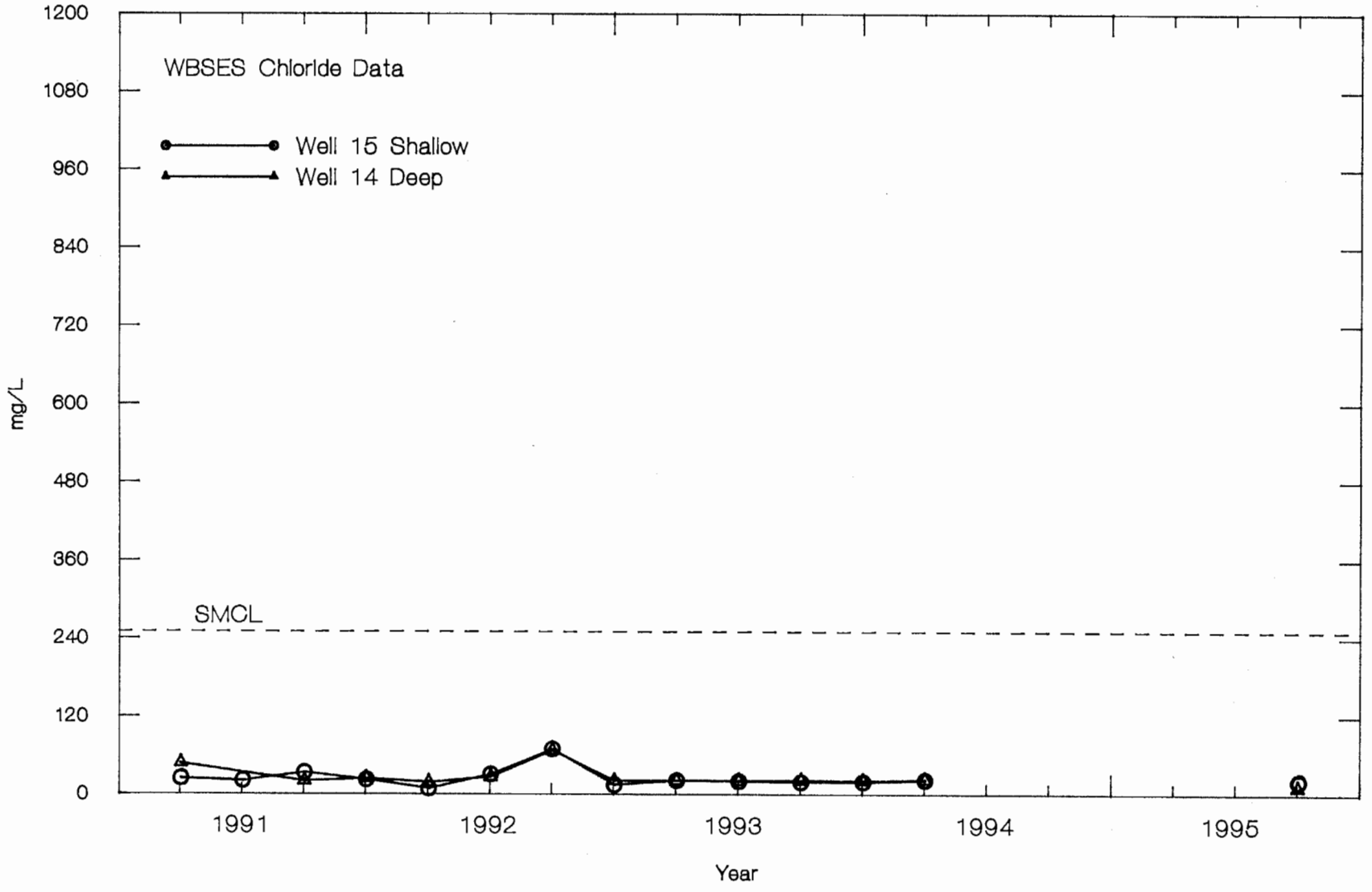
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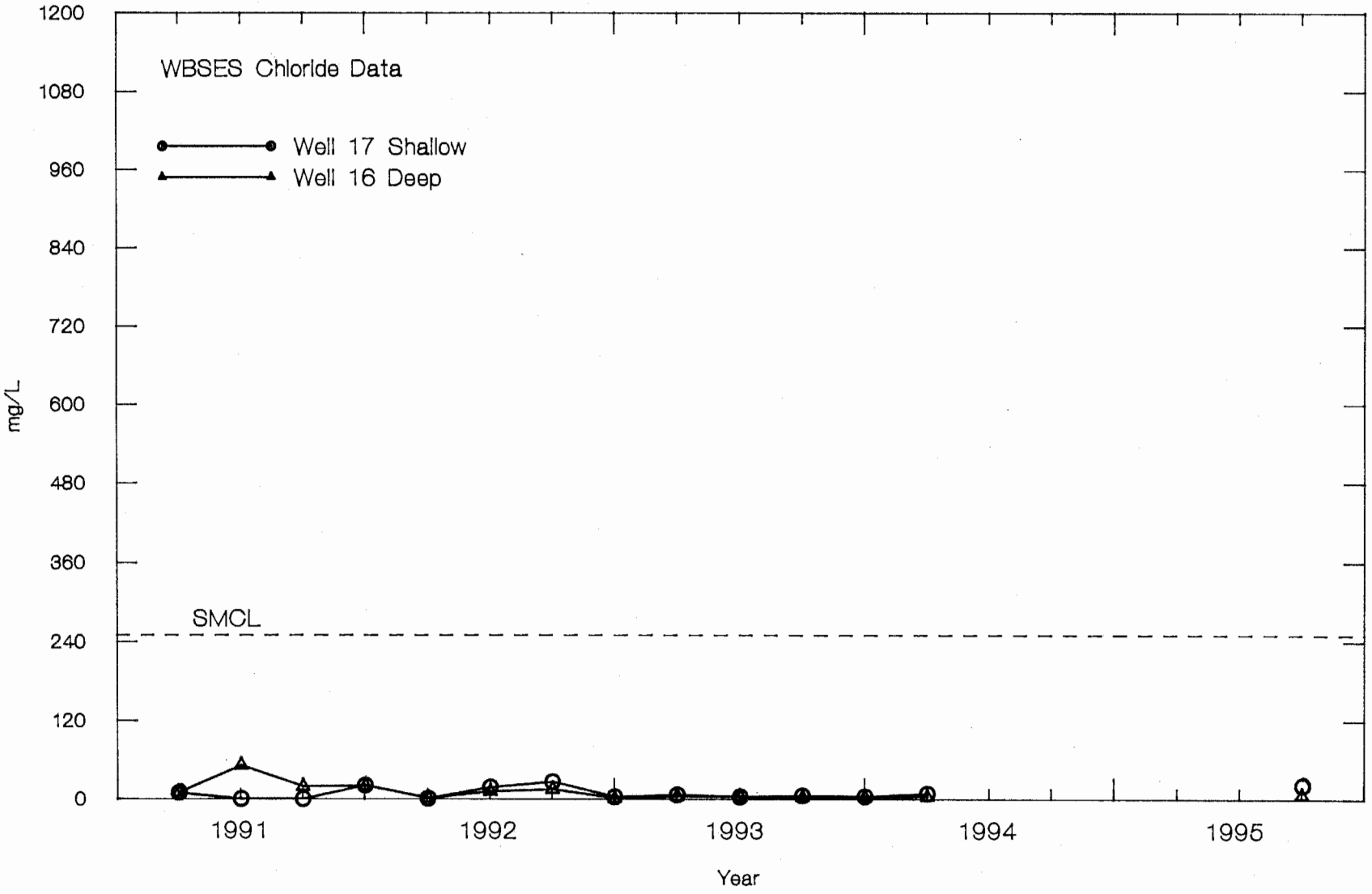
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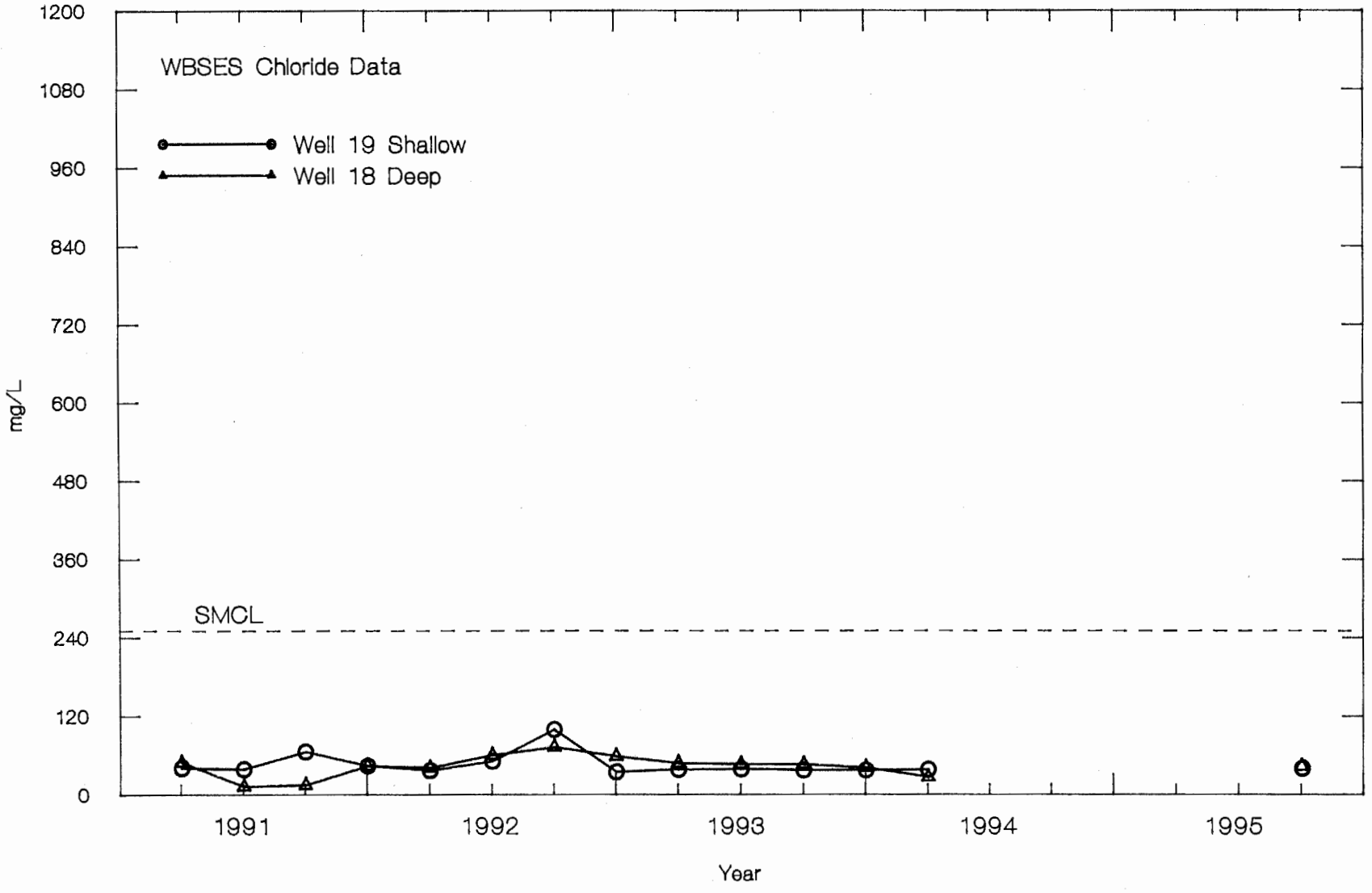
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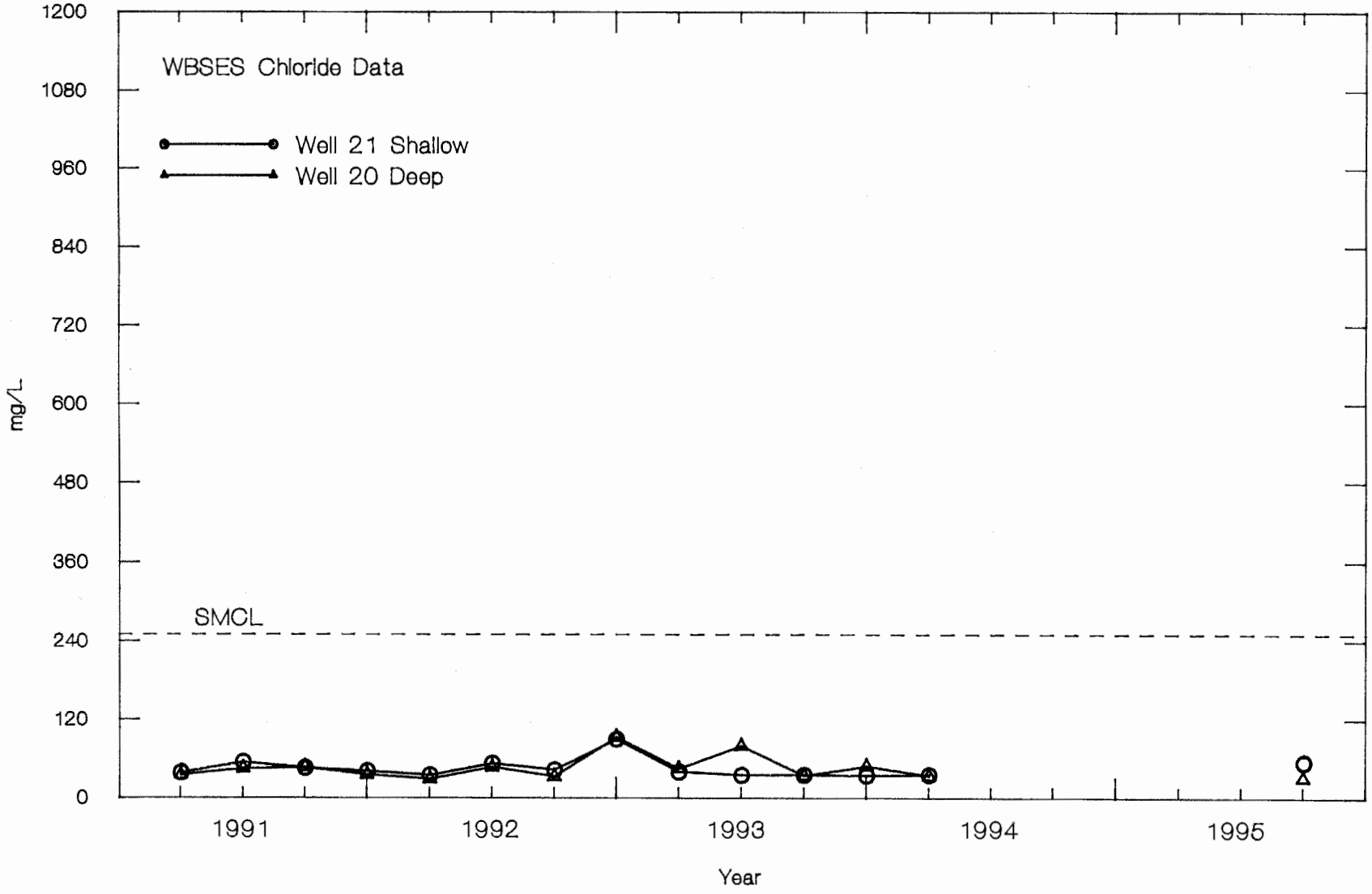
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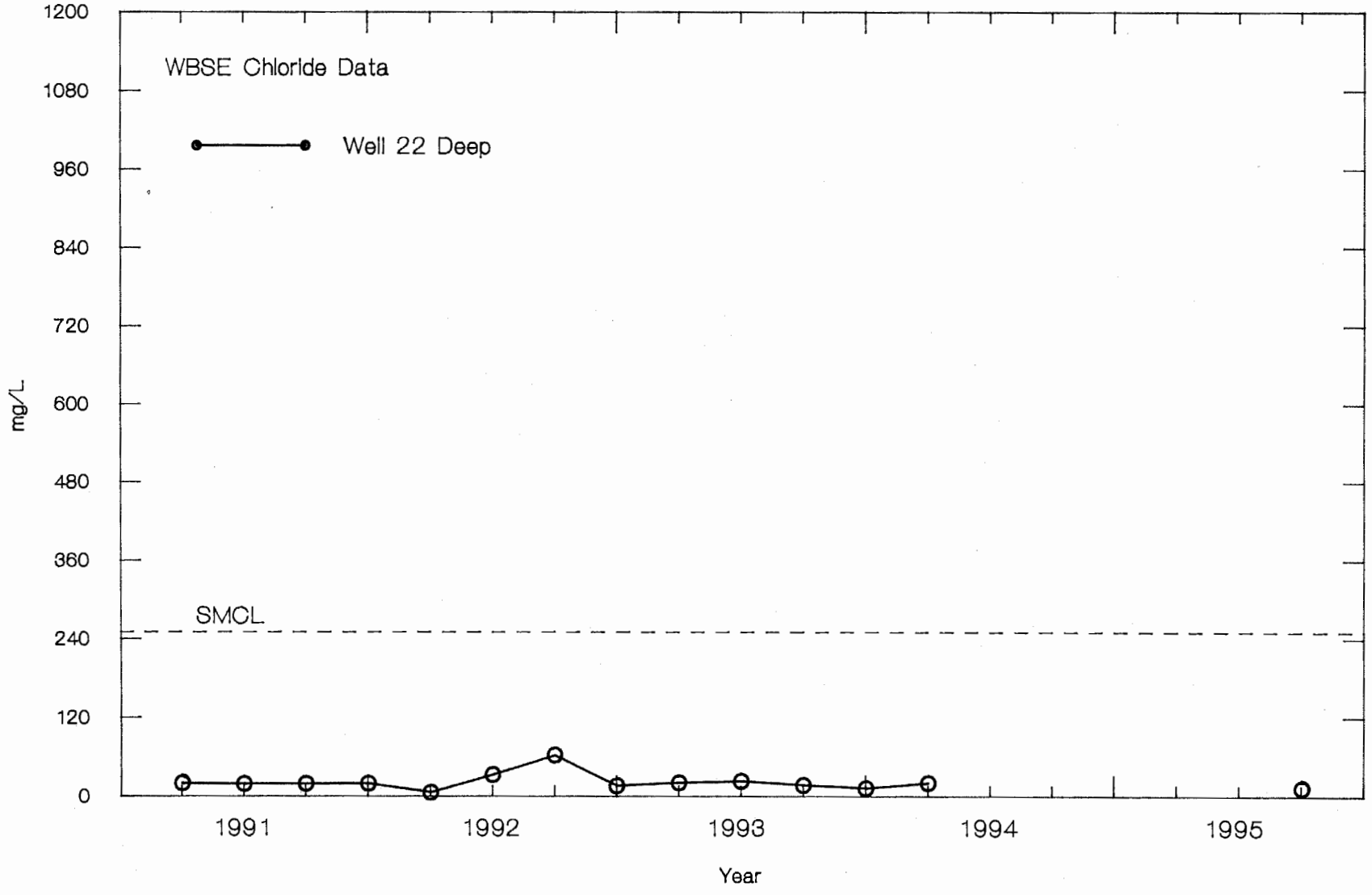
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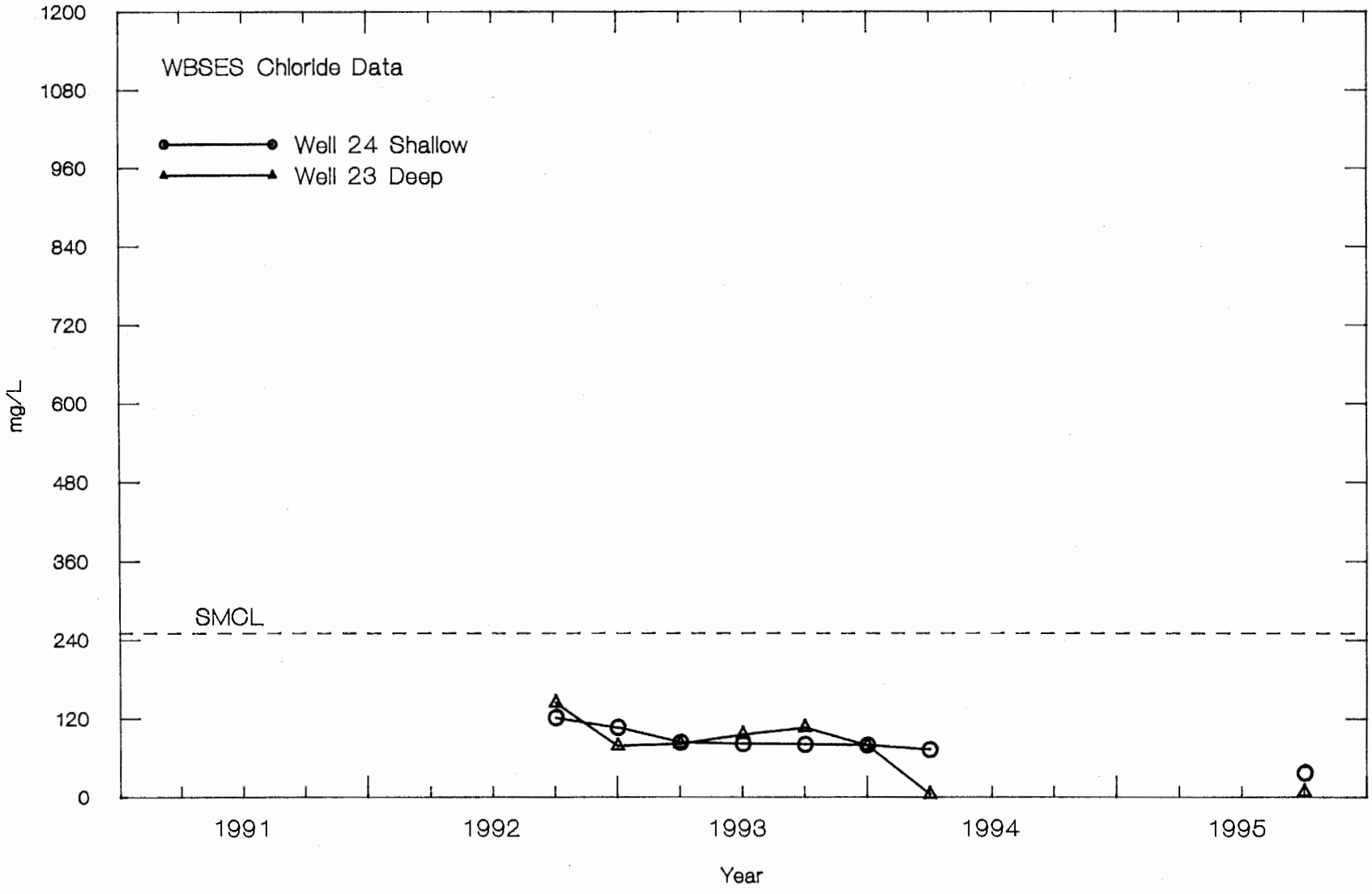
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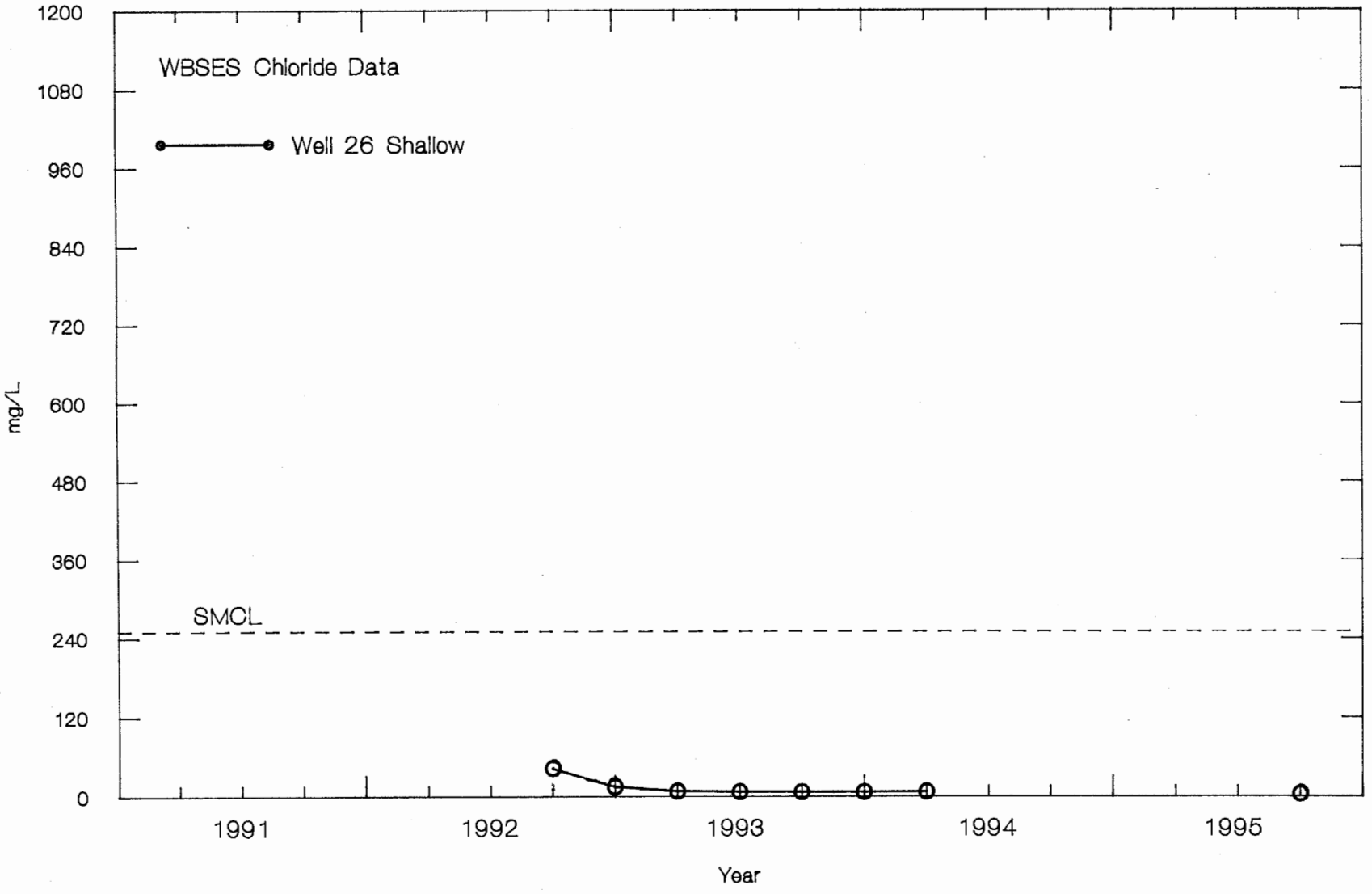
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2:22 pm, 1/26/96
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10:06 am 1/26/96
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10:12 am 1/26/96
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Appendix H

Data Trend Analysis

A positive value of Z indicates a positive trend, while a negative value indicates a negative trend. To test this statistically, the value of Z is compared with tabulated values of the standard normal distribution (i.e., if the null hypothesis of no trend is true, the statistic Z follows a standard normal distribution). To test for the presence of a significant trend (a two-tailed test), at the α level of significance, the null hypothesis is rejected if the absolute value of Z is greater than the tabulated value of $Z_{1-\alpha/2}$. This normal approximation is generally valid so long as $n \geq 10$.

If a significant trend is found to exist in the data, then the magnitude of that trend is computed by Sen's nonparametric estimator of slope. First compute the N slope estimates

$$Q = (x_j - x_k) / (j - k),$$

where k runs from $k = 1$ to $k = n - 1$, and j from $j = k + 1$ to $j = n$, and $N = n(n-1)/2$. The quantity (j - k) is a measure of the time (e.g., days, months, ...) between successive samples. The median of these N values of Q is Sen's estimator of slope. A normal approximation is used to calculate a $100(1-\alpha)\%$ confidence interval for the slope.

This set of procedures was employed in this study to detect the presence of trends, and to quantify the magnitude of those trends, for the wells and parameters selected for analysis. A significance level of $\alpha = 0.10$ was used in all tests. Summary sheets follow which list the mean, the test statistic Z, the probability, and the calculated trend slope, if any.

Input data file: WELL1TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 2.7E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-19.00000	-0.98541	0.32456

Seasonal Kendall test statistic: -19.00000

variance: 333.66667

Z: -0.98541

Prob[|S| ≥ 19.00000] = 0.325

Input data file: WELL2TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.2E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-5.00000	-0.21898	0.82659

Seasonal Kendall test statistic: -5.00000

variance: 333.66667

Z: -0.21898

Prob[|S| ≥ 5.00000] = 0.827

Input data file: WELL3TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 2.2E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-38.00000	-2.02860	0.04250

Seasonal Kendall test statistic: -38.00000

variance: 332.66667

Z: -2.02860

Prob[|S| ≥ 38.00000] = 0.042

Seasonal Kendall slope estimate: -6.80000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-20.985	-6.800	2.997
0.050	-17.861	-6.800	-0.442
0.100	-16.000	-6.800	-1.550
0.200	-13.202	-6.800	-3.410

Input data file: WELL4TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 2.3E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	38.00000	2.04298	0.04105

Seasonal Kendall test statistic: 38.00000

variance: 328.00000

Z: 2.04298

Prob[|S| ≥ 38.00000] = 0.041

Seasonal Kendall slope estimate: 12.80000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-0.942	12.800	24.530
0.050	0.000	12.800	19.400
0.100	3.472	12.800	17.616
0.200	6.614	12.800	16.810

Input data file: WELL5TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 13 Pct obs: 23.64

Mean: 3.0E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	0.00000	0.00000	1.00000

Seasonal Kendall test statistic: 0.00000

variance: 268.66667

Z: 0.00000

Prob[|S| ≥ 0.00000] = 1.000

Input data file: WELL7TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 4.8E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-52.00000	-2.79618	0.00517

Seasonal Kendall test statistic: -52.00000

variance: 332.66667

Z: -2.79618

Prob[|S| ≥ 52.00000] = 0.005

Seasonal Kendall slope estimate: -22.66667

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-40.661	-22.667	-1.505
0.050	-35.035	-22.667	-5.563
0.100	-32.334	-22.667	-8.000
0.200	-30.532	-22.667	-9.872

Input data file: WELL8TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 3.8E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-5.00000	-0.21898	0.82659

Seasonal Kendall test statistic: -5.00000

variance: 333.66667

Z: -0.21898

Prob[|S| ≥ 5.00000] = 0.827

Input data file: WELL9TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 9.3E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-27.00000	-1.42337	0.15468

Seasonal Kendall test statistic: -27.00000

variance: 333.66667

Z: -1.42337

Prob[|S| ≥ 27.00000] = 0.155

Input data file: WELL10TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 5.5E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	51.00000	2.73724	0.00619

Seasonal Kendall test statistic: 51.00000

variance: 333.66667

Z: 2.73724

Prob[|S| ≥ 51.00000] = 0.006

Seasonal Kendall slope estimate: 41.45455

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	5.073	41.455	133.009
0.050	11.919	41.455	89.219
0.100	16.505	41.455	84.349
0.200	23.698	41.455	75.209

Input data file: WELL11TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.1E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	12.00000	0.60310	0.54655

Seasonal Kendall test statistic: 12.00000

variance: 332.66667

Z: 0.60310

Prob[|S| ≥ 12.00000] = 0.547

Input data file: WELL12TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.0E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-1.00000	0.00000	1.00000

Seasonal Kendall test statistic: -1.00000

variance: 333.66667

Z: 0.00000

Prob[|S| ≥ 1.00000] = 1.000

Input data file: WELL13TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 13 Pct obs: 23.64

Mean: 3.2E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-36.00000	-2.14330	0.03209

Seasonal Kendall test statistic: -36.00000

variance: 266.66667

Z: -2.14330

Prob[|S| ≥ 36.00000] = 0.032

Seasonal Kendall slope estimate: -21.00000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-44.818	-21.000	5.421
0.050	-41.503	-21.000	-0.221
0.100	-36.361	-21.000	-2.161
0.200	-29.247	-21.000	-6.114

Input data file: WELL14TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 13 Pct

Mean: 6.6E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-16.00000	-0.91513	0.36026

Seasonal Kendall test statistic: -16.00000

variance: 268.66667

Z: -0.91513

Prob[|S| ≥ 16.00000] = 0.360

Input data file: WELL15TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 6.1E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-21.00000	-1.09490	0.27368

Seasonal Kendall test statistic: -21.00000

variance: 333.66667

Z: -1.09490

Prob[|S| ≥ 21.00000] = 0.274

Input data file: WELL16TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.1E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	3.00000	0.10982	0.91246

Seasonal Kendall test statistic: 3.00000

variance: 331.66667

Z: 0.10982

Prob[|S| ≥ 3.00000] = 0.912

Input data file: WELL17TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 2.8E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-53.00000	-2.84673	0.00442

Seasonal Kendall test statistic: -53.00000

variance: 333.66667

Z: -2.84673

Prob[|S| ≥ 53.00000] = 0.004

Seasonal Kendall slope estimate: -43.00000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-114.339	-43.000	-9.836
0.050	-102.140	-43.000	-20.883
0.100	-94.996	-43.000	-22.626
0.200	-78.165	-43.000	-27.833

Input data file: WELL18TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.5E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-57.00000	-3.06571	0.00217

Seasonal Kendall test statistic: -57.00000

variance: 333.66667

Z: -3.06571

Prob[|S| ≥ 57.00000] = 0.002

Seasonal Kendall slope estimate: -131.20000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-289.148	-131.200	-32.642
0.050	-228.264	-131.200	-66.919
0.100	-216.349	-131.200	-82.863
0.200	-214.298	-131.200	-96.810

Input data file: WELL19TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.4E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-39.00000	-2.08031	0.03750

Seasonal Kendall test statistic: -39.00000

variance: 333.66667

Z: -2.08031

Prob[|S| ≥ 39.00000] = 0.037

Seasonal Kendall slope estimate: -78.18182

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-281.165	-78.182	15.923
0.050	-196.560	-78.182	-7.829
0.100	-187.015	-78.182	-16.559
0.200	-170.005	-78.182	-35.359

Input data file: WELL20TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.5E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-43.00000	-2.29929	0.02149

Seasonal Kendall test statistic: -43.00000

variance: 333.66667

Z: -2.29929

Prob[|S| ≥ 43.00000] = 0.021

Seasonal Kendall slope estimate: -79.55556

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-149.765	-79.556	12.082
0.050	-128.800	-79.556	-11.097
0.100	-119.982	-79.556	-19.476
0.200	-111.368	-79.556	-24.319

Input data file: WELL21TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.2E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-57.00000	-3.06571	0.00217

Seasonal Kendall test statistic: -57.00000

variance: 333.66667

Z: -3.06571

Prob[|S| ≥ 57.00000] = 0.002

Seasonal Kendall slope estimate: -84.00000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-174.703	-84.000	-17.973
0.050	-158.914	-84.000	-35.465
0.100	-152.955	-84.000	-38.825
0.200	-125.327	-84.000	-44.552

Input data file: WELL22TD.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 2.5E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	3.00000	0.10949	0.91272

Seasonal Kendall test statistic: 3.00000

variance: 333.66667

Z: 0.10949

Prob[|S| ≥ 3.00000] = 0.913

Input data file: WELL23TD.TXT

First obs: 21 1 Last obs: 57 1 Max obs: 37 Act obs: 8 Pct

Mean: 6.4E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-24.00000	-2.84551	0.00443

Seasonal Kendall test statistic: -24.00000

variance: 65.33333

Z: -2.84551

Prob[|S| ≥ 24.00000] = 0.004

Seasonal Kendall slope estimate: -257.60000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-866.587	-257.600	-39.425
0.050	-604.850	-257.600	-128.158
0.100	-556.273	-257.600	-132.814
0.200	-398.190	-257.600	-144.551

Input data file: WELL24TD.TXT

First obs: 21 1 Last obs: 57 1 Max obs: 37 Act obs: 8 Pct

Mean: 3.4E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-18.00000	-2.10320	0.03545

Seasonal Kendall test statistic: -18.00000

variance: 65.33333

Z: -2.10320

Prob[|S| ≥ 18.00000] = 0.035

Seasonal Kendall slope estimate: -609.21212

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-2331.633	-609.212	460.323
0.050	-1540.502	-609.212	-34.773
0.100	-1339.156	-609.212	-152.699
0.200	-1021.439	-609.212	-287.325

Input data file: WELL26TD.TXT

First obs: 21 1 Last obs: 57 1 Max obs: 37 Act obs: 8 Pct

Mean: 2.8E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-10.00000	-1.11346	0.26562

Seasonal Kendall test statistic: -10.00000

variance: 65.33333

Z: -1.11346

Prob[|S| ≥ 10.00000] = 0.266

Input data file: WELL1SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.1E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	11.00000	0.54745	0.58416

Seasonal Kendall test statistic: 11.00000

variance: 333.66667

Z: 0.54745

Prob[|S| ≥ 11.00000] = 0.584

Input data file: WELL2SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 6.4E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	19.00000	0.98541	0.32456

Seasonal Kendall test statistic: 19.00000

variance: 333.66667

Z: 0.98541

Prob[|S| ≥ 19.00000] = 0.325

Input data file: WELL3SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 13 Pct obs: 23.64

Mean: 9.0E+0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	12.00000	0.67110	0.50229

Seasonal Kendall test statistic: 12.00000

variance: 268.66667

Z: 0.67110

Prob[|S| ≥ 12.00000] = 0.502

Input data file: WELL4SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct obs: 25.45

Mean: 1.2E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	11.00000	0.54745	0.58416

Seasonal Kendall test statistic: 11.00000

variance: 333.66667

Z: 0.54745

Prob[|S| ≥ 11.00000] = 0.584

Input data file: WELL5SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 7.6E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	25.00000	1.31388	0.18896

Seasonal Kendall test statistic: 25.00000

variance: 333.66667

Z: 1.31388

Prob[|S| ≥ 25.00000] = 0.189

Input data file: WELL7SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.8E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	35.00000	1.86133	0.06270

Seasonal Kendall test statistic: 35.00000

variance: 333.66667

Z: 1.86133

Prob[|S| ≥ 35.00000] = 0.063

Seasonal Kendall slope estimate: 63.26666

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-20.292	63.267	104.649
0.050	-2.182	63.267	96.559
0.100	9.084	63.267	93.195
0.200	14.096	63.267	81.525

Input data file: WELL8SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 1.6E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	5.00000	0.21898	0.82659

Seasonal Kendall test statistic: 5.00000

variance: 333.66667

Z: 0.21898

Prob[|S| ≥ 5.00000] = 0.827

Input data file: WELL9SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 4.3E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-27.00000	-1.42337	0.15468

Seasonal Kendall test statistic: -27.00000

variance: 333.66667

Z: -1.42337

Prob[|S| ≥ 27.00000] = 0.155

Input data file: WELL10SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 2.2E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	31.00000	1.64235	0.10054

Seasonal Kendall test statistic: 31.00000

variance: 333.66667

Z: 1.64235

Prob[|S| ≥ 31.00000] = 0.101

Input data file: WELL11SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 5.9E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	5.00000	0.21898	0.82659

Seasonal Kendall test statistic: 5.00000

variance: 333.66667

Z: 0.21898

Prob[|S| ≥ 5.00000] = 0.827

Input data file: WELL12SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 5.9E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	7.00000	0.32847	0.74253

Seasonal Kendall test statistic: 7.00000

variance: 333.66667

Z: 0.32847

Prob[|S| ≥ 7.00000] = 0.743

Input data file: WELL13SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 13 Pct obs: 23.64

Mean: 6.6E+0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	8.00000	0.42706	0.66936

Seasonal Kendall test statistic: 8.00000

variance: 268.66667

Z: 0.42706

Prob[|S| ≥ 8.00000] = 0.669

Input data file: WELL14SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 12 Pct

Mean: 3.0E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	28.00000	1.85146	0.06411

Seasonal Kendall test statistic: 28.00000

variance: 212.66667

Z: 1.85146

Prob[|S| ≥ 28.00000] = 0.064

Seasonal Kendall slope estimate: 25.70002

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-29.661	25.700	88.835
0.050	-5.067	25.700	65.529
0.100	1.708	25.700	56.412
0.200	5.823	25.700	46.017

Input data file: WELL15SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 3.1E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-5.00000	-0.21898	0.82659

Seasonal Kendall test statistic: -5.00000

variance: 333.66667

Z: -0.21898

Prob[|S| ≥ 5.00000] = 0.827

Input data file: WELL16SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 4.6E+0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-7.00000	-0.32847	0.74253

Seasonal Kendall test statistic: -7.00000

variance: 333.66667

Z: -0.32847

Prob[|S| ≥ 7.00000] = 0.743

Input data file: WELL17SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 8.1E+0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-23.00000	-1.20439	0.22853

Seasonal Kendall test statistic: -23.00000

variance: 333.66667

Z: -1.20439

Prob[|S| ≥ 23.00000] = 0.229

Input data file: WELL18SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 7.1E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	13.00000	0.65694	0.51134

Seasonal Kendall test statistic: 13.00000

variance: 333.66667

Z: 0.65694

Prob[|S| ≥ 13.00000] = 0.511

Input data file: WELL19SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 7.2E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	5.00000	0.21898	0.82659

Seasonal Kendall test statistic: 5.00000

variance: 333.66667

Z: 0.21898

Prob[|S| ≥ 5.00000] = 0.827

Input data file: WELL20SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 7.0E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	35.00000	1.86133	0.06270

Seasonal Kendall test statistic: 35.00000

variance: 333.66667

Z: 1.86133

Prob[|S| ≥ 35.00000] = 0.063

Seasonal Kendall slope estimate: 135.23635

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-59.777	135.236	462.003
0.050	-5.536	135.236	376.854
0.100	1.978	135.236	330.645
0.200	38.298	135.236	268.234

Input data file: WELL21SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 14 Pct

Mean: 5.6E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	25.00000	1.31388	0.18896

Seasonal Kendall test statistic: 25.00000

variance: 333.66667

Z: 1.31388

Prob[|S| ≥ 25.00000] = 0.189

Input data file: WELL22SO.TXT

First obs: 3 1 Last obs: 57 1 Max obs: 55 Act obs: 13 Pct

Mean: 8.6E+0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	4.00000	0.18303	0.85469

Seasonal Kendall test statistic: 4.00000

variance: 268.66667

Z: 0.18303

Prob[|S| ≥ 4.00000] = 0.855

Input data file: WELL23SO.TXT

First obs: 21 1 Last obs: 57 1 Max obs: 37 Act obs: 8 Pct

Mean: 2.8E+0002
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-2.00000	-0.12372	0.90144

Seasonal Kendall test statistic: -2.00000

variance: 65.33333

Z: -0.12372

Prob[|S| ≥ 2.00000] = 0.901

Input data file: WELL24SO.TXT

First obs: 21 1 Last obs: 57 1 Max obs: 37 Act obs: 8 Pct

Mean: 1.9E+0003
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-2.00000	-0.12372	0.90144

Seasonal Kendall test statistic: -2.00000

variance: 65.33333

Z: -0.12372

Prob[|S| ≥ 2.00000] = 0.901

Input data file: WELL26SO.TXT

First obs: 21 1 Last obs: 57 1 Max obs: 37 Act obs: 8 Pct

Mean: 2.2E+0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	-18.00000	-2.10320	0.03545

Seasonal Kendall test statistic: -18.00000

variance: 65.33333

Z: -2.10320

Prob[|S| ≥ 18.00000] = 0.035

Seasonal Kendall slope estimate: -10.80000

Confidence intervals for Kendall slope estimate

Alpha	Lower	Slope	Upper
0.010	-50.651	-10.800	2.213
0.050	-34.390	-10.800	-2.028
0.100	-31.251	-10.800	-2.461
0.200	-21.163	-10.800	-2.806

Input data file: WELL1ST.TXT

First obs: 15 1 Last obs: 57 1 Max obs: 43 Act obs: 10 Pct

Mean: 4.9E+0000
Probability: 0.10

Season	Mann-Kendall	Z	p
1	13.00000	1.07331	0.28325

Seasonal Kendall test statistic: 13.00000

variance: 125.00000

Z: 1.07331

Prob[|S| ≥ 13.00000] = 0.283

Input data file: WELL2ST.TXT

First obs: 15 1 Last obs: 57 1 Max obs: 43 Act obs: 10 Pct

Mean: 3.4E+0000
Probability: 0.10

Season	Mann-Kendall	Z	p
1	13.00000	1.07331	0.28325

Seasonal Kendall test statistic: 13.00000

variance: 125.00000

Z: 1.07331

Prob[|S| ≥ 13.00000] = 0.283

Input data file: WELL5ST.TXT

First obs: 15 1 Last obs: 57 1 Max obs: 43 Act obs: 10 Pct

Mean: 6.4E+0000
Probability: 0.10

Season	Mann-Kendall	Z	p
1	5.00000	0.35777	0.72051

Seasonal Kendall test statistic: 5.00000

variance: 125.00000

Z: 0.35777

Prob[|S| ≥ 5.00000] = 0.721

Input data file: WELL11ST.TXT

First obs: 18 1 Last obs: 57 1 Max obs: 40 Act obs: 9 Pct

Mean: 1.1E+0000
Probability: 0.10

Season	Mann-Kendall	Z	p
1	14.00000	1.35534	0.17537

Seasonal Kendall test statistic: 14.00000

variance: 92.00000

Z: 1.35534

Prob[|S| ≥ 14.00000] = 0.175

Input data file: WELL12ST.TXT

First obs: 15 1 Last obs: 57 1 Max obs: 43 Act obs: 10 Pct

Mean: 1.6E+0000
Probability: 0.10

Season	Mann-Kendall	Z	p
1	16.00000	1.34704	0.17803

Seasonal Kendall test statistic: 16.00000

variance: 124.00000

Z: 1.34704

Prob[|S| ≥ 16.00000] = 0.178

Input data file: WELL13ST.TXT

First obs: 15 1 Last obs: 57 1 Max obs: 43 Act obs: 10 Pct

Mean: 3.9E-0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	6.00000	0.44901	0.65346

Seasonal Kendall test statistic: 6.00000

variance: 124.00000

Z: 0.44901

Prob[|S| ≥ 6.00000] = 0.653

Input data file: WELL22ST.TXT

First obs: 15 1 Last obs: 57 1 Max obs: 43 Act obs: 10 Pct

Mean: 4.3E-0001
Probability: 0.10

Season	Mann-Kendall	Z	p
1	19.00000	1.60997	0.10743

Seasonal Kendall test statistic: 19.00000

variance: 125.00000

Z: 1.60997

Prob[|S| ≥ 19.00000] = 0.107

EXPANDED RECOMMENDATIONS TO ASSESS SURFACE-WATER AND GROUND-WATER CONDITIONS AT THE INDEPENDENCE AND WHITE BLUFF STEAM ELECTRIC STATIONS

Prepared for

ARKANSAS POWER AND LIGHT COMPANY
Little Rock, Arkansas

January 1985

Prepared by

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APPENDIX B: Original Set of Recommendations from the September 1984 Report, White Bluff Steam Electric Station..... B-1

The recommendations for the two sites contained in this report have been divided into three stages of work, with the understanding that each successive stage will provide an additional body of information to help in the assessment of the overall problems and liabilities. The three stages are the: (1) core program; (2) expanded core program; and (3) a "nice to have" addition to the previously listed programs. The main objective of these programs is to reduce the possible on-site and off-site liabilities by early detection of potential contaminant migrations.

EXPANDED RECOMMENDATIONS

Independence Steam Electric Station

A copy of the recommendations made in September 1984 for the ISES is presented in Appendix A. The core program is to: (1) clean all existing monitor wells and abandoned irrigation wells and test their structural integrity; (2) install new monitor wells and abandon or replace any existing monitor wells not meeting the well-installation standards; (3) equip selected monitor wells with continuous water-level recording instruments and measure others monthly; and (4) begin a ground-water quality monitoring program.

The expanded core program would include the following: (5) collect and analyze representative soil cores; (6) conduct a pumping test to determine the aquifer characteristics; (7) make a careful and regular survey of the time, pumpage, and yields of irrigation wells in the surrounding area; and (8) begin to measure the rate of flow and water quality in the White River and Mud Creek.

Implementation of several remaining recommendations would round off the program. They are to (9) collect and analyze samples of liquids from each of the potential source areas, and (10) determine the capacity of the soils to absorb the chemicals contained in the leachates from the ash-disposal areas. Each of the foregoing recommendations is expanded below.

1) Check and Clean Existing Monitor Wells:

Figure 1 shows the locations of the existing water-supply and monitor wells at the ISES plant site, along with the locations of two abandoned domestic supply wells just outside the southern boundary of the property. According to information contained in a bid document prepared by C.T. Main, the water-supply wells are constructed with a grout seal in the annulus. This is the proper construction procedure to eliminate the potential for migration of contaminants through the annulus. However, no data can be found to indicate that monitor wells C401 through C407 were constructed according to the RCRA protocol. On construction drawing 3013-6-3005-00 prepared by C.T. Main on September 11, 1979, and amended to contain monitor-well information, no mention is made of the requirements for grouting the annular spaces of these monitor wells. This needs to be checked by probing the area around each well casing with a metal rod. If no grout is found, the wells may be in violation of the RCRA construction protocol and might have to be replaced. Similar tests need to be made for the abandoned irrigation well on the property.

Once the structural integrity of all of the wells has been found to be in order, the wells will have to be cleaned by swabbing and bailing the screened areas using a small work-over drilling rig. Clean-up of a well can be terminated

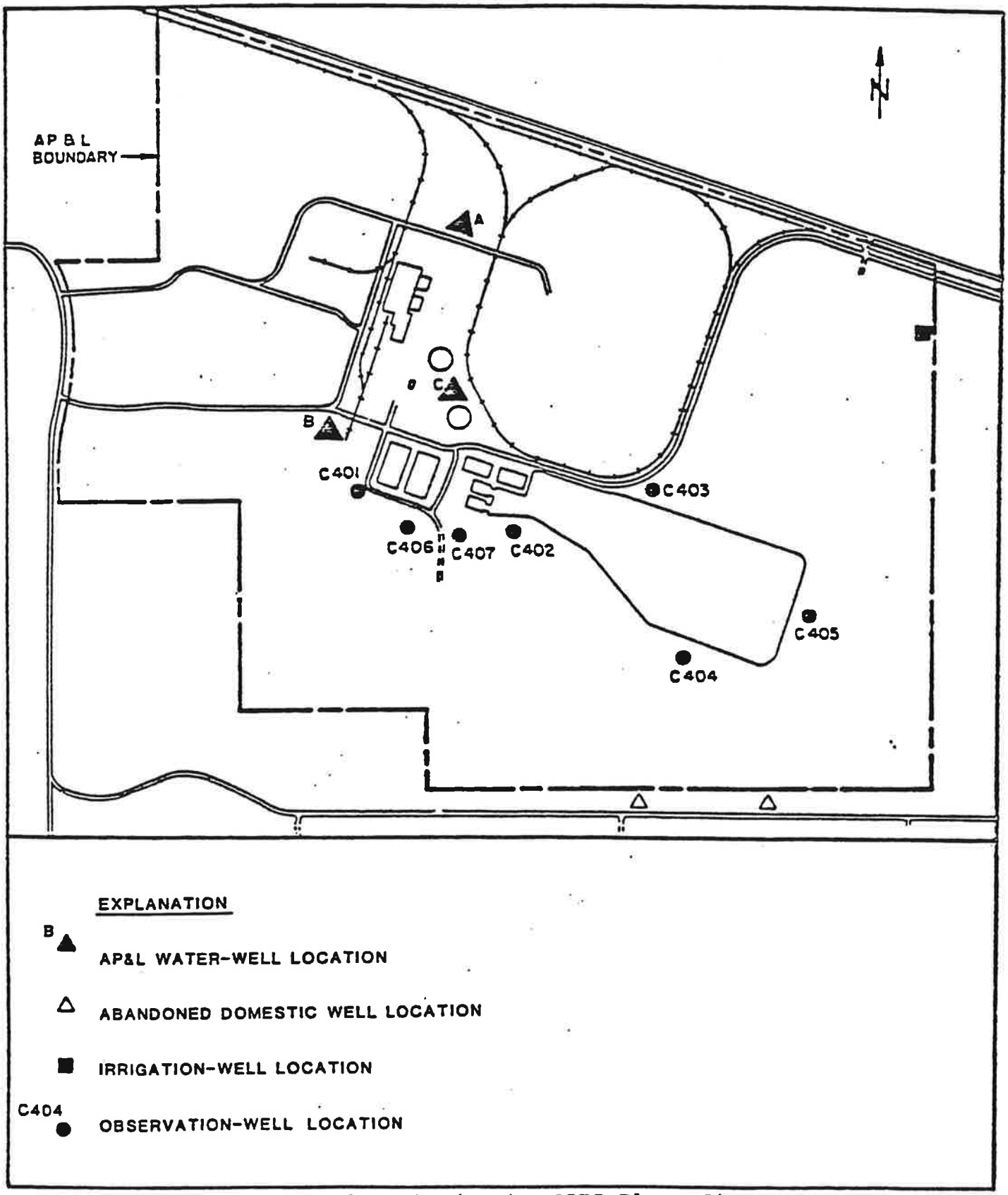


FIGURE 1. Locations of Wells in the ISES Plant Site.

if the water pumped from the well is clear and free of suspended solids.

2) New Monitor-Well Installation:

The configuration of the present monitor-well network apparently was based on the assumption that the major direction of ground-water flow is from the north to the south. That assumption was supported by the report on the installation and testing of the production wells prepared by the Layne Well Drilling Company. G&M's assessment of the present conditions, using a digital ground-water flow model, shows that the ground water under the recycle ponds tends to migrate toward production wells A and B, as shown in Figure 2, when those wells are in operation and the nearby irrigation wells are shut down.

When the irrigation wells are operating, the ground water tends to move from the White River under the ISES plant site towards the irrigated area, as shown in Figure 3. In both cases, only monitor well C403 will intercept the flow path of potential contaminants during the seasonal irrigation periods. Monitor wells C402, C404, C405, and C406 are basically upgradient of the potential contaminant sources at the ISES under both pumping scenarios.

It is recommended that AP&L consider (1) the abandonment of monitor well C407; (2) the relocation of monitor well C401; (3) the installation of new monitor wells C409 through

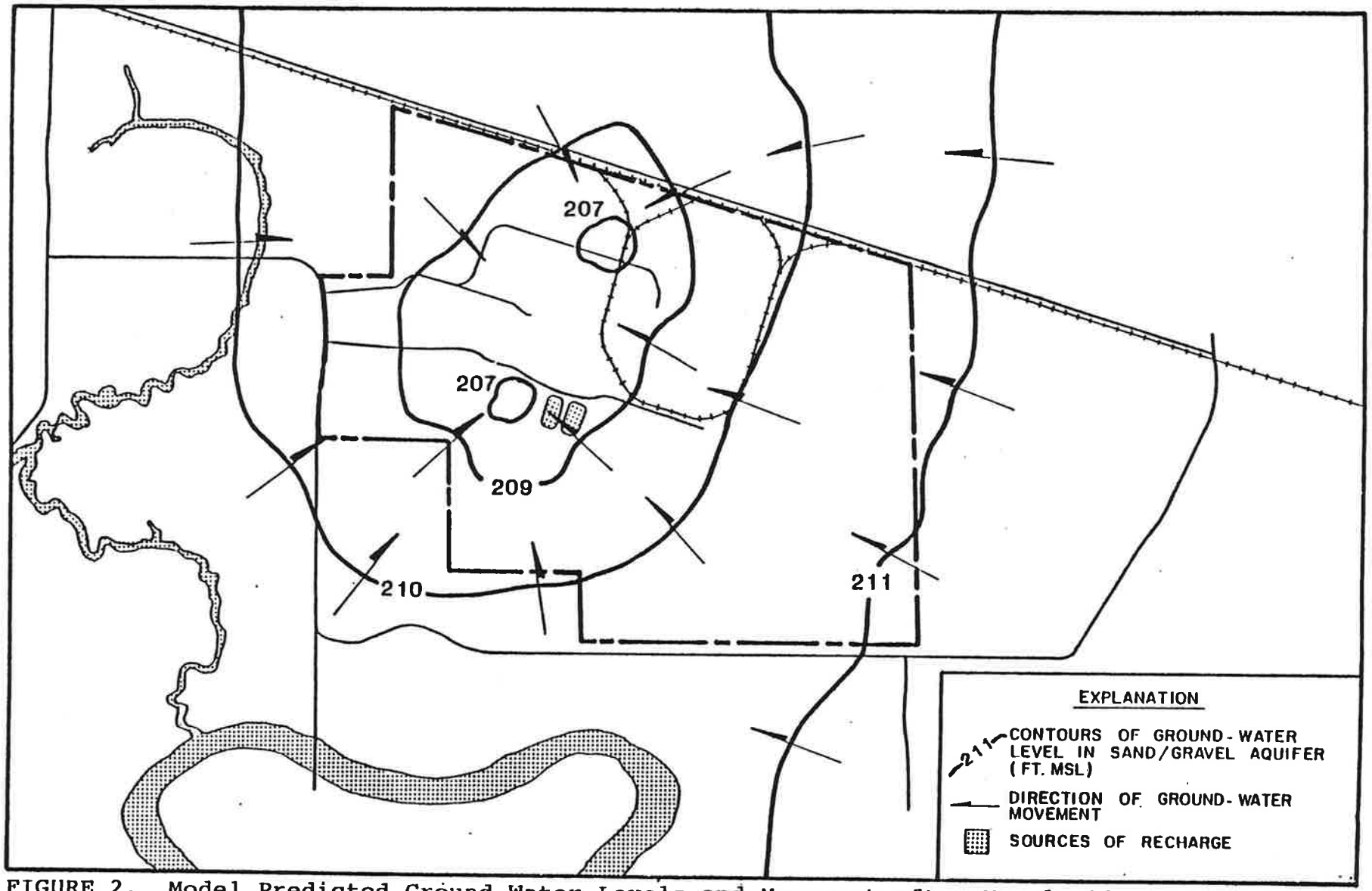


FIGURE 2. Model Predicted Ground-Water Levels and Movement after Nearly 90 Days of Pumpage from the Plant Production Wells with Recharge from the Ponds and Nearby Rivers.

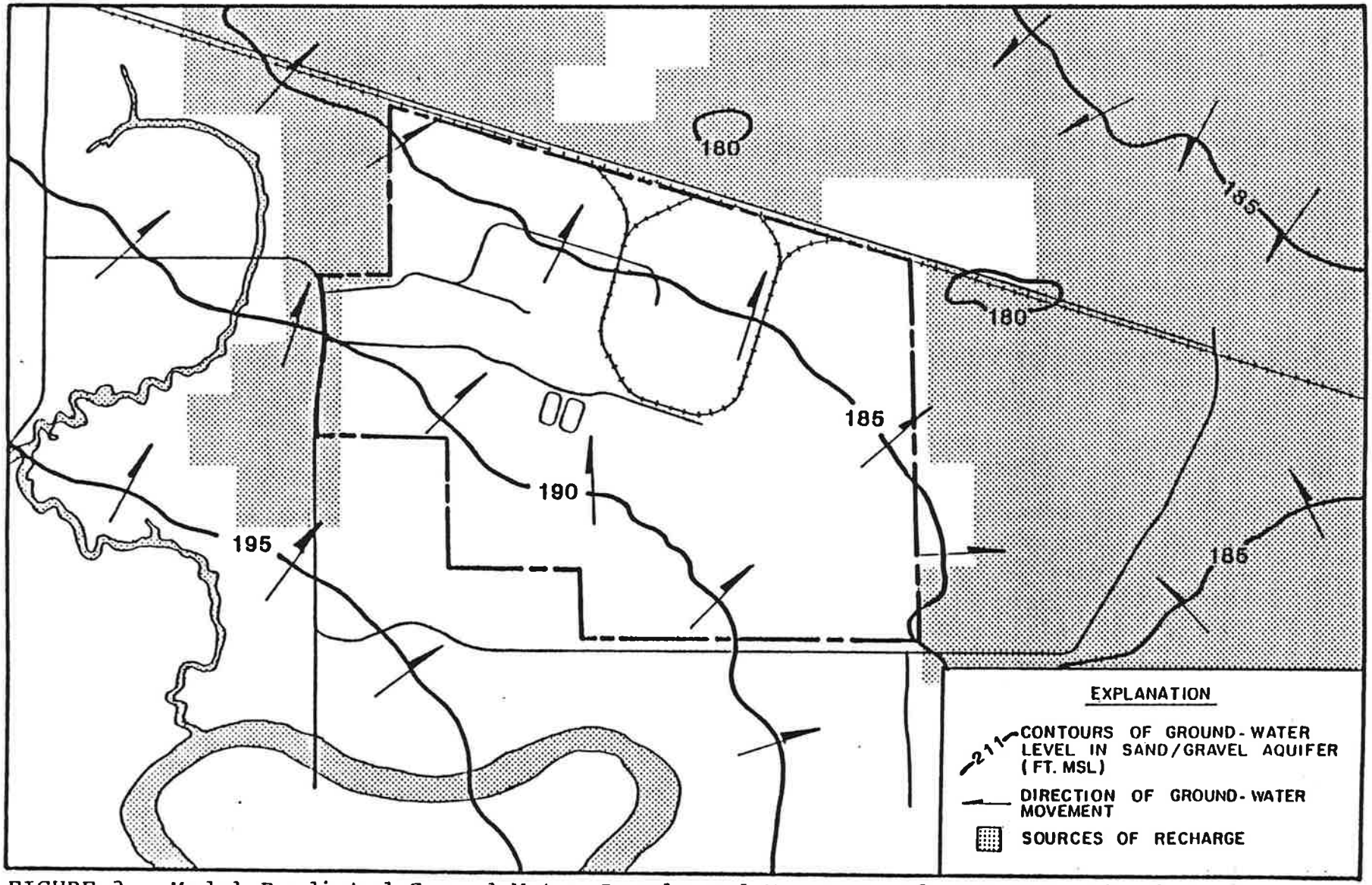


FIGURE 3. Model Predicted Ground-Water Levels and Movement after One Month of Pumpage from All Wells with Recharge from the Rivers, Ponds, and Irrigated Fields.

C415, and (4) the conversion of the abandoned irrigation well on the east side of the plant (if it is found to be structurally sound) to monitor well C416. The recommended well locations are shown on Figure 4 and the constructtion details of the additional monitor wells are presented in Figure 5.

3) Measurements of Ground-Water Levels

The directions of ground-water movement can be accurately established based on the contours of the ground-water levels in the aquifer. To verify the findings from the ground-water model and to better determine the possible migration paths of the contaminants through the ground-water system, regular measurements of the ground-water levels have to be made. It is recommended that continuous water-level recording instruments be installed in monitor wells C405, C409, C413, and C415. These instruments could be of the float-drive/time clock type, such as those made by Leopold Stevens, Inc., or the transducer type with computerized data handling.

Ground-water levels in the other wells should be measured monthly. The monthly measurements can be correlated with the continuous water-level records to construct detailed water-level maps.

4) Monitoring of Ground-Water Quality

The purpose of the ground-water quality monitoring

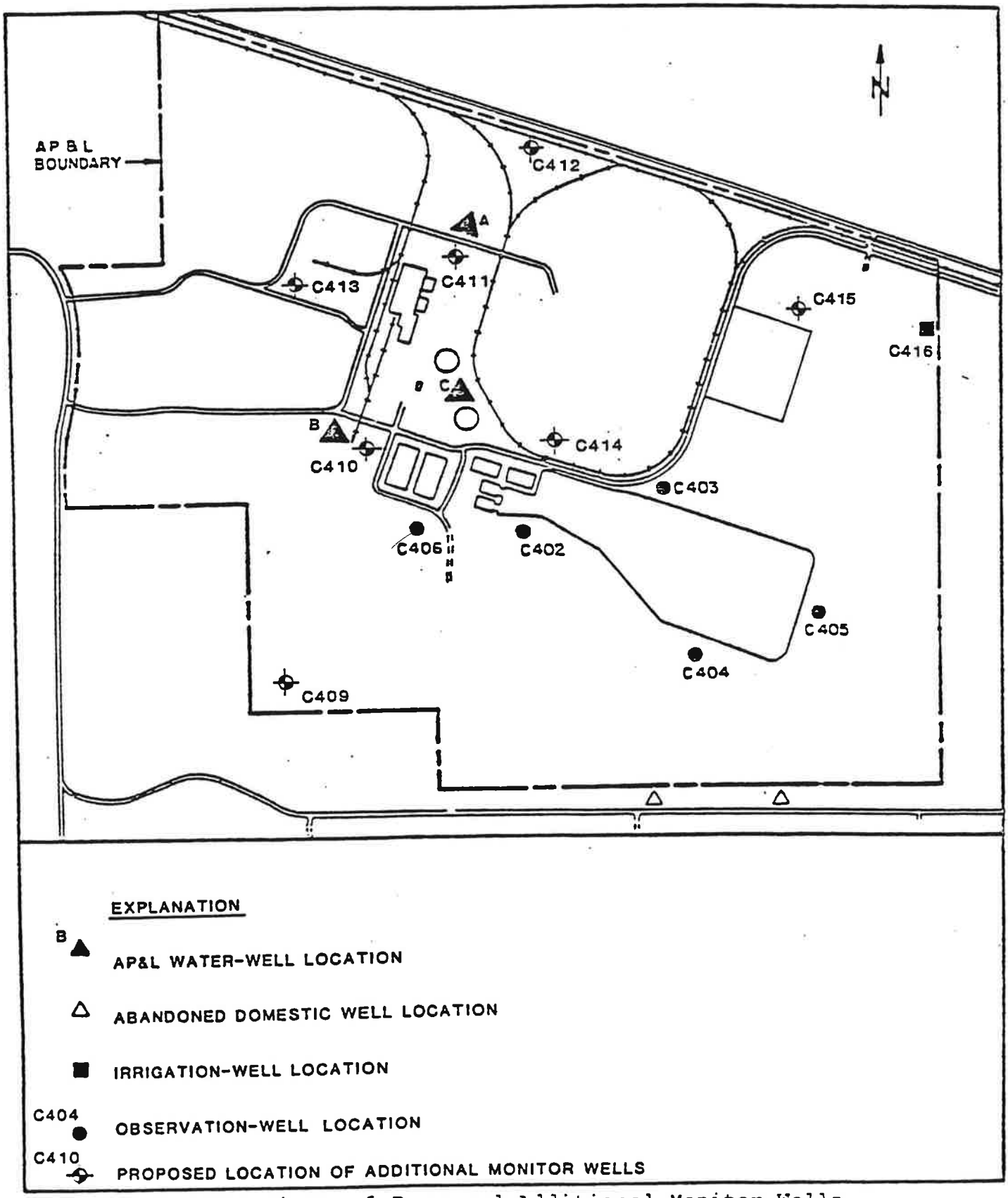


FIGURE 4. Locations of Proposed Additional Monitor Wells.

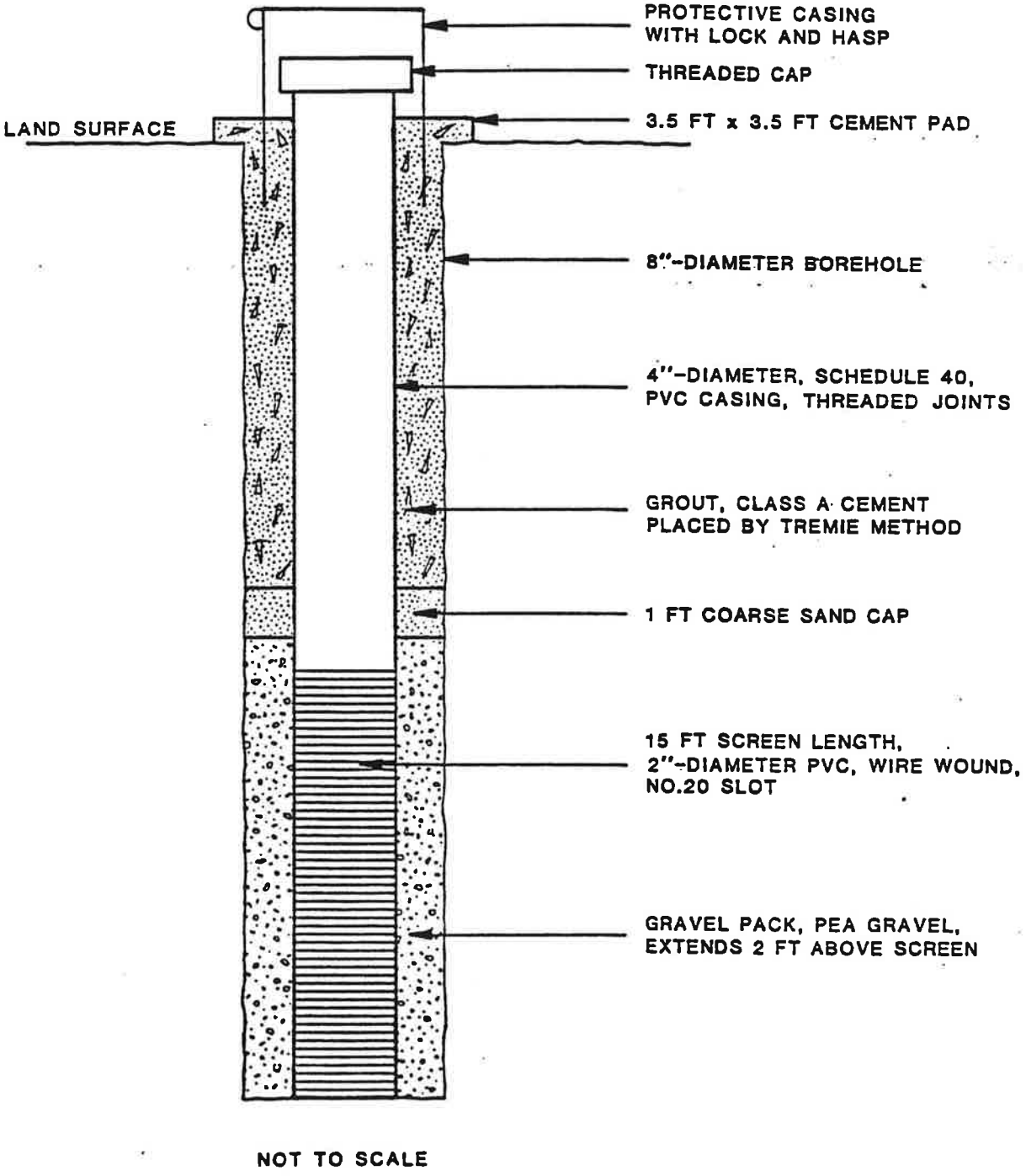


FIGURE 5. Construction Diagram of Monitor Well.

program is to document if contamination of the ground water has taken place, and if so, to estimate the effects on on-site and off-site users. Ground-water samples should be collected quarterly for the first two years and semi-annually thereafter. The laboratory analyses should be for chemical constituents most likely to be found in the leachates of the ash-storage area, runoff from the coal yard, or water in the pond systems. It is recommended that AP&L analyze the ground-water samples for:

Physical Parameters

Temperature (at time of collection)
Specific electrical conductance
pH
Suspended solids
Total dissolved solids
Turbidity
Color

Cations

Aluminum
Arsenic
Barium
Boron
Cadmium
Calcium
Chromium
Copper
Iron
Lead
Magnesium
Mercury
Potassium
Selenium
Silver
Sodium
Zinc

Anions

- Chloride
- Nitrates
- Sulfate
- Phosphates

In addition, water samples from the production wells should be checked for the kinds of fungicides, insecticides, herbicides, and pesticides most likely to have been used or still being used in the surrounding agricultural areas.

5) Collection of Soil Cores

A continuous soil core should be collected before installation of each new monitor well. Representative sections of the cores should be selected by a hydrogeologist and submitted for laboratory testing to determine their horizontal and vertical hydraulic conductivities. In the preparation of the leakance map shown in the September 1984 report, G&M used reasonable values quoted in the literature for the vertical hydraulic conductivity of each soil type (clay, silty clay, and silt) encountered at the ISES plant site. To upgrade the leakance map and thereby improve the ground-water model, more accurate determinations of the vertical hydraulic conductivities must be made.

Once the monitor wells are completed, aquifer testing should be performed on the wells using the slug/bail test method. In a slug/bail test, a volume of water in the well is displaced by suddenly inserting (or withdrawing) a solid object and carefully measuring the resulting rise (or

decline) of the water level in the well. The change in the water level with time is then plotted and interpreted to calculate the horizontal hydraulic conductivity of the aquifer materials.

6) Aquifer Pumping Test

To upgrade the predictive capability of the ground-water model, it will be necessary to collect data on the actual aquifer characteristics, which can only be done by performing an aquifer pumping test. In such a test, a production well is pumped at a steady rate and the water-level response of the aquifer system is measured in nearby wells.

It is recommended that the aquifer pumping test be performed using production well B. Well "C" nearby in the coal-storage area and monitor wells C401 through C407 should be used to provide water-level data during the test. Monitor wells C403, C405, C406, C411, and C413 should be equipped with continuous water-level recorders, which should operate for at least a week prior to the test and for the entire test and recovery periods. Aquifer conditions must be stabilized before the test begins, which can be accomplished by continuously pumping from production well "A" at a constant rate; the pumping rate will have to be accommodated to the plant's water requirements. Once the test starts, production well B will be pumped at a rate of at least 1,000 gpm (gallons per minute) for three days, with the water being pumped from the well to be discharged via the outfall to the

the ISES site should be made from aerial photographs and information available from agencies such as the U.S. Geological Survey, the State Department of Health, and others. An attempt should be made to determine the rate of discharge and the periods of pumping for each well. An assessment also has to be made of how much water pumped onto the fields will run off as surface-water flow.

8) Measurements of Surface Water

The data from the Layne report suggest that during non-pumping conditions, ground water under the site migrates toward the White River. However, as noted previously, the ground-water model indicates that during periods of pumping from the ISES production wells, the ground-water flow is reversed and the river may become a potential source of recharge to ground water. This condition is even more pronounced during the irrigation season. To estimate the potential amount of recharge from the river, surface-water gaging stations should be established at the locations shown in Figure 6. AP&L should consider discussing the establishment of the gaging stations with representatives of the U.S. Geological Survey and the State Geological Survey, inasmuch as data collected from those stations would be of benefit to the regional monitoring of water resources.

To determine if any contaminants present in the surface water might enter the ground-water system and migrate towards the plant, it will be important to collect samples of the

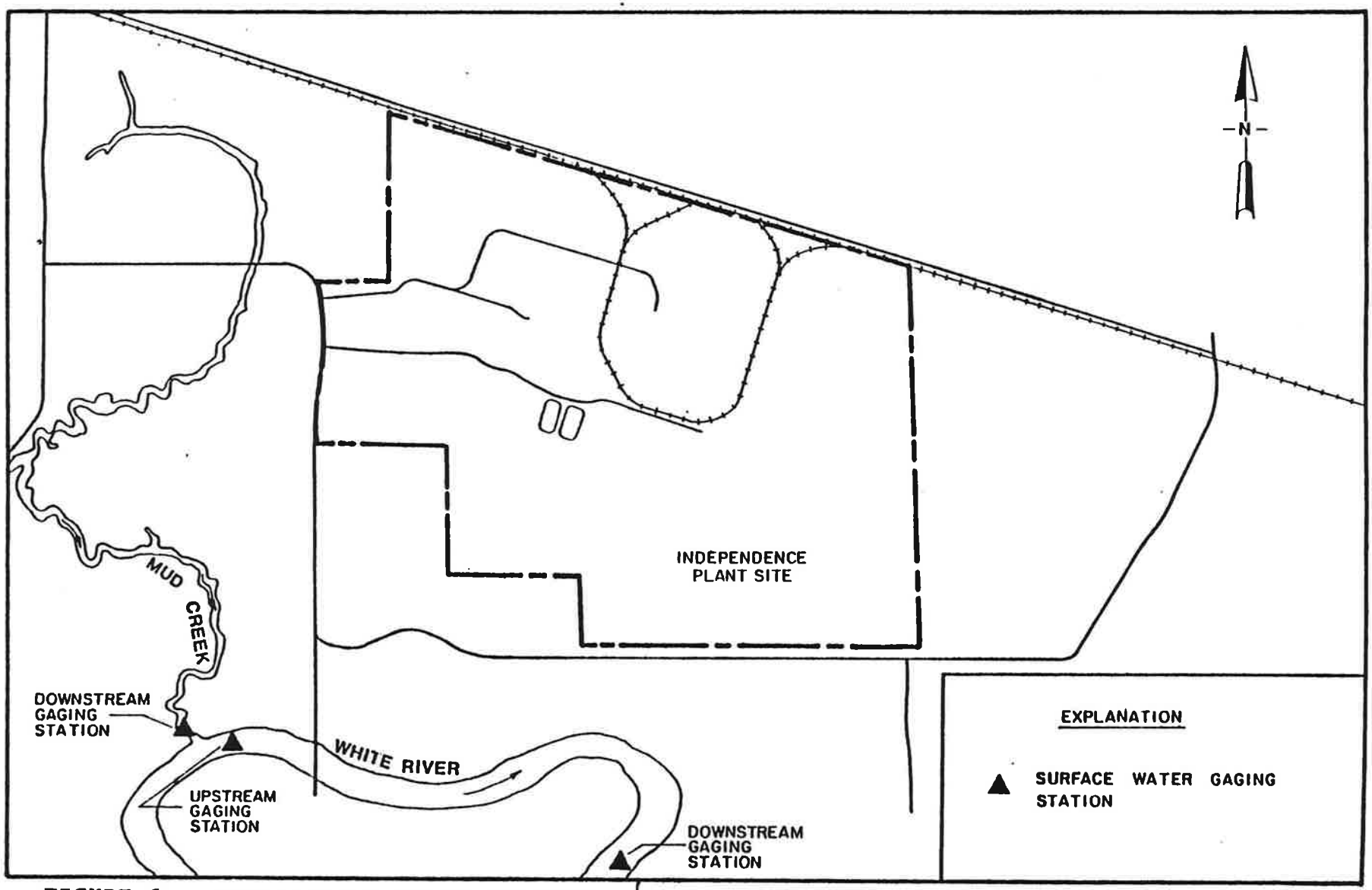


FIGURE 6. Proposed Locations of Surface-Water Gaging Stations.

Geraghty & Miller, Inc.

surface water for chemical analyses. Such samples would only have to be collected at one of the gaging stations, and should be analyzed for the chemical compounds listed under recommendation 4). In addition, analyses should be made for selected organic chemicals suspected to be present. The samples should be collected on a quarterly basis for two years and semi-annually thereafter.

9) Measurements of Ash for Leachate Formation

Previous studies have been conducted to determine the chemical compounds in the ash. However, the question to be addressed is whether leachate is present at the bottom of the ash-disposal sites, and if so, what chemicals are in the leachate and at what concentrations. It is therefore recommended that bench-type leachate tests be performed using ash from the plant, to determine how much water is needed to produce leachates (if at all), how much leachate is produced in relation to the volume of water applied, and what the concentrations of the various chemical constituents might be.

If the bench-test data prove positive, a pilot field test site should be set up in the ash-storage area. A schematic diagram of such a test site is shown in Figure 7.

10) Absorptive Capacity of Soils

The two key questions in this area are: (1) will leachates be produced at the ash-storage areas on a long-term basis, and if so, (2) will the underlying clayey soils absorb

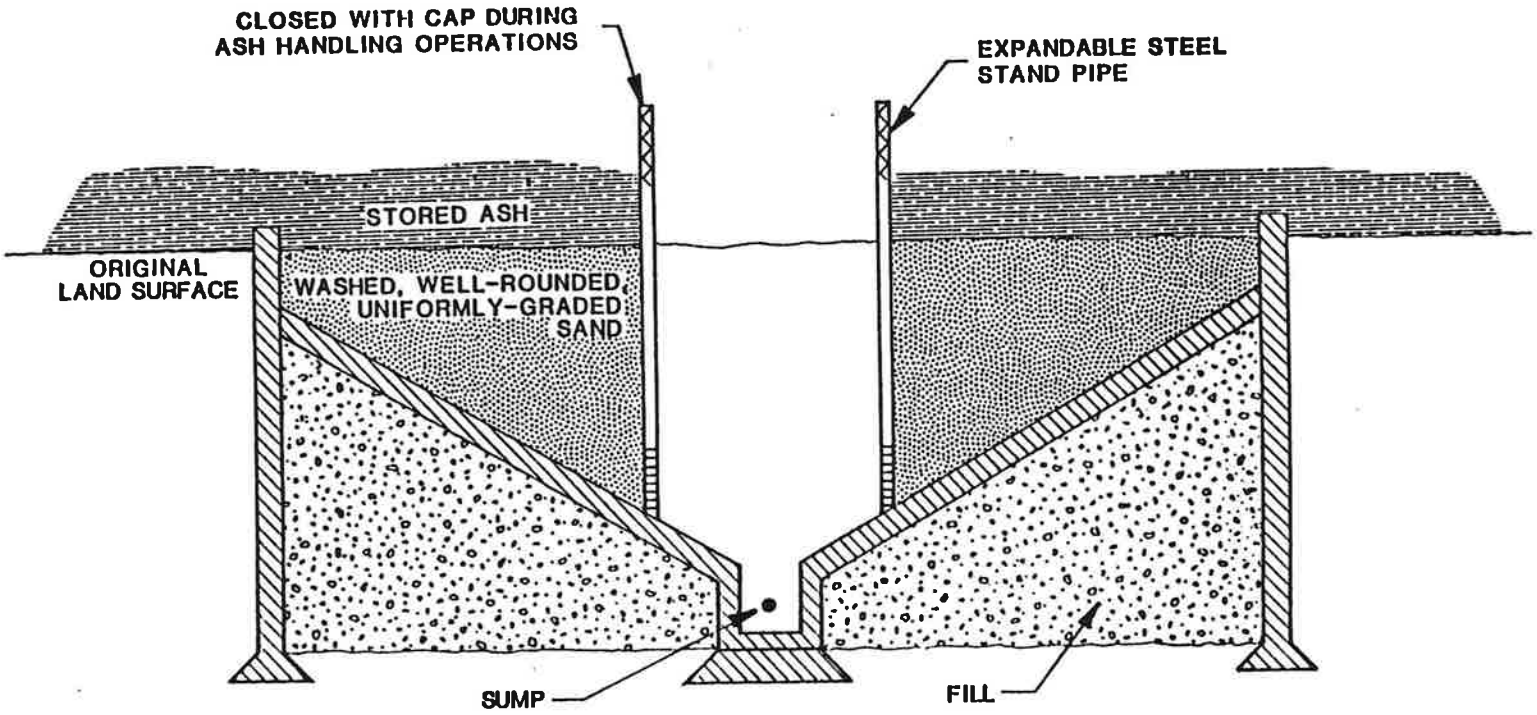


FIGURE 7. Schematic Diagram of Pilot Test Site at Ash Storage Area to Measure and Collect Leachates.

the chemicals in the leachates. To answer the latter question, it is recommended that the leachates generated in the bench tests described in recommendation 9) be used as the liquids for percolation tests on selected soil samples obtained in the soil coring program described in recommendation 5). The purpose of the tests will be to determine the maximum capacity of the soils to absorb the chemical compounds (primarily metal ionic species) contained in the leachates.

EXPANDED RECOMMENDATIONS

White Bluff Steam Electric Station

A copy of the original set of recommendations in the September 1984 report is enclosed in Appendix B. The core program recommendation (11) is to install additional monitor wells in the 230-ft sands, 260-ft sands, and the water-bearing sands of the Cockfield Aquifer. Aquifer pumping tests and analyses of water-quality samples will be needed for the newly installed wells.

The expanded core program recommends: (12) installation of additional monitor wells and monitor-well clusters downgradient from the surge pond and clear-water holding pond and the performance of aquifer tests and water-quality sampling; (13) collection of continuous soil cores at all of the proposed monitor-well locations; and (14) setting up of surface-water gaging stations on Love, Tar Camp, and Lipscomb Creeks upgradient and downgradient of the potential contaminant source areas. Discharge measurements should be taken at the times of collection of water-quality samples.

The program would be completed with two recommendations similar to those proposed for the ISES, namely (15) test the ash for the generation of leachate, and if present, its chemical qualities, and (16) collect leachate at the site and run it through the previously collected soil cores to determine the capacity of the soils to absorb chemical

compounds. Each of these recommendations is discussed in detail below.

I) Installation of Monitor Wells

At the WBSES plant site, four piezometer wells have been installed at the dam impounding the waters in the clear-water holding pond, mainly to check on the structural integrity of the dam. No monitor wells have been installed to measure ground-water levels or to collect ground-water samples.

It is recommended that monitor wells be installed in the 230-ft sand at the locations shown in Figure 8; a construction diagram of a typical monitor well is shown on Figure 5. In addition, monitor wells should be installed in the 260-ft sand at the locations suggested in Figure 9; the construction details of these wells are as shown in Figure 5. The locations of proposed monitor wells tapping the Cockfield aquifer are presented in Figure 10. Owing to the large variations in the topography of the site and the depth of the water-bearing sands, site-specific, specifications will have to be prepared for the wells at the time AP&L decides to implement these recommendations. After completion, each well will be developed by swabbing, bailing, and pumping until the water is clear and free of suspended solids. Aquifer tests then will be conducted by pumping the wells for a given time period and measuring the water-level responses in the pumped well. During the pumping test, samples will have to be collected and analyzed for the

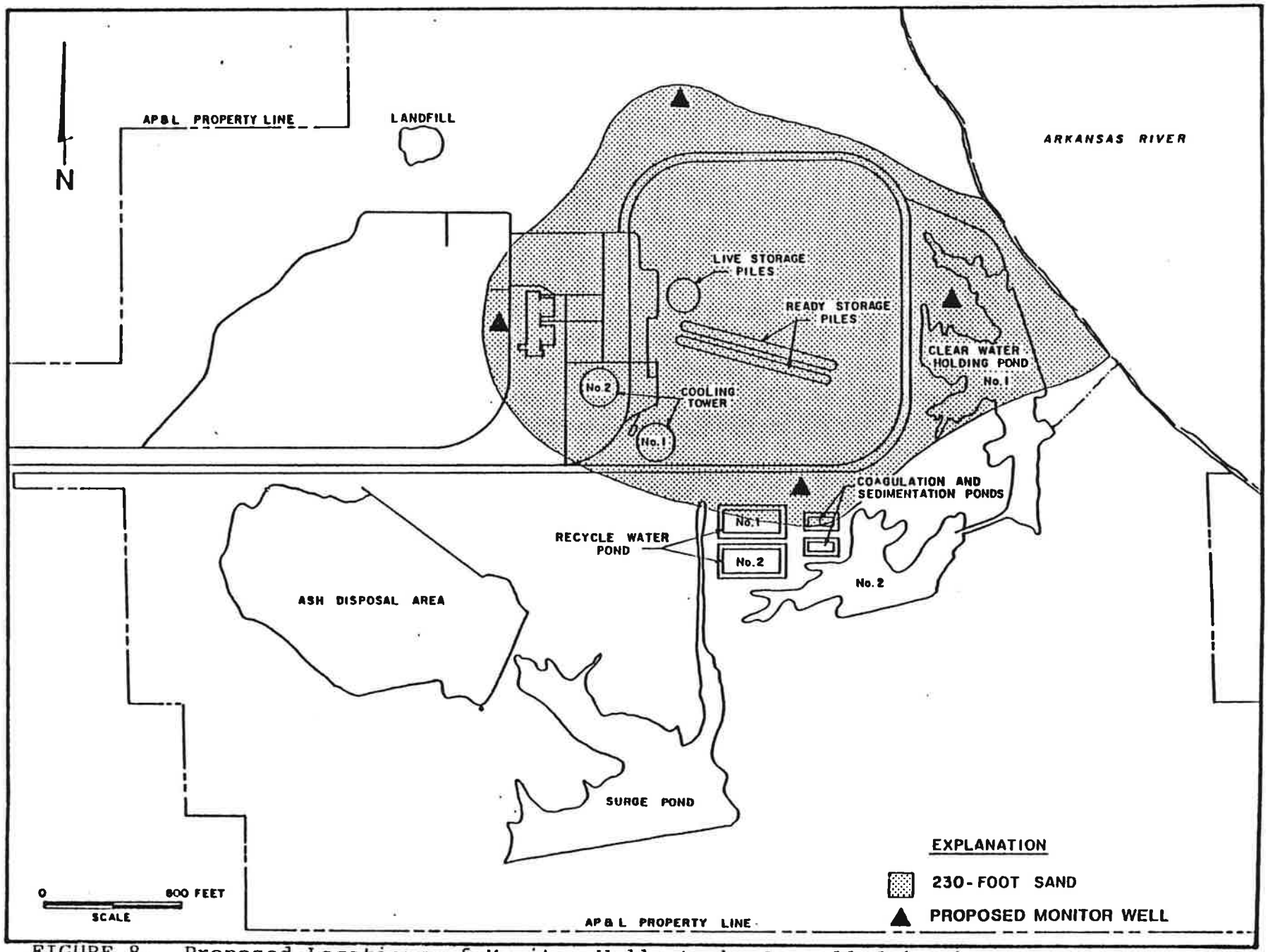


FIGURE 8. Proposed Locations of Monitor Wells to be Installed in the 230-Foot Sand.

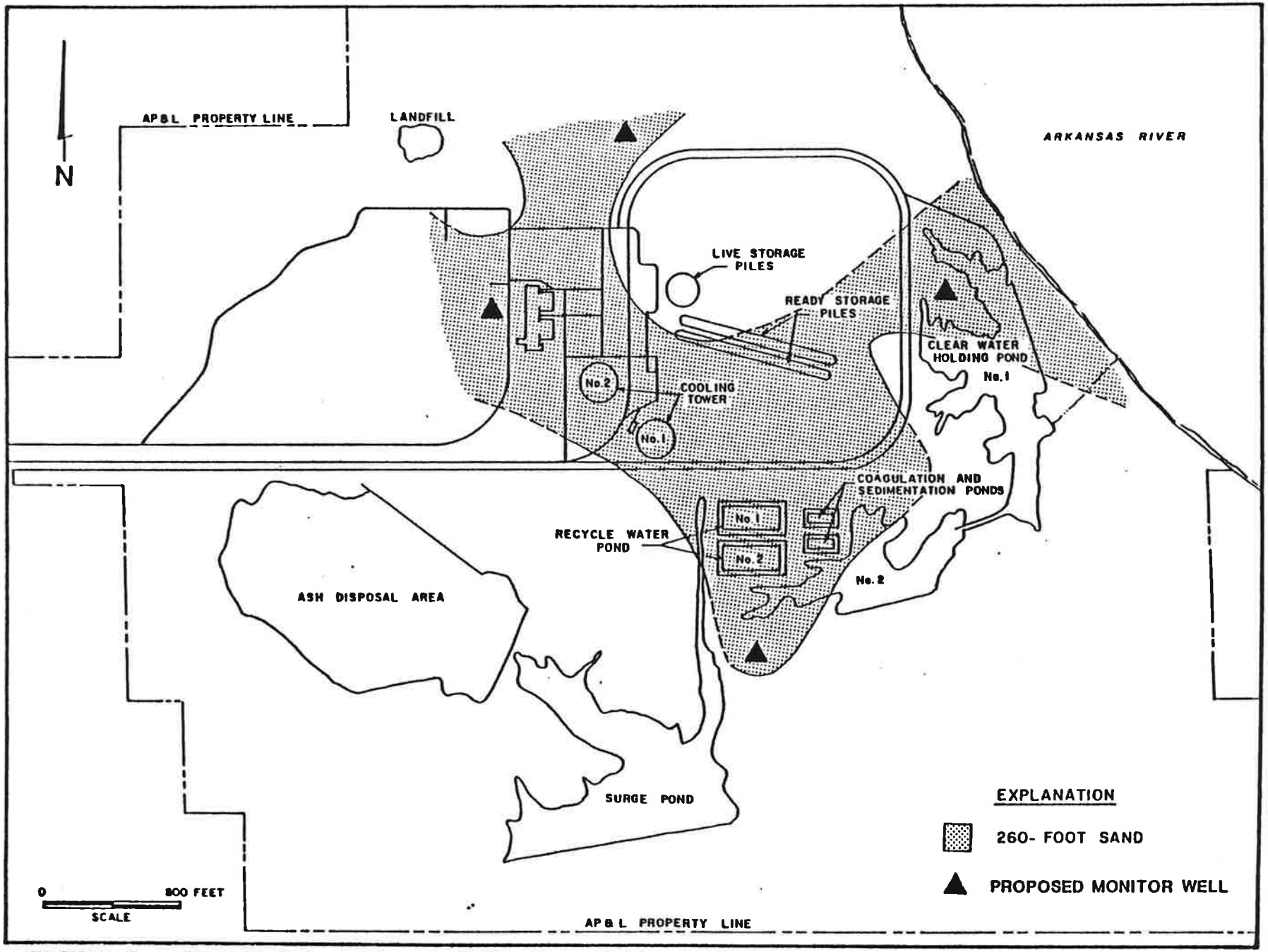


FIGURE 9. Proposed Locations of Monitor Wells to be Installed in the 260-Foot Sand.

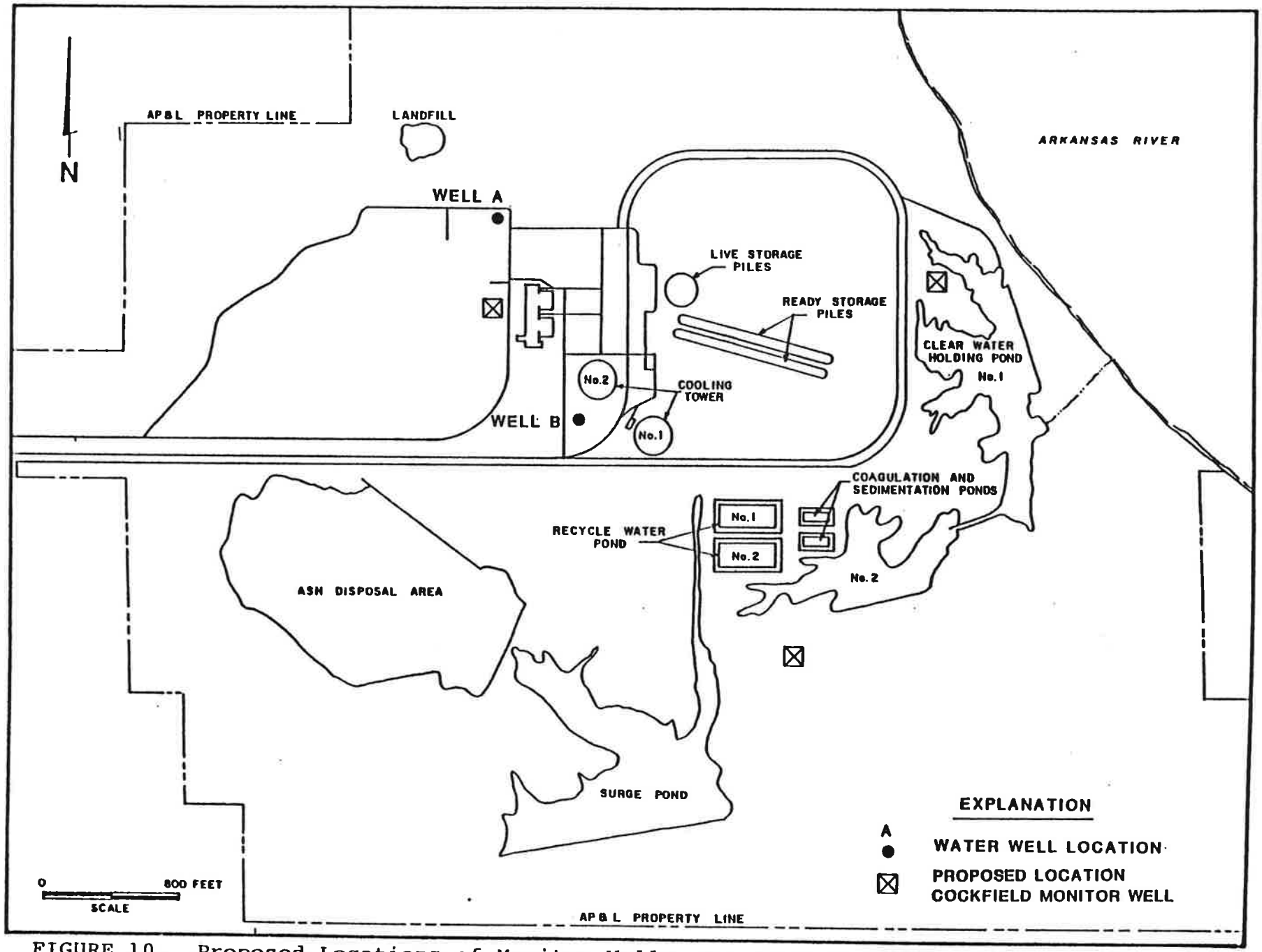


FIGURE 10. Proposed Locations of Monitor Wells Installed in the Cockfield Aquifer.

presence of the chemical and physical parameters shown in Section 4.

12) Installation of Additional Monitor Wells

There is circumstantial evidence that water from the surge pond may be migrating through the subsurface to possibly emerge in the stream channel of Love Creek. To qualify or quantify this evidence, it is recommended that a monitor-well cluster be installed in the vicinity of boring B-203 (see Figure 11).

An important gap in information is the potential for migration of leachate from the ash disposal areas to the neighboring surface-water drainage of Love Creek via the shallow aquifer, as shown in the hypothetical cross section in Figure 12. To test this hypothesis, it is recommended that a monitor well be installed near the ash-disposal area as shown in Figure 13.

To evaluate the potential for seepage from the clear-water holding pond, it is recommended that two monitor wells be installed downgradient from the two dams that impound the waters of the pond. The well locations are shown in Figure 13.

Slug/bail tests need to be performed on all of the monitor wells to determine the hydraulic properties of the water-bearing formations. Prior to the tests, it is recommended that water samples be collected and analyzed for

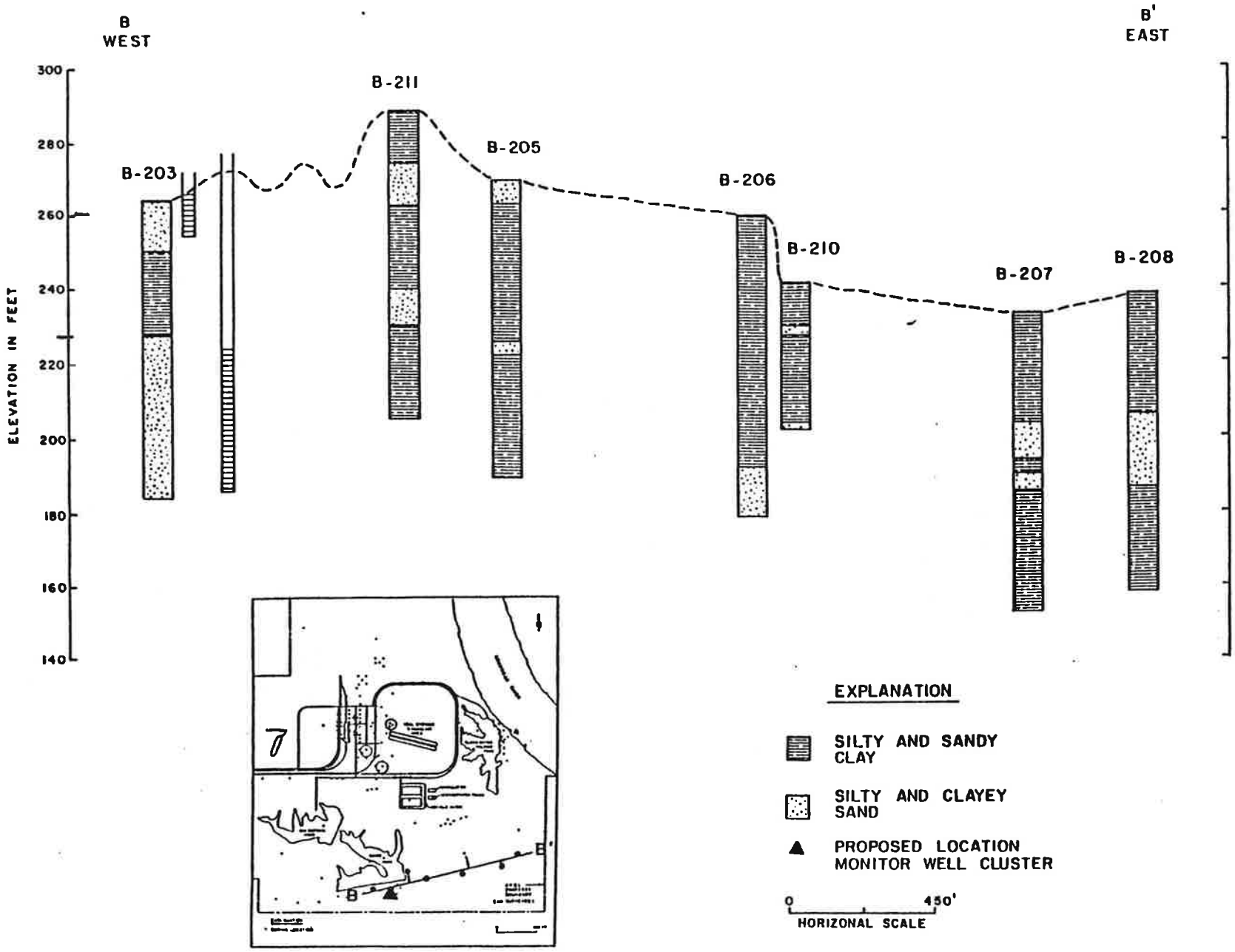


FIGURE 11. Cross-Section B-B' and Proposed Location of Monitor-Well Clusters at Surge Pond Dam.

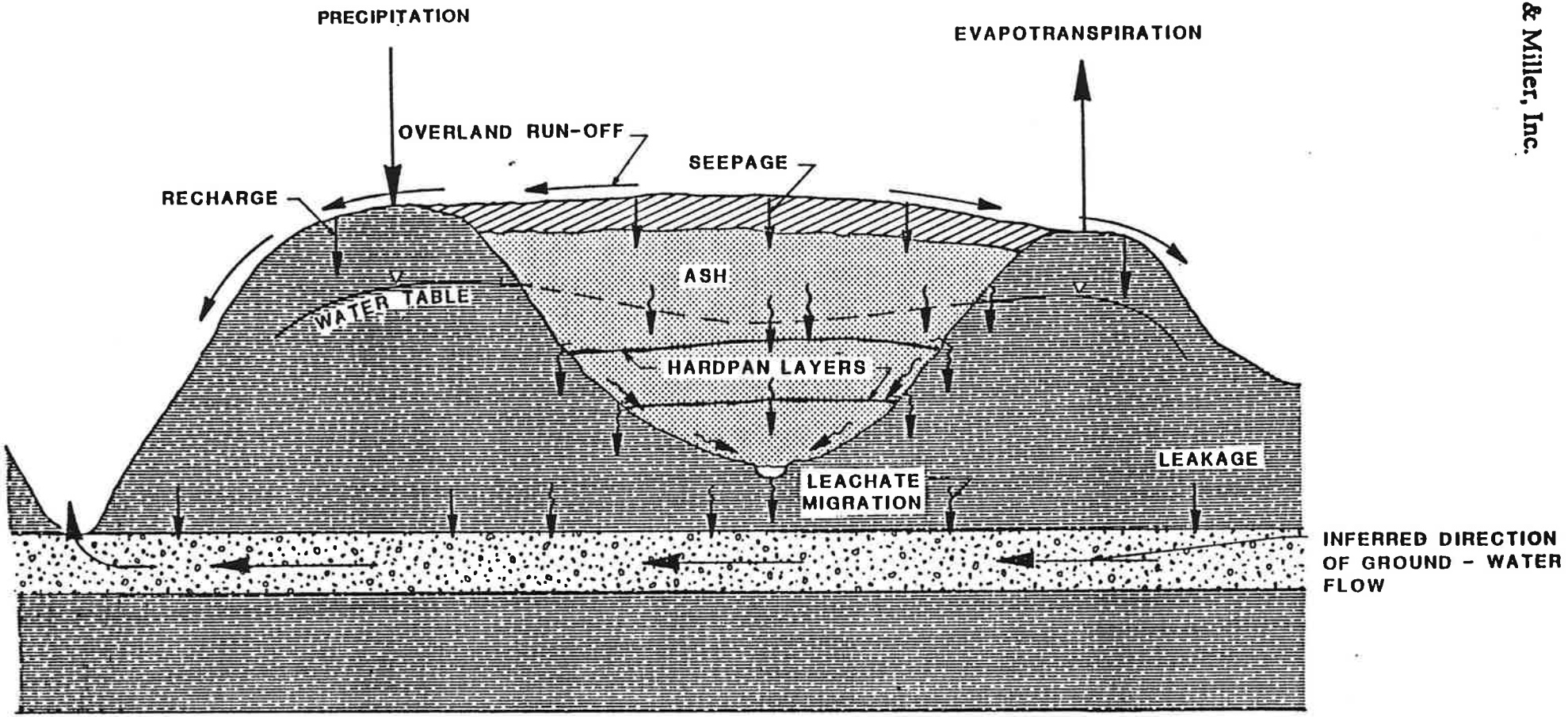


FIGURE 12. Inferred Potential Migration of Leachates from Ash-Disposal Area to Nearby Surface Waters via Shallow Water-Bearing Sands Layer.

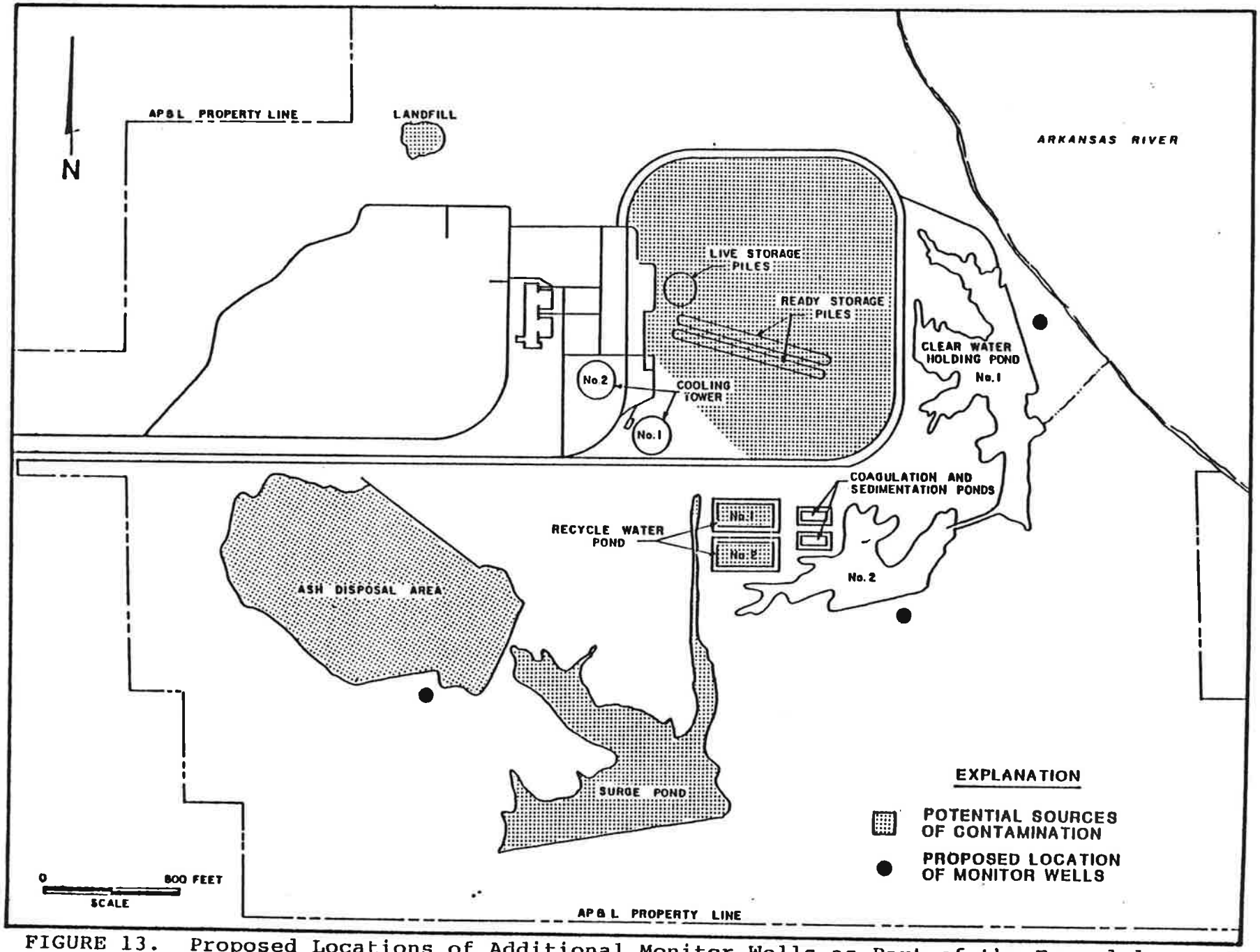


FIGURE 13. Proposed Locations of Additional Monitor Wells as Part of the Expanded Core Program.

the presence of the chemical constituents listed in Recommendation 4).

Once all the monitor wells are installed, a water-level measurement program needs to be instituted. It is recommended that at least one of the wells in the 230-ft sand, the 260-ft sands, and the Cockfield Aquifer be equipped with continuous water-level recorders. It is also recommended that the well downgradient from the surge pond dam and the clear-water holding pond dam near the Arkansas River be equipped with continuous water-level recorders. In the remaining wells, water levels should be measured every two weeks for one year and monthly thereafter.

13) Continuous Soil Cores

Prior to the construction of the monitor wells, continuous soil cores should be taken in the shallow wells. For the deeper wells, it is recommended that drilling samples be collected during the drilling of the wells, and upon completion of the open boreholes, subsurface geophysical logs be run. The types of logs to be considered are electrical resistivity, gamma ray, temperature, conductivity, and caliper.

14) Surface-Water Gaging Stations

To measure the potential for off-site migration of contaminants via the surface-water system, it is recommended that gaging stations be established as shown on Figure 14.

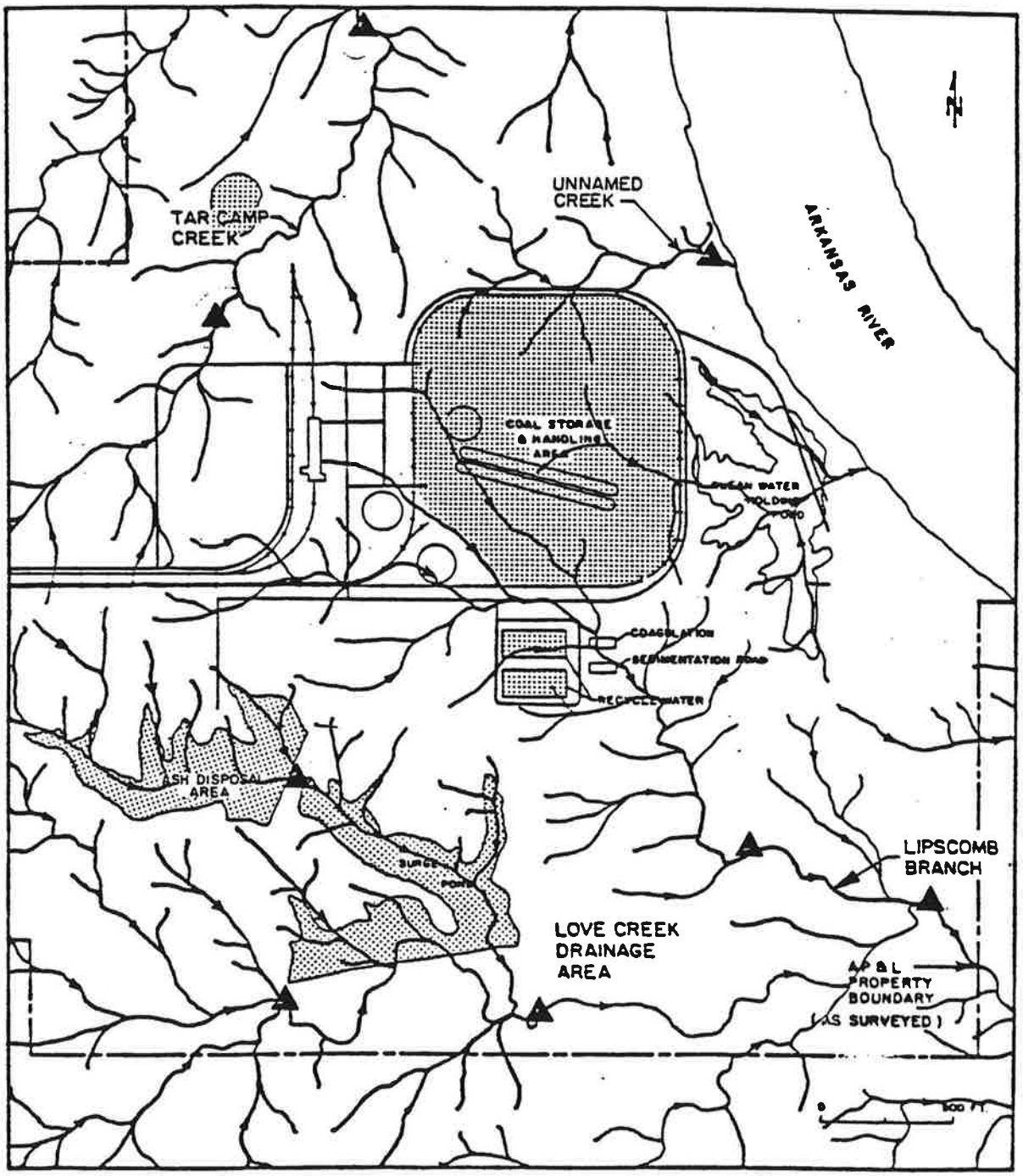


FIGURE 14. Proposed Locations of Surface-Water Gaging Stations.

The downstream stations on Tar Camp, Love Creek and Unnamed Creek should be equipped with continuous water-level recorders. All the other stations should be equipped with a weir and staff gages. Because little is known about the flow regimes of the streams, frequent measurements should be made (at least twice a month) to establish a trend so that a schedule for discharge measurements can be prepared. At the times of discharge measurements, water samples should be collected to be analyzed for the parameters listed in Section 4).

15) Leachate Tests

Testing of the leachates, on a bench test scale and in the field, should be run as described in Section 9).

16) Soil-Leachate Absorption Test

Tests to determine the capacity of the soils to absorb the particular chemicals in the leachates should be run, as described in Section 10).

APPENDIX A

Original Set of Recommendations from the September 1984 Report, Independence Steam Electric Station

RECOMMENDATIONS

The following recommendations are designed to fill the data gaps previously noted under the list of deficiencies. The recommendations are general in nature and will be discussed in greater detail in a scheduled review meeting. It is recommended that:

(a) Representative soil cores be collected at selected locations and at different depths to provide laboratory determinations of vertical hydraulic conductivity.

(b) An aquifer-pumping test be conducted using production well B. Nearby wells in the coal storage area and monitor wells near the recycle ponds should be used to provide water-level data during the pumping test. The test should be conducted for several days and only commence after pumpage from well B has ceased for a week to allow stable aquifer conditions to develop. The data collected during the pumping test and recovery periods (after the test) will be used to determine transmissivity, storage coefficient, and leakance from the overlying confining bed.

(c) All existing monitor wells and abandoned irrigation wells at the ISES site be cleaned and checked structurally to incorporate them in a plant-wide

ground-water level monitoring network. Selected wells will need to be equipped with continuous water-level recorders, and other wells need to be measured each month. New monitor wells should be installed between production well B and the recycle ponds, plus additional monitor wells on the perimeter of the plant site.

(d) Ground-water samples be collected and analyzed from all the monitor wells and selected existing but abandoned irrigation wells (if structurally sound). Parameters to analyze for are those that will be found in the potential source areas.

(e) Samples of liquids from each of the potential contaminant source areas be collected and analyzed.

(f) Laboratory tests be conducted using columns of soil from the ISES site and leachates from the potential contaminant source areas to determine the effective absorptive capacity for selected ion species in the leachates.

(g) The extent of rice irrigation and the estimated pumping yield of irrigation wells be determined.

(h) Tests with the stacked materials at the ash disposal area need to be conducted to determine if future rainfall events during and after closure

will generate leachate and what the nature of that leachate will be.

(i) Surface-water gaging stations be established to measure rates of flow in the White River and Mud Creek upgradient and downgradient of the plant site. Surface-water samples be collected to define water-quality parameters.

Once the recommendations listed under (a), (b), (c) and (g) are implemented and the data collected, the present ground-water flow model can be updated and calibrated against actual water-level measurements.

APPENDIX B

Original Set of Recommendations from the September 1984 Report, White Bluff Steam Electric Station

RECOMMENDATIONS

The following recommendations are designed to fill the data gaps previously noted under the list of deficiencies. The recommendations are general in nature and will be discussed in greater detail in a scheduled review meeting. It is recommended that:

(a) Representative soil cores be collected at selected locations and at different depths, especially in the ash storage and surge pond areas, to provide a better definition of the shallow hydrogeology.

(b) Monitor-well clusters be installed downgradient of the surge pond dam and ash storage areas, and between the Arkansas River, Lipscomb Branch, and the clear- water holding pond. Each cluster should consist of one well screened in the 260-ft sand and one well screened in the 230-ft sand.

(c) Additional upgradient monitor-well clusters be installed to the west and north of the plant site to determine the general direction of ground-water flow in the 230- and 260-ft zones.

(d) Wells be installed at three points to monitor water levels and water quality in the Cockfield aquifer (which underlies the Jackson Formation).

(e) Slug tests be conducted in the newly installed monitor wells to determine the in-situ hydraulic conductivity and transmissivity of the aquifers.

(f) Surface-water gauging stations be established on Love, Tar Camp, and Lipscomb Creeks upgradient and downgradient of the potential contaminant source areas. Discharge measurement should be taken along with the collection of water-quality samples.

(g) Water-level measurements be made and ground-water samples be collected and analyzed from all the newly installed monitor wells on a regular basis.

(h) Laboratory tests be conducted using columns of soil from the WBSES site and leachates from the potential contaminant source areas to determine the effective absorptive capacity for selected ion species.

(i) Tests be conducted with the stacked materials for the ash storage area to determine if future rainfall events during and after closure will generate leachate and what the nature of that leachate will be.

(j) Soil moisture and lysimeters be installed in the stored ash to determine moisture build-up and leachate production after disposal.

FINAL REPORT

Assessment of Surface-Water and Ground-Water Conditions, White Bluff Steam Electric Station, Redfield, Arkansas

Prepared for

ARKANSAS POWER
AND LIGHT COMPANY

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SUMMARY

A preliminary assessment of the surface-water and ground-water conditions at the White Bluff Steam Electric Station indicates that a potential exists for contaminants to migrate off-site through the surface-water system draining the site. However, the data base is not sufficient to clearly quantify the off-site migration of contaminants and the possible liabilities thereof.

The potential for contamination of the Sparta aquifer, generally used for water supply in the area, is negligible. However, the potential for contamination of the 230 and 260-ft zones in the Jackson Formation exists but its magnitude and extent depends on the ground-water levels in these zones.

The lowest parts of the bottom of the clear-water holding pond appear to penetrate the 260 and 230-ft sands. The storage of water in the clear-water holding pond will recharge these sand layers, which drain towards the Arkansas River. Seepage of more than 400,000 gallons per day is estimated to migrate from the pond to the Arkansas River.

The existence of a shallow permeable zone underlying the surge pond dam will allow an estimated 5,000 gpd to migrate through the subsurface towards Love Creek. The amounts of chloride and sulfate salts to reach Love Creek in this manner are estimated to be more than 13 lbs per day. Although this

does not appear to be a large quantity, its long-term effect on the vegetation downgradient of the surge pond dam might be quite noticeable.

A surficial silty clay unit separates the shallow aquifers in the Jackson Formation from the contaminant sources in the recycle ponds and slows the vertical migration of the contaminants. It is nevertheless estimated that 4,740 gpd of seepage from the recycle ponds will reach the 260-ft (upper) sand zone, introducing 10.5 lbs/day of chloride and sulfate salts in that aquifer. These salts are expected to migrate and enter the clear-water holding pond.

The clayey soils underlying the potential contaminant sources should adsorb to some extent positively-charged cation species such as heavy metals and certain trace elements, but this aspect cannot presently be quantitively assessed. In general, however, existing reports from other areas note that cation-exchange is a major long-term deterrent to movement of many heavy metal contaminants.

Information on the possible long-term formation of leachates from the ash storage area is minimal. Site-specific studies are needed to assess this potential at WBSES, and to define the types and concentrations of the contaminants in the leachates at the bottom of the ash storage area. The possible vertical movement toward the aquifer of some of the heavy metal species and conservative ions in leachate that might be generated needs further

investigation. It is anticipated that much of the leachate from the ash storage areas will enter the surge pond. However, leachates can also enter the shallow aquifers and migrate in the nearby surface-water drainage areas of Love Creek upstream from the surge pond dam.

The available chemical data from Tar Camp Creek appears to indicate a chloride content in the surface water that is somewhat higher than observed in the other streams. Its potential origin is unknown at this time, and might need to be established by additional measurements.

INTRODUCTION

In February 1984, Geraghty & Miller, Inc., (hereinafter referred to as G&M) was retained by Arkansas Power & Light (hereinafter referred to as AP&L) to investigate surface-water and ground-water conditions at the White Bluff Steam Electric Station (hereinafter referred to as WBSES) in Jefferson County, Arkansas.

The principal purpose of the assessment was to evaluate potential impacts on the quality of the surface waters and on the underlying ground-water resources from waste-handling and disposal practices at the plant. The study was based entirely on an interpretation of engineering, soils, and environmental data compiled from the files of AP&L, its contractors, and State and Federal agencies.

Several national studies by the U.S. EPA (U.S. Environmental Protection Agency) and EPRI (Electric Power Research Institute) have shown that adverse impacts on ground-water resources at power-generation plants tend to be site-specific and generally not very large. Although the WBSES plant is rather new, so that significant adverse impacts cannot yet be expected, AP&L felt that an assessment of potential impacts would be useful to avoid or minimize any liabilities at a later date. The liabilities could be related to (1) environmental monitoring and permitting, (2) damage to the on-site and off-site eco-systems along surface-water streams, (3) damage to off-site users of ground

water, or (4) damage to on-site consumers of drinking water provided by the plant's wells.

Scope of The Assessment

The scope of the investigation has been directed primarily toward a description of the hydrogeologic system, including the potential for contamination of surface water and ground water. Available data have been collected from industrial, governmental, and private sources, and a G&M representative visited the site to conduct an on-site investigation. A description of the hydrogeology and aquifer-flow system was prepared, and an evaluation was made of the potential impacts from contaminant sources. Where the available information did not allow for detailed calculation of potential impacts, reasonable values were assumed and recommendations have been made for collection of the appropriate information.

Location

The White Bluff facility is located in Jefferson County, approximately 24 miles south of Little Rock, Arkansas, near Redfield, Arkansas, as shown in Figure 1; the Pine Bluff Arsenal is 1.5 miles south of the plant. AP&L owns approximately 3,400 acres, 1,100 acres of which are cleared for plant use. The land use of the area surrounding the

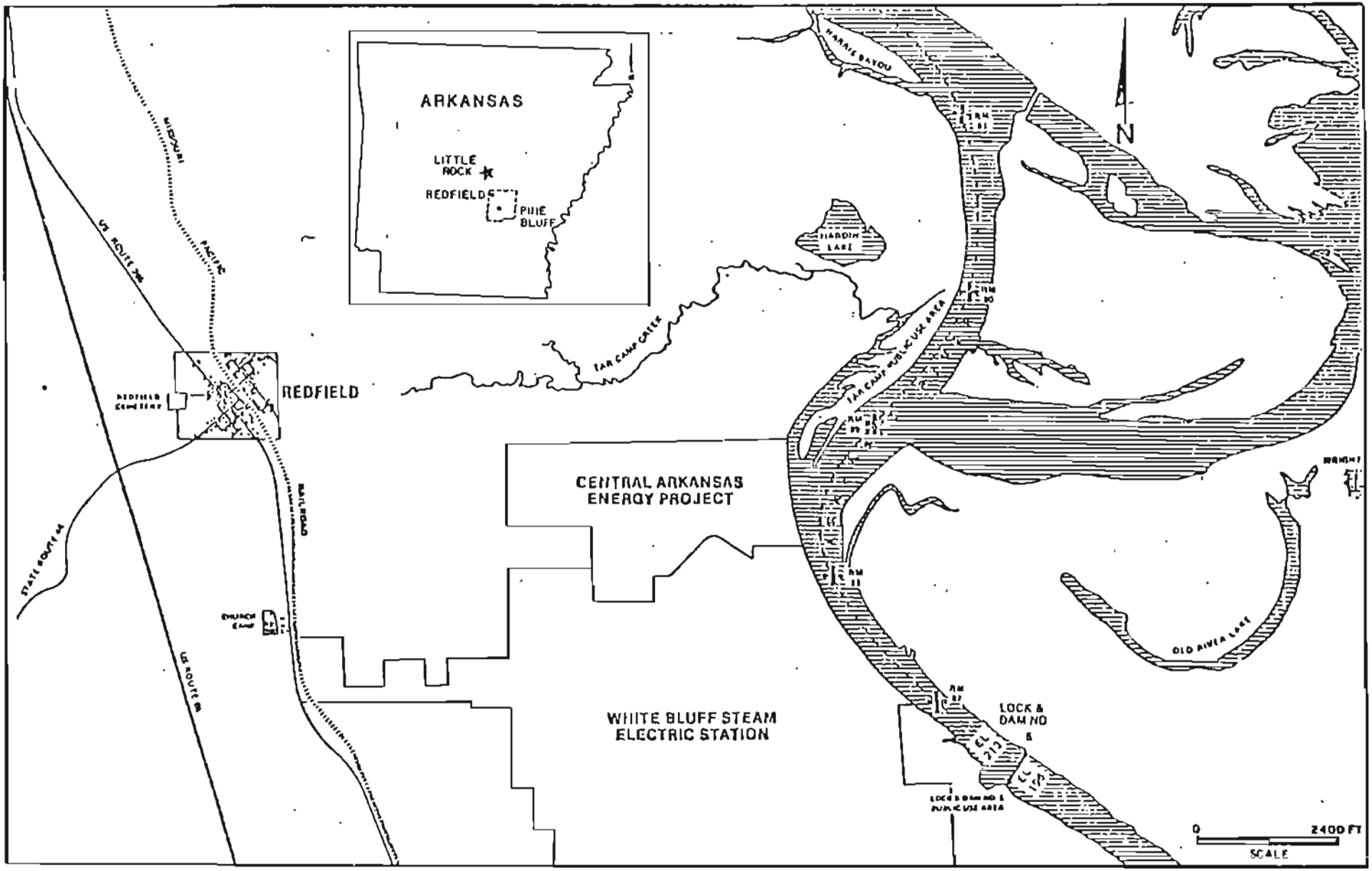


FIGURE 1. Location of White Bluff Steam Electric Station.

plant is silvacultural. The plant is a coal-burning power plant that obtains coal by rail from mines in the Powder River Basin near Gillette, Wyoming.

THEORETICAL APPROACH

Three key elements should be described as fully as possible in order to assess the potential impacts of contaminant sources on the ground-water system. They are: (1) the locations, types, and concentrations of the chemical compounds in the potential source areas; (2) the likely migratory paths of the leachates generated in the source areas; and, (3) the physical and chemical influences exerted on the leachate flow by the geologic system.

Chemical compounds leaching from the potential sources at the WBSES first pass through an unsaturated zone as they migrate through the soil downward to the water table, as shown in Figure 2a. The pore spaces in the unsaturated zone are occupied by both air and water, and the flow in this zone is essentially downward under the influence of gravity. Concentrations of chemicals moving vertically through the unsaturated zone vary initially according to the concentrations at the source. As the chemicals move through the unsaturated zone, they are modified (attenuated) by processes such as oxidation, aerobic biological degradation, sorption, dispersion, precipitation, filtration, ion exchange, and reduction. Generally, the clayier the soil the greater its attenuative capacity with regard to cations such as metals and certain trace elements. Prediction of the attenuation in soils is difficult owing to the almost

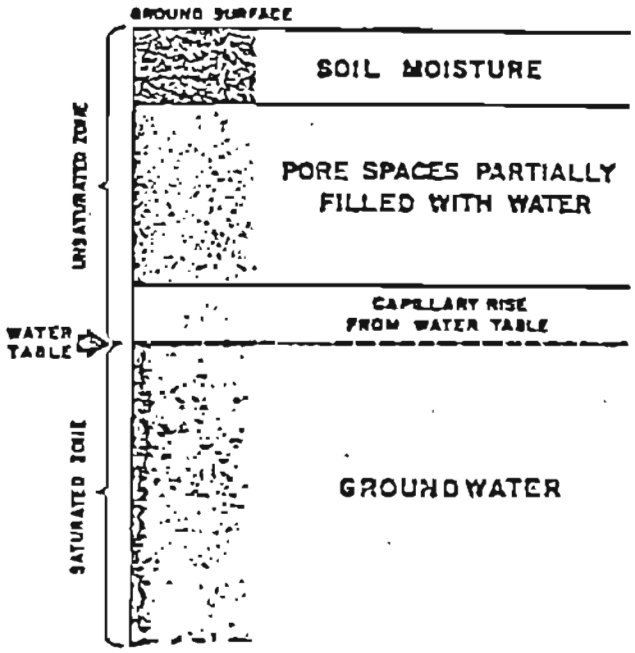


FIGURE 2a. Schematic Diagram Showing Unsaturated and Saturated Zones.

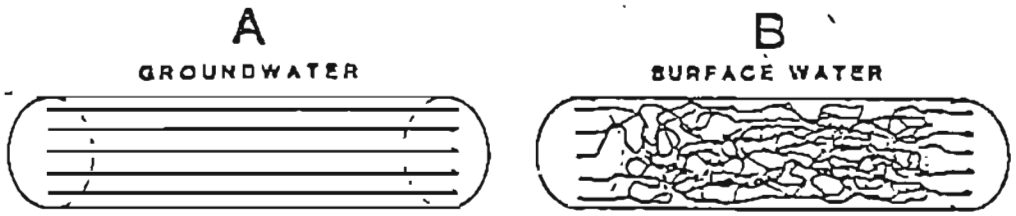


FIGURE 2b. A. Flow paths of water molecules in laminar flow;
B. Flow paths of water molecules in turbulent flow

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pumping of nearby wells, the types and concentrations contaminants, and variations in rates of leaching. The f. that chemicals are also attenuated in the saturated zone through adsorption and chemical interaction with other organic and inorganic constituents of the aquifer makes it difficult to predict the movement and fate of chemicals in the moving ground water. Other variables affecting mobility are solubility, adsorption characteristics, and degradation (Battelle, February, 1984). A schematic representation of the relative movement of chemicals in ground water is shown in Figure 3.

At the WBSES site, leachates from a potential contaminant source such as the recycle ponds could contain heavy metal and trace elements and conservative ions such as nitrates, chlorides, and sulfates. Heavy metals might be absorbed by the clayey fractions in the saturated zone and therefore might not be found past Zone A (Figure 3). Carbonate ions might be affected by the somewhat acidic nature of the shallow ground water and could change to bicarbonates or else totally disappear at a pH value of 4.5 or less at the edge of Zone B. Nitrate ions in anaerobic conditions might decompose into nitrate, ammonium, or even nitrogen gas under influence of denitrification bacteria, and therefore, this might not be found past Zone C. Any ions such as chloride, not affected by pH values or micro-organisms, will reach the river (Zone D) in Figure 3.

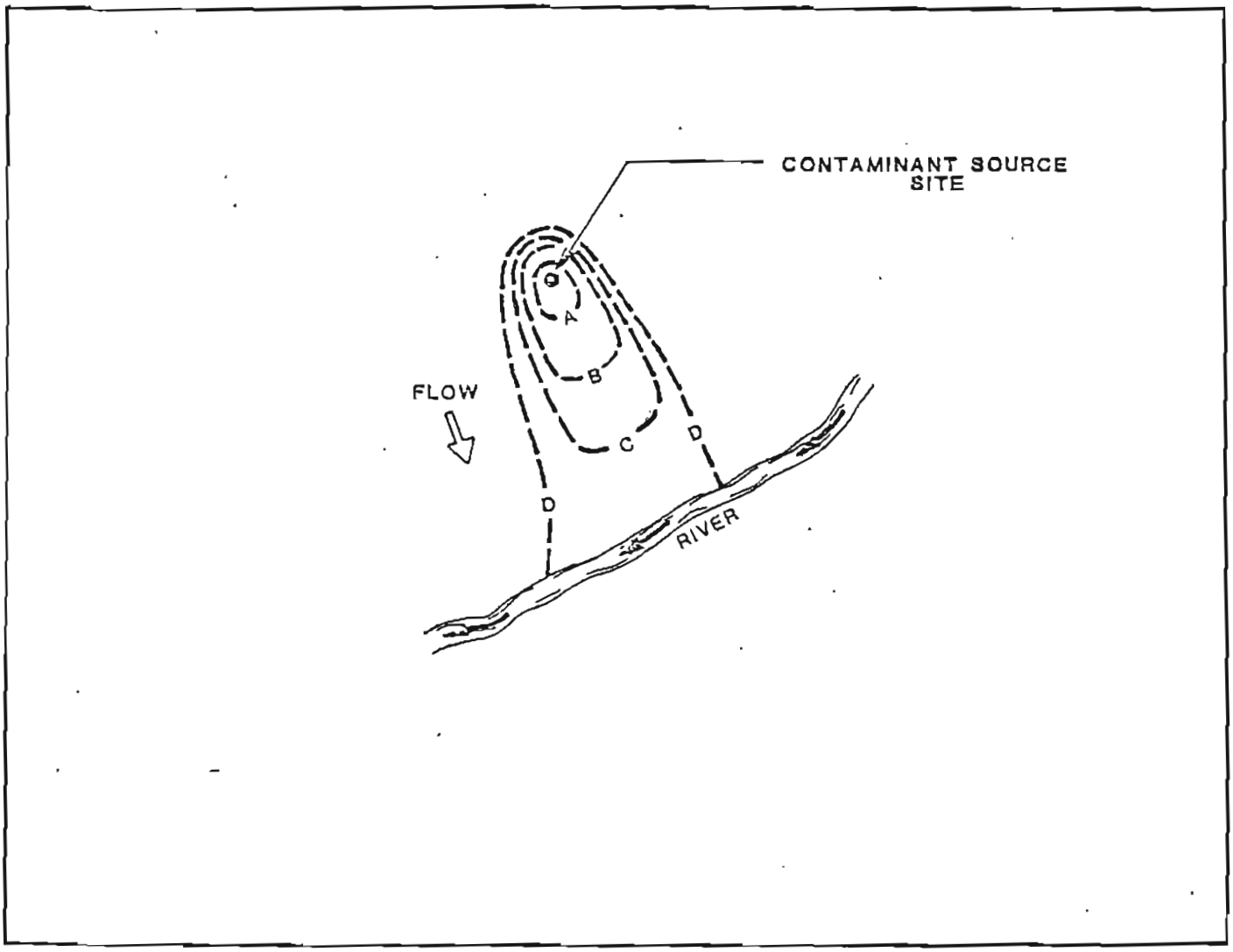


FIGURE 3. Diagram of Plumes of Contaminants Moving at Different Rates from the Same Source.

The theoretical contaminant mass-transport model for the WBSES site hinges on two major components: surface water and shallow ground water. Figure 4 shows the general surface-water and ground-water conditions prior to the deposition of ash. Perched ground water exists just below land surface on the ridges on each side of the valley, tending to seep toward the valley floor where it emerges as baseflow in the small stream.

The sand and silt zone shown in Figure 4 is bounded above and below by less permeable soil materials. However, the ground water in this zone drains relatively freely compared with ground water in the tighter overlying soil. The potential of the ground water in the sand and silt zone to move laterally is much greater than that in the perched water table. Depending on the pressures of the ground water, the sand and silt zone could be receiving recharge from the overlying perched water table.

Figure 5 depicts the valley filled with fly ash and bottom ash and capped. Each cap is presumed to leak to some extent, the rate depending on the rainfall intensity, the materials used in constructing the cap, and the slope of the cap. After an initial period, the ash originally deposited in a dry state will become moist, will then reach field capacity, and eventuallly will become partially saturated and produce leachate. The leachate will enter the perched water table in the nearby ridge or will percolate to the bottom of

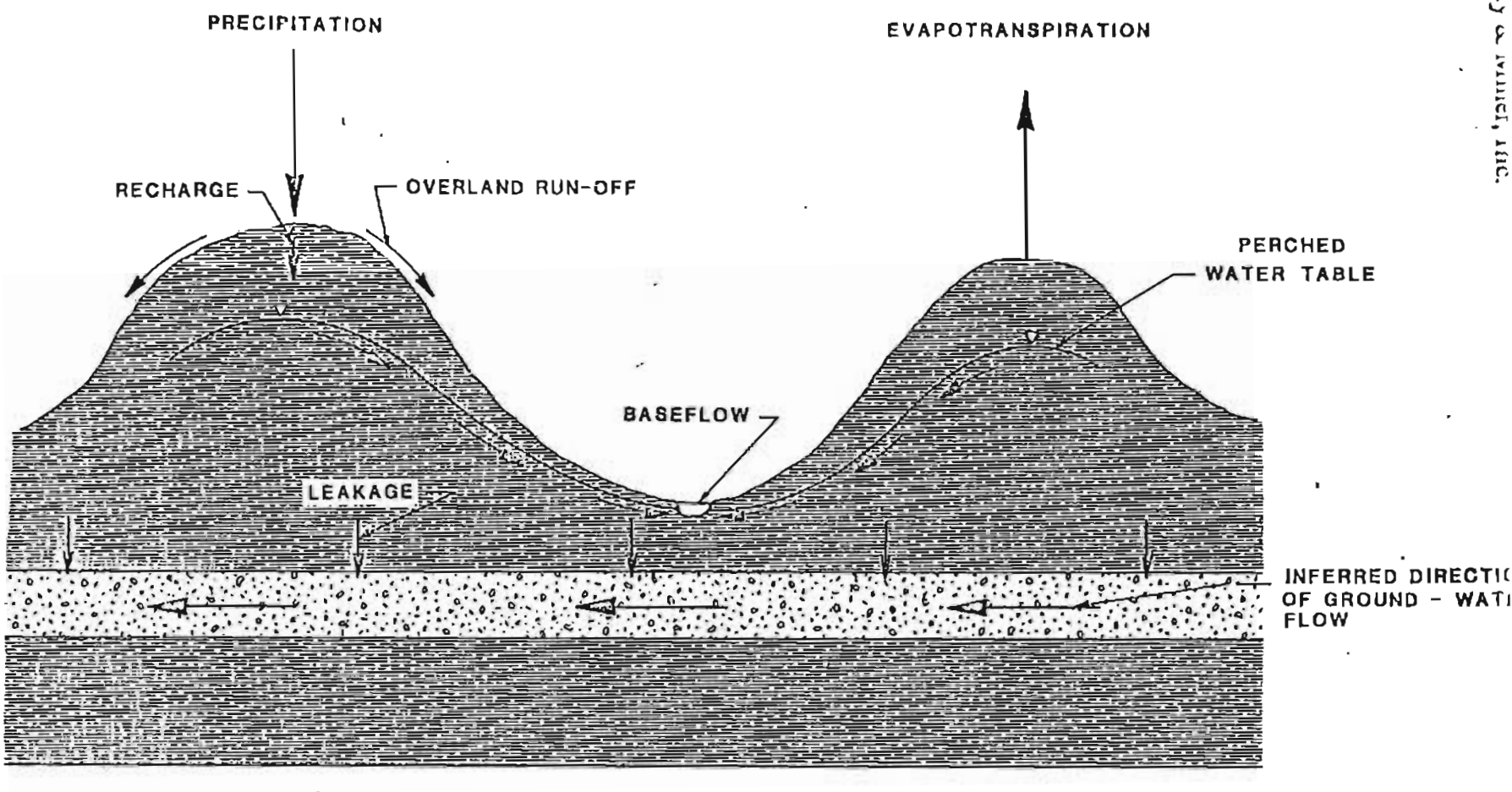


FIGURE 4. Generalized Hydrogeologic Conditions at Ash Storage Area Prior to Deposition of Ash.

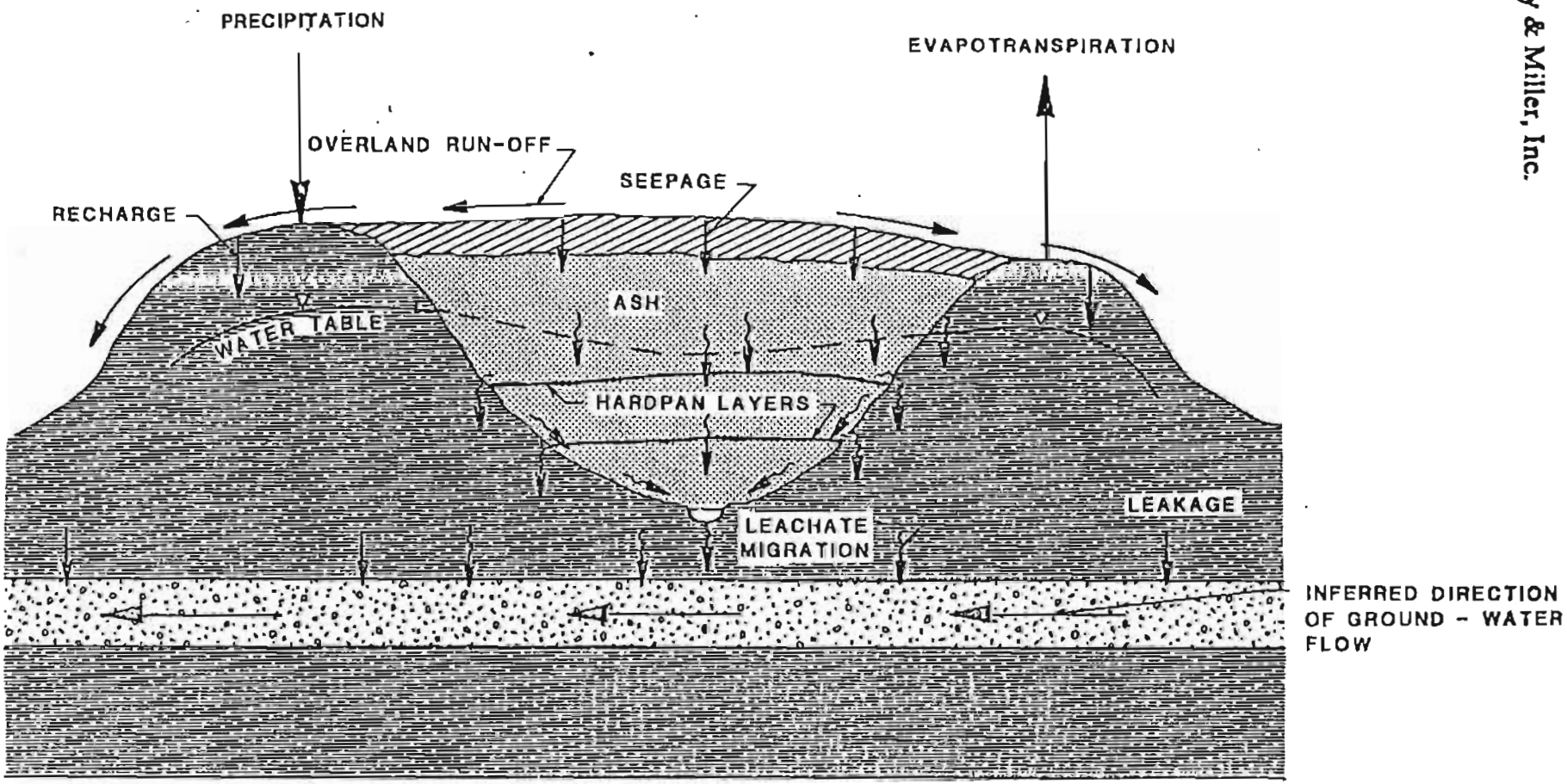


FIGURE 5. Generalized Hydrogeologic Conditions at Ash Storage Area After Closure.

the valley where it will migrate downgradient through the original stream sediments. It is also possible that the leachate might percolate further downward to reach ground water in the sand and silt zone, where it will become part of the shallow ground-water system. This basic concept of the contaminant-migration model has been used to assess the present surface-water and ground-water conditions at the WBSES site.

HYDROGEOLOGICAL SETTING

Geology and Soils

The AP&L plant is situated on a bluff overlooking the floodplain of the Arkansas River. The surface topography at the plant is rolling hills with some steep slopes, and the topographic relief is about 120 ft (elevations range from 230 to 350 ft msl). The site is highly dissected by small creeks and branches draining primarily south and east into the Arkansas River. Prior to construction of the plant, the entire site was sloped so that almost no natural flat areas remained. Most of the present power-generating area was graded prior to construction.

The stratigraphy of the subsurface formations has been described in various reports by the USGS (U.S. Geological Survey) and AGS (Arkansas Geological Survey). Figure 6 is a stratigraphic column of the formations developed by the U.S. Army Corps of Engineers. The sequence of the geologic units, in order of increasing depth below land surface, is as follows:

1. A 0 to 30-ft-thick surficial terrace deposit of sandy and silty clays with a few sand lenses;

2. A 450 to 650-ft-thick sequence of consolidated silty and sandy clays with sand and limestone lenses;

System	Series	Geologic Unit		Lithology	Approximate Thickness (feet)
Sedimentary rocks					
Quarternary	Pleistocene	Terrace deposits		Silt, sand, and clay with gravel.	0 - 30
Tertiary	Eocene	Jackson Group	Redfield Formation of Wilbert (1953)	Clay and silt, lignite, and minor amounts of fine sand.	90 - 150
			White Bluff Formation of Dall (1898)	Very fine to fine argillaceous sand; fossiliferous silt and clay; in southeast corner of Grant County contains much more clay.	60 - 100
		Claiborne Group	Cockfield Formation	Sand, fine to very fine, and Carbonaceous clay.	150 - 200
			Cook Mountain Formation	Clay, carbonaceous, sandy; locally glauconitic; contains beds of sand 10-30 feet thick.	150 - 200
			Sparta Sand	Sand, medium to very fine; little sandy lignitic clay. Sand occurs as much as 300 feet thick in Grant County; in Hot Spring County, in beds commonly 20-60 feet thick; and in places, 100 feet thick.	400 - 500
			Cane River Formation	Clay, lignitic, sandy, and fine sand. Sand occurs commonly as beds 20-60 feet thick; in places 150 feet thick.	Source: Public Service Commission Response to Question No. A-42.
			Carrizo Sand	Sand, very fine to medium, and carbonaceous lignitic clay. Sand occurs commonly in beds 20-60 feet thick; in places, 150 feet thick.	
		Wilcox Group		Clay, blue to tan, sandy, gray fine sand; sandy marl; contains thin sonestone stringers; white fossiliferous sandy chalk.	
		Midway Group	Porters Creek Clay	Clay, blue to black	
	Paleocene		Clayton Formation	Limestone, fractured, porous; some sand.	

FIGURE 6. Stratigraphic Column of Geologic Formations Underlying the WBSES.

3. A 400 to 500-ft-thick massive fine to medium sand (Sparta).

The primary sources of site-specific geologic information are the 300 logs of soil borings installed by McClelland Engineers and Grubbs Consulting Engineers as part of the plant construction program; the borings range in depth from about 20 to 250 ft. The number and distribution of the borings is sufficient to show details of the subsurface geology to a depth of about 60 ft. None of the core borings extends through the intermediate silty and sandy clay to the aquifer of the Sparta Sand Formation. The locations of the borings are shown in Figure 7 and cross-section A-A' on Figure 8 shows the relationships of the geologic units under the plant. The cross-section A-A' clearly shows the existence of two layers of sand. The shallowest is at 280-ft msl (mean sea level), the next one below that is at 230-ft msl. Because of their greater permeability, these layers are potential pathways of contaminant migration. In Figure 9, the shallow geology along the cross-section B-B' is shown. This is in an area south of the surge pond and clear-water holding pond. It shows that the 230 and 260-ft sands are still present at the location of the surge pond dam but do not appear to be continuous eastward of boring B-203 and B-211.

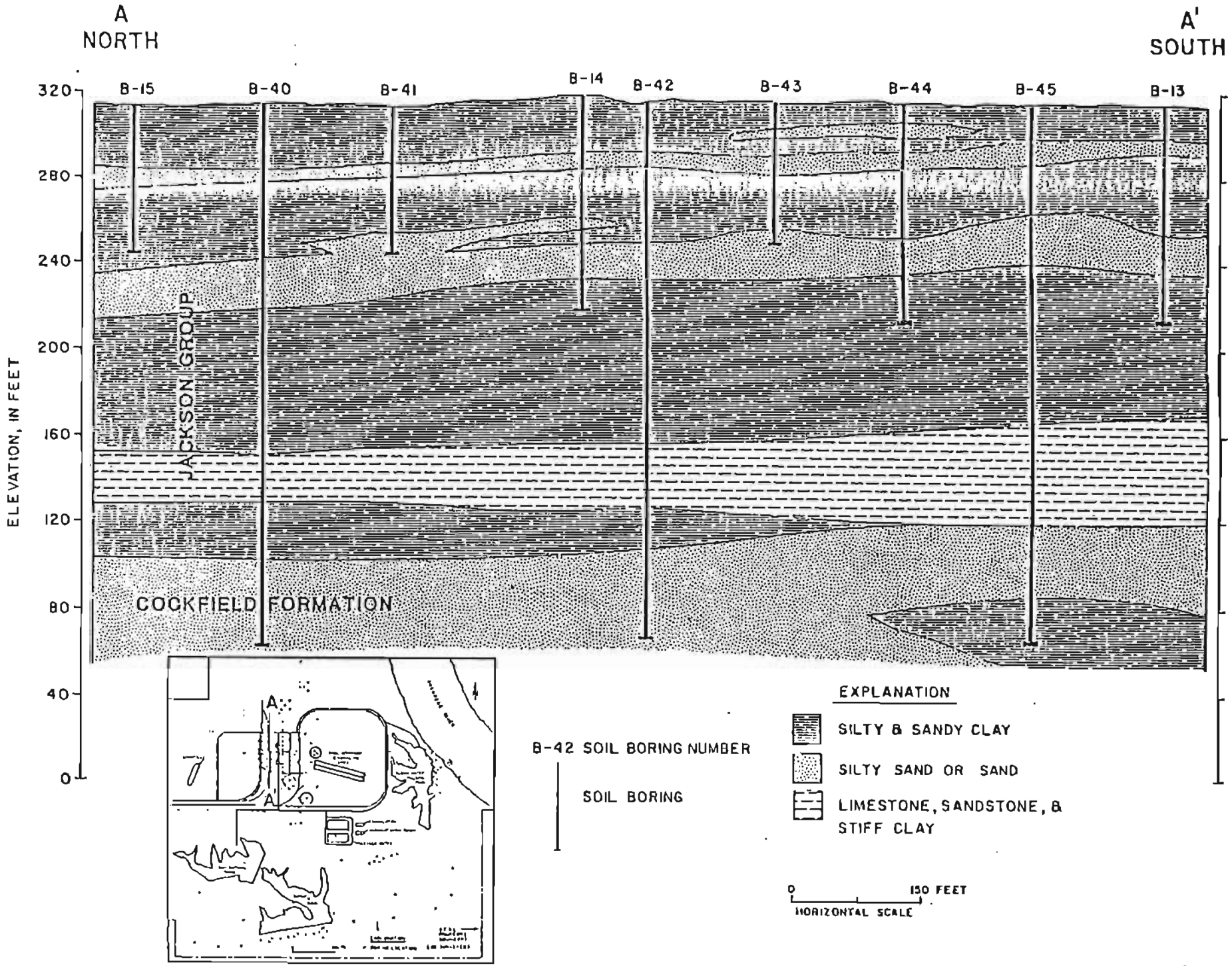


FIGURE 8. Cross-Section A-A'.

Surficial Terrace Deposits

The surficial terrace deposits, of Quaternary age, form a thin layer of silty and sandy clay covering the crests of the hills. The deposits are not found in the stream valleys at lower elevations, where they have been eroded. Most of the power-station facilities have been constructed on the terrace deposits.

Tertiary Deposits

The surficial deposits are underlain by deposits of Tertiary age that range in thickness from 2,000 to 3,500 ft. The parts of the plant that are not on terrace deposits, such as the ash-disposal area and the surge pond, are situated on the Jackson Group, which is the uppermost and youngest group of the Tertiary system. The Jackson Group includes the Redfield Formation and the White Bluff Formation. The Jackson Group contains the first aquifer directly beneath the land surface at the plant site; this aquifer is sometimes called the "perched aquifer" or "shallow aquifer."

The youngest formation of the Jackson Group is the Redfield Formation, which is a sequence of silty and sandy clay deposits with a few sand beds. It is about 90 to 150 ft thick at the facility, depending on the location and the elevation of the land surface, and is composed primarily of thin beds, lenses, and stringers of clay, silt, and fine sand, and mixtures of these materials, with some very thin

beds of lignite. Clay and silt predominate, and the formation as a whole has a very low permeability, although it contains some permeable sand lenses as much as 15 ft thick. Some sandy zones at similar elevations in borings close together may be interconnected (see Figure 8), but it is not possible to assume such interconnections between other sandy zones (see Figure 9).

Beneath the Redfield is the White Bluff Formation. This unit is about 60 to 100 ft thick and consists mostly of clay or sandy clay; it is reported to have a little more sand than the overlying Redfield.

The Claiborne Group underlies the Jackson Group, and includes the Cockfield, the Cook Mountain, the Sparta Sand, the Cane River, and the Carrizo Sand Formations. The Cockfield, Sparta,some permeable and Carrizo Formations are aquifers.

Small capacity well yields

The Cockfield, which underlies the White Bluff Formation, is composed in this area of beds of clay, silt, fine sand, and varying mixtures of these materials. It is about 150 to 200 ft thick and has considerably more sand beds than the overlying deposits. In the White Bluff area, it is not an outstanding aquifer like the Sparta Sand, but its sand beds generally yield enough water for small-capacity wells.

Beneath the Cockfield, and forming a confining bed between the Cockfield and the Sparta Sand, is the Cook

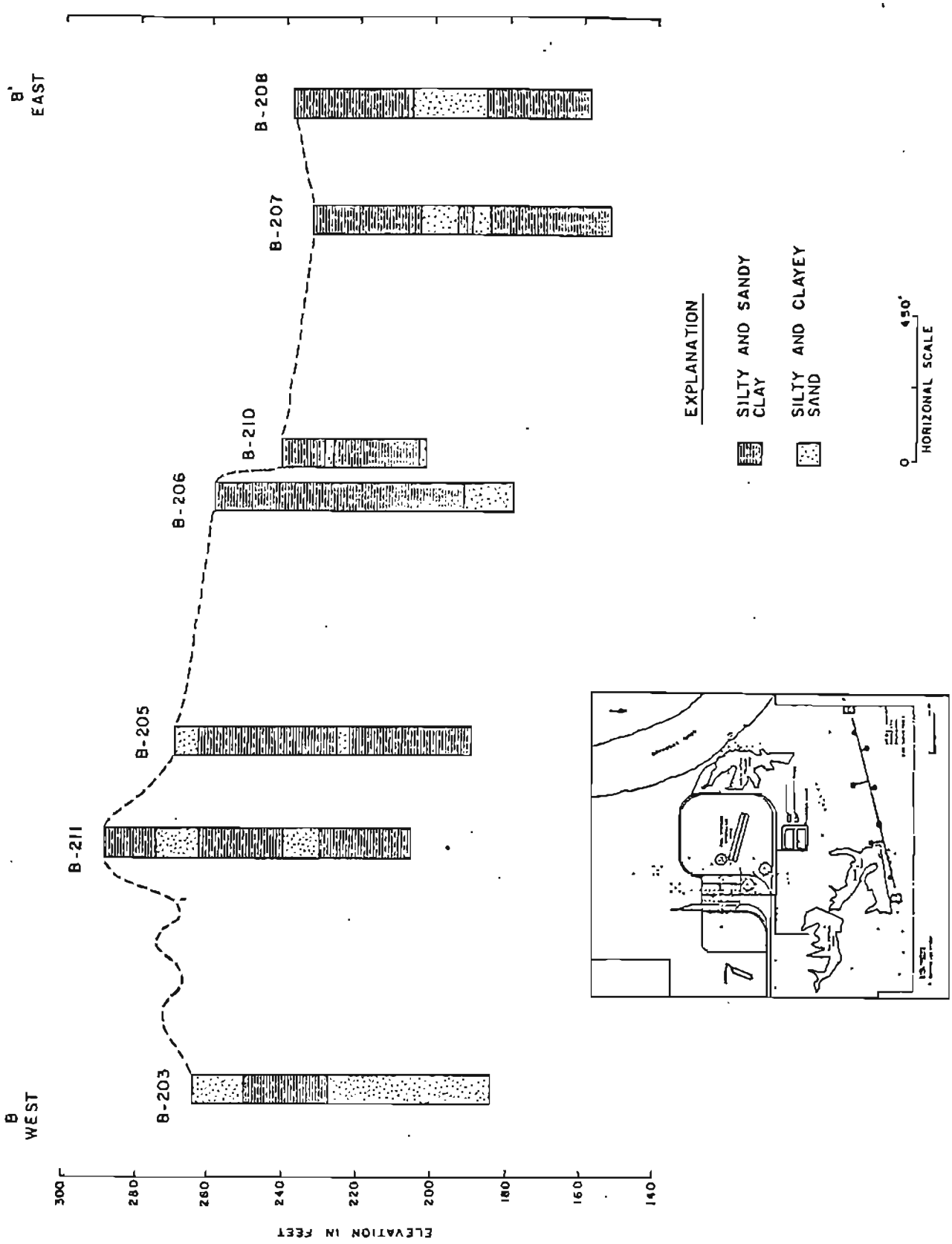


FIGURE 9. Cross-Section B-B'.

Mountain Formation, which is 150 to 200 ft thick. This unit is primarily clayey, with a few thin lenticular beds of sand.

The top of the Sparta Formation is at an elevation of about 200 to 350 ft below msl at the plant site. This formation is about 500 ft thick and is composed mostly of massive sand beds that are finer at the top and coarser toward the base. It is laterally continuous to its recharge area, located a few miles northwest of Jefferson County. The Sparta is the major aquifer of the region because it yields good quality water to wells at rates of up to 1,000 gpm (gallons per minute).

The lower part of the Tertiary below the Sparta includes the Cane River Formation, the Carrizo Sand Formation, and the Wilcox and Midway Groups. These formations and groups are not considered to be potable aquifers. The Cane River Formation and the Midway Group generally have a low permeability and the Wilcox Group mostly contains saline water.

Surface Waters

The Arkansas River is the major surface-water body in the area. Flow rates in the river range from 3,000 cfs (cubic ft per second) to 536,000 cfs; the stage of the river is maintained at an elevation of 213 ft msl except during floods. The river is fed locally by Tar Camp Creek and Love Creek; Lipscomb Branch is a tributary of Love Creek (see Figure 10). The branches and creeks are mostly fed by

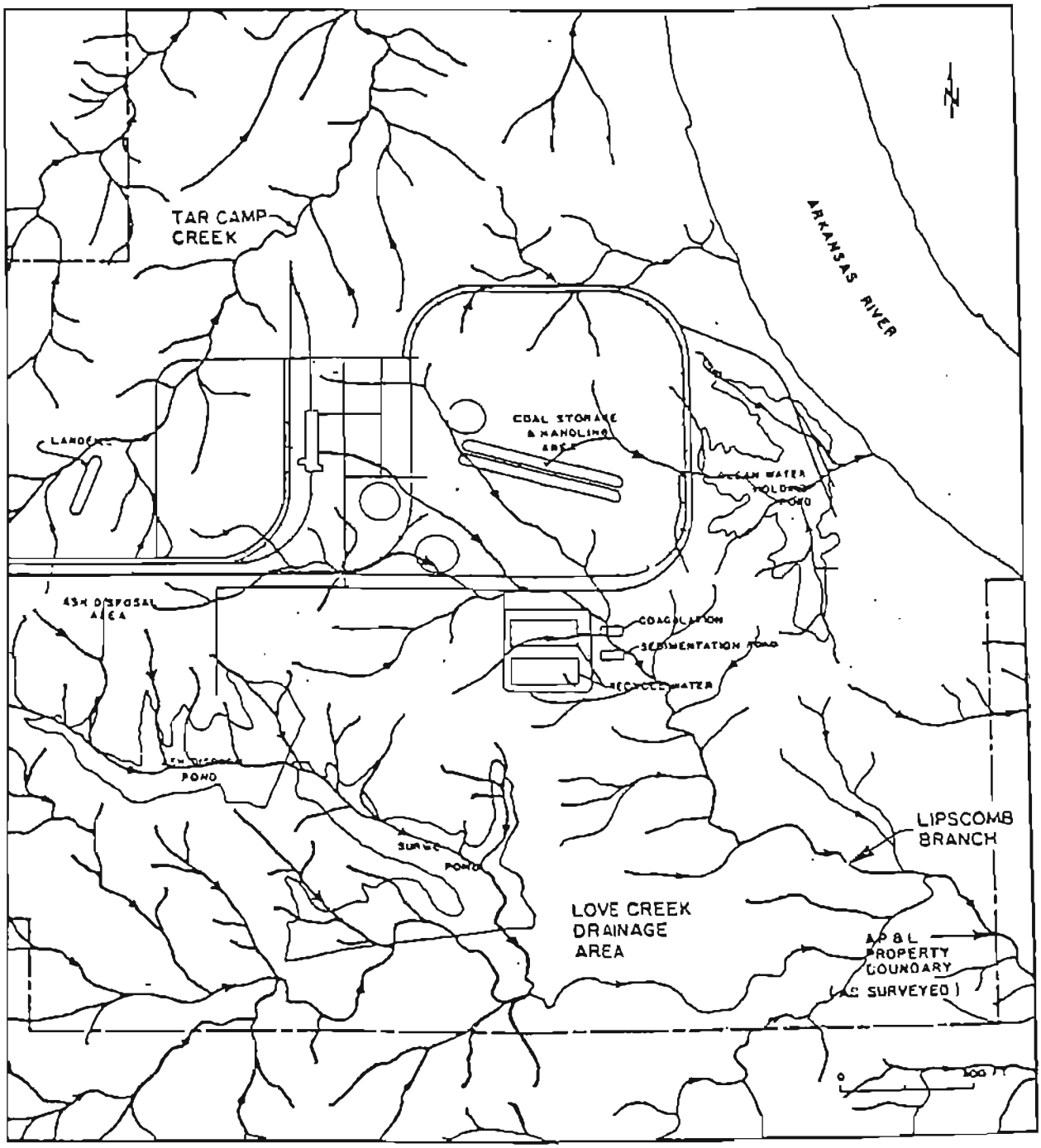


FIGURE 10. Surface-Water Drainage Prior to Plant Construction.

surface-water runoff. Love Creek, for example, is not a constantly flowing stream.

At the plant site, the Arkansas River is the primary drainage feature into which shallow ground water flows from the sediments of the Jackson Group. Lipscomb Branch, Love Creek, and Tar Camp Creek are other surface-water bodies receiving shallow ground-water flows in this area.

Ground-Water Systems

Jackson Aquifer

In the White Bluff area, the water table in the Jackson Aquifer is shallow. Appendices A and B of the report of McClelland Engineers, Inc., dated August 1979, contain data showing that in the Ash Storage Area, the depth to the water table generally ranges from 0 to 10 ft (see Figure 11). The data are too scanty to permit drawing a water-table map, but the configuration of the water table at the plant site most likely mirrors the configuration of the land surface, as it does in the Ash Storage Area as shown in Figure 12. The water-table elevations indicate that shallow ground water will migrate from high topographic elevations to lower altitudes. Hydraulic gradients in two places (between TP 19 and B215 and between B218 and TP5) are as high as 10^{-1}. The Jackson Aquifer yields small quantities of water -- generally 1 to 5 gpm.

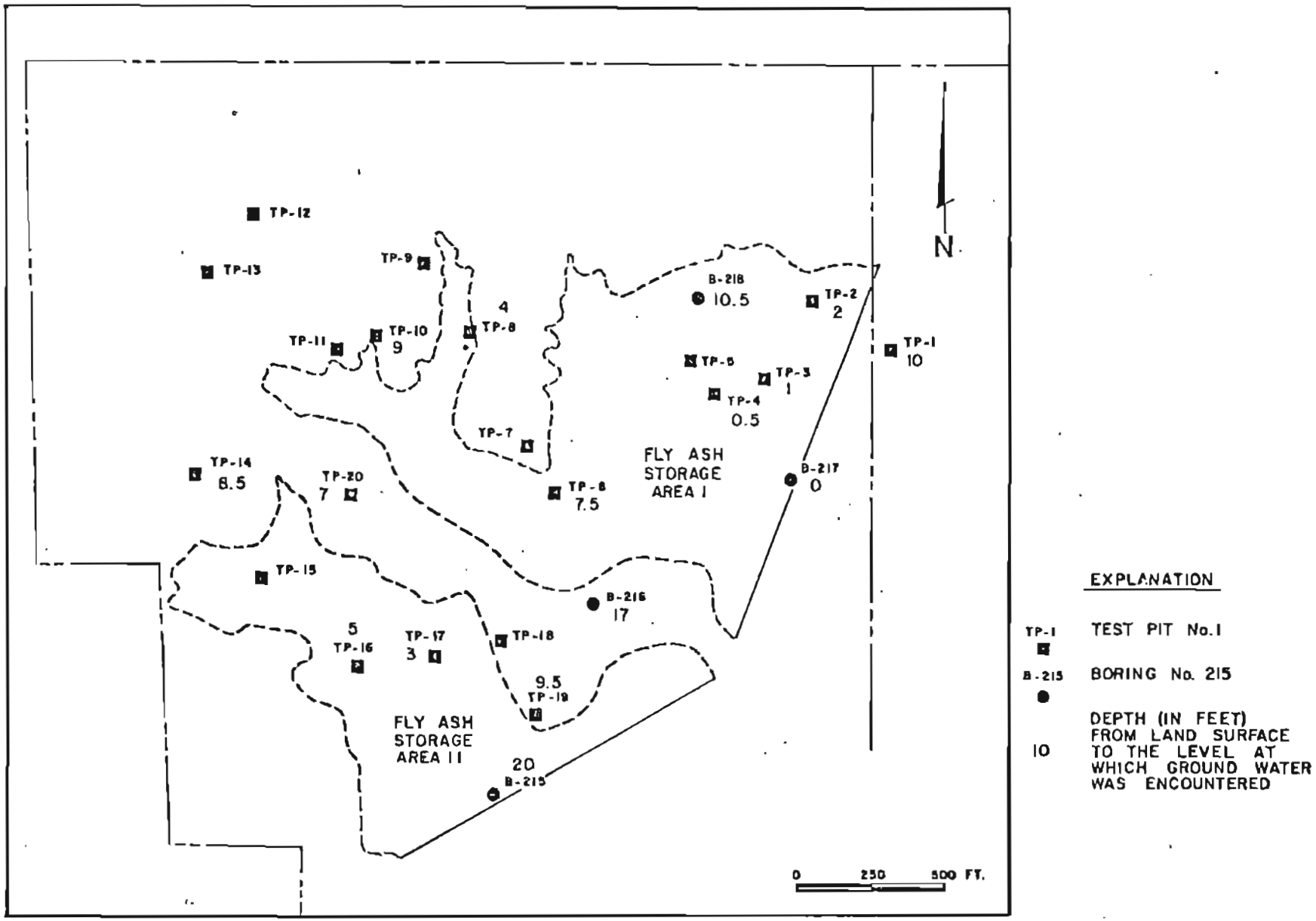


FIGURE 11. Depth from Land Surface to Perched Water Table in the Jackson Aquifer (in feet).

The two major zones in the Jackson that can be considered as aquifers are the 230- and 260-ft sands. In Figure 13, the extent of the 260-ft sand is shown. This is a rather generalized map because the density of borings was greater near the plant construction site than at the outlying areas. But based on this general information, the 260-ft sand does not seem to be clearly present under the ash storage area.

The extent of the 230-ft sand is shown in Figure 14. It does not seem to be areally extensive, but it should be kept in mind that many borings were too shallow to have penetrated this zone.

When the precipitation rate is high and evapotranspiration is low, recharge to the water-table aquifer is greatest, typically during winter and spring months. The average monthly and annual precipitation rates at Little Rock, Arkansas, are shown in Table 1. A network of observation wells to be measured monthly would be needed to precisely determine the seasonal water levels and the flow patterns.

Cockfield Aquifer

The potentiometric surface of the Cockfield Aquifer was mapped by the USGS in 1968. According to that map, the potentiometric surface was about 275 ft above msl in the plant area. In the Ash Storage Area, the bottom of the creek

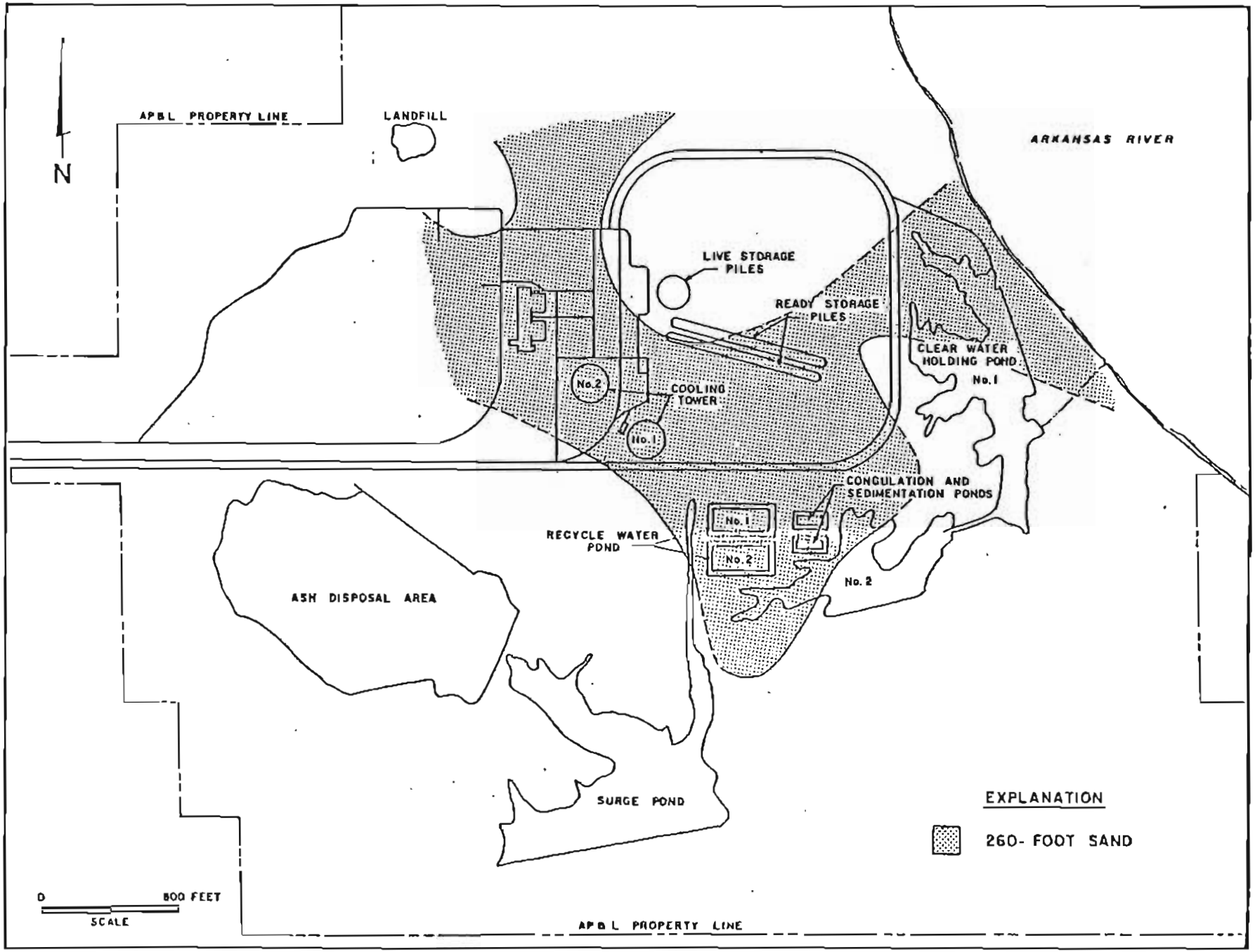


FIGURE 13. Location of the 260-Foot Sand.

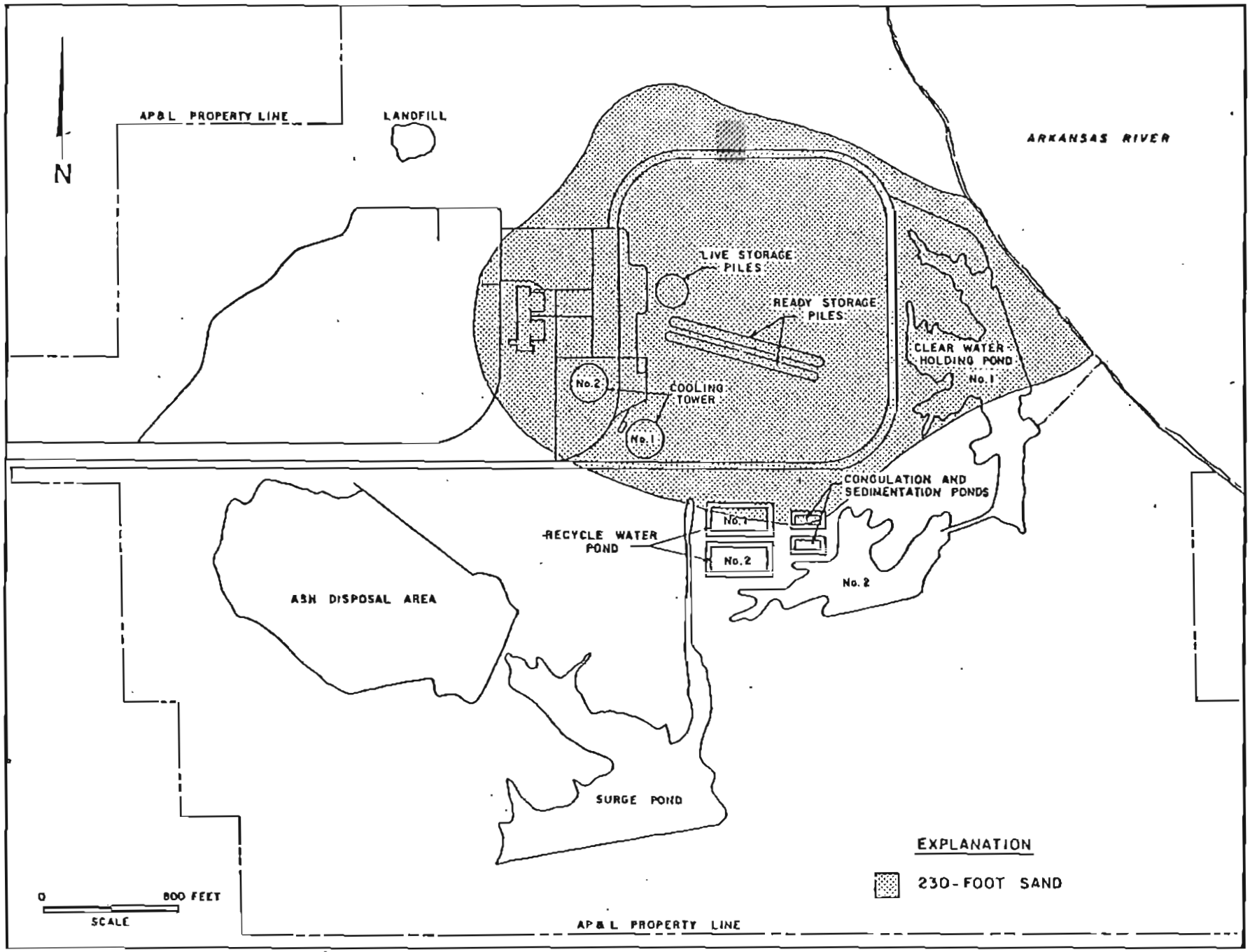


FIGURE 14. Location of the 230-foot Sand.

wash water, potable water, and sanitary waste system water for the White Bluff station. Each well is capable of producing 1,000 gpm or 1.43 mgd (million gallons per day). The wells are pumped alternately almost continuously (90% of the time). The locations of the wells are shown in Figure 15.

Using values for aquifer characteristics determined from the pumping tests conducted by Layne-Western in 1975 (a transmissivity of 90,000 gpd/ft and a storage coefficient of 0.03), a drawdown of about 10 ft was predicted about 0.1 mile from the pumping well. The Layne-Western report indicates that pumping of the AP&L well will cause a drawdown of approximately 4 ft at the town of Redfield's well, located about three miles northwest of the plant boundary. The drawdown at the Pine Bluff Arsenal will be about 3 ft.

Ground-Water Movement in the Jackson Aquifer

Direction

The direction of ground-water movement in the shallow sediments is horizontal toward the channels of branches, creeks, and the Arkansas River. The configuration of the water table at the WBSES has not been investigated, as noted previously, but most likely conforms with the configuration of the land surface. Where tributary channels are incised into the shallow aquifer, the ground water emerges as springs.

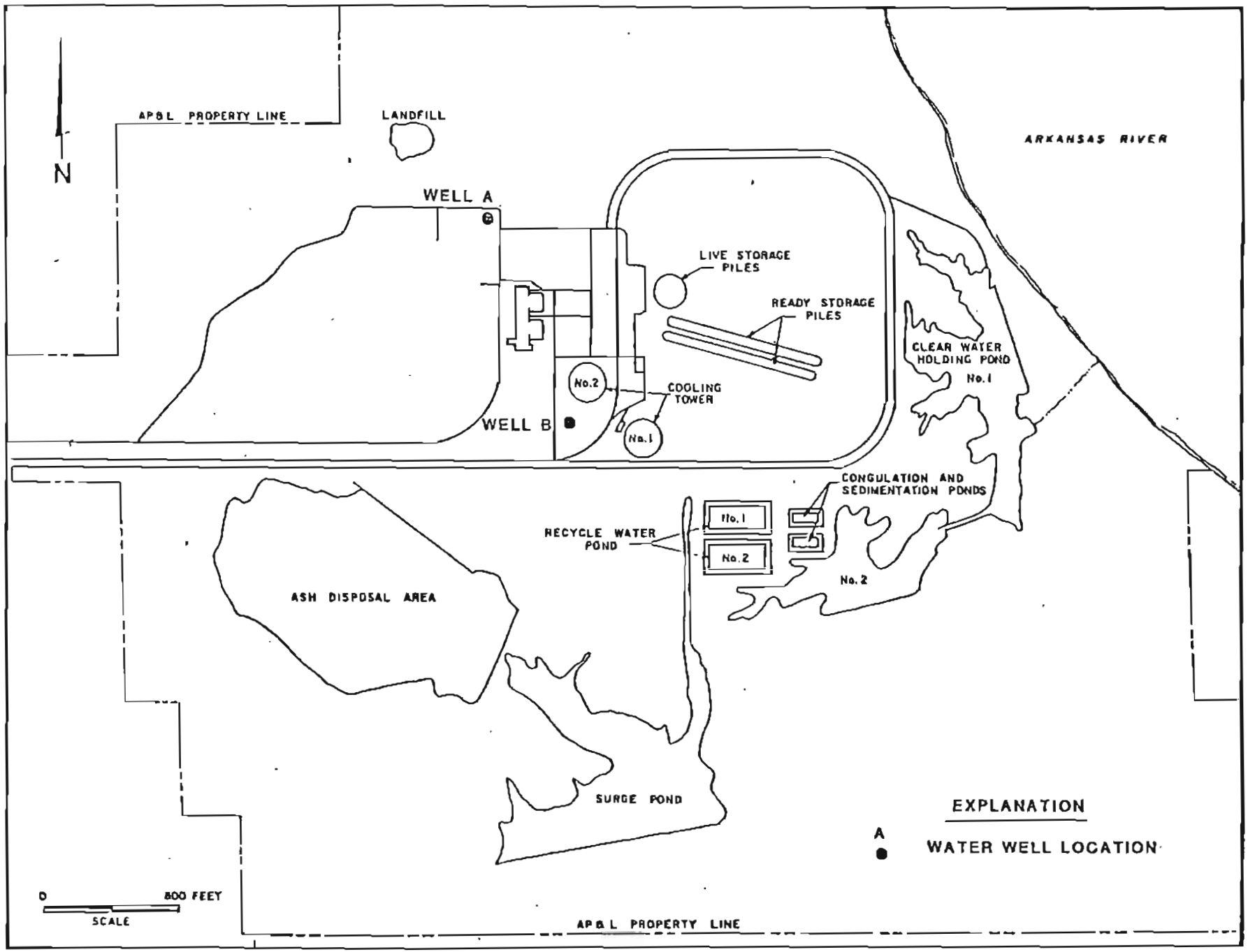


FIGURE 15. Locations of WBSES Water Wells.

Rate

The rate of ground-water movement depends on the hydraulic gradient in the aquifer and the vertical and horizontal hydraulic conductivities of the earth materials through which the ground water migrates. Because no observation wells exist, the hydraulic gradient is estimated from topographic maps and cross sections to be about 10^{-2} (approximately 1 ft per 100 ft). The hydraulic conductivity of the shallow sandy zones has been determined from falling head permeability tests (by McClelland Engineers) of soil cores to be about 5×10^{-4} cm/sec (10.6 gal/ft^2). Assuming an effective porosity of 0.20, the interstitial pore-water velocity of ground water moving laterally through the aquifer materials is about 25 ft/yr. The velocity will be greater if hydraulic conductivities are greater than reported and/or if the gradient is steeper, such as near the surge pond and ash storage pond.

POTENTIAL SOURCES OF CONTAMINATION

The sources of potential contamination that are thought to exist at the plant site include, in a descending order of importance:

Sources	Potential Contaminants
Recycle Ponds	Trace metals, high pH, conservative ions, calcium, sodium
Ash Disposal Area	Trace metals, high pH, conservative ions
Surge Pond	Trace metals, high pH, conservative ions
Coal Handling Area and Coal Storage Piles	Trace metals, low pH, coal-derived organics, conservative ions
Landfills	Unknown
Sedimentation and Coagulation Basins	Trace metals, high pH
Buried Fuel Tanks	Organic priority pollutant compounds

The locations of these potential sources are shown in Figure 16. A detailed discussion of each of the potential sources follows along with the site-specific hydrogeologic information and the types and levels of the chemical constituents thought to be in each of the sources.

Recycle Ponds

The surface area of each of the two recycle ponds is about 4.5 acres. Each pond contains 20.6×10^6 gallons and receives waters from the ash handling system dewatering bins, boiler turbine generator chemical cleaning wastes, fireside wash, blowdown, and drains. The water from the recycle ponds

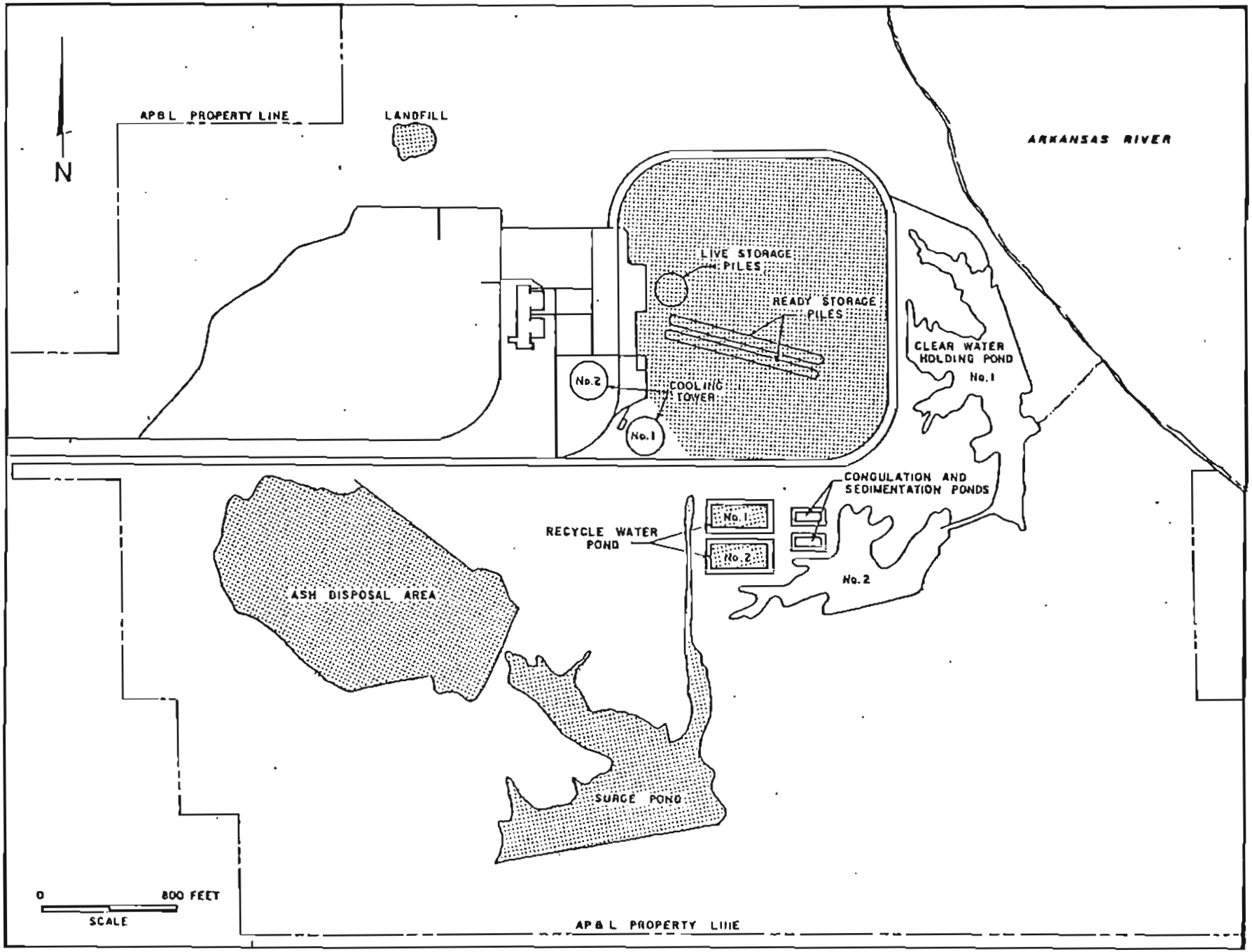


FIGURE 16. Location of Potential Contaminant Source Areas.

is used for dust control in the ash disposal area. The ponds are located in the waste-water treatment area directly south of the coal storage and handling area, as shown in Figure 16, and are about 1,500 ft southeast of the WBSES water well B. They are excavated about 10 to 12 ft into the silty clay soil and are unlined.

The natural soils are very soft sandy clay and loose fine clayey sand to a depth of 5 ft, becoming stiff to a depth of 12 ft. From 12 to 50 ft the soils are alternating layers of stiff gray silty clay and dense clayey sand. The permeabilities of the surface soils determined in the laboratory (falling-head method) range from 4×10^{-7} cm/sec to 1×10^{-6} cm/sec, according to McClelland Engineers (August 1979).

Data on the ponds collected by AP&L have been analyzed and are summarized in Table 2. Analyses of water samples from the North and South recycle ponds since 1982 generally show that concentrations of sulfate, chloride, and calcium are rather elevated compared with concentrations in samples of ground water from the plant production wells A & B (see Table 3). However, the observed values shown in Table 2 do not compare well with the predicted values shown in Table 4. The difference undoubtedly lies in the fact that the water system, of which the recycle ponds are a part, are "flushed" from time to time via the surge pond, according to the waste-water flow system diagram shown in Figure 17.

TABLE 2. WATER QUALITY FOR NORTH AND SOUTH RECYCLE PONDS

Pond	Date	pH (units)	Specific Conductance (micromhos/cm)	SO_4 (mg/l)	Ca (mg/l)	Cl (mg/l)
N	Nov 82	6.8	2,300	700	210	340
S	Nov 82	6.9[1]	1,200	720[2]	215	340
N	Feb 83	7.3	2,000	480	170	220
S	Feb 83	7.5	2,100	80	180	240
N	Sept 83	7.2	1,800	540	180	180
S	Sept 83	7.4	1,800	580	180	180
N	Nov 83	8.1	2,100	650	195	260
S	Oct 83	7.4	2,000	600	190	260
N	Dec 83	8.53	1,900	450	450	175
S	Dec 83	7.62	1,750	512	480	170
N	Feb 84	8.55	1,700	475	450	150
S	Feb 84	7.7[2]	1,700	488	410	155
N	Apr 84	8.58	1,450	530	415	95
S	Apr 84	7.62	1,400	500	370	105
N	mean	7.8	1,893	546	296	203
S	mean	7.45	1,707	497	289	207

1. Minimal value
2. Maximal value

SOURCE: Arkansas Power & Light and Calgon Analyses

TABLE 3. WATER QUALITY FOR WBSES PRODUCTION WELLS A & B

	Dates	pH (units)	Specific Conductance (micromhos/cm)	SO_4 (mg/l)	Ca (mg/l)	Cl (mg/l)
A	Dec 83	6.08	72.5	6	12	5.4
A	Feb 84	6.00	80.0	8	12	2.0
B	Feb 84	6.00	74.0	5	11	2.1
A	Apr 84	6.74	67.0	5	10	12.0
B	Apr 84	6.64	73.0	2	10	10.0

Source: AP&L and Calgon Analyses.

TABLE 4. PREDICTED RECYCLE POND WATER QUALITY

Calcium	1,500 - 2,000 mg/l
Sodium and Potassium	20,000 - 30,000 mg/l
Total Dissolved Solids	30,000 mg/l
Magnesium	0 - 2 mg/l
Iron	0 - 2 mg/l
Silicon	Low
Sulfates	High
pH (units)	Above 11

Source: Arkansas Power & Light, 1974

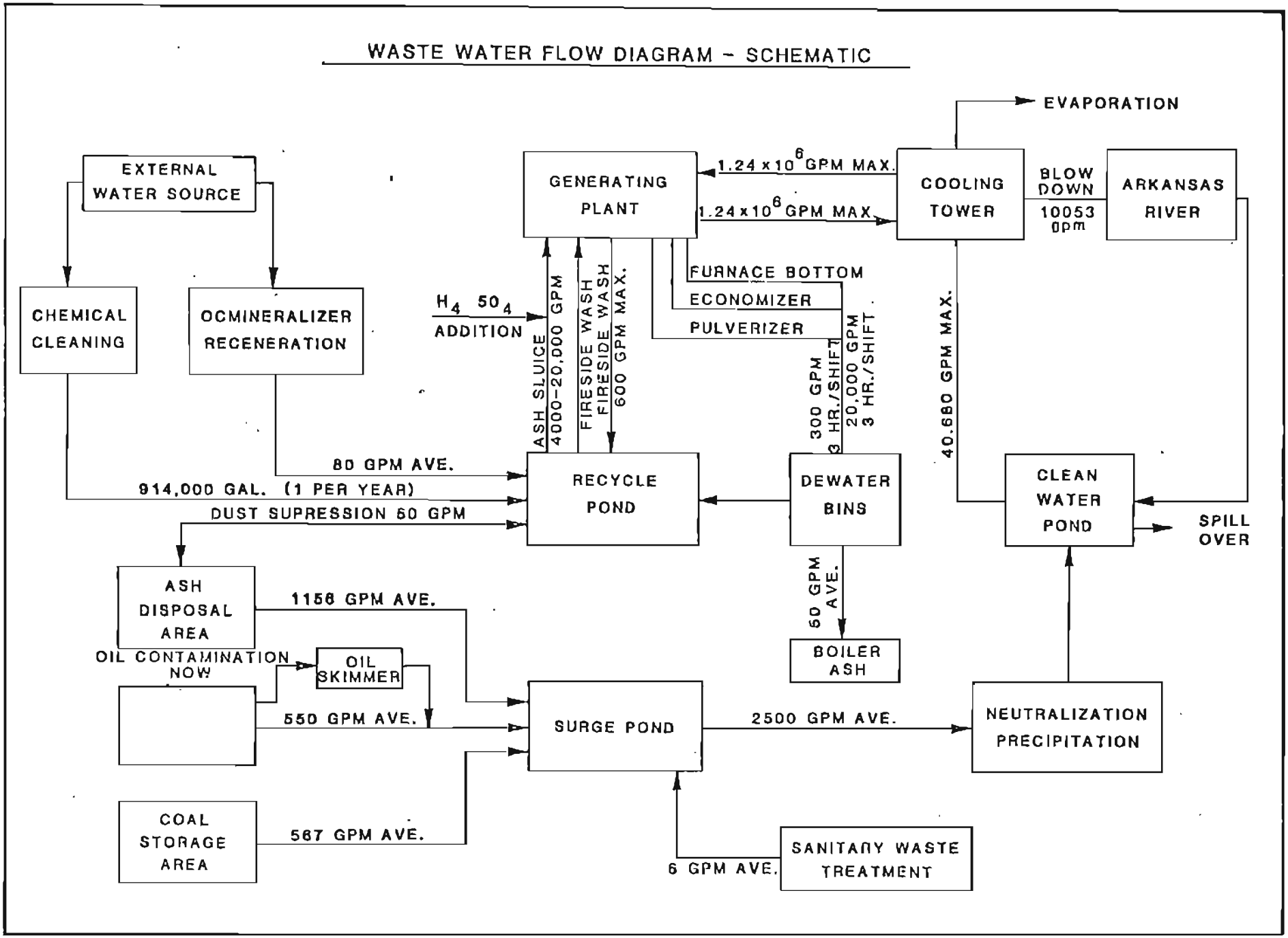


FIGURE 17. Waste-Water Flow System Diagram at WBSES.

Ash Storage Area

The ash storage area has 150 acres allotted for above-ground storage/disposal of the fly ash and bottom ash that will be generated by the plant during 30 years of operation. It is located directly northwest of the surge pond; the ash is presently being stored directly on the natural soil surface. Water moving through the pile that does not seep into the ground drains into the ash disposal pond located in a natural depression in the southwest corner of the plant. The pond was constructed by installing a dike to retain runoff from the ash disposal area. Only a very limited area (less than 50 acres) is presently used for storage of the ash.

Because large amounts of dust are generated from the ash during dry periods, recycle pond water is sprayed in the area to hold down the dust. Rainfall and the sprayed recycle pond waters will increase the moisture content in the dry ash, and ultimately, the ash will become moist and a saturated and unsaturated zone will develop. This might result from direct seepage of rainfall through the cap or from horizontal ground-water seepage from the surrounding soil in the original ridges (see Figure 5). The moisture entering the stored ash will produce leachates. Table 5A shows analyses of samples of runoff collected at the ash storage area, indicating that the pH values are elevated along with concentrations of sulfate, chloride, and calcium.

The shallowest permeable zone underlying the ash disposal area is about 10 ft below the bottom of the original stream channel. Leachate could be migrating into this zone, from which it would move laterally southward. According to a letter report of Texas A&M University (May 1983), fly ash produced from western coal might produce a leachate high in heavy metals, dissolved solids, and pH.

Surge Pond

The surge pond is a 33.3-acre collection basin for water from most of the plant including direct discharges from the ash disposal area, the plant yard, coal storage area, sewage treatment pond, and oily water treatment system. It is located in the southern part of the plant site, as shown in Figure 16. Water from the surge pond can be sent to chemical treatment facilities and then to the clear water pond. Figure 17 is an AP&L schematic of the plant waste-water flow system. Some of the potential contaminants may be lost to the air by volatilization or may be lost to the ground water by infiltration and percolation. Except for these losses, the surge pond should contain all of the contaminants that originate on the plant site. The pond has been constructed on the natural land surface and is not lined. The lowest elevation of the bottom of the pond (boring 204) is reported to be 250 ft msl. The soil profile below the pond bottom includes the shallowest permeable zone, which consists of 14 ft of silty sand with a stiff silty clay below, below that is

another layer of silty sand 27 ft thick. The silty clay is reported to have a hydraulic conductivity ranging from 5 x 10^{-6} cm/sec to 1 x 10^{-7} cm/sec. The silty sand has a hydraulic conductivity of 1 x 10^{-4} cm/sec or less.

Water samples from the surge pond have been analyzed, and a summary of the water-quality information is presented in Table 5b. The data show that concentrations of chloride, sulfate, and calcium are much higher than those found in the ground waters, but considerably less than those in the recycle pond. The concentrations of sulfate and chloride ions, however, do not exceed the limits of 250 mg/l each recommended by the U.S. EPA in the secondary drinking-water standards. Predicted concentrations of selected anions and cations are shown in Table 6; comparison with observed values indicates that the surge pond water contains more chloride ions than predicted. This salt originates most likely from the Arkansas River. There is a relatively good correlation between the predicted and observed values for sulfate and calcium, but not for values of pH.

Coal Handling and Storage Area

The coal storage area is centrally located at the site and covers approximately 70 acres (Figure 16). Leachate is generated by the rainfall that passes through the coal, which then flows laterally away and is collected in ditches that flow to the surge pond. Leachate that might infiltrate into the ground water would flow laterally away from the coal

TABLE 5A. WATER QUALITY FOR ASH STORAGE AREA

Dates	pH (units)	Specific Conductance (micromho/cm)	SO4 (mg/l)	Ca (mg/l)	Cl (mg/l)
Nov 82	9.0	2,100	700	210	280
Oct 83	7.3	1,800	550	155	220

TABLE 5B. WATER QUALITY FOR SURGE POND

Dates	pH (units)	Specific Conductance (micromho/cm)	SO4 (mg/l)	Ca (mg/l)	Cl (mg/l)
Dec 83	7.04	1,200	250	270	125
Feb 84	7.47	940	160	160	110
Apr 84	8.07	660	210	115	79

Source: Arkansas Power & Light and Calgon Analyses.

TABLE 6. SURGE POND WATER QUALITY

Parameter	Concentrations in MG/L
Chloride	10 - 50
Calcium	250 - 350
Sulfate	125 - 175
Zinc	0.333
Selenium	N.D.
Cadmium	0.042
Copper	0.024
Aluminum	0.15
Barium	1.78
Chromium	0.024
Boron	0.29
Strontium	2.94
Titanium	0.026
Total Dissolved Solids	700 - 800
Total Suspended Solids	500 - 1000
pH	10 - 12 units

SOURCE: Arkansas Power & Light, 1974.

storage area, but how much of it might reach the ground water is unknown at this time. However, the types and concentrations of the contaminants, mainly some heavy metal and trace elements as well as sulfate and low pH values, are thought to be of minor significance in comparison with those at the ash storage area and recycle ponds.

Landfill

A landfill area at the White Bluff facility has been used for burial of plant construction debris and for burning and disposal of some non-hazardous waste material such as wood, cardboard, paper, etc. The location of the landfill is shown in Figure 16. The face of the landfill is approximately 200 ft long and 20 ft high. The quality of the seepage from the landfill area has not been determined. No leachate was observed at the surface of the landfill during a plant visit by the G&M hydrogeologist.

Coagulation and Sedimentation Ponds

These two basins have a surface area of about two acres each and are used for coagulation and settling of solids from the surge pond prior to pumping to the clear water pond. They are located directly south of the plant and the coal storage and handling area and directly east of the recycle ponds, as shown in Figure 16. The basins are excavated 10 to 12 ft into the silty clay and are unlined. They receive water from the surge pond and therefore contain waters of

similar chemical quality. Calgon CAT-FLOC T is added to flocculate suspended coal and ash particles.

Buried Fuel Tanks

The buried gasoline and diesel fuel tanks at WBSES are located a few hundred ft north of the coal handling area. The potential for leakage is not known at this time, but in many other parts of the country, buried fuel tanks and their piping systems have been found to be sources of ground-water contamination. This problem has prompted several states to adopt regulations that will require all buried tanks to be monitored.

ASSESSMENT OF POTENTIAL CONTAMINATION OF SURFACE WATER AND GROUND WATER

Surface Water

Water Quality

Averages of water-quality parameters for Tar Camp Creek, Lipscomb Branch, and Love Creek, given in Table 7, serve as a general characterization of the surface-water quality. Basically, the data show that the surface-water quality in the three creeks is apparently influenced by overland runoff from uncovered soil areas. The soils in the area contain lignite which, oxydized by air, will produce sulfate ions and a lower pH value. The runoff in Lipscomb Branch seems to be most affected by this process.

An interesting aspect is the relatively high value of chloride ions in Tar Camp Creek. No potential source of the chloride ions could be identified without further investigation.

Discharge Rates

The data base did not include any measurements on the rates of discharge of surface water from any of the creeks in the area. All creeks drain into the Arkansas River (Figure 10) as does the discharge from the cooling tower blowdown.

TABLE 7. WATER QUALITY FOR LIPSCOMB BRANCH, LOVE CREEK AND TAR CAMP CREEK

	pH (units)	Specific Conductance (micromhos/cm)	SO_4 (mg/l)	Ca (mg/l)	Cl (mg/l)
Lipscomb Branch Feb, May, 1979-1982	4.7	105	74	15	6.2
Love Creek Feb, May, Aug, Nov, 1979-1982	5.96	72.5	16.9	4	3.4
Tar Camp Creek Feb, May, Aug, Nov, 1979-1982	6.24	210	21.8	13.7	31.7

SOURCE: Arkansas Power and Light Company, 1982. Wells, Lakes, Ponds and Streams, Monitoring Program for White Bluff Stream Electric Station.

Contaminant Discharge

The most likely surface-water body to be affected by contaminants is Love Creek, because it will receive contaminants from the surge pond and ash disposal area. Part of the creek bed used to be where the dam of the surge pond is now located (see Figure 10). In fact, there are three locations where the creek bed has been covered by the dam. Indications that water from the surge pond may be migrating through the sediments in the old creek beds under the dam are given by the stressed vegetation where the old creek beds used to be. The difficulty in the contaminant assessment of the creeks is that the overland runoff from the disturbed area generally contains the same contaminants, such as sulfate, as those coming from the ash storage area and surge pond. The chloride ion can be very helpful as a tracer for the surge pond water, because its concentration builds up in the recycling and discharge of plant water circulation. Based on the values of chloride presented in Table 7 for Love Creek, no major seepage could be detected from the surge pond, because the average chloride concentration of 3.4 mg/l is essentially a background value. This does not necessarily mean that seepage has not occurred, since dilution by surface waters upgradient from the surge pond area also could explain the low chloride value.

The water quality in Lipscomb Branch might be affected by seepage from the clear water pond. According to

water-quality information from AP&L, the concentrations of sulfate and chloride ions are in the range of from 80 to 100 mg/l. In Lipscomb Branch, the average concentrations of sulfate ions are rather elevated (74 mg/l) and are in the range of those in the clear water pond, but the average chloride concentrations are at background value (6.2 mg/l).

The water quality in Tar Camp Creek may reflect some influence of coal yard runoff; an analysis of that runoff by Calgon in October 1983 showed concentrations of 500 and 440 mg/l respectively for sulfate and chloride with a pH of 6.7. Because the chloride concentrations in Tar Camp Creek (31 mg/l) is significantly higher than in Lipscomb Branch and Love Creek (6.2 and 3.4 mg/l). However, the potential source(s) of these ions is (are) not known and should be investigated further by collection of additional surface-water samples in the creek during low flow conditions.

Ground Water

Water Quality

The information collected by AP&L (1982) and published in the Wells, Lakes, Ponds, and Streams Monitoring Program report for WBSES contained the analyses of several wells in the area surrounding the plant. All of these analyses basically showed low concentrations of sulfate and chloride (generally less than 10 mg/l). In this report, an attempt

was made to quantify the water quality in the sand layers in the Jackson Formation, although no well construction data for the sampled wells were available to determine from what zone the water was withdrawn. It is most likely, however, that none of these wells is screened so shallow as to tap any of these layers. Instead, they are probably completed in the Sparta Sands.

The water quality of the plant's production wells have been previously mentioned and are shown in Table 7.

Aquifer-Flow Systems

The geologic cross-sections in Figures 8 and 9 show the presence of two layers of clean, fine to medium sand in the Jackson Formation underlying the plant area. Some of the boring records showed the presence of these layers whereas others did not. Some borings did not go deep enough. Figure 14 shows the extent of the deepest layer, called the 230-foot sand, from the plant site through the coal yard, cooling towers, and clear water pond to the Arkansas River. At the river, the bottom of this layer was reported at approximately 210 ft msl.

A comparison of the topographic map with the boring information indicates that some parts of the bottom of the clear-water holding pond have been cut into the 230-ft sand. The actual extent of exposure was hard to determine. However, the fact remains that the hydraulic head created by

the water in the pond will recharge the 230-ft sand. Assuming, for example, that the water level in the pond is at approximately 270 ft msl, the hydraulic head in the 230-ft sand will be nearly the same. Thus, the possibility exists that water will seep from the clear-water holding pond through the 230-ft sand to the Arkansas River.

Assuming the width of the ground-water flow path to be 1250 ft, the average thickness of the sand layer to be 20 ft, the hydraulic conductivity of the sand to be 7×10^{-3} cm/sec, and the head gradient between the pond and the river to be 57 ft, the subsurface seepage rate from the pond to the river could be approximately 425,000 gallons per day. This is not a very significant amount of seepage compared with the total pumpage. The most important point of the recharge to the 230-ft sand is that the hydraulic loading of this sand layer might act as a barrier to downward migration of contaminants under other areas of the plant. However, the 230-ft sand does not seem to extend to certain areas nor is there any data.

The shallower sand layer at 260 ft msl is called the 260-ft sand; its extent is shown in Figure 13. The layer consists of fine sand grading to silty sand at its farthest extent; definition of the layer is not as "clear cut" as for the 230-ft sand. Its significance in the contamination picture is greatest in the potential seep areas of the ash storage area and surge pond, where its occurrence is not well documented.

the flow path is approximately 1000 ft, the thickness of the sand 14 ft, and the head gradient 25 ft. Considering these assumptions, the minimum total flow is 5000 gpd.

The water-quality data for the surge pond indicate that the average total concentrations of the chloride and sulfate ions is 315 mg/l, which implies that the outflow of contaminants can be expected to be a minimum of 13.2 lbs/day. This is a rather small amount of contaminant load for chlorides and sulfates. The soil has a general tendency to adsorb heavy metal and trace elements, but the presence of these substances could not be quantified because no reasonable assumptions could be made.

The risk of off-site migration of potential contaminants is highest at the surge pond and ash storage areas. Seepage from the recycle ponds is not considered to be a likely mechanism for off-site migration.

DATA DEFICIENCIES

Many of the foregoing findings have been based on reasonable assumptions for the values of horizontal and vertical hydraulic conductivities, water quality, and ground- and surface-water levels. All these assumed values need to be "firmed up" by actual measurements.

(1) Hydraulic conductivity values for selected soils, especially the fine sands and silty sands.

(2) Aquifer parameters (transmissivity, storage coefficient, and leakance factor) for the two sand zones in the Jackson Formation.

(3) Ground-water level measurements on a spatial and temporal basis in the sand zones in the Jackson Formation.

(4) Better definition of types and the concentrations of the contaminants in potential leachates from ash storage area.

(5) Surface-water-quality samples from stream-gaging locations upstream of potential source areas.

(6) Cation exchange capacity of soils.

RECOMMENDATIONS

The following recommendations are designed to fill the data gaps previously noted under the list of deficiencies. The recommendations are general in nature and will be discussed in greater detail in a scheduled review meeting. It is recommended that:

(a) Representative soil cores be collected at selected locations and at different depths, especially in the ash storage and surge pond areas, to provide a better definition of the shallow hydrogeology.

(b) Monitor-well clusters be installed downgradient of the surge pond dam and ash storage areas, and between the Arkansas River, Lipscomb Branch, and the clear- water holding pond. Each cluster should consist of one well screened in the 260-ft sand and one well screened in the 230-ft sand.

(c) Additional upgradient monitor-well clusters be installed to the west and north of the plant site to determine the general direction of ground-water flow in the 230- and 260-ft zones.

(d) Wells be installed at three points to monitor water levels and water quality in the Cockfield aquifer (which underlies the Jackson Formation).

(e) Slug tests be conducted in the newly installed monitor wells to determine the in-situ hydraulic conductivity and transmissivity of the aquifers.

(f) Surface-water gauging stations be established on Love, Tar Camp, and Lipscomb Creeks upgradient and downgradient of the potential contaminant source areas. Discharge measurement should be taken along with the collection of water-quality samples.

(g) Water-level measurements be made and ground-water samples be collected and analyzed from all the newly installed monitor wells on a regular basis.

(h) Laboratory tests be conducted using columns of soil from the WBSES site and leachates from the potential contaminant source areas to determine the effective absorptive capacity for selected ion species.

(i) Tests be conducted with the stacked materials for the ash storage area to determine if future rainfall events during and after closure will generate leachate and what the nature of that leachate will be.

(j) Soil moisture and lysimeters be installed in the stored ash to determine moisture build-up and leachate production after disposal.

CLOSING COMMENTS

This initial assessment of the potential for ground-water contamination by activities at the WBSES points to a series of minor impacts. These are believed to be small enough not to warrant any remedial actions at the present time. However, a better definition of the assumptions underlying this study should be made, especially of those regarding potential off-site migration of contaminants via surface-water streams. If this were to indicate possible liabilities, they almost certainly would fall under the heading of risk to the off-site ecology.

We have enjoyed performing this investigation for AP&L. The close coordination and cooperation of Ms. Roberta Patey and Mr. Jerry Roberts of AP&L proved most beneficial throughout the course of the investigation and is appreciated. We look forward to assisting AP&L in the future.

Sincerely,

GERAGHTY & MILLER, INC.

Peter J. Schreuder
Vice President

September 21, 1984

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ISES/WBSES

A PROPOSED PLAN FOR ENVIRONMENTAL MONITORING SYSTEMS AT INDEPENDENCE AND WHITE BLUFF STEAM ELECTRIC STATIONS FOR ARKANSAS POWER AND LIGHT COMPANY LITTLE ROCK, ARKANSAS

JUNE, 1990

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INTRODUCTION

Concern for the potentially adverse impact of its coal fired power generating facilities at Newark (ISES) and White Bluff (WBSES) on the local groundwater environment has prompted Arkansas Power and Light to establish on-site monitoring systems for detection of contaminants.

Initial efforts at the ISES plant included the installation, in 1983, of seven monitoring wells (401-407) located in proximity to the surge pond, recycle ponds, and sedimentation ponds. The wells were screened at a depth of approximately 30-40 feet below land surface, in the upper part of the alluvial aquifer. Subsequently, six additional wells were installed to complement the existing wells near the recycle ponds (408-410) and to monitor the western periphery of the coal yard (411, 413). Well (412) was located upgradient from the plant site, to provide data on baseline levels of naturally occurring constituents in the aquifer for comparison with those at the monitoring sites at the plant.

Twelve monitoring wells have been installed at the White Bluff plant site. The wells were installed in November, 1989 and were designed primarily to monitor ground-water conditions in two sandy zones beneath the coal yard. Two of the wells (1, 6) are located upgradient from the plant site to provide base-line levels of constituents for comparison with other wells at the plant site.

Current efforts by AP&L to minimize the risk of migration of undetected contaminants into the environment has focused on the development of a network of monitoring wells and stream sampling stations dedicated to the task of providing long-term hydrologic data for an evaluation, and possible remediation, of water-quality problems at the plant sites. The network is to be installed in accordance with Environmental Protection Agency (EPA) guidelines and to be sampled at intervals compatible with the movement of water in the natural flow systems. Spatial distribution of the monitoring wells and surface-water sampling sites is to be determined from an analysis of underground and surface flow patterns to satisfy specific data requirements for a given area.

PURPOSE AND SCOPE

The purpose of this study was to evaluate the integrity of the current monitoring systems at Independence (ISES) and White Bluff (WBSES) steam electric stations and to propose modifications to the current systems that would minimize the risk of: 1) offsite migration of contaminants produced at the plants, 2: onsite migration of contaminants from external sources, and 3) ground-water contamination within the plant-sites themselves.

The study was based on hydrologic information contained in reports prepared by consulting firms under contract with Arkansas Power and light Company (AP&L), and on data from the files of AP&L, Environmental Services/Chemistry Section.

Site visits were made to each facility for familiarization with existing monitoring networks.

The study was authorized by contract dated April 24, 1990 with Arkansas Power and Light.

HYDROGEOLOGY

Independence Plant

The stratigraphic relationship between each of the principal geologic units at the Independence plant has been described in detail in the report by Geraghty & Miller, Inc., 1984, p. 11. As stated in the report, the consolidated Paleozoic age rocks that underlie the area are essentially impermeable, relative to the overlying alluvial deposits. Thus, when analyzing the ground water flow regime, the Paleozoic bedrock can be considered as being a zero-flow boundary.

The Alluvial section is composed of an upper confining layer overlying a highly productive sand and gravel aquifer (Fig. 1). The coarsest and therefore, most highly permeable, part of the aquifer is near the base of the section immediately above the contact with the Paleozoic Rocks.

The alluvial aquifer is recharged by downward percolation of water through the more permeable parts of the upper confining layer. Once in the aquifer, water moves laterally toward the White River which is incised into the aquifer. The driving force moving the water is the pressure defined by the difference in elevation between the place of recharge and the stage of the river. The normal flow direction is interrupted periodically when high river stages temporarily reverse the flow causing an increase in bank storage near the river.

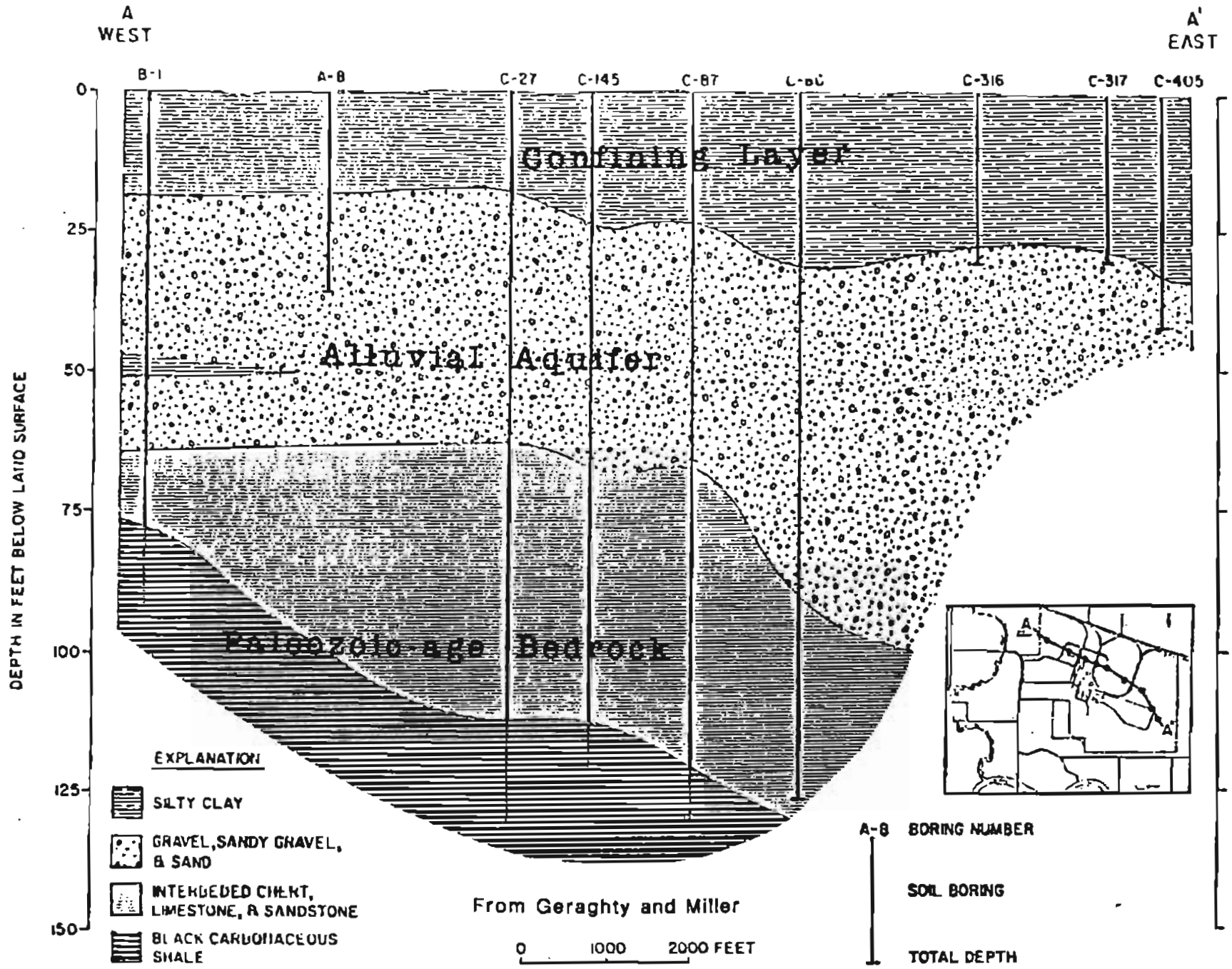


FIGURE I. Geologic Cross Section Beneath the Independence Plantsite

Current withdrawals from production wells at ISES, the Newark municipal well, and producing irrigation wells have also interrupted the normal gradient, causing local depressions in the potentiometric surface with corresponding reversals in the direction of flow. Although the combined withdrawals from all sources is large, they are apparently less than the recharge rate to the aquifer. This can be inferred from the fact that no long-term cone of depression has developed at the site. Water level declines resulting from withdrawals impact a relatively small area and recovery after cessation of pumpage is apparently rapid and complete. Two conclusions that can be drawn from these facts are; 1) In spite of present-date withdrawals, the general riverward ground-water gradient remains essentially the same, and, 2) The aquifer has the potential for yielding significantly more water than is presently being produced.

White Bluff Plant

Based on an evaluation of data from previous reports (Geraghty and Miller, 1984, Holloway, 1990), subsurface movement of contaminants produced at the plant site would be controlled by, and be restricted to, movement within two permeable zones beneath the site. These zones are identified by the approximate elevation at which they occur in the section and are known as the 260- and 230- foot sands. Figure 2 (from Geraghty and Miller, 1984) is a north-south cross section through the plant site showing the relative position of the sand zones within the section.

Because of its area of occurrence and proximity to the land surface, the upper or 260- foot sand can be expected to be the principal conduit for potential contaminants. The sand has been identified in most the borings made at the plant site and is shown on the cross section as being nearly flat lying. It is reasonable to assume that the sand extends laterally in all directions from the plant site, although possible varying in thickness and character from place to place, and outcrops along hillsides north, east, and south of the plant at an elevation of about 260 feet. Figure 3 is a delineation of the 260 foot contour on a topographic map of the area, indicating the probable maximum extent of the 260- foot sand, and showing that the sand extends only a short distance in the downgradient directing from the plant site.

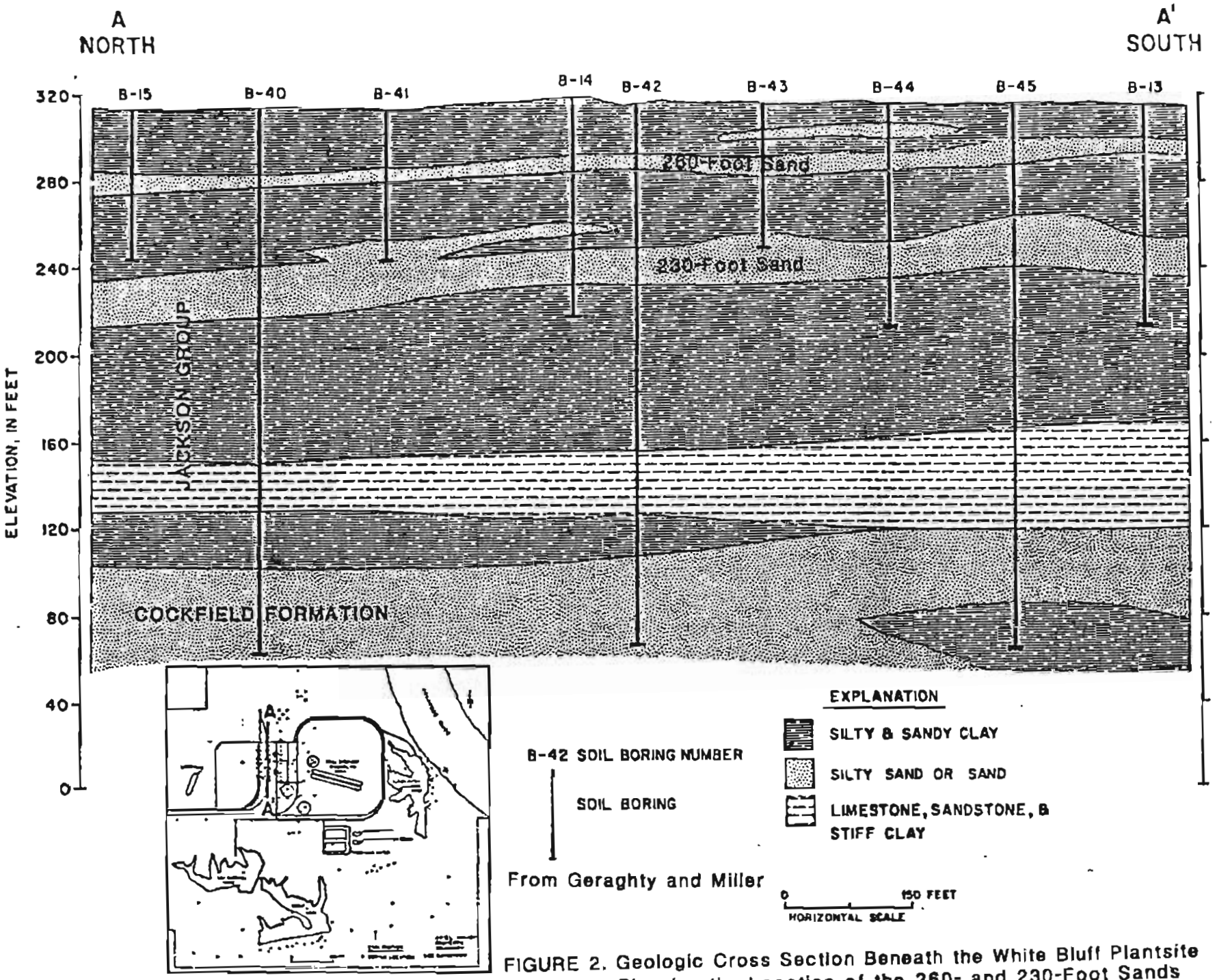


FIGURE 2. Geologic Cross Section Beneath the White Bluff Plantsite Showing the Location of the 260- and 230-Foot Sands

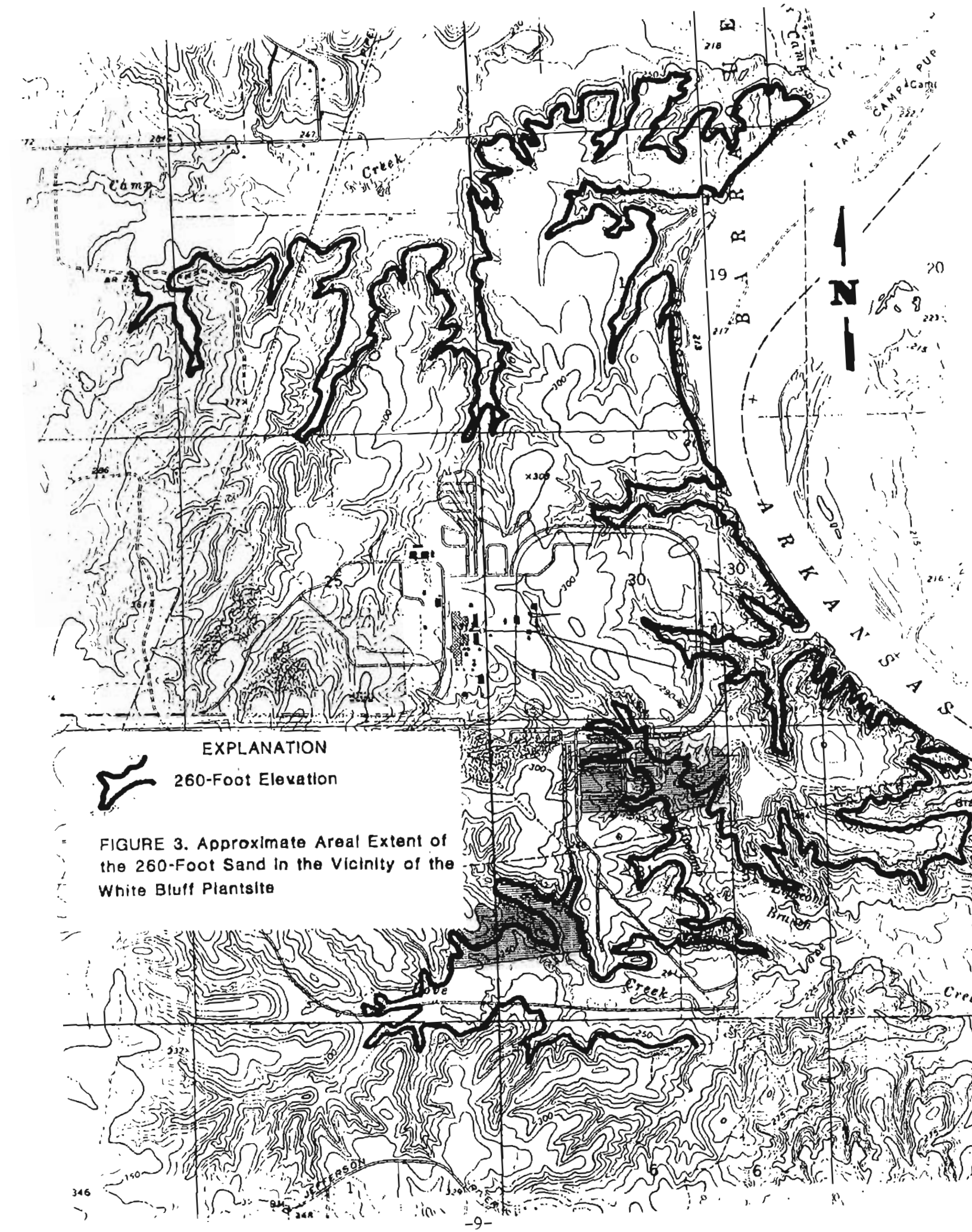


FIGURE 3. Approximate Areal Extent of the 260-Foot Sand in the Vicinity of the White Bluff Plantsite

The 230- foot sand is separated from the upper sand by a predominantly clay section which is described by Holloway (page 36) as being an effective barrier to the movement of water between the two sand zones. However, Holloway also states (page 64) that excavation for the tunnel in the coal yard may have penetrated the 230- foot sand causing a more direct connection between the two sands. The section beneath the 230- foot sand is also composed of clay, the top of which constitutes the lowermost horizon at which potential contaminants could be expected to migrate downward from the surface.

The 230- foot sand, like the upper sand, extends laterally from the plant site. Based on the relative elevations of the sand unit, and the Arkansas River (213- feet msl), the sand unit probably outcrops along the bluff on the west side of the river. It is probably also penetrated by stream channels along the lower reaches Tar Camp Creek on the north and Love Creek on the south where elevations are below 230 feet.

Previous studies have shown that the slope of the potentiometric surface, and consequently the direction of low, approximates land surface in the upper sand and is toward the southeast in the lower sand. This fact, along with the existence of outcrop areas for both sands in the easterly (downgradient) direction indicates that the plant site is the most nearly hydrologically isolated system that could be designed. The significance of this observation is that any ground-water problem occurring at the plant site would be

limited by physical boundaries to the area in the immediate vicinity of the plant. The risk of underground migration of contaminants beyond the immediate vicinity of the plantsite is highly improbable.

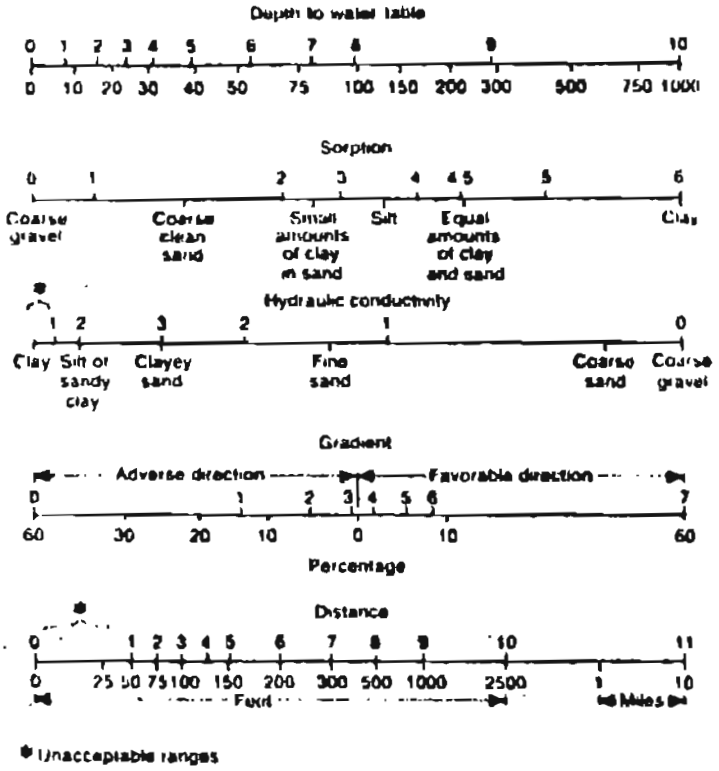
RISK ANALYSIS

Any activity associated with the storage or use of foreign materials at a given location creates the possibility that at least locally the ground-water environment will be adversely effected. The probability that the contaminant will migrate a certain distance depends on the nature of the contaminant and the character of the transport medium.

The nature of the contaminant determines whether it will most likely occur at the water table, or near the base of the aquifer.

The character of the transport medium (aquifer) controls the rate and direction of movement within the aquifer. The most important of these aquifer characteristics include: 1. depth to water table; 2. sorption capability of the soil; 3. hydraulic conductivity of the aquifer; 4. water-table gradient (adverse direction-downgradient, favorable direction-upgradient) and, 5. distance from a pollution source. Le Grand (1964) combined these factors into a numerical system that indicates the pollution potential at a site. The method is imperfect because of the complex set of variable present at each site but it does provide a means of categorizing the pollution potential according to a consistent, and logical set of guidelines. Figure 4A shows the evaluation graphs for each of the five parameters and the associated pollution possibility. A numerical value can be read above the line for each parameter. The sum of these values is then used to estimate the pollution potential (Figure 4B) at a site. The use of these scheme is presented for evaluating the potential for pollution at the AP & L plantsites.

(4A)



(4B)

TOTAL POINTS	POLLUTION POSSIBILITY	PERCENT AT RISK
0 - 4	Imminent	80 - 100
4 - 8	Probable or possible	60 - 80
8 - 12	Possible but not likely	40 - 60
12 - 25	Very improbable	20 - 40
23 - 35	Virtually impossible	0 - 20

After LeGrand, 1964

FIGURE 4. Rating Chart (A) and Table (B) for Determining the Pollution Potential at a Site

Independence Plantsite

The hydrologic framework at ISES consists of an approximately 25-foot thick clay section overlying a highly transmissive sand and gravel aquifer. The aquifer is bounded on the bottom by an impermeable sandstone and shale bedrock. The land surface, as well as the water table, are flat to gently sloping toward the White River. Water-table fluctuations are caused by natural processes, by withdrawals from industrial wells at the plantsite, and from irrigation wells in the vicinity of the plant. The gradient is generally less than 1 percent except possibly in the immediate vicinity of a pumping well. Applying the hydrologic information for the site to the graph in figure 4 provides an estimate of the pollution potential from various sources at the plantsite.

Assuming that leachate from the coal yard were to contaminate the ground-water system, the most likely direction of movement would be towards the White River, and as well, toward the southern boundary of the plantsite. The probability that the contaminant would noticeably impact the ground-water quality at the property boundary can be determined as follows:

Factor	Value	Numeric Rating
Depth to water	5 - 15 ft.	1
Sorption (clay cap)	Clay and sand	4.5
Hydraulic conductivity	Med. sand	1
Gradient (adverse)	1% or less	3
Distance	6,000 ft.	10.5
	Total	20

A numeric value of 20 indicates that it is very improbable (an estimated 30% risk factor) that contamination originating at the center of the plantsite could impair water quality at the southern boundary of the plantsite. Obviously, the most influential factor is the distance between the source and point of interest which allows for dispersion and ultimately dillution of a contaminant within the confines of the plantsite. Similarly, dispersion associated with the length of the flowpath (distance) from other potential sources of contamination to nearby plant boundaries suggest that there is only a slight probability of water-quality degredation at and beyond the plant perimeter.

Estimates supporting this conclusion are as follows. All hydrologic factors except for the distance factor are assumed to have a constant numeric value of 9.5.

Source	Point at Risk	Distance	Numeric Value	Percent at Risk
Coal Storage Yard	No. Property Bdy.	2000	19	30
Surge Pond (S.E. Cor.)	So. Property Bdy.	2000	19	30
Landfill Trenches	So. Property Bdy.	2500	19.5	25
Recycle Ponds	So. Property Bdy.	3000	20	25
Ash Disposal Area	East Property Bdy.	3000	20	25

These analyses assume a direct flow path from the point of contaminant injection to the point at risk. Movement of contaminants entering the ground-water system from any of the potential contamination sources would be alternately influenced by seasonal irrigation pumpage east and north of the plantsite, by intermittent production-well pumpage at the plantsite, and by the normal riverward gradient (Geraghty and Miller, 1964, p. 48). The net result of these stresses is to achieve increased dispersion onsite resulting from a greater length of flow path.

White Bluff Plantsite

The hydrologic framework at WBSES consists of predominantly silt and clay section containing two slowly-permeable silty-sand aquifers. The aquifers range in thickness from five to twenty feet and are located at depths of approximately 25 and 50 feet below land surface. The base of the lower aquifer (230-foot sand) is considered to be the base of the local ground-water flow system. There are no wells tapping the aquifers locally and ground-water gradients conform to the general slope of the land surface, which is generally toward the east and southeast.

The extent of the upper aquifer (260-foot sand) closely approximates the property boundaries at the plantsite. Since the 260-foot sand is the primary medium through which potential contaminants would move, an evaluation of the pollution potential at the downgradient outcrop of the 260-foot sand nearest the contaminant source is appropriate for the White Bluff plantsite. An evaluation of the fixed parameters for the plantsite gives a numeric rating of 12 (depth, 2; sorption, 5; conductivity, 3; and gradient, 2). From this it can be seen that because of the nature of the sediments at the plantsite there is a less than even chance (approximately 40%) for degredation of ground-water quality even in the immediate vicinity of the potential contamination sources.

The fixed-parameter rating (12) combined with the length of flow path provides the following evaluation of pollution potential at the plantsite.

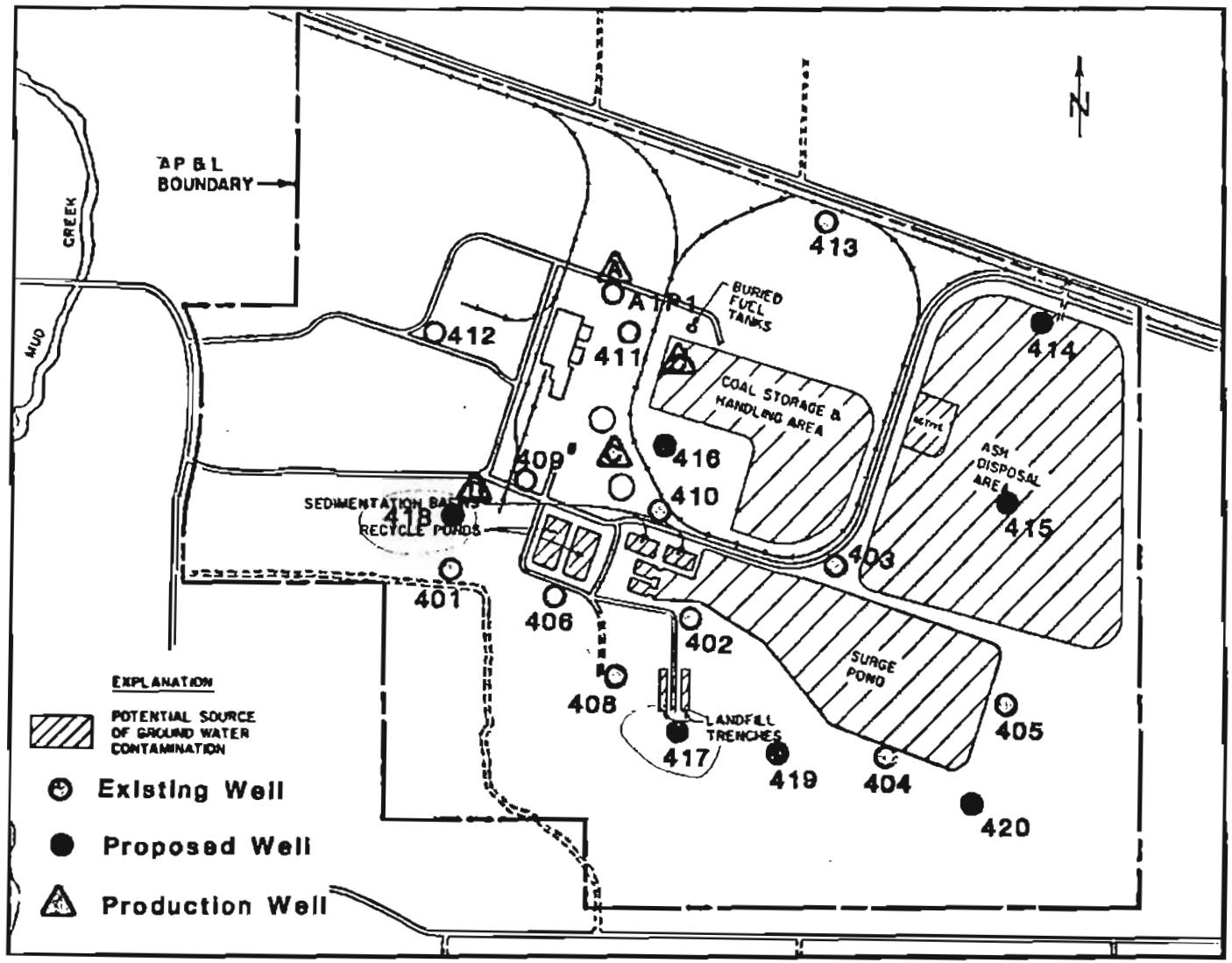


FIGURE 5. Locations of Existing and Proposed Monitoring Wells, Independence Plantsite

There are no apparent physical features that would tend to channelize a potential contaminant in a given direction. Therefore, because of the homogeneous nature of the aquifer, it is believed that the suggested down-gradient network would intercept any contaminant plume, from within the plantsite. Well 401 should be screened within the range of water-table fluctuations, to intercept possible low-density substances.

2. Background wells ((412,) 413, 414*, 415*, and AI P1). Well 412 has been designated as being indicative of background conditions and should be retained for that purpose. The remaining wells in the group are located so as to identify water-quality changes that may occur either off or on site. Normal ground-water movement is toward the south but the direction of flow is probably reversed during the irrigation season. However, the net result of the normal gradient and plant pumpage to the south and the seasonal irrigation pumpage to the north may produce a nearly static flow condition at the northern boundary of the plant. Additional wells (414 and 415) are recommended for installation to provide data on the movement of contaminants toward the eastern boundary of the plant site.

3. On-site monitoring (409, 410, 411, and 416*). This suite of wells is suggested as an early-warning system for monitoring water quality changes in production well C. Because of its location in the center of all of the potential contamination sources, production well C is in the greatest jeopardy. Therefore, the installation of monitoring wells around Well C should be given the highest priority.

4. Construction-waste landfills (417*, 418*). Two wells are suggested for this purpose. Well 417 is proposed for a location down-gradient from the east landfill and well 418 for a site between the west landfill and production well B. These wells should be screened within the range of water table fluctuations to monitor the possible movement of organic substances from the landfill sites.

* Proposed new wells.

White Bluff Plantsite

While it can be stated with certainty that any potential contaminant would not impact ground-water system(s) regionally, the development and maintenance of an "early warning" monitoring network is necessary to detect contaminants in the immediate vicinity of the plant site where they are most likely to occur, and before they are discharged into the local surface drainages.

With few additions, the existing monitoring well scheme, (Fig. 6) is considered to be adequate to provide for monitoring ground-water conditions at the plant site. Three additional wells are proposed.

One monitoring well (B-13) is proposed for installation along the property line on the north side of the construction landfill site. The well should be screened in the 260 foot sand, which should be encountered within 25 feet of the land surface. Since the landfill is located essentially in the stream channel itself, any contaminated discharge from the landfill will almost certainly move toward the stream channel, the normal discharge point, rather than vertically downward into the ground. Water-quality information from the proposed well is expected to provide documentation of the absence of ground-water contamination from the landfill.

Two wells (B-14 and B-15), screened in the 230 foot sand, should be installed in the vicinity of the surge pond (fig. 6). The wells should be multiple screened, if necessary, opposite each significant sand lens encountered to the approximate horizon of the 230-foot sand.

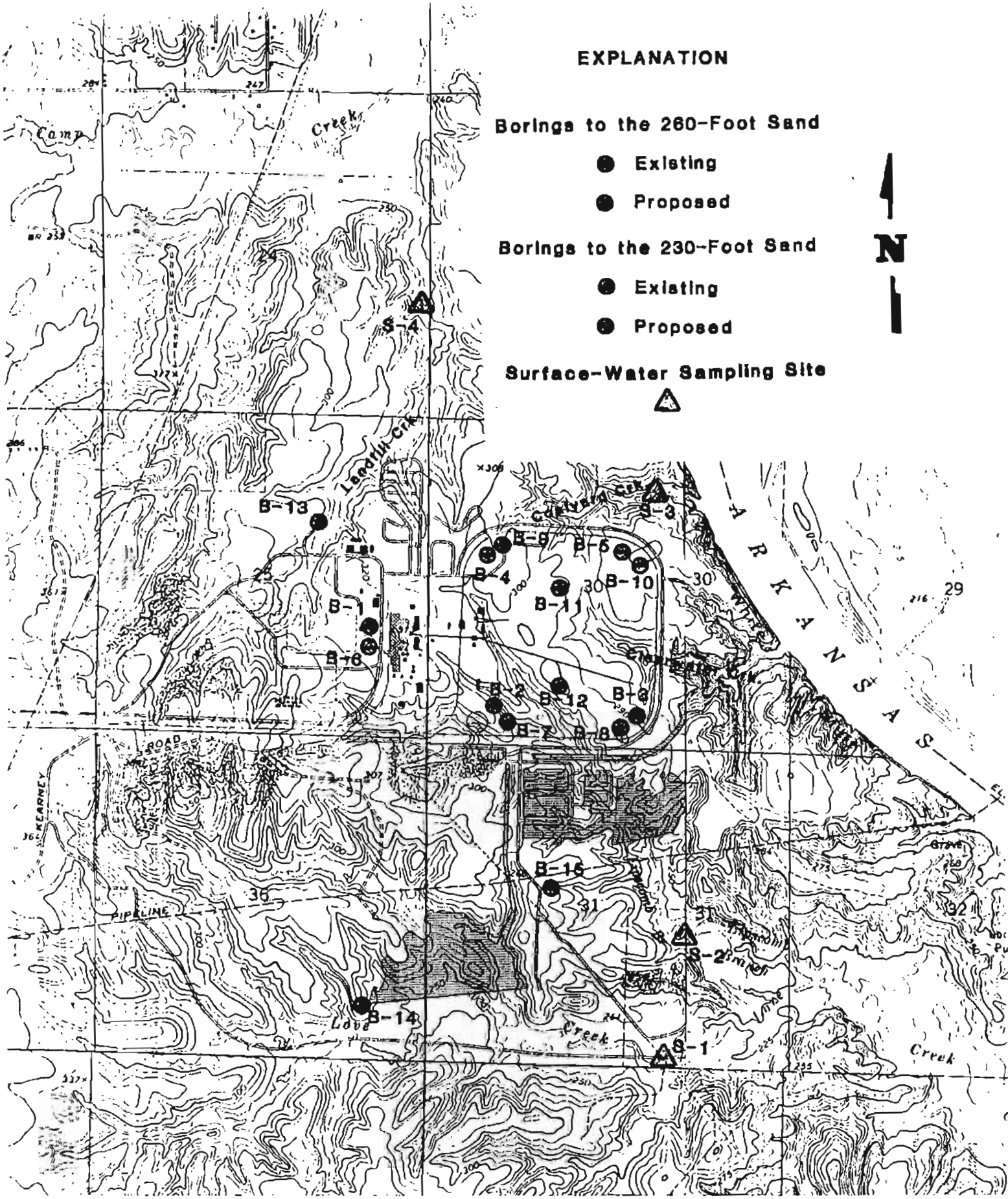


FIGURE 6. Locations of Existing and Proposed Monitoring Wells and Surface-Water Sampling Sites, White Bluff Plantsite

DATA COLLECTION

Independence Plantsite

Water Quality Monitoring

The water-quality monitoring program sponsored by James L. Grant and Associates (1990) p. 3-3, should be implemented at the Independence Plant after completion of the permanent monitoring-well network. Specifically, the sampling program includes the following recommendations:

> Wells 408, 409, 410, 411, 412, and 413, as well as the new wells, should be sampled and analyzed for the attached Appendix IX list of constituents on a one-time basis to identified any hazardous constituents of concern. The data from the other wells should be compared to the data from the background well to identify concentrations above background.
>
> If this program of monitoring for environmental impacts is implemented, both the existing wells and the proposed new wells should be monitored monthly for field parameters and semi-annually for chemical parameters. The chemical parameters include both those identified in Section 3.1, and the constituents from Appendix IX that were detected above background in the previous step.

Water-Level Monitoring

Mean-sea-level elevations of the measuring points and the land surface should be determined for all wells in the permanent monitoring network. Water levels should be measured monthly during the first year of monitoring and twice each year thereafter. For the semi-annual measurements, one set should be made in April, prior to the initiation of irrigation pumpage in the area. This set of measurements will define the highest annual water levels and enable the determination of trends, if they occur, in the potentiometric surface from year to year.

A second set of water-level measurements should be made in August when the influence of irrigation pumpage on water levels at the plantsite is greatest. Because of the generally slow rate of ground-water level fluctuations, the two sets of measurements are considered adequate for long-term monitoring needs unless information for a special situation is required.

White Bluff Plantsite

Water-Quality Monitoring

The quality of water monitoring program proposed by James L. Grant and Associates (1990) for the Independence site should also be implemented at the White Bluff site after completion of the permanent monitoring-well program. All wells should be sampled at the same frequencies and analyzed for the list of constituents as stated in the Grant report.

Water-Level Monitoring

Mean-sea-level elevations of the measuring points and land surface should be determined for all wells in the permanent monitoring system. All wells should be measured monthly during the first year of operation and twice yearly thereafter. The first set of semi-annual measurements should be made in April and the second in September. Water-level measurements will provide information for the determination of gradients in the 260- and 230-foot sands and for year-to-year comparisons of hydrostatic heads in the sands.

Surface Water Sampling

The positioning of, and sample scheduling for, surface-water monitoring sites is crucial to the evaluation of contaminant migration at the White Bluff plantsite. As shown in Fig. 3, all of the potential contamination sources, except for the ash-disposal pits, are located on or near the outcrop of the 260 foot sand. Specifically, the landfill site is only a slight distance vertically above and a short distance up-valley from the outcrop; the north side of the coal yard is practically on the outcrop; and the surge pond is at and below the outcrop.

Although the plant-site topography, and, as a result, the ground-water flow regime, has been significantly altered during plant construction, the greatest tendency is still for ground water to discharge by the shortest path through a natural exit, ie, the outcrop. Since there are no pumping stresses to distort the ground water flow pattern, contaminants may be observed in stream monitoring stations before they appear in the monitoring wells. For this reason, the stream-sampling stations should be located downstream from the outcrop of the 260 foot sand. More precise location of the sand outcrop could probably be determined, for siting purposes, by a field examination conducted shortly after a general rain. That is, the sand should exhibit more seeps than the under- or overlying clays. The distribution and general location of proposed surface-water monitoring sites is shown in Fig. 6.

Surface water samples can provide data for three purposes: 1) to evaluate the quality of plant-site effluent, 2) to evaluate the quantity of storm runoff, and 3) to evaluate the quality of ground-water discharges. Effluent and storm runoff evaluation require that a particular event, i.e. plant discharge or storm events, occur. Sampling for ground-water evaluation should be conducted after all overland flow has ceased and flow is from ground water seepage only. Since all of the streams in the network are intermittent, sampling for ground water will be limited to the dormant season for vegetation when evapotranspiration is lowest. Sampling should be conducted semiannually, but will depend more on climatic conditions than on a rigid calendar schedule.

Sorption Studies

Attempts should be made to more fully understand the chemical composition of leachates from all potential contamination sources at the plantsites. This might be accomplished using either in-situ tests or laboratory methods. Column drainage studies, using leachates from the plants, could then be conducted to determine the ion-exchange or adsorption capacity of the confining layers and aquifers. Such information would have considerable usefulness in evaluating the types and amounts of foreign substances entering the ground-water system.

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PHASE I - GEOTECHNICAL EVALUATION
PROPOSED FLY ASH DISPOSAL AREAS(S)
ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF STEAM ELECTRIC STATION
NEAR REDFIELD, ARKANSAS

R e p o r t
t o

ARKANSAS POWER AND LIGHT COMPANY
Redfield, Arkansas



McClelland engineers

geotechnical consultants

PHASE I - GEOTECHNICAL EVALUATION
PROPOSED FLY ASH DISPOSAL AREA(S)
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NEAR REDFIELD, ARKANSAS

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R e p o r t
t o

ARKANSAS POWER AND LIGHT COMPANY
Redfield, Arkansas

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M c C L E L L A N D E N G I N E E R S, I N C.
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Little Rock, Arkansas

February 1979

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February 9, 1979
LR79-023

Arkansas Power and Light Company
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Redfield, Arkansas 72123

ATTENTION: Mr. Michael Coombs

SUBJECT: Phase I - Geotechnical Evaluation
Proposed Fly Ash Disposal Area(s)
Arkansas Power and Light Company
White Bluff Steam Electric Station
Near Redfield, Arkansas

INTRODUCTION

Presented herein is the report of our preliminary evaluation of site and subsurface conditions in the areas presently proposed for long-term fly ash storage at the White Bluff Steam Electric Station site near Redfield, Arkansas. It is our understanding, after discussions with Arkansas Power and Light representatives, that the fly ash disposal area should be underlain by a minimum of 5 ft of nearly impervious natural soils with mass vertical permeability values less than or equal to 1.0×10^{-7} cm/sec. In areas where the minimum thicknesses of the nearly impervious natural soils are not encountered, it may be necessary to place and compact a clay blanket with a minimum thickness of 3 ft.

The primary objective of this study was to evaluate the presently planned fly ash storage area(s) in relation to the aforementioned permeability requirements. An additional objective was to evaluate specified areas within the White Bluff site not presently planned for fly ash storage. This preliminary study was accomplished through review and analysis of existing geologic, subsurface and topographic data.

SITE GEOLOGY

The project site is located on the West Gulf Coastal Plain Physiographic Region near the western margin of the Mississippi Embayment area. The West Gulf Coastal Plain Region consists of Cretaceous and Tertiary Age marine and non-marine deposits. The adjacent Mississippi Embayment Region, which comprises large portions of Louisiana, Mississippi, and Arkansas, consists of a broad trough, filled to a considerable depth by primarily fine-grained stream sediments.

The Mississippi Embayment owes its existence to structural movements of Paleozoic rocks of the central lowlands. The axis of the trough approximately follows the course of the Mississippi River and plunges generally to the south. The structure of the Cretaceous and Tertiary sediments within the Gulf Coastal Plain Region are related to the presence of the broad trough of the Mississippi Embayment, as well as the Monroe Uplift located in northeastern Louisiana and southeastern Arkansas.

The primary geologic group exposed at the site is the Tertiary Age Jackson Group. The Jackson Group consists of deposits, both marine and non-marine in origin. The name White Bluff Formation is given to the marine unit and the name Redfield Formation is given to the non-marine unit.

The geologically more recent non-marine Redfield beds overlie the marine White Bluff Formation at the site. The Redfield Formation is characterized by the general absence of marine fossils and other marine indicators, such as glauconite and the presence of lignitic and carbonaceous matter. The non-marine formation consists generally of thinly laminated silts and silty clays and cross-bedded sands with some lignitic units.

The marine White Bluff Formation dips generally to the south and is covered by the Redfield Formation. The White Bluff Formation is not a homogeneous unit and, characteristically, consists of calcareous and glauconitic clay, dark gray clayey sand and thinly bedded silty clay and blocky clay. Stratified layers, pockets and inclusions are common in the unit, and due to the various stages of deposition, erosion and redeposition, many of the beds are erratic or discontinuous. The clays within the White Bluff Formation are generally very stiff and over-consolidated and the granular units within the Formation are in a dense to very dense condition.

Pleisteocene Terrace Deposits mantle the uplands in localized areas at the White Bluff site. The terrace deposits vary appreciably in texture and may consist of beds of clay, silt, sand and/or gravel or mixtures of these. Discontinuous layers or lenses of sand and gravel may be present to depths of approximately 20 ft. Geologically recent alluvium is present at the base of numerous stream valleys over the site. The stratigraphy of the alluvium is irregular and the alluvium may consist of clayey silt, silty and clayey fine sand or sandy clay with organic matter and some embedded gravel.

RESULTS AND CONCLUSIONS

The following discussions with regard to the proposed fly ash storage area(s) are based on the available topographic information and limited subsurface data. It should be noted that the discussions include generalizations of the subsurface conditions based on the available data and should not be considered as precise or conclusive. A more precise definition of conditions may be provided only through additional field studies, which are discussed in detail in the Additional Studies section of this report.

Fly Ash Disposal Areas I and II

As presently planned, two areas are designated for initial fly ash storage. Fly Ash Storage Areas I and II are located in adjacent ravines in a presently undeveloped area southwest of the main plant area. The present intentions are to deposit the waste fly ash in the natural depressions up to El 320. All runoff from the fly ash area is to be collected behind earth dikes to prevent possible contamination of surface water.

Subsurface conditions within the aforementioned fly ash storage areas were investigated by a total of four (4) sample borings (Borings 215 through 218 - report dated January 15, 1975) drilled at the approximate locations as indicated on the Plan of Borings, Plate 1. Logs of the borings, presenting descriptions of the various soil types encountered and results of field and laboratory tests, are presented on Plates 2 through 5. A key to the terms and symbols used on the boring logs is presented as Plate 6.

To assist in discussion and visualization of the subsurface stratigraphy at the site, one (1) Generalized Soils Profile was prepared and is shown on Plate 7. In using this Soils Profile, it should be understood that the stratigraphy between borings is inferred and variations in stratigraphy should be anticipated. Additionally, the natural transition between the various soil types is generally gradual and the indicated boundaries cannot be considered as precise.

The upper 1 to 4 ft over the entire proposed area apparently consists of tan and gray sandy silt to clayey silt with some organic matter. In the vicinity of Boring 218, the upper organic-containing stratum is underlain by very stiff brown and light gray fine sand to El 332. Medium dense light brown clayey fine sand was encountered beneath the sandy clay stratum to near El 316. In the southern portion of the proposed storage areas, stiff to very stiff tan, gray and brown clay and silty clay was encountered beneath the upper organic-containing stratum to El 272 in Boring 215 and El 292 in Boring 216.

In Boring 217, which is located in the alluvium filled stream valley, stiff light brown and light gray sandy clay with gravel was encountered beneath the upper sandy silt stratum to approximately El 264. The sandy clay stratum was underlain by approximately 6 ft of gray clayey fine sand present to El 258. Very stiff dark gray and greenish gray silty clay and fine sandy clay was encountered beneath the upper silty clay stratum in Borings 215 and 216, beneath the clayey fine sand in Boring 217, and beneath the brown clayey fine sand in Boring 218. Gray, dark gray and greenish gray silty clay and fine sandy clay was encountered to the completion depths of the borings (below El 229 in Boring 217).

In summary, granular and more highly permeable soils are apparently present in the upland areas above El 316 and at the base of the stream valleys to near El 258. On the basis of the available data, moderate to high plasticity and slowly permeable clays and silty clays should be exposed in the proposed fly ash storage areas below El 316 to the surface of the alluvium filled stream valleys. Granular stratum may be exposed within the aforementioned limits, but such exposures should be confined to localized areas. Slowly to moderately permeable sandy clay was present at the base of the stream valley, but the lateral extent of the stratum was not sufficiently defined to properly evaluate the condition of the valley bottom.

The typical range of permeability coefficients for the clayey fine sand and sandy clay encountered above El 316 is 1.0×10^{-6} to 1.0×10^{-7} cm/sec. The typical range for the alluvial sandy clay present in Boring 217 is 5.0×10^{-7} to 1.0×10^{-7} cm/sec. The typical range for marine clay and silty clay soils of the type encountered is 1.0×10^{-7} to 1.0×10^{-8} cm/sec. Mass horizontal permeability values are anticipated to be slightly greater than the vertical permeability values, due to the presence of silt and sand seams and/or layers in the strata.

In conclusion, waste fly ash should not generally be deposited above El 315 without installation of a clay liner. The presence of soils with a mass vertical permeability value greater than 1.0×10^{-7} cm/sec is likely within the valley bottom; nevertheless, the available data is not sufficient to positively present such a conclusion. Excessive leachate seepage associated with the presence of moderately permeable alluvial soils must be precluded using either installation of a partial or complete clay blanket or installation of a cutoff trench. Selection of either system should be based on the results of additional subsurface studies.

Fly Ash Storage Area III

Fly Ash Area III is located in a ravine southeast of the main plant area. In general, stiff to very stiff gray, tan and brown silty clay to fine sandy clay was encountered to near El 210. It should be noted that this generalization is based on data obtained from widely spaced borings. Very stiff dark gray fine sandy clay to silty clay with clayey fine sand was encountered below El 210. In the stream valley bottom, approximately 13 ft of alluvial clayey silt with silt and fine sand partings was encountered (El 233 to El 220). The clayey silt was underlain by approximately 15 ft of silty clay to fine sandy clay.

The typical range of permeability coefficients for the silty clay to fine sandy clay generally present between El 280 and 210 is 5.0×10^{-7} to 1.0×10^{-8} cm/sc. A typical range for the soils present below El 210 is 1.0×10^{-6} to 1.0×10^{-8} cm/sec. The typical range for the alluvial clayey silt encountered in the valley bottom is 1.0×10^{-5} to 1.0×10^{-6} cm/sec. Mass horizontal permeability values, primarily within the strata encountered below El 210, would be slightly to moderately greater than the estimated vertical permeability values.

In conclusion, a complete or partial clay blanket would likely be required over the valley bottom and in other localized areas where granular strata may potentially be exposed. As with Fly Ash Storage Areas I and II, the installation of a cutoff trench could provide a successful alternate to installation of a clay blanket over the valley bottom. The conclusions presented herein should be verified or modified on the basis of data obtained in additional studies.

Other Areas

In discussions with Arkansas Power and Light representatives, it is our understanding that the presently undeveloped areas north of the main plant area may potentially be utilized for long-term fly ash storage, if conditions permit. The relatively flat-lying area located northeast of the main plant and adjacent to the Aransas River is apparently mantled with Quaternary Terrace deposits. As discussed previously, the terrace deposits are highly variable and may reach thicknesses on the order of 20 to 30 ft. Permeability coefficents within the terrace deposits could vary over the wide range of 1.0×10^{-1} cm/sec. to less than 1.0×10^{-7} cm/sec.

The dissected uplands located north of the main plant area likely consist of interbedded tan and gray silty clay and fine sandy clay and fine sand on the surface to near El 285. Brown, tan and gray silty clay should be present from El 285 to El 265, and interbedded gray silty clay and gray fine sand should be present below El 265. It must be noted that no borings were present within this area, and the aforementioned generalizations were based on a projection of stratigraphy. In conclusion, there is no data to indicate that the soil conditions north of the main plant area would be better suited for fly ash storage.

ADDITIONAL STUDIES

As discussed previously, the accumulation of additional data on subsurface conditions from further field and laboratory studies is necessary to verify the conclusions presented herein. It is recommended that each proposed fly ash storage area be investigated by a series of test pits (i.e. backhoe pits)

to evaluate the shallow soil conditions and establish the lateral extent of questionable strata. The test pit investigation should be supplemented by investigation of deeper soil conditions by sample borings. Falling-head permeability tests and classification tests should be performed on selected representative soil samples obtained from the borings and test pits to provide the necessary data for correlation and proper evaluation of seepage potentials.

The number, location and depth of additional borings should be based, in part, on site access considerations and results of the recommended backhoe test pit excavations. As soon as weather conditions permit, a field reconnaisance will be performed to aid in determining the locations accessible to the drilling and backhoe equipment. Upon completion of the reconnaisance, specific recommendations regarding additional field studies will be prepared.

We have appreciated the opportunity to be of serive to you on this phase of the project. If there are any questions with regard to the data or recommendations presented herein, please contact us.

McCLELLAND ENGINEERS, INC.

Richard E. Ackley 2/13/79

Richard E. Ackley

John P. Hoskyn

John P. Hoskyn, P.E.

REA/JPH/bjf

Copies Submitted: Arkansas Power and Light Company (3)

LOG OF BORING NO. 217

ASH POND
AP&L WHITE BLUFF PLANT
REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-NO. 200 %
			SURF. EL: 279.2				
			Soft brown sandy silt with roots				
5			Stiff light brown fine sandy clay with roots -light gray with organic matter and tan stains below 4 ft		101	$K=2.38\times10^{-6}$ cm/sec	
10			-fine gravel and coarse sand with clay from 8 to 11 ft -gray silty clay layer at 14 ft				
15			Gray clayey fine sand				
20							
25			Very stiff greenish gray silty clay with organic matter -silt partings and pockets to 38 ft				
30							
35			-fine sand pockets below 38 ft				
40							
45			Very stiff gray fine sandy clay with organic matter				
50							

COMPLETION DEPTH: 50 ft
DATE: 6-4-74

DEPTH TO WATER IN BORING: Ground level
DATE: 6-4-74

PLATE

LOG OF BORING NO. 216

ASH POND

AP&L WHITE BLUFF PLANT

REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- NO. 200 %
			SURF. EL: 324.3				
			Loose tan and light gray sandy silt				
			Stiff gray and tan fine sandy clay	11			86
5							
			Stiff tan silty clay with fine sand pockets -ferrous partings -yellow seams below 10 ft -very stiff and blocky below 10 ft				
10							
15							
20			Very stiff tan and brown clay with silt partings -few ferrous partings				
25							
30							
			Very stiff grayish green clay				
35			-become sandy with fine sand pocket and organic specks below 37 ft				
40							
45							
50							

COMPLETION DEPTH: 50 ft

DATE: 7/24/74

DEPTH TO WATER IN BORING: 17 ft

DATE: 8/27/74

GRUBBS CONSULTING ENGINEERS

PLATE 3

LOG OF BORING NO. 218

ASH POND
AP&L WHITE BLUFF PLANT
REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- NO. 200 %
			SURF. EL: 339.0				
			Stiff light brown sandy silt with organic matter				
5			Very stiff brown and light gray fine sandy clay -stiff with organic matter below 6 ft				
10			Medium dense light brown clayey fine sand with organic matter -tan stains from 11 to 22 ft				
15			K=5.92x10^{-6} cm/sec				36
20			-brown silty clay partings from 19 to 22 ft -silt layer from 22 to 23 ft				
25			Very stiff dark gray silty clay -organic matter below 28 ft				
30							
35			-fine sand and silt pockets below 38 ft				
40							
45							
50							

COMPLETION DEPTH: 50 ft
DATE: 6-4-74

DEPTH TO WATER IN BORING: Caved at 10.5 ft
DATE: 7-5-74

PLATE

LOG OF BORING NO. 215

ASH POND
AP&L WHITE BLUFF PLANT
REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

SURF. EL: 308.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	Loose tan fine sandy silt with organic material	7
	-tan & gray sandy clay 3-5 ft	16
5	Very stiff red and tan silty clay -blocky and slickened to 28 ft -tan below 8.5 ft	
10		
15	-redish tan partings below 13.5 ft	
20	-yellow silt pockets below 18.5 ft -yellow partings below 23.5 ft	
25		
30	-silty below 28.5 ft	
35	-occasional tan silt pockets below 33.5 ft	
40	Very stiff gray fine sandy clay	

Note Scale Change

UNIT DRY WT LB/CU FT

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

-NO. 200 %

COMPLETION DEPTH: 40 ft
DATE: 8-16-74

DEPTH TO WATER IN BORING: 20 ft

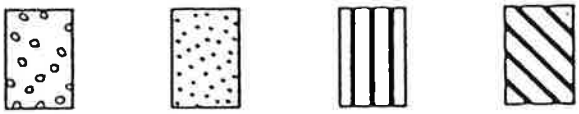
DATE: 8-17-74

GRUBBS CONSULTING ENGINEERS

PLATE 2

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES
(SHOWN IN SYMBOL COLUMN)



Gravel | Sand | Silt | Clay

Predominant type shown heavy

SAMPLER TYPES
(SHOWN IN SAMPLES COLUMN)



Shelby Tube | Rock Core Barrel | Split Spoon | No Recovery

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	RELATIVE DENSITY
Loose	0 to 40%
Medium dense	40 to 70%
Dense	70 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ FT
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided – having inclined planes of weakness that are slick and glossy in appearance.

Fissured – containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated – composed of thin layers of varying color and texture.

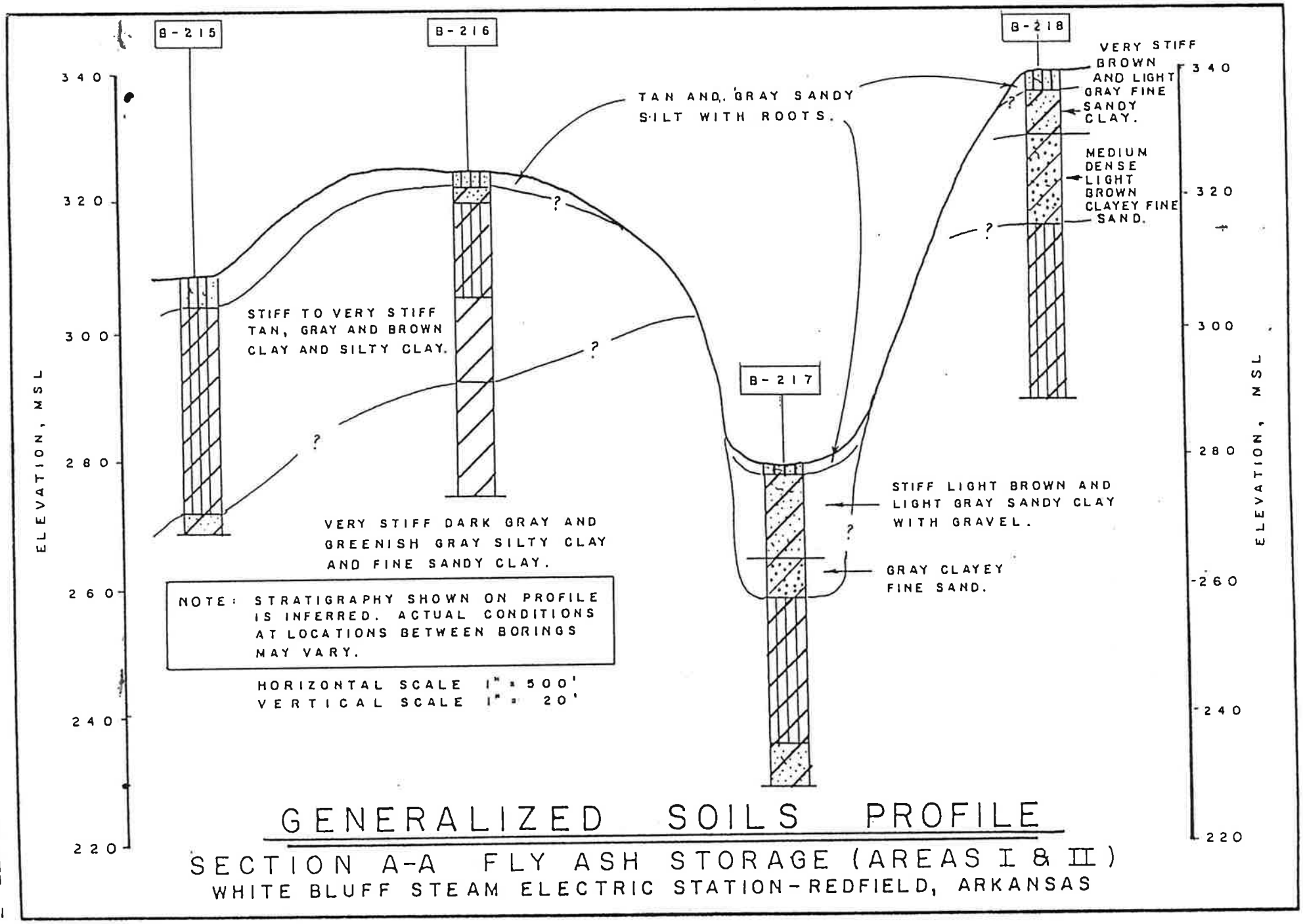
Interbedded – composed of alternate layers of different soil types.

Calcareous – containing appreciable quantities of calcium carbonate.

Well graded – having wide range in grain sizes and substantial amounts of all intermediate particle sizes.

Poorly graded – predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953



GENERALIZED SOILS PROFILE

SECTION A-A FLY ASH STORAGE (AREAS I & II)

WHITE BLUFF STEAM ELECTRIC STATION - REDFIELD, ARKANSAS

McCLELLAND

PLATE 7

DEL COPY

PHASE I - GEOTECHNICAL EVALUATION
PROPOSED FLY ASH DISPOSAL AREAS(S)
ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF STEAM ELECTRIC STATION
NEAR REDFIELD, ARKANSAS

R e p o r t
t o

ARKANSAS POWER AND LIGHT COMPANY
Redfield, Arkansas



McClelland engineers

geotechnical consultants

PHASE I - GEOTECHNICAL EVALUATION
PROPOSED FLY ASH DISPOSAL AREA(S)
ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF STEAM ELECTRIC STATION
NEAR REDFIELD, ARKANSAS

* * *

R e p o r t
t o

ARKANSAS POWER AND LIGHT COMPANY
Redfield, Arkansas

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b y

M c C L E L L A N D E N G I N E E R S, I N C.
Geotechnical Consultants
Little Rock, Arkansas

February 1979

McClelland engineers, inc./geotechnical consultants
P.O. Box 5239/1311 Stagecoach Road, Little Rock, Arkansas 72215
Tel. 501/565-0936

February 9, 1979
LR79-023

Arkansas Power and Light Company
P. O. Box 1621
Redfield, Arkansas 72123

ATTENTION: Mr. Michael Coombs

SUBJECT: Phase I - Geotechnical Evaluation
Proposed Fly Ash Disposal Area(s)
Arkansas Power and Light Company
White Bluff Steam Electric Station
Near Redfield, Arkansas

INTRODUCTION

Presented herein is the report of our preliminary evaluation of site and subsurface conditions in the areas presently proposed for long-term fly ash storage at the White Bluff Steam Electric Station site near Redfield, Arkansas. It is our understanding, after discussions with Arkansas Power and Light representatives, that the fly ash disposal area should be underlain by a minimum of 5 ft of nearly impervious natural soils with mass vertical permeability values less than or equal to 1.0×10^{-7} cm/sec. In areas where the minimum thicknesses of the nearly impervious natural soils are not encountered, it may be necessary to place and compact a clay blanket with a minimum thickness of 3 ft.

The primary objective of this study was to evaluate the presently planned fly ash storage area(s) in relation to the aforementioned permeability requirements. An additional objective was to evaluate specified areas within the White Bluff site not presently planned for fly ash storage. This preliminary study was accomplished through review and analysis of existing geologic, subsurface and topographic data.

SITE GEOLOGY

The project site is located on the West Gulf Coastal Plain Physiographic Region near the western margin of the Mississippi Embayment area. The West Gulf Coastal Plain Region consists of Cretaceous and Tertiary Age marine and non-marine deposits. The adjacent Mississippi Embayment Region, which comprises large portions of Louisiana, Mississippi, and Arkansas, consists of a broad trough, filled to a considerable depth by primarily fine-grained stream sediments.

The Mississippi Embayment owes its existence to structural movements of Paleozoic rocks of the central lowlands. The axis of the trough approximately follows the course of the Mississippi River and plunges generally to the south. The structure of the Cretaceous and Tertiary sediments within the Gulf Coastal Plain Region are related to the presence of the broad trough of the Mississippi Embayment, as well as the Monroe Uplift located in northeastern Louisiana and southeastern Arkansas.

The primary geologic group exposed at the site is the Tertiary Age Jackson Group. The Jackson Group consists of deposits, both marine and non-marine in origin. The name White Bluff Formation is given to the marine unit and the name Redfield Formation is given to the non-marine unit.

The geologically more recent non-marine Redfield beds overlie the marine White Bluff Formation at the site. The Redfield Formation is characterized by the general absence of marine fossils and other marine indicators, such as glauconite and the presence of lignitic and carbonaceous matter. The non-marine formation consists generally of thinly laminated silts and silty clays and cross-bedded sands with some lignitic units.

The marine White Bluff Formation dips generally to the south and is covered by the Redfield Formation. The White Bluff Formation is not a homogeneous unit and, characteristically, consists of calcareous and glauconitic clay, dark gray clayey sand and thinly bedded silty clay and blocky clay. Stratified layers, pockets and inclusions are common in the unit, and due to the various stages of deposition, erosion and redeposition, many of the beds are erratic or discontinuous. The clays within the White Bluff Formation are generally very stiff and over-consolidated and the granular units within the Formation are in a dense to very dense condition.

Pleisteocene Terrace Deposits mantle the uplands in localized areas at the White Bluff site. The terrace deposits vary appreciably in texture and may consist of beds of clay, silt, sand and/or gravel or mixtures of these. Discontinuous layers or lenses of sand and gravel may be present to depths of approximately 20 ft. Geologically recent alluvium is present at the base of numerous stream valleys over the site. The stratigraphy of the alluvium is irregular and the alluvium may consist of clayey silt, silty and clayey fine sand or sandy clay with organic matter and some embedded gravel.

RESULTS AND CONCLUSIONS

The following discussions with regard to the proposed fly ash storage area(s) are based on the available topographic information and limited subsurface data. It should be noted that the discussions include generalizations of the subsurface conditions based on the available data and should not be considered as precise or conclusive. A more precise definition of conditions may be provided only through additional field studies, which are discussed in detail in the Additional Studies section of this report.

Fly Ash Disposal Areas I and II

As presently planned, two areas are designated for initial fly ash storage. Fly Ash Storage Areas I and II are located in adjacent ravines in a presently undeveloped area southwest of the main plant area. The present intentions are to deposit the waste fly ash in the natural depressions up to El 320. All runoff from the fly ash area is to be collected behind earth dikes to prevent possible contamination of surface water.

Subsurface conditions within the aforementioned fly ash storage areas were investigated by a total of four (4) sample borings (Borings 215 through 218 - report dated January 15, 1975) drilled at the approximate locations as indicated on the Plan of Borings, Plate 1. Logs of the borings, presenting descriptions of the various soil types encountered and results of field and laboratory tests, are presented on Plates 2 through 5. A key to the terms and symbols used on the boring logs is presented as Plate 6.

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The upper 1 to 4 ft over the entire proposed area apparently consists of tan and gray sandy silt to clayey silt with some organic matter. In the vicinity of Boring 218, the upper organic-containing stratum is underlain by very stiff brown and light gray fine sand to El 332. Medium dense light brown clayey fine sand was encountered beneath the sandy clay stratum to near El 316. In the southern portion of the proposed storage areas, stiff to very stiff tan, gray and brown clay and silty clay was encountered beneath the upper organic-containing stratum to El 272 in Boring 215 and El 292 in Boring 216.

In Boring 217, which is located in the alluvium filled stream valley, stiff light brown and light gray sandy clay with gravel was encountered beneath the upper sandy silt stratum to approximately El 264. The sandy clay stratum was underlain by approximately 6 ft of gray clayey fine sand present to El 258. Very stiff dark gray and greenish gray silty clay and fine sandy clay was encountered beneath the upper silty clay stratum in Borings 215 and 216, beneath the clayey fine sand in Boring 217, and beneath the brown clayey fine sand in Boring 218. Gray, dark gray and greenish gray silty clay and fine sandy clay was encountered to the completion depths of the borings (below El 229 in Boring 217).

In summary, granular and more highly permeable soils are apparently present in the upland areas above El 316 and at the base of the stream valleys to near El 258. On the basis of the available data, moderate to high plasticity and slowly permeable clays and silty clays should be exposed in the proposed fly ash storage areas below El 316 to the surface of the alluvium filled stream valleys. Granular stratum may be exposed within the aforementioned limits, but such exposures should be confined to localized areas. Slowly to moderately permeable sandy clay was present at the base of the stream valley, but the lateral extent of the stratum was not sufficiently defined to properly evaluate the condition of the valley bottom.

The typical range of permeability coefficients for the clayey fine sand and sandy clay encountered above El 316 is 1.0×10^{-6} to 1.0×10^{-7} cm/sec. The typical range for the alluvial sandy clay present in Boring 217 is 5.0×10^{-7} to 1.0×10^{-7} cm/sec. The typical range for marine clay and silty clay soils of the type encountered is 1.0×10^{-7} to 1.0×10^{-8} cm/sec. Mass horizontal permeability values are anticipated to be slightly greater than the vertical permeability values, due to the presence of silt and sand seams and/or layers in the strata.

In conclusion, waste fly ash should not generally be deposited above El 315 without installation of a clay liner. The presence of soils with a mass vertical permeability value greater than 1.0×10^{-7} cm/sec is likely within the valley bottom; nevertheless, the available data is not sufficient to positively present such a conclusion. Excessive leachate seepage associated with the presence of moderately permeable alluvial soils must be precluded using either installation of a partial or complete clay blanket or installation of a cutoff trench. Selection of either system should be based on the results of additional subsurface studies.

Fly Ash Storage Area III

Fly Ash Area III is located in a ravine southeast of the main plant area. In general, stiff to very stiff gray, tan and brown silty clay to fine sandy clay was encountered to near El 210. It should be noted that this generalization is based on data obtained from widely spaced borings. Very stiff dark gray fine sandy clay to silty clay with clayey fine sand was encountered below El 210. In the stream valley bottom, approximately 13 ft of alluvial clayey silt with silt and fine sand partings was encountered (El 233 to El 220). The clayey silt was underlain by approximately 15 ft of silty clay to fine sandy clay.

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In conclusion, a complete or partial clay blanket would likely be required over the valley bottom and in other localized areas where granular strata may potentially be exposed. As with Fly Ash Storage Areas I and II, the installation of a cutoff trench could provide a successful alternate to installation of a clay blanket over the valley bottom. The conclusions presented herein should be verified or modified on the basis of data obtained in additional studies.

Other Areas

In discussions with Arkansas Power and Light representatives, it is our understanding that the presently undeveloped areas north of the main plant area may potentially be utilized for long-term fly ash storage, if conditions permit. The relatively flat-lying area located northeast of the main plant and adjacent to the Aransas River is apparently mantled with Quaternary Terrace deposits. As discussed previously, the terrace deposits are highly variable and may reach thicknesses on the order of 20 to 30 ft. Permeability coefficents within the terrace deposits could vary over the wide range of 1.0×10^{-1} cm/sec. to less than 1.0×10^{-7} cm/sec.

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ADDITIONAL STUDIES

As discussed previously, the accumulation of additional data on subsurface conditions from further field and laboratory studies is necessary to verify the conclusions presented herein. It is recommended that each proposed fly ash storage area be investigated by a series of test pits (i.e. backhoe pits)

to evaluate the shallow soil conditions and establish the lateral extent of questionable strata. The test pit investigation should be supplemented by investigation of deeper soil conditions by sample borings. Falling-head permeability tests and classification tests should be performed on selected representative soil samples obtained from the borings and test pits to provide the necessary data for correlation and proper evaluation of seepage potentials.

The number, location and depth of additional borings should be based, in part, on site access considerations and results of the recommended backhoe test pit excavations. As soon as weather conditions permit, a field reconnaisance will be performed to aid in determining the locations accessible to the drilling and backhoe equipment. Upon completion of the reconnaisance, specific recommendations regarding additional field studies will be prepared.

We have appreciated the opportunity to be of serive to you on this phase of the project. If there are any questions with regard to the data or recommendations presented herein, please contact us.

McCLELLAND ENGINEERS, INC.

Richard E. Ackley 2/13/79

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John P. Hoskyn

John P. Hoskyn, P.E.

REA/JPH/bjf

Copies Submitted: Arkansas Power and Light Company (3)

LOG OF BORING NO. 217

ASH POND
AP&L WHITE BLUFF PLANT
REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-NO. 200 %
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30							
35			-fine sand pockets below 38 ft				
40							
45			Very stiff gray fine sandy clay with organic matter				
50							

COMPLETION DEPTH: 50 ft
DATE: 6-4-74

DEPTH TO WATER IN BORING: Ground level
DATE: 6-4-74

PLATE

LOG OF BORING NO. 216

ASH POND

AP&L WHITE BLUFF PLANT

REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- NO. 200 %
			SURF. EL: 324.3				
			Loose tan and light gray sandy silt				
			Stiff gray and tan fine sandy clay	11			86
5							
			Stiff tan silty clay with fine sand pockets -ferrous partings -yellow seams below 10 ft -very stiff and blocky below 10 ft				
10							
15							
20			Very stiff tan and brown clay with silt partings -few ferrous partings				
25							
30							
			Very stiff grayish green clay				
35			-become sandy with fine sand pocket and organic specks below 37 ft				
40							
45							
50							

COMPLETION DEPTH: 50 ft

DATE: 7/24/74

DEPTH TO WATER IN BORING: 17 ft

DATE: 8/27/74

GRUBBS CONSULTING ENGINEERS

PLATE 3

LOG OF BORING NO. 218

ASH POND
AP&L WHITE BLUFF PLANT
REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- NO. 200 %
			SURF. EL: 339.0				
			Stiff light brown sandy silt with organic matter				
5			Very stiff brown and light gray fine sandy clay -stiff with organic matter below 6 ft				
10			Medium dense light brown clayey fine sand with organic matter -tan stains from 11 to 22 ft				
15			K=5.92x10^{-6} cm/sec				36
20			-brown silty clay partings from 19 to 22 ft -silt layer from 22 to 23 ft				
25			Very stiff dark gray silty clay -organic matter below 28 ft				
30							
35			-fine sand and silt pockets below 38 ft				
40							
45							
50							

COMPLETION DEPTH: 50 ft
DATE: 6-4-74

DEPTH TO WATER IN BORING: Caved at 10.5 ft
DATE: 7-5-74

PLATE

LOG OF BORING NO. 215

ASH POND
AP&L WHITE BLUFF PLANT
REDFIELD, ARKANSAS

TYPE: Wash

LOCATION: See Plate 1

SURF. EL: 308.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	Loose tan fine sandy silt with organic material	7
	-tan & gray sandy clay 3-5 ft	16
5	Very stiff red and tan silty clay -blocky and slickened to 28 ft -tan below 8.5 ft	
10		
15	-redish tan partings below 13.5 ft	
20	-yellow silt pockets below 18.5 ft -yellow partings below 23.5 ft	
25		
30	-silty below 28.5 ft	
35	-occasional tan silt pockets below 33.5 ft	
40	Very stiff gray fine sandy clay	

Note Scale Change

UNIT DRY WT LB/CU FT

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

-NO. 200 %

COMPLETION DEPTH: 40 ft
DATE: 8-16-74

DEPTH TO WATER IN BORING: 20 ft

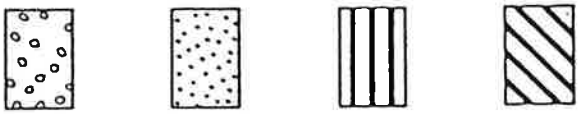
DATE: 8-17-74

GRUBBS CONSULTING ENGINEERS

PLATE 2

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES
(SHOWN IN SYMBOL COLUMN)



Gravel | Sand | Silt | Clay

Predominant type shown heavy

SAMPLER TYPES
(SHOWN IN SAMPLES COLUMN)



Shelby Tube | Rock Core Barrel | Split Spoon | No Recovery

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	RELATIVE DENSITY
Loose	0 to 40%
Medium dense	40 to 70%
Dense	70 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ FT
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided – having inclined planes of weakness that are slick and glossy in appearance.

Fissured – containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated – composed of thin layers of varying color and texture.

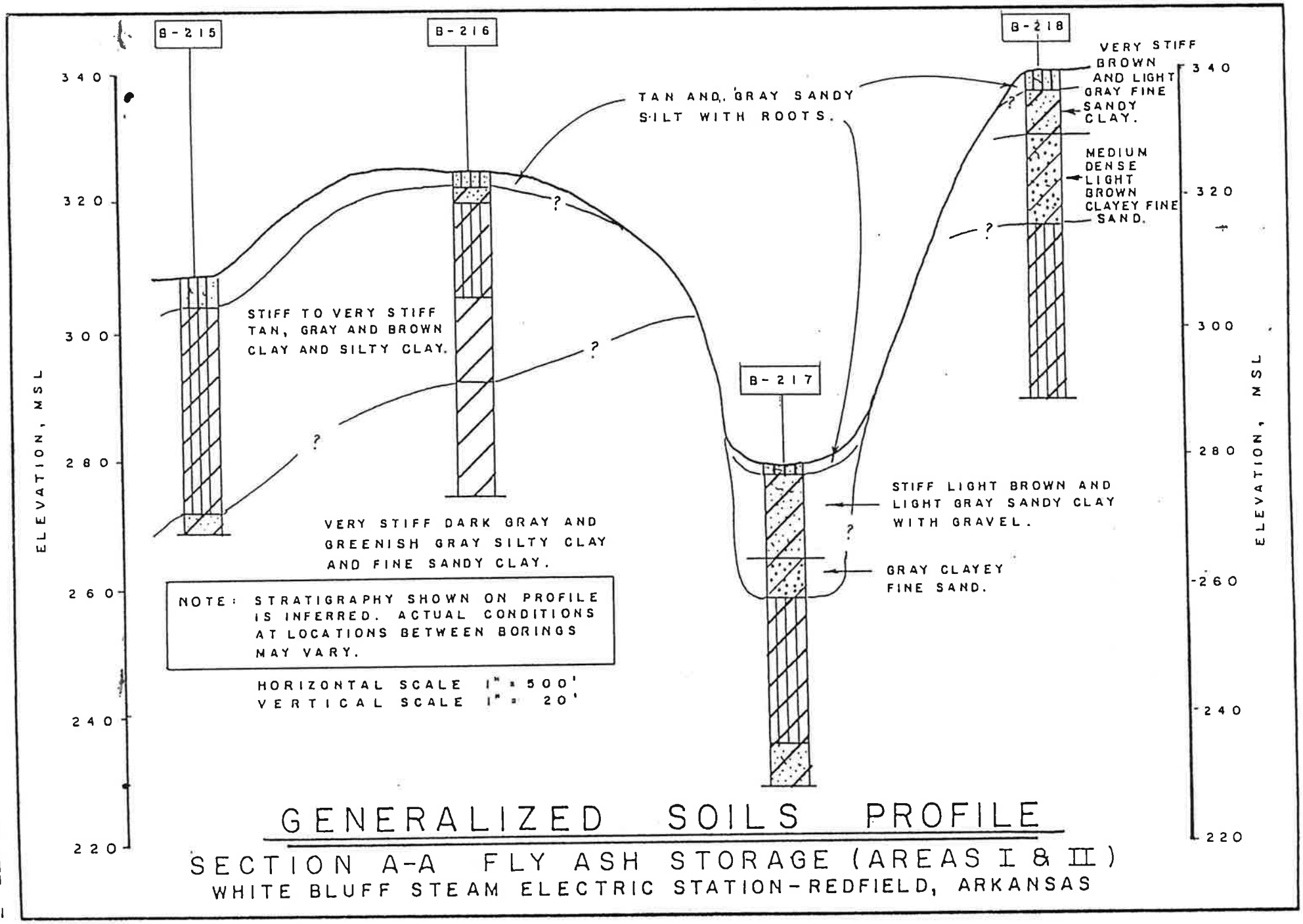
Interbedded – composed of alternate layers of different soil types.

Calcareous – containing appreciable quantities of calcium carbonate.

Well graded – having wide range in grain sizes and substantial amounts of all intermediate particle sizes.

Poorly graded – predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953



GENERALIZED SOILS PROFILE

SECTION A-A FLY ASH STORAGE (AREAS I & II)

WHITE BLUFF STEAM ELECTRIC STATION - REDFIELD, ARKANSAS

McCLELLAND

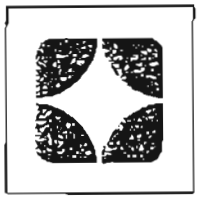
PLATE 7

DEL COPY

PHASE II-GEOTECHNICAL EVALUATION
PROPOSED ASH STORAGE AREAS
ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF STEAM ELECTRIC STATION
NEAR REDFIELD, ARKANSAS

R e p o r t
t o

ARKANSAS POWER AND LIGHT COMPANY
Redfield, Arkansas



McClelland engineers

geotechnical consultants

PHASE II-GEOTECHNICAL EVALUATION
PROPOSED ASH STORAGE AREAS
ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF STEAM ELECTRIC STATION
NEAR REDFIELD, ARKANSAS.

* * *

Report
to

ARKANSAS POWER AND LIGHT COMPANY
Redfield, Arkansas

* * *

by

McCLELLAND ENGINEERS, INC.
Geotechnical Consultants
Little Rock, Arkansas

August 1979

McClelland engineers, inc./geotechnical consultants
P.O. Box 5239/1311 Stagecoach Road, Little Rock, Arkansas 72215
Tel. 501/565-0936

August 14, 1979
LR79-023

Arkansas Power and Light Company
P. O. Box 1621
Redfield, Arkansas 72123

ATTENTION: Mr. Kenneth B. Bennett
Field Construction Manager

SUBJECT: Phase II-Geotechnical Evaluation
Proposed Ash Storage Areas
Arkansas Power and Light Company
White Bluff Steam Electric Station
Near Redfield, Arkansas

INTRODUCTION

Presented herein is the report of our additional studies conducted to provide a comprehensive evaluation of subsurface conditions within the presently proposed Ash Storage Areas at the White Bluff Steam Electric Station site near Redfield, Arkansas. The additional studies were authorized by Mr. Kenneth B. Bennett on March 22, 1979 and were performed in general accordance with our proposal letter of February 28, 1979.

Present plans indicate that fly ash and bottom ash are to be stored in separate disposal areas to allow for potential marketing of the waste products. Subsurface conditions within the presently proposed Fly Ash Storage Areas were investigated initially in 1974, but more strict requirements have since necessitated more extensive studies. Further, no studies were previously conducted for the proposed Bottom Ash Areas. The primary objectives of the additional studies were to include:

a) A refinement and extension of the known subsurface stratigraphy;

b) Determination of soil permeability values and other properties relevant to design of suitable ash storage systems; and

c) Analyses to establish the impact of ash storage on the natural hydrogeologic conditions.

The objectives of the additional studies were accomplished through a multi-stage program consisting of the following major components:

1) A field investigation consisting of a series of widely-spaced borings and test pits, ground water level observations and visual inspection of site conditions;

2) A laboratory testing program planned following completion of the field studies to establish the permeability characteristics and index properties of the natural soils; and

3) An engineering analysis of the data compiled in the field and laboratory studies and analyses of the available aerial photography.

FIELD INVESTIGATION

The soil conditions for the proposed Fly Ash Storage Areas were investigated initially by a total of four (4) sample borings (Borings 215 through 218) drilled to depths of 40 to 50 ft in 1974. In order to supplement that information and provide data for evaluation of the adjacent Bottom Ash Storage Areas, a total of six (6) additional borings (Borings 1 through 6) were drilled and a total of twenty (20) (Test Pits 1 through 20) were excavated. The approximate locations of the borings and test pits are indicated on Plate 1. Also shown on Plate 1 are the approximate locations of Borings 215 through 218 and Boring 8 drilled for a previous transmission line study (MEI Job No. 75-283). Logs of Borings 1 through 6 and Test Pits 1 through 20, presenting descriptions of the various soil types encountered and results of field and laboratory tests, are presented on Plates 2 through 27. A key to the terms and symbols used on the log forms is included as Plate 28. Logs of Borings 215 through 218 and Boring 8 are included in Appendix A.

The sample borings were advanced through a combination of auger and rotary wash boring procedures. Samples were obtained using a 3-in. diameter thin-wall tube sampler forced hydraulically into the soil strata. Shear strengths of the soils were estimated in the field using a calibrated hand penetrometer, and the estimated cohesion values are plotted on the boring logs, in tons per sq ft, as small circles enclosing an "x". The test pit excavations were advanced using a rubber-tired backhoe, and disturbed samples were collected from the spoil. All soil samples were visually classified in the field and placed in appropriate containers to prevent loss in moisture or disturbance during transfer to the laboratory for further testing and evaluation.

The use of drilling fluids during the drilling and sampling operations precluded definitive evaluation of ground water conditions for the borings. Ground water entering the test pit excavations, however, was observed, and the shallow ground water conditions are noted on the appropriate log forms.

LABORATORY TESTING

Falling-head permeability tests were performed on both remolded specimens obtained from test pit excavations and on disturbed specimens obtained from the borings to aid in evaluating the seepage potential. In the falling-head permeability test, a soil specimen is placed in a permeameter, and a highly permeable medium is placed on the top and bottom of the specimen. De-aired water is then allowed to flow under gravity through the specimen of known cross-sectional area until a specified head loss occurs. Computations are then performed to determine the coeffecient of peremability (k). The computed permeabilities are presented on the appropriate log forms and are also tabulated on the Summary of Classification Tests Sheets included in Appendix B.

The natural water content and unit dry weight of each laboratory permeability test specimen were determined in conjunction with the aforementioned tests. In addition, a series of water content determinations were performed to complete a basic soil-moisture profile for each test pit and boring. Classification tests, including Atterberg Limits, mechanical grain-size analyses, and hydrometer analyses, were performed. The classification test results are plotted on the Summary of Classification Tests Sheets included in Appendix B. The percentage of soil passing the No. 200 Sieve is also noted at the appropriate depth on the log forms. The natural moisture content and Atterberg Limits test results are plotted in accordance with the scales and symbols contained in the legend in the upper right portion of each log form. The grain-size curve for the sample obtained from Test Pit 12 is also included in Appendix B.

SITE GEOLOGY AND GROUND WATER CONDITIONS

As stated in our previous report, the project site is located on the West Gulf Coastal Plain physiographic region near the western margin of the Mississippi Embayment area. The West Gulf Coastal Plain consists of Cretaceous and Tertiary

marine and nonmarine deposits. The adjacent Mississippi Embayment region, which comprises large portions of Louisiana, Mississippi and Arkansas, consists of a broad trough filled to a considerable depth by primarily fine-grained stream sediments.

The Mississippi Embayment owes its existence to structural movements of the Paleozoic rocks of the central lowlands. The axis of the trough approximately follows the course of the Mississippi River and plunges generally to the south. The structure of the Cretaceous and Tertiary sediments within the Gulf Coastal Plain region are related to the presence of the broad trough of the Mississippi Embayment, as well as the Monroe Uplift located in northeastern Louisiana and southeastern Arkansas.

The primary geologic group exposed at the site is the Tertiary Age Jackson Group. The Jackson Group consists of deposits, both marine and nonmarine in origin. The name Redfield Formation is given to the nonmarine unit, and White Bluff Formation is given to the marine unit.

The geologically more recent nonmarine Redfield beds overlie the marine White Bluff Formation at the site. The Redfield Formation is characterized by the general absence of marine fossils and other marine indicators, such as glauconite and the presence of lignitic and carbonaceous matter. The nonmarine formation consists generally of thinly laminated silts and silty clays with cross-bedded sands with some lignitic units.

The marine White Bluff Formation dips generally to the south and is covered by the Redfield Formation. The White Bluff Formation is not a homogeneous unit, and characteristically, consists of calcareous and glauconitic clay, dark gray clayey sand and thinly bedded silty clay and blocky clay. Stratified layers, pockets and inclusions are common in the unit and, due to the various stages of deposition, erosion and redeposition, many of the beds are erratic or discontinuous The clays within the White Bluff Formation are very stiff and overconsolidated, and the granular units within the formation are in a dense to very dense condition.

The Jackson Group is underlain at approximately El 100 by the Claiborne Group, which may be subdivided into a number of formations. The Cockfield Formation directly underlies the Jackson Group and consists of interbedded fine sand and silt and dark gray and dark brown and green lignitic silty clay. The

Cockfield formation is present to approximately 100 ft below sea level at the project site. The Cook Mountain formation underlies the Cockfield Formation to approximately El -200. The formation consists predominantly of deep-water marine clays and may contain some silt, sand and lignitic clay.

The Sparta Sand Formation is present below El -200 and consists of white to light gray fine to medium-grained massive sands with beds and lenses of light gray and tan clay and sandy clay. Lignite is not as common as in the overlying and underlying formations. Sands of the Sparta Formation probably provide all of the water pumped from deep wells that penetrate the deposits of Eocene Age in Jefferson County. As with other wells, the well for the White Bluff site penetrated into the Sparta Sand Formation. On April 6, 1978, the ground water level within the well was recorded at a depth of approximately 175 ft (El 136).

As noted on the appropriate log forms, ground water was encountered in a number of the test pit excavations. It should be noted, however, that the ground water encountered represents a "perched" ground water condition and should not be considered as an aquifer. The Jackson Group and upper units of the Claiborne Group are only "secondary" aquifers.

Pleistocene terrace deposits mantle the uplands in localized areas of the White Bluff site. The terrace deposits vary appreciably in texture and may consist of beds of clay, silt and sand and/or gravel or mixtures of these. Geologically recent alluvium is present at the base of numerous stream valleys over the site. The stratigraphy of the alluvium is irregular and may consist of clayey silt, silty and clayey fine sand or sandy clay with organic matter and some embedded gravel.

TERRAIN ANALYSES

Analyses of the available aerial photographic coverage indicated the presence of three (3) basic soil groups of the Jackson group within the proposed ash storage areas. The boundaries of the three (3) basic soil groups are indicated on Plate 1. Analyses of aerial photography correlated with the boring and test pit data provides the basis of the three soil groups. Zones of alluvial soils and terrace deposits were, however, not delineated.

The aforementioned analyses included an examination of tonal characterisitics and the first-order drainage systems, i.e. gullies. Gullies are formed when sheet runoff collects in channelized flow and eroding the bottom forms the first order drainage system. As the gullies erode through the surface soils, they adopt cross-sectional shapes which reflect the textural composition and cohesiveness of the surrounding soils. Moderately cohesive silts are indicated by "U"-shaped cross-sections with compound gradient profiles and fins and pinnacles near the head; whereas, clays and silty clays are indicated by shallow and rounded gullies and low, uniform gradient profiles.

GENERAL SOIL CONDITIONS

As discussed previously, three (3) distinct geologic units are present at the surface of the project site. To assist in discussion and visualization of the stratigraphy, two (2) Generalized Soils Profiles were prepared and are shown on Plates 29 and 30. In using these profiles, it should be understood that the subsurface stratigraphy between borings and test pits was inferred from conditions encountered at those locations. Variations in stratigrahy and condition of the soil units should be anticipated. In addition, a natural transition between the various soil types is generally gradual and the indicated boundaries cannot be considered as precise.

The alluvial soils which are geologically most recent, are present primarily in the valley bottoms. The alluvial soils consist generally of interbedded sandy clay, silt and silty fine sand with some embedded gravel and organic matter. The peremability characteristics of the alluvial soils are variable and largely dependent upon the textural character of the soil at an individual location.

The Pleistocene terrace deposits are an older unit than the recent alluvial deposits. The terrace deposits are often characterized by the presence of gravel in addition to clay, silt and/or sand. As a consequence, the permeability characteristics of the terrace deposits are highly variable. Isolated zones of the terrace deposits were noted in upland areas, but were not present in the proposed ash storage areas. The terrace units are thus of little consequence to this study and are not discussed further.

As discussed in the previous section, the upper Jackson Group deposits have been subdivided into three basic groups (See Plate 1) which may be described as follows:

Group I:	Silty clay with some clayey silt and fine sandy silt partings, seams and layers;
Groupt II:	Interbedded silty clay, clayey silt, fine sandy silt and clayey sand; and
Group III:	Clayey silt-fine sandy silt with silty clay and clayey sand seams and layers.

The Group I soils are considered to be nonmarine deposits of the Redfield Formation; whereas, the Group III deposits are considered to be of the marine White Bluff Formation. Group II would represent a transition between those areas. Although clayey silt and fine sandy silt appear to be the predominant soil types in the Group III area, the upland areas are often capped with a layer of silty clay.

The soils of Groups I through III are near surface deposits and are, consequently, weathered and in some instances, reworked. At depths of approximately 10 to 30 ft below the existing ground surface, very stiff dark gray silty clay with some silty fine sand seams and layers was encountered. The deep zone is considered to represent the unaltered Jackson Group deposits and are considered to be largely marine in origin and possesses generally low vertical permeability characteristics. The borings for this study did not extend through the Jackson into the Claiborne Group, and thus, the total thickness of the Jackson Group at the site is not precisely known.

CONCLUSIONS

To summarize, the soils of Group I are generally of low permeability (less than 1.0×10^{-7} cm/sec). The soils of Group II are generally of low permeability with some zones of moderate to high permeability (less than 1.0×10^{-7} cm/sec in the clay and as high as 1.0×10^{-5} cm/sec in the sand and silt layers). Soils of Group III generally possess permeability values in the order of 1.0×10^{-7} to 1.0×10^{-6} cm/sec. Clay zones within the Group I would, however, possess permeability values less than 1.0×10^{-7} cm/sec.

On the whole, the Jackson Group deposits possess a mass vertical permeability less than 1.0×10^{-7} cm/sec. The mass horizontal permeability value would be

somewhat higher and would be variable. It is our conclusion that installation of the ash storage areas would represent little threat to the deep Sparta Sand aquifer. The principal impact of the storage areas would be on the shallow ground water system, which in turn, could lead to contamination of the surface water in the area.

In order to prevent undue contamination of the shallow ground water system, it is recommended that a clay blanket or suitable alternate be installed on the valley bottom and side walls where silty sand, sandy silt and clayey silt soils are exposed, primarily in areas of Soil Groups I and II. The clay blanket or alternate should be of sufficient thickness to comply with EPA Standards.

The presence of a small lake in the eastern portion of Fly Ash Storage Area I precluded any additional investigation of the alluvial soils on the valley bottom. Alluvial soils of moderate to high permeability may be present in some areas and a clay blanket may be required. Following drawdown of the lake, additional investigations may be in order to more adequately define the condition of the alluvial soils and possible clay blanket requirements.

Substantial quantities of clay suitable for clay blanket construction may be obtained from the Group I area and from portions of the other areas. It is our understanding that consideration is being given to use of lime-fly ash modification of the existing soils to reduce the permeability characteristics. It should be emphasized that permeability reduction would likely not be obtained for all soil types. Conclusions should be based solely on lime-fly ash specimens obtained from within the ash storage areas.

* * *

The following illustrations are attached and complete this report:

Plate 1	Boring and Test Pit Locations
Plates 2 through 27	Boring and Test Pit Logs
Plate 28	Key to Terms and Symbols
Plates 29 and 30	Generalized Soils Profiles
Plates A-1 through A-5	Appendix A Logs of Borings 215 through 218 and Boring 8
Plates B-1 through B-4	Appendix B Summary of Classification Tests and Grain Size Curves

We have appreciated the opportunity to be of service to you on this phase of the project. If there are questions or comments with regard to the conclusions presented herein, please contact us.

Very truly yours,

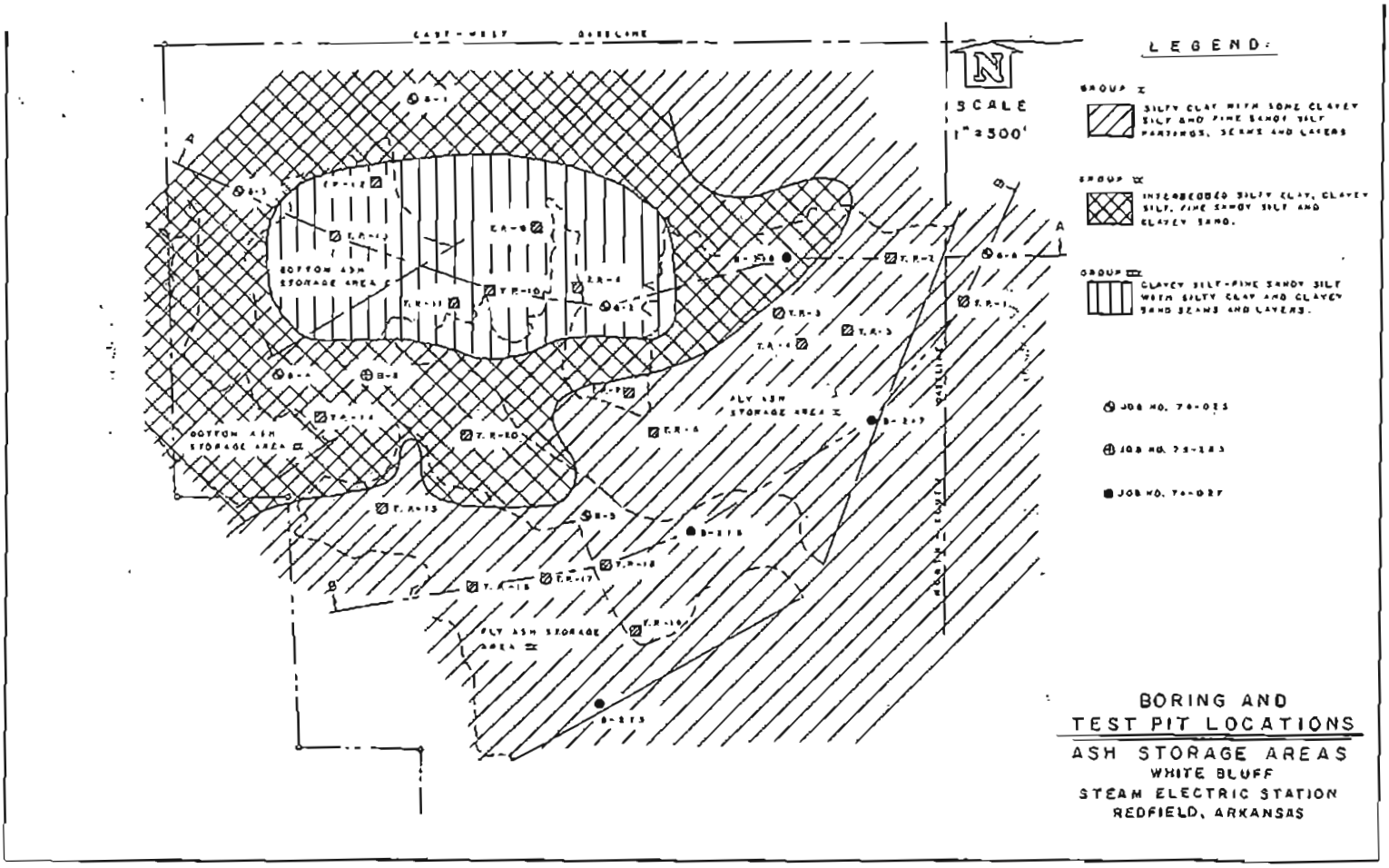
McCLELLAND ENGINEERS, INC.

Richard E. Ackley

John P. Hoskyn, P.E.

RRA/JPH/bjf

Copies Submitted: Arkansas Power and Light Company (5)



BORING AND TEST PIT LOCATIONS

ASH STORAGE AREAS
WHITE BLUFF
STEAM ELECTRIC STATION
REDFIELD, ARKANSAS

PLATE 1

LOG OF BORING NO. 1

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Auger to 2 ft - Wash

LOCATION: See Plate 1

SURF. EL: 375 ±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% - NO. 200
			Loose gray fine sandy silt with organic matter to 1 ft	ML			
5			Stiff tan with light gray and reddish tan fine sandy clay with light gray clay pockets	CL	107	NON-PLASTIC	21
			Medium dense tan with reddish tan and light gray silty sand	SM		K = 1.7 x 10^{-5} cm/sec at 4.5 to 5 ft	
10			Laminated very stiff light gray clay and silty fine sand with tan ferrous stains	CL/SM	88	K = 6.2 x 10^{-7} cm/sec at 9.5 to 10 ft	56
15			Very stiff dark gray silty clay with light gray silt partings and some lignitic seams	CL			
20			-with light gray silty fine sand partings below 15 ft				
25			-with more silty fine sand below 20 ft -predominantly silty fine sand from 22 to 24 ft				
30							

NOTE SCALE CHANGE

COMPLETION DEPTH: 29.5 ft
DATE: 6/4/79

DEPTH TO WATER IN BORING:

DATE:

LOG OF BORING NO. 2

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Auger to 2 ft - Wash LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL: 345 ±)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% - NO. 200
			Loose light gray and tan fine sandy silt with organic matter to 0.5 ft		ML		
5			Very stiff light gray fine sandy clay with tan ferrous stains		CL		
10			Very stiff light brown and light gray silty clay with light gray silt partings and yellowish tan ferrous stains		CL 88	$K = 1.3 \times 10^{-7}$ cm/sec at 9.5 to 10 ft	77
15			Medium dense to dense brown silty fine sand with lignite seams and pockets		SM		
20			Dense gray silty fine sand with tan ferrous stains		SM		
25			Laminated very stiff dark gray silty clay, light gray silt and light gray silty fine sand		CL ML SM		
30							
35							

NOTE SCALE CHANGE

35 ft
8/4/70

LOG OF BORING NO. 3

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Auger to 2 ft - Wash LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TONS/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% NO. 200
			SURF. EL: 377 ±				
			Soft tan sandy clay with some organic matter to 0.5 ft		CL		
5			Stiff light gray and reddish tan silty clay with some fine sand		CL		
10			Laminated medium dense light gray fine sandy silt and gray silty clay	85	ML CL	$K = 8.8 \times 10^{-9}$ cm/sec at 9.5 to 10 ft	74
15			Very stiff dark gray silty clay with light gray silt partings -with light gray fine sand partings and seams and a trace of lignite below 15 ft		CL		
20							
25							
30							

NOTE SCALE CHANGE

30 ft
5/5/79

LOG OF BORING NO. 4

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Auger to 2 ft - Wash

LOCATION: See Plate 1

SURF. EL: 357 ±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			Loose tan fine sandy silt with organic matter and gravel		ML			
			Firm tan silty clay					
5			Laminated stiff light gray silty clay and silty fine sand		99 CL SM	K = 6.2 x 10^{-8} cm/sec at 4.5 to 5 ft		66
10								
15			Very stiff dark gray silty clay with light gray silt partings		CL			
20			Dense light brown and tan silty fine sand with organic matter -occasional brown clay partings and seams below 20 ft		SM 88	NON-PLASTIC		46
25								
30			Laminated very stiff gray silty clay and light gray fine sandy silt with some lignitic seams		CL ML			
35								

NOTE SCALE CHANGE

35 ft

LOG OF BORING NO. 5

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Auger to 2 ft - Wash LOCATION: See Place 1

SURF. EL: 333 ±

NOTE SCALE CHANGE

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			Loose to medium dense tan fine sandy silt with some organic matter		ML		
5			Very stiff gray and tan silty clay with some fine sand and a trace of embedded gravel		CL		
10			Very stiff light brown and light gray silty clay with light gray and yellowish tan silt partings and seams -with ferrous seams below 10 ft -dark brown with dark gray silty clay with light gray silt partings		82 CL	K = 5.4 x 10^{-7} cm/sec at 9.5 to 10 ft	98
15							
20							
25							
30			Very stiff dark gray silty clay with light gray silt partings		CL		
35					84	K = 4.1 x 10^{-9} cm/sec. at 34.5 to 35 ft	96
40							

LOG OF BORING NO. 6

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Auger to 2 ft - Wash LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- NO. 200, %
			SURF. EL: 316 ±				
			Loose to medium dense fine sandy silt with some organic matter				
			Very stiff light gray and tan silty clay with some fine sand and a trace of fine gravel		105		57
						K = 6.1 x 10^{-8} cm/sec at 4.5 to 5 ft	
5							
			Very stiff light brown silty clay with light gray, yellowish tan and tan fine sandy silt partings and seams				
10							
15							
20							
25							
30							
35			Laminated very stiff dark gray silty clay and gray silty fine sand				
40							

NOTE SCALE CHANGE

DEPTH OF BORING: 40 ft
DATE: 6/5/79

DEPTH TO WATER IN BORE HOLE:

DATE:

LOG OF TEST PIT NO. 1

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			SURF. EL: 297 ±				
			Brown silty clay with organic matter				
			Reddish tan silty clay with some light gray silty clay				
			Light gray silty clay with some tan and yellowish tan silt pockets				
			-light gray with light brown, blocky and with clayey silt pockets below 4.5 ft				
5			-more silty with increasing depth				94
10							

NOTE: GROUND WATER SEEPAGE INTO EXCAVATION BELOW 10 FT

COMPLETION DEPTH: 10.5 Ft
DATE: 4/9/79

DEPTH TO WATER IN PIT: DRY HOLE

DATE: 4/9/79

LOG OF TEST PIT NO. 2

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT Lb/CU FT	COHESION, TON/SQ FT (C) 0.2 0.4 0.6 0.8 1.0 1.2 1.4	PLASTIC LIMIT ÷ WATER CONTENT, % ÷ LIQUID LIMIT 10 20 30 40 50 60 70	NO. 200, %
			SURF. EL: 305 ±					
			Brown silty clay with organic matter					97
			Reddish tan with some light gray silty clay					
			Light gray silty clay with some tan and yellowish tan silt pockets -predominantly light gray with light brown and blocky below 4 ft -more silty with increasing depth			$K = 2.2 \times 10^{-8}$ cm/sec. at 0.5 to 1 ft		
5								
10								

NOTE: GROUND WATER SEEPAGE INTO EXCAVATION AT 1.5 TO 2 FT

DEPTH OF EXCAVATION: 10 ft
DATE: 4/9/79

DEPTH TO WATER WHILE DRILLING: SEE NOTE
DATE: 4/9/79

LOG OF TEST PIT NO. 3

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			SURF. EL: 310 ±					
			Brown clayey silt with organic matter					70
			Light gray with tan fine sandy silt					
			Light gray with reddish tan silty clay					
5			Light gray silty clay with some tan and yellowish tan silt pockets -light gray with light brown and blocky below 8 ft					
10								

NOTE: GROUND WATER SEEPAGE INTO EXCAVATION AT 0.5 TO 1 AND 8 TO 10 FT

COMPLETED IN DEPTH: 10 Ft
DATED: 4/9/79

DEPTH TO WATER
WHILE DRILLING: SIDE NOTE

DATED: 4/9/79

LOG OF TEST PIT NO. 4

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (C) 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (+) 10 20 30 40 50 60 70	% PASSING NO. 200
			SURF. EL: 305 ±				
			Brown silty clay with organic matter				
			Reddish tan with some light gray silty clay				
			Light gray silty clay with some yellowish tan and tan silt pockets -light gray with light brown and blocky below 3.5 ft -with clay pockets below 4 ft				
5							81 → 97
10			NOTE: GROUND WATER SEEPAGE INTO EXCAVATION AT 0.5 FT				

COMPLETION DEPTH: 9 ft DEPTH TO WATER IN PIT AT: SEE NOTE
DATE: 4/9/79 DATE: 4/9/79

LOG OF TEST PIT NO. 5

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			SURF. EL: 330 ±					
			Brown clayey silt with organic matter					
			Tan fine sandy silt					
			Reddish tan with light gray silty clay with some fine sand					
			Light gray silty clay with tan and yellowish tan silt pockets					
5			Light brown with gray silty clay with light gray silt partings and seams					98
10								

DEPTH EXCAVATED: 9.5 ft
DATE: 4/9/79

DEPTH TO WATER INITIAL: Dry

DATE: 4/9/79

LOG OF TEST PIT NO. 6

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% PASSING NO. 200
			SURF. EL: 307 ±				
			Light gray and tan clayey silt- silty clay			①	
			Tan silty clay with some fine sand				
5			Light gray with tan and reddish tan silty clay with clayey silt pockets and seams -more silty below 7.5 ft			②	71
10			NOTE: GROUND WATER SEEPAGE INTO EXCAVATION BELOW 7.5 FT				

CAVING IN DEPTH: 3.5 ft
DATE: 4/9/79

DEPTH TO WATER AT TIME OF EXCAVATION: SEE NOTE

DATE: 4/9/79

LOG OF TEST PIT NO. 7

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			SURF. EL: 327 ±					
			Brown clayey silt with organic matter					
			Light gray with tan clayey silt with some fine sand					
			Reddish tan silty clay					
5			Light gray silty clay with some tan and yellowish tan silt pockets -light gray with light brown and blocky below 4.5 ft -with clayey silt pockets and seams below 5 ft					
10								

CAVED IN BOTTOM AT: 9.5 ft
DATE: 4/9/79

DEPTH TO WATER IN PIT: Dry

DATE: 4/9/79

LOG OF TEST PIT NO. 8

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	CONSOLIDATION, TONS/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% PASSING NO. 200 SIEVE
			SURF. EL: 320 ±				
			Brown clayey silt with some organic matter				
			Reddish tan silty clay				
			Light gray clayey silt with tan and yellowish tan silt and light gray silty clay pockets and seams -blocky below 3.5 ft			Kr = 1.9 x 10^{-7} cm/sec. at 5 to 6 ft	
5							93
			Light brown and light gray silty clay with light gray clayey silt seams				
			Bluish gray clayey silt with occasional silty clay seams				
10							

NOTE: GROUND WATER SEEPAGE INTO EXCAVATION BELOW 4 FT

LEVEL ON COMPLETION: 9.5 ft
DATE: 4/9/79

SEE NOTE

DATE: 4/9/79

LOG OF TEST PIT NO. 9

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TONS/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			SURF. EL: 335 ±					
			Brown fine sandy silt with organic matter					
			Tan very silty clay					
			Light gray with tan clayey silt.					
5			-fine sandy silt with occasional silty clay pockets					50
			$K_r = 7.6 \times 10^{-8}$ cm/sec at 4 to 5 ft					
10								
15								

COMPLETION DEPTH: 11.5 ft
DATE: 4/17/79

PLATE 11.1.2-2
REV. 0

DAY

DATE: 4/17/79

LOG OF TEST PIT NO. 10

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT Lb/CU FT	COHESION, TSF/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT WATER CONTENT, % LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200
			SURF. EL: 337 ±				
			Brown fine sandy silt with organic matter				
			Tan fine sandy silt				
			Mottled tan, gray and reddish tan silty clay with some fine sand				71
5			Light gray with some tan blocky silty clay with some clayey silt seams and pockets				
			Light gray with tan clayey silt -fine sandy silt with occasional silty clay pockets				
10							
			NOTE: GROUND WATER SEEPAGE INTO EXCAVATION BELOW 9 FT				
15							

[illegible] 10 FT [illegible] SEE NOTE [illegible] 4/17/79

PLATE E7

LOG OF TEST PIT NO. 11

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (C) 0.2 0.4 0.6 0.8 1.0 1.2 1.4	PLASTIC LIMIT + / WATER CONTENT, % C / LIQUID LIMIT + (10 20 30 40 50 60 70)	% PASSING NO. 200
			SURF. EL: 337 ±					
			Brown fine sandy silt with organic matter					
			Tan very silty clay with some fine sand					56
			Light gray with tan clayey silt -fine sandy silt with occasional silty clay pockets -numerous brown and light gray silty clay seams below 8 ft			$K_r = 1.5 \times 10^{-8}$ sm/sec at 1 to 2 ft		
5								
10								

COMPLETION DEPTH: 9 Ft
DATE: 4/17/79

DATE OF WATER IN HOLE: Dry

DATE: 4/17/79

PLATE 13

LOG OF TEST PIT NO. 12

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

SURF. EL: 335 ±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TONS/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	U.S.C.S.
			Brown fine sandy silt with organic matter					
			Tan and light gray very silty clay with clayey silt pockets					
			Light gray with tan clayey silt					62
5			-fine sandy silt with some silty clay pockets					
			Bluish gray fine sandy silt with some clayey and lignitic partings					
10								
15								

COMPLETION DEPTH: 12.5 ft
DATE: 4/17/79

DEPTH TO WATER: Dry
DATE: 4/17/79

LOG OF TEST PIT NO. 13

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Place 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	PASSING NO. 200 SIEVE, %
			SURF. EL: 356 ±					
			Brown with some tan clayey silt with some organic matter					
			Reddish tan with some light gray silty clay					91
5			Light gray silty clay with some tan and yellowish tan fine sandy silt pockets and light gray clayey silt seams					
10			Light gray with tan clayey silt -fine sandy silt with some silty clay pockets (partially cemented) -with some brown silty clay seams below 9.5 ft					

DEPTH IN DRILLING: 10.5 ft
DATE: 4/17/79

WATER LEVEL IN DRILLING: Dry
DATE: 4/17/79

LOG OF TEST PIT NO. 14

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TONS/SQ FT (C) 0.2 0.4 0.6 0.8 1.0 1.2 1.4	PLASTIC LIMIT + / WATER CONTENT, % C / LIQUID LIMIT + 10 20 30 40 50 60 70	- NO. 200, %
			SURF. EL: 351 ±					
			Brown fine sandy silt with organic matter					
			Tan fine sandy silt				NON-PLASTIC	72
			Tan and light gray silty clay with fine sandy silt seams and pockets and some embedded gravel				+ C – – +	81
5								
			Light gray with tan clayey silt -fine sandy silt					
10								
			NOTE: GROUND WATER SEEPAGE INTO EXCAVATION BELOW 8.5 FT					

EXCAVATION DEPTH: 11 Ft DEPTH TO WATER IN BORING: Dry
DATE: 4/17/79 DATE: 4/17/79

LOG OF BORING NO. 8

WOODWARD-LITTLE ROCK SOUTH 115 KV LINE

TYPE: Auger

LOCATION: White Bluff Area
As staked

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4) / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)	% RECOVERY
SURF. EL:							
			Loose tan and gray fine sandy silt				
			Very stiff tan and light gray sandy clay -gravelly 4.5 to 6 ft	13			
5					104		
			-very sandy below 7 ft -stiff below 7 ft				
10							
			Stiff tan and light gray very sandy and clayey sand with clay pockets				
15							
			Very stiff gray silty clay with sandy silt seams and layers		89		
20							
			-silt partings below 23 ft				
25							
			Very stiff gray and green sandy clay		85		1.7
30							

Note Scale Change

COMPLETION DEPTH: 30 ft
DATE: 12/1/75

DEPTH TO WATER IN BORING:

DRY

DATE: 12/1/75

PLATE A-5

A P P E N D I X B

SUMMARY OF CLASSIFICATION TESTS SHEETS
(Plates B-1 through B-3)

GRAIN SIZE CURVES FOR TEST PIT 12
(Plate B-4)

SUMMARY OF CLASSIFICATION TESTS

PROJECT: ASH STORAGE AREAS — SITE: WHITE BLUFF STEAM ELECTRIC STATION

SAMPLED FROM	LOCATION DEPTH, FT.	WATER CONTENT PERCENT (NATURAL)	L.L.	P.L.	P.I.	MECHANICAL ANALYSIS PERCENT FINER 3"	3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 200	PERMEABILITY, k_v Cm / SEC	UNIFIED CLASSIFICATION
Boring 1	4.5-5.0	21.5	NON-PLASTIC			-	-	-	-	-	100	21	1.7×10^{-5}	SM
	9.5-10.0	27.7				-	-	100	96	88	77	56	6.2×10^{-7}	CL
Boring 2	9.5-10.0	33.3	36	28	8	-	-	-	-	100	99	77	1.3×10^{-7}	ML
Boring 3	9.5-10.0	29.5	48	26	22	-	-	100	97	90	81	74	8.8×10^{-9}	CL
Boring 4	4.5-5.0	25.8	31	23	8	-	-	-	-	100	99	66	6.2×10^{-8}	CL-ML
	19.0-19.5	28.5	NON-PLASTIC			-	-	-	-	-	100	46		SM
Boring 5	9.5-10.0	36.5	54	28	26	-	-	-	-	100	99	98	5.4×10^{-7}	CH
	34.5-35.0	38.0	111	35	76	-	-	-	-	100	99	96	4.1×10^{-9}	CH
Boring 6	4.5-5.0	24.0	48	22	26	100	70	70	70	70	69	57	6.1×10^{-8}	CL

SUMMARY OF CLASSIFICATION TESTS

PROJECT: ASH STORAGE AREAS SITE: WHITE BLUFF STEAM ELECTRIC STATION

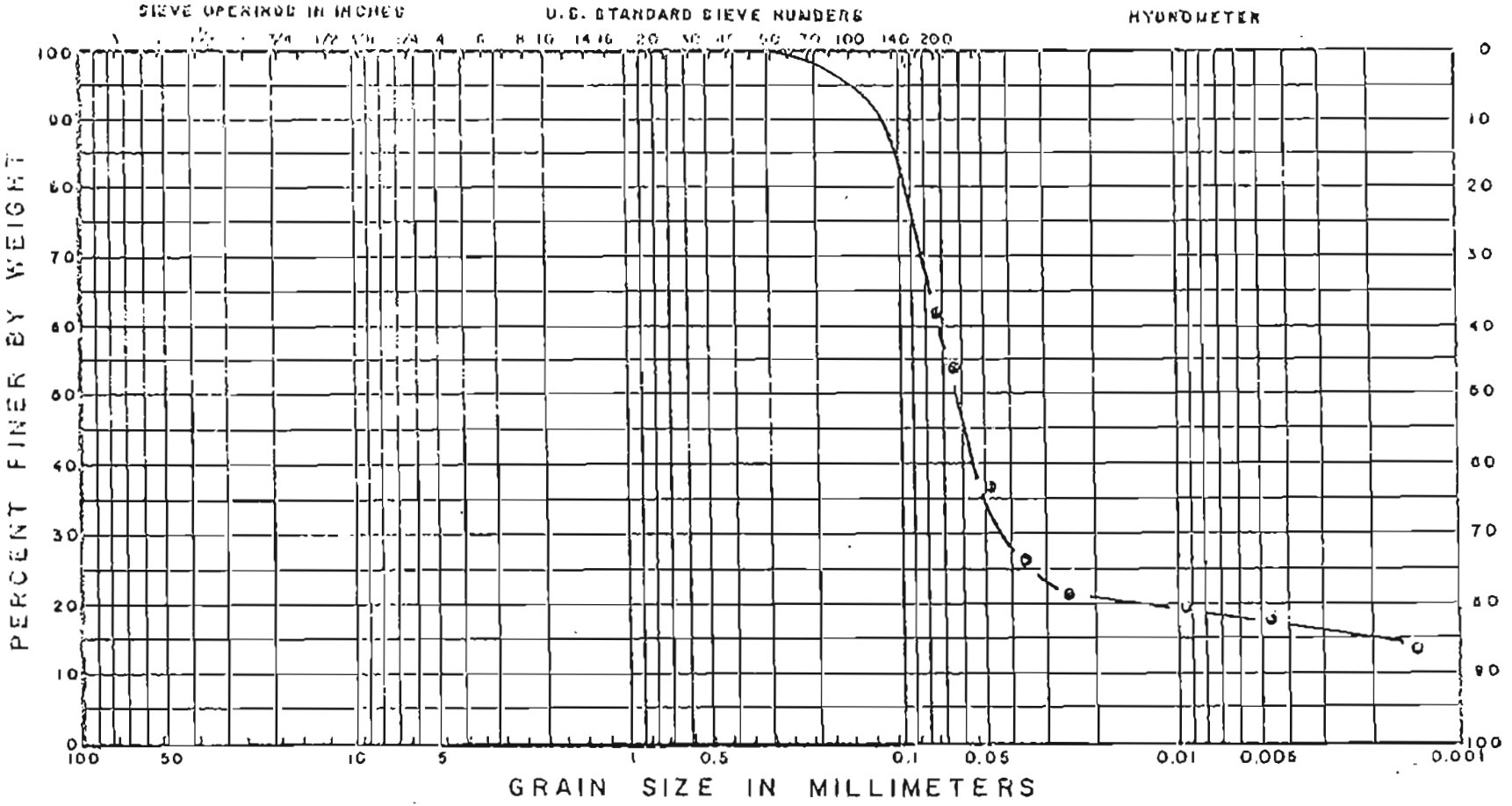
SAMPLED FROM	LOCATION DEPTH, FT.	WATER CONTENT PERCENT (NATURAL)	L.L.	P.L.	P.I.	MECHANICAL ANALYSIS PERCENT FINER 3"	3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 200	PERMEABILITY, k_v Cm / SEC	UNIFIED CLASSIFICATION
Test Pit 1	4.0-4.5	34.5	60	31	29	-	-	-	-	100	99	94		CH-MH
Test Pit 2	0.5-1.0	48.3	78	36	42	-	-	-	100	99	98	97	2.2×10^{-8}	CH-MH
Test Pit 3	0.5-1.0	21.0	23	16	7	-	-	-	-	100	98	70		CL
Test Pit 4	5.0-6.0	43.4	81	31	50	-	-	-	-	100	98	97		CH
Test Pit 5	6.0-7.0	37.8	66	32	34	-	-	-	-	-	100	98		CH
Test Pit 6	5.0-6.0	27.2	48	25	23	-	-	100	99	97	93	71		CL
Test Pit 8	5.0-6.0	31.9	37	29	8	-	-	-	100	99	99	93	1.9×10^{-7}	ML
Test Pit 9	4.0-5.0	24.7	34	20	14	-	-	-	100	99	99	50	7.6×10^{-8}	CL
Test Pit 10	2.0-3.0	21.7	46	19	27	-	-	-	-	100	98	71		CL
Test Pit 11	1.0-2.0	26.5	46	23	23	-	-	-	-	100	96	56	1.5×10^{-8}	CL

SUMMARY OF CLASSIFICATION TESTS

PROJECT: ASH STORAGE AREAS SITE: WHITE BLUFF STEAM ELECTRIC STATION

SAMPLED FROM	LOCATION DEPTH, FT.	WATER CONTENT PERCENT (NATURAL)	L.L.	P.L.	P.I.	MECHANICAL ANALYSIS PERCENT FINER 3"	3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 200	PERMEABILITY, k_v Cm / SEC	UNIFIED CLASSIFICATION
Test Pit 12	3.5-4.0	26.2	26	24	2	-	-	-	-	-	100	62		ML
Test Pit 13	2.0-3.0	40.0	72	34	38	-	-	-	100	99	97	91		CH-MH
Test Pit 14	1.0-2.0	19.6	NON-PLASTIC			-	-	100	99	99	99	72		ML
	3.0-4.0	21.9	35	18	17	-	-	-	100	99	97	81		CL
Test Pit 15	4.0-5.0	43.3	85	33	52	-	-	-	-	-	100	99		CH
Test Pit 16	5.0-6.0	39.4	73	29	44	-	-	-	-	100	98	89		CH
Test Pit 17	7.5-8.0	29.7	54	24	30	-	-	-	-	-	100	93		CH
Test Pit 18	4.0-5.0	35.1	52	23	29	-	-	-	100	99	98	86		CH
Test Pit 19	2.0-3.0	21.5	28	18	10	-	-	-	100	99	98	49	8.5×10^{-8}	SC
Test Pit 20	5.0-6.0	24.9	28	23	5	-	-	-	-	100	99	71	1.5×10^{-7}	CL-ML

GRAIN SIZE CURVES



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

TEST PIT NO. 12 SAMPLE NO. 1 DEPTH: 3.5 - 4.0 FEET

LOG OF TEST PIT NO. 15

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TONS/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	% PASSING NO. 200 SIEVE
			SURF. EL: 305 ±					
			Brown clayey silt with some organic matter					
			Tan clayey silt					
			Reddish tan and light gray silty clay					
			Light gray silty clay with some tan and yellowish tan fine sandy silt pockets -light gray with light brown and blocky below 6.5 ft				85+	99
5								
10								

DEPTH OF EXCAVATION: 10.5 ft
DATE: 4/17/79

DEPTH TO WATER: Dry

DATE: 4/17/79

PLATE 22

LOG OF TEST PIT NO. 16

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TONS/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4)	PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10 20 30 40 50 60 70)	% PASSING NO. 200
			SURF. EL: 300 ±					
			Brown clayey silt with some organic matter					
			Reddish tan and light gray blocky silty clay -mostly light gray below 2.5 ft					
5								89
			Light gray with some light brown blocky silty clay with tan and yellowish tan fine sandy silt pockets					
10								
			NOTE: GROUND WATER SEEPAGE INTO EXCAVATION AT 5 FT					
15								

COMPLETION DEPTH: 11.5 ft
DATE: 4/17/79

DEPTH TO WATER WHILE DRILLING: SEE NOTE

DATE: 4/17/79

LOG OF TEST PIT NO. 17

ARKANSAS POWER AND LIGHT COMPANY
WHITE BLUFF

TYPE: Backhoe LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (C) 0.2 0.4 0.6 0.8 1.0 1.2 1.4	PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT 10 20 30 40 50 60 70	NO. 200, %
			SURF. EL: 290 ±					
			Brown and tan clayey silt with organic matter					
			Light gray with tan very silty clay					
5			Light gray with light brown blocky very silty clay with tan and yellowish tan fine sandy silt pockets					
			Dark gray silty clay					93
10			NOTE: SOME GROUND WATER SEEPAGE INTO EXCAVATION AT 3 FT					

BOTTOM OF DEPTH: 8.5 Ft DATE: 4/17/79 DEPTH TO WATER IN PIT: SEE NOTE DATE: 4/17/79