HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

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25th
Anniversary
2004

September 14, 2004

<u>COURIER</u>

Mr. Harry Ehrlich
Deputy General Manager
OLIVENHAIN MUNICIPAL WATER DISTRICT
1966 Olivenhain Road
Encinitas, CA 92024

Re: <u>Appendices for Hydrogeologic Report, San Dieguito Basin Aquifer Storage and Recovery Program</u>

Dear Mr. Ehrlich:

Enclosed is one copy of Volume II Appendices for the report titled:

Hydrogeologic Report
Aquifer Storage And Recovery Project
San Dieguito Basin
San Diego, California

If you have any questions or comments, please contact us.

Sincerely,

HARGIS + ASSOCIATES, INC.

Roger A. Niemeyer

Roger A. Niemeyer, RG 3616, CHG 43
Principal Hydrogeologist
Technical Director

MAP/RAN/kal

Attachments

cc: Mr. Jack White, White Environmental Consulting
Ms. Maya Rohr, Kleinfelder

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WATER DISTRICT

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Mesa, AZ
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HARGIS + ASSOCIATES, INC.

HYDROGEOLOGIC REPORT
AQUIFER STORAGE AND RECOVERY PROJECT
SAN DIEGUITO BASIN
SAN DIEGO, CALIFORNIA

VOLUME II

APPENDICES

APPENDIX A

WATER LEVEL MONITORING DATA

APPENDIX A

WATER LEVEL MONITORING DATA

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APPENDIX A

WATER LEVEL MONITORING DATA

1.0 SUMMARY OF WATER LEVEL MONITORING

Water levels have been monitored in selected wells and at several locations along the San Dieguito River on a semi-annual basis from 1997 to 1999, and 2001 to May 2004 (Figure A-1). Water levels are measured to the nearest 0.01 foot using a 2-wire electric sounder. The surveyed top of the well casing or sounding tube was used as the reference point for each well. Surveyed reference points were also established on bridges over the San Dieguito River where water levels could be measured. Water level elevations in feet mean sea level (msl) were calculated by subtracting the depth to water measurement from the surveyed reference point elevation. Manual water level measurement data and elevations are summarized in Table A-1.

Several of the monitor wells have been equipped with pressure transducers at various times to record water level data on a continuous basis. Transducer data are helpful in assessing the static water level in wells that are affected by frequent drawdown and recovery due to cyclic pumping. Active and inactive production wells that have been the primary focus for pressure transducer data collection are:

5FB/5FC	Rancho Santa Fe (RSF) Polo Club No. 2;
5H2	Morgan Run Fairway 2;
32JB/32JD	Morgan Run The Gun;
32RA/32RB	Morgan Run No. 3 Green North;
33EA	McFarlane North;
33N2	Rancho Paseana South; and
33NC	Morgan Run East.

In addition, since 2002 selected piezometers have also been monitored using pressure transducers to evaluate the water level response due to groundwater production and pilot testing. Piezometers that have been monitored using pressure transducers include:

- Shallow Piezometer 1 (P-1);
- Shallow Piezometer 3 (P-3);
- Shallow Piezometer 4S (P-4S);
- Deep Piezometer 4D (P-4D);
- Shallow Piezometer 6 (P-6);
- Shallow Piezometer 9 (P-9);
- Shallow Piezometer 11A (P-11A);
- Intermediate Piezometer 11B (P-11B); and
- Deep Piezometer 11D (P-11D).

Hydrographs for key wells and piezometers are shown in Figures A-2 to A-23. Figures A-2 to A-8 show water levels that were measured in deep production wells. Therefore, the water level elevations shown in these hydrographs are representative of the hydraulic head in the deeper, confined aquifer.

Water levels shown in Figures A-9 through A-12, A-14 through A-20, and A-23 were measured in shallow piezometers and are representative of water table conditions. Water levels shown in Figure A-21 were measured in intermediate Piezometer P-11B. Water levels shown in Figures A-13 and A-22 were measured in deep Piezometers, screened in the confined aquifer.

Water level contour maps for routine monitoring events conducted during 2003 and 2004 are shown in Figures A-27 to A-32. Water level contour maps for routine monitoring events, conducted in 1997 to 1999, 2001, and June 2002 have been previously published (Hargis + Associates, Inc., 2002). Water level contours based on shallow piezometers are indicative of the water table elevation (Figures A-27, A-29, and A-31). San Dieguito River water level elevations at bridge monitoring locations are also presented on these maps for comparison to the water table elevation. As noted above, the water level contours based on data from production wells and deep piezometers are representative of the hydraulic head or pressure in the deeper, confined aquifer (Figures A-28, A-30, and A-32).

The water level in the San Dieguito River has been measured since about 1998 at the following four bridges:

- El Camino Real
- Morgan Run South Bridge
- Morgan Run North Bridge
- Camino De Santa Fe (north of El Apajo)

Water level data for the San Dieguito River are provided in Table A-1. During the winter of 2003-04, stilling wells with transducers were installed at the Morgan Run North and South Bridges to allow continuous monitoring of storm-related changes in river water levels (Figures A-24 and A-25). In addition, a surveyed reference point was established in 2003 on the Morgan Run Middle Bridge, which is located near the test well, to allow monitoring of the river level during the pilot testing program (Figure A-26).

2.0 REFERENCES

Hargis + Associates, Inc., 2002. Volume II, Project Report Appendices, Aquifer Storage and Recovery Program, San Dieguito Basin, San Diego, California. October 18, 2002.

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Albert Court	33BA	12/14/97	44.77	NM	NM
Albert Court	33BA	05/14/98	44.77	17.88	26.89
Albert Court	33BA	11/10/98	44.77	19.90	24.87
Albert Court	33BA	04/15/99	44.77	18.52	26.25
Albert Court	33BA	10/14/99	44.77	20.42	24.35
Albert Court	33BA	06/06/01	44.77	19.60	25.17
Albert Court	33BA	12/20/01	44.77	18.70	26.07
Albert Court	33BA	06/06/02	44.77	19.68	25.09
Albert Court	33BA	03/13/03	44.77	18.24	26.53
Albert Court	33BA	10/23/03	44.77	19.40	25.37
Albert Court	33BA	03/12/04	44.77	18.65	26.12
Chino Farms	33C7	12/15/97	43.16	NM	NM
Chino Farms	33C7	04/22/98	43.16	19.88	23.28
Chino Farms	33C7	11/10/98	43.16	24.42	18.74
Chino Farms	33C7	04/15/99	43.16	21.60	21.56
Chino Farms	33C7	10/14/99	43.16	25.11	18.05
Chino Farms	33C7	06/07/01	43.16	22.85	20.31
Chino Farms	33C7	12/20/01	43.16	22.34	20.82
Chino Farms	33C7	06/06/02	43.16	23.29	19.87
Chino Farms	33C7	03/14/03	43.16	21.43	21.73
Chino Farms	33C7	10/23/03	43.16	22.73	20.43
Chino Farms	33C7	03/12/04	43.16	21.13	22.03
FBR Homeowners No 1(east)	33L7	12/16/97	34.43	29.74	4.69
FBR Homeowners No 1(east)	33L7	04/23/98	34.43	17.65	16.78
FBR Homeowners No 1(east)	33L7	11/10/98	34.43	30.66	3.77
FBR Homeowners No 1(east)	33L7	04/15/99	34.43	17.95	16.48
FBR Homeowners No 1(east)	33L7	10/14/99	34.43	Dry	Dry
FBR Homeowners No 1(east)	33L7	06/05/01	34.43	29.95	4.48
FBR Homeowners No 1(east)	33L7	12/20/01	34.43	19.25	15.18
FBR Homeowners No 1(east)	33L7	06/06/02	34.43	> 90	Dry
FBR Homeowners No 1(east)	33L7	10/23/03	34.43	35.07	-0.64
FBR Homeowners No 1(east)	33L7	03/17/04	34.43	NM	NM
FBR Homeowners No 2 (west)	33LA	12/16/97	34.94	29.7	5.24
FBR Homeowners No 2 (west)	33LA	04/22/98	34.94	NM	NM
FBR Homeowners No 2 (west)	33LA	11/10/98	34.94	30.15	4.79
FBR Homeowners No 2 (west)	33LA	04/15/99	34.94	17.05	17.89
FBR Homeowners No 2 (west)	33LA	10/14/99	34.94	44.41	-9.47
FBR Homeowners No 2 (west)	33LA	06/05/01	34.94	30.90	4.04
FBR Homeowners No 2 (west)	33LA	12/20/01	34.94	19.83	15.11
FBR Homeowners No 2 (west)	33LA	06/06/02	34.94	39.60	-4.66
FBR Homeowners No 2 (west)	33LA	03/20/03	34.94	18.01	16.93

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
FBR Homeowners No 2 (west)	33LA	10/23/03	34.94	35.44	-0.50
FBR Homeowners No 2 (west)	33LA	03/17/04	34.94	19.18	15.76
Helen Woodward Animal Center (north)	33K8	12/15/97	31.84	NM	NM
Helen Woodward Animal Center (north)	33K8	05/14/98	31.84	NM	NM
Helen Woodward Animal Center (north)	33K8	11/10/98	31.84	27.46	4.38
Helen Woodward Animal Center (north)	33K8	04/15/99	31.84	15.34	16.50
Helen Woodward Animal Center (north)	33K8	10/14/99	31.84	40.45	-8.61
Helen Woodward Animal Center (north)	33K8	06/05/01	31.84	27.46	4.38
Helen Woodward Animal Center (north)	33K8	12/20/01	31.84	16.67	15.17
Helen Woodward Animal Center (north)	33K8	06/06/02	31.84	36.75	-4.91
Helen Woodward Animal Center (north)	33K8	03/14/03	31.84	17.35	14.49
Helen Woodward Animal Center (north)	33K8	10/23/03	31.84	31.74	0.10
Helen Woodward Animal Center (north)	33K8	03/11/04	31.84	19.75	12.09
International Farms Deep Well	28RC	12/17/97	46.05	20.5	25.55
International Farms Deep Well	28RC	05/15/98	46.05	14.45	31.60
International Farms Deep Well	28RC	11/10/98	46.05	16.94	29.11
International Farms Deep Well	28RC	04/15/99	46.05	15.81	30.24
International Farms Deep Well	28RC	10/14/99	46.05	17.35	28.70
International Farms Deep Well	28RC	06/05/01	46.05	16.10	29.95
International Farms Deep Well	28RC	12/20/01	46.05	16.05	30.00
International Farms Deep Well	28RC	06/06/02	46.05	15.95	30.10
International Farms Deep Well	28RC	03/13/03	46.05	15.23	30.82
International Farms Deep Well	28RC	10/23/03	46.05	15.81	30.24
International Farms Deep Well	28RC	03/12/04	46.05	15.01	31.04
International Farms Shallow Well	28RB	12/17/97	52.62	23.54	29.08
International Farms Shallow Well	28RB	05/15/98	52.62	20.57	32.05
International Farms Shallow Well	28RB	11/10/98	52.62	24.30	28.32
International Farms Shallow Well	28RB	04/15/99	52.62	22.70	29.92
International Farms Shallow Well	28RB	10/14/99	52.62	25.35	27.27
International Farms Shallow Well	28RB	06/05/01	52.62	22.98	29.64
International Farms Shallow Well	28RB	12/20/01	52.62	22.75	29.87
International Farms Shallow Well	28RB	06/06/02	52.62	23.20	29.42
International Farms Shallow Well	28RB	03/13/03	52.62	22.22	30.40
International Farms Shallow Well	28RB	10/23/03	52.62	22.58	30.04
International Farms Shallow Well	28RB	03/12/04	52.62	21.89	30.73
Mc Farlane North	33EA	11/10/98	36.62	29.45	7.17
Mc Farlane North	33EA	04/15/99	36.62	19.30	17.32
Mc Farlane North	33EA	10/14/99	36.62	45.21	-8.59
Mc Farlane North	33EA	06/05/01	36.62	30.00	6.62
Mc Farlane North	33EA	08/23/01	36.62	45.20	-8.58

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Mc Farlane North	33EA	12/20/01	36.62	20.68	15.94
Mc Farlane North	33EA	02/27/02	36.62	21.94	14.68
Mc Farlane North	33EA	03/21/02	36.62	20.31	16.31
Mc Farlane North	33EA	04/18/02	36.62	33.60	3.02
Mc Farlane North	33EA	06/06/02	41.57	41.96	-0.39
Mc Farlane North	33EA	10/04/02	41.57	40.98	0.59
Mc Farlane North	33EA	03/13/03	41.57	26.01	15.56
Mc Farlane North	33EA	05/01/03	41.57	28.58	12.99
Mc Farlane North	33EA	05/01/03	41.57	28.63	12.94
Mc Farlane North	33EA	05/01/03	41.57	25.58	15.99
Mc Farlane North	33EA	05/29/03	41.57	34.08	7.49
Mc Farlane North	33EA	10/22/03	41.57	42.56	-0.99
Mc Farlane North	33EA	03/11/04	41.67	33.00	8.67
Mc Farlane North	33EA	03/12/04	41.67	34.33	7.34
Mc Farlane North	33EA	03/12/04	41.67	34.34	7.33
Mc Farlane South	33E2	11/10/98	36.46	19.03	17.43
Mc Farlane South	33E2	04/15/99	36.46	16.88	19.58
Mc Farlane South	33E2	10/14/99	36.46	20	16.46
Mc Farlane South	33E2	06/05/01	36.46	16.90	19.56
Mc Farlane South	33E2	12/20/01	36.46	18.78	17.68
Mc Farlane South	33E2	06/06/02	36.46	17.14	19.32
Morgan Run East Well	33NC	12/16/97	31.18	28.98	2.20
Morgan Run East Well	33NC	02/19/98	31.18	16.20	14.98
Morgan Run East Well	33NC	02/24/98	31.18	14.84	16.34
Morgan Run East Well	33NC	04/22/98	31.18	14.57	16.61
Morgan Run East Well	33NC	05/14/98	31.18	23.5	7.68
Morgan Run East Well	33NC	11/10/98	31.18	26.64	4.54
Morgan Run East Well	33NC	04/15/99	31.18	14.85	16.33
Morgan Run East Well	33NC	10/14/99	31.18	35.45	-4.27
Morgan Run East Well	33NC	06/05/01	31.18	26.24	4.94
Morgan Run East Well	33NC	08/23/01	31.18	38.33	-7.15
Morgan Run East Well	33NC	12/20/01	31.18	16.22	14.96
Morgan Run East Well	33NC	02/19/02	31.18	17.73	13.45
Morgan Run East Well	33NC	02/27/02	31.18	17.63	13.55
Morgan Run East Well	33NC	03/21/02	31.18	15.94	15.24
Morgan Run East Well	33NC	04/18/02	31.18	22.16	9.02
Morgan Run East Well	33NC	06/06/02	31.18	32.59	-1.41
Morgan Run East Well	33NC	10/04/02	31.18	32.00	-0.82
Morgan Run East Well	33NC	03/13/03	31.18	16.52	14.66
Morgan Run East Well	33NC	05/01/03	31.18	20.15	11.03
Morgan Run East Well	33NC	09/30/03	31.18	28.41	2.77
Morgan Run East Well	33NC	09/30/03	31.18	27.50	3.68

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Morgan Run East Well	33NC	10/03/03	31.18	22.95	8.23
Morgan Run East Well	33NC	10/08/03	31.18	21.74	9.44
Morgan Run East Well	33NC	10/10/03	31.18	21.25	9.93
Morgan Run East Well	33NC	10/15/03	31.18	24.30	6.88
Morgan Run East Well	33NC	10/22/03	31.18	28.30	2.88
Morgan Run East Well	33NC	03/11/04	31.18	15.88	15.30
Morgan Run East Well	33NC	03/22/04	31.18	16.17	15.01
Morgan Run East Well	33NC	03/23/04	31.18	17.80	13.38
Morgan Run East Well	33NC	03/24/04	31.18	18.25	12.93
Morgan Run East Well	33NC	03/25/04	31.18	16.74	14.44
Morgan Run East Well	33NC	03/26/04	31.18	14.80	16.38
Morgan Run East Well	33NC	03/27/04	31.18	13.15	18.03
Morgan Run East Well	33NC	03/28/04	31.18	12.14	19.04
Morgan Run East Well	33NC	03/29/04	31.18	11.40	19.78
Morgan Run East Well	33NC	03/30/04	31.18	10.85	20.33
Morgan Run East Well	33NC	03/31/04	31.18	10.70	20.48
Morgan Run East Well	33NC	04/01/04	31.18	12.06	19.12
Morgan Run East Well	33NC	04/09/04	31.18	18.18	13.00
Morgan Run Fairway 2	5H2	12/15/97	21.18	NM	NM
Morgan Run Fairway 2	5H2	04/15/98	21.18	3.6	17.58
Morgan Run Fairway 2	5H2	05/18/98	21.18	6.42	14.76
Morgan Run Fairway 2	5H2	11/10/98	21.18	10.98	10.20
Morgan Run Fairway 2	5H2	04/15/99	21.18	3.6	17.58
Morgan Run Fairway 2	5H2	10/14/99	21.18	15.63	5.55
Morgan Run Fairway 2	5H2	06/05/01	21.18	8.88	12.30
Morgan Run Fairway 2	5H2	08/23/01	21.03	16.17	4.86
Morgan Run Fairway 2	5H2	12/20/01	21.03	4.32	16.71
Morgan Run Fairway 2	5H2	02/19/02	21.03	4.73	16.30
Morgan Run Fairway 2	5H2	03/21/02	21.03	4.1	16.93
Morgan Run Fairway 2	5H2	04/01/02	21.03	9.75	11.28
Morgan Run Fairway 2	5H2	04/02/02	21.03	10.8	10.23
Morgan Run Fairway 2	5H2	04/18/02	21.03	7.92	13.11
Morgan Run Fairway 2	5H2	06/06/02	21.03	13.74	7.29
Morgan Run Fairway 2	5H2	10/04/02	21.03	14.41	6.62
Morgan Run Fairway 2	5H2	03/13/03	21.03	4.07	16.96
Morgan Run Fairway 2	5H2	09/30/03	21.03	11.31	9.72
Morgan Run Fairway 2	5H2	10/03/03	21.03	5.08	15.95
Morgan Run Fairway 2	5H2	10/08/03	21.03	3.42	17.61
Morgan Run Fairway 2	5H2	10/10/03	21.03	3	18.03
Morgan Run Fairway 2	5H2	10/16/03	21.03	8.51	12.52
Morgan Run Fairway 2	5H2	10/22/03	21.03	9.64	11.39
Morgan Run Fairway 2	5H2	03/11/04	21.03	3.37	17.66
Morgan Run Fairway 2	5H2	03/23/04	26.05	9.11	16.94

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Morgan Run Fairway 2	5H2	03/24/04	26.05	9.27	16.78
Morgan Run Fairway 2	5H2	03/25/04	26.05	7.51	18.54
Morgan Run Fairway 2	5H2	03/26/04	26.05	6.06	19.99
Morgan Run Fairway 2	5H2	03/27/04	26.05	4.65	21.40
Morgan Run Fairway 2	5H2	03/28/04	26.05	3.96	22.09
Morgan Run Fairway 2	5H2	03/29/04	26.05	3.53	22.52
Morgan Run Fairway 2	5H2	03/30/04	26.05	3.03	23.02
Morgan Run Fairway 2	5H2	03/31/04	26.05	2.85	23.20
Morgan Run Fairway 2	5H2	04/01/04	26.05	2.89	23.16
Morgan Run Fairway 2	5H2	04/09/04	26.05	10	16.05
Morgan Run Gun	32JB	12/16/97	29.1	28.04	1.06
Morgan Run Gun	32JB	02/19/98	29.10	13.70	15.40
Morgan Run Gun	32JB	02/24/98	29.10	12.08	17.02
Morgan Run Gun	32JB	04/23/98	29.10	16.17	12.93
Morgan Run Gun	32JB	05/14/98	29.1	13.37	15.73
Morgan Run Gun	32JB	11/10/98	29.10	21.65	7.45
Morgan Run Gun	32JB	11/10/98	29.10	21.65	7.45
Morgan Run Gun	32JB	04/15/99	29.10	12.14	16.96
Morgan Run Gun	32JB	04/15/99	29.10	12.14	16.96
Morgan Run Gun	32JB	10/14/99	29.05	25.35	3.70
Morgan Run Gun	32JB	06/05/01	29.05	15.34	13.71
Morgan Run Gun	32JB	12/20/01	29.05	13.70	15.35
Morgan Run Gun	32JB	02/15/02	29.05	14.77	14.28
Morgan Run Gun	32JB	02/27/02	29.05	12.55	16.50
Morgan Run Gun	32JB	03/04/02	29.05	12.31	16.74
Morgan Run Gun	32JB	03/21/02	29.05	12.85	16.20
Morgan Run Gun	32JB	04/18/02	29.05	16.77	12.28
Morgan Run Gun	32JB	06/06/02	29.05	23.55	5.50
Morgan Run Gun	32JB	03/13/03	29.05	12.29	16.76
Morgan Run Gun	32JB	10/22/03	29.05	15.86	13.19
Morgan Run Gun	32JB	03/12/04	28.05	13.75	14.30
Morgan Run GunR	32JD	06/05/01	30.78	17.85	12.93
Morgan Run GunR	32JD	12/20/01	30.78	15.58	15.20
Morgan Run GunR	32JD	02/15/02	30.78	34.62	-3.84
Morgan Run GunR	32JD	02/19/02	30.78	35.47	-4.69
Morgan Run GunR	32JD	02/27/02	30.78	14.51	16.27
Morgan Run GunR	32JD	03/04/02	30.78	14.24	16.54
Morgan Run GunR	32JD	03/05/02	30.78	18.20	12.58
Morgan Run GunR	32JD	03/21/02	30.78	16.05	14.73
Morgan Run GunR	32JD	04/18/02	30.78	20.70	10.08
Morgan Run GunR	32JD	06/06/02	30.78	46.53	-15.75
Morgan Run GunR	32JD	10/04/02	30.78	55.38	-24.60

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Morgan Run GunR	32JD	03/13/03	30.78	14.28	16.50
Morgan Run GunR	32JD	10/22/03	30.78	18.29	12.49
Morgan Run GunR	32JD	03/12/04	30.78	28.00	2.78
Morgan Run GunR	32JD	05/24/04	30.78	17.85	12.93
Morgan Run No. 3 Green North	32RB	12/16/97	38.82	38.5	0.32
Morgan Run No. 3 Green North	32RB	05/14/98	38.82	24.24	14.58
Morgan Run No. 3 Green North	32RB	11/10/98	38.82	32.41	6.41
Morgan Run No. 3 Green North	32RB	04/15/99	38.82	22.75	16.07
Morgan Run No. 3 Green North	32RB	10/14/99	38.82	36.15	2.67
Morgan Run No. 3 Green North	32RB	06/05/01	38.82	27.31	11.51
Morgan Run No. 3 Green North	32RB	12/20/01	38.82	24.72	14.10
Morgan Run No. 3 Green North	32RB	06/06/02	38.82	45.55	-6.73
Morgan Run No. 3 Green North	32RB	03/13/03	38.82	23.41	15.41
Morgan Run No. 3 Green North	32RB	10/22/03	38.82	27.89	10.93
Morgan Run No. 3 Green North	32RB	03/12/04	38.82	30.85	7.97
Morgan Run No. 3 Green North Old 2	32RA	08/23/01	37.32	42.28	-4.96
Morgan Run No. 3 Green North Old 2	32RA	12/20/01	37.32	22.40	14.92
Morgan Run No. 3 Green North Old 2	32RA	03/04/02	37.32	20.92	16.40
Morgan Run No. 3 Green North Old 2	32RA	03/21/02	37.32	25.26	12.06
Morgan Run No. 3 Green North Old 2	32RA	04/18/02	37.32	31.11	6.21
Morgan Run No. 3 Green North Old 2	32RA	06/06/02	37.32	37.57	-0.25
Morgan Run No. 3 Green North Old 2	32RA	10/04/02	37.24	36.97	0.27
Morgan Run No. 3 Green North Old 2	32RA	03/13/03	37.24	21.04	16.20
Morgan Run No. 3 Green North Old 2	32RA	10/22/03	37.24	25.44	11.80
Morgan Run No. 3 Green North Old 2	32RA	03/12/04	37.24	24.94	12.30
Morgan Run No. 3 Green North Old 2	32RA	03/12/04	37.24	24.97	12.27
Shallow Piezometer P-1	P-1	03/12/02	24.84	5.4	19.44
Shallow Piezometer P-1	P-1	03/13/02	24.84	5.31	19.53
Shallow Piezometer P-1	P-1	03/21/02	24.84	5.17	19.67
Shallow Piezometer P-1	P-1	04/18/02	24.84	5.1	19.74
Shallow Piezometer P-1	P-1	06/06/02	24.84	5.13	19.71
Shallow Piezometer P-1	P-1	10/04/02	24.84	4.96	19.88
Shallow Piezometer P-1	P-1	03/13/03	24.84	5	19.84
Shallow Piezometer P-1	P-1	04/21/03	24.84	4.62	20.22
Shallow Piezometer P-1	P-1	05/01/03	24.84	4.72	20.12
Shallow Piezometer P-1	P-1	07/30/03	24.84	5.06	19.78
Shallow Piezometer P-1	P-1	09/28/03	24.84	5.01	19.83
Shallow Piezometer P-1	P-1	09/30/03	24.84	5.05	19.79
Shallow Piezometer P-1	P-1	10/03/03	24.84	4.97	19.87
Shallow Piezometer P-1	P-1	10/08/03	24.84	4.84	20.00
Shallow Piezometer P-1	P-1	10/10/03	24.84	4.88	19.96

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Shallow Piezometer P-1	P-1	10/15/03	24.84	5.12	19.72
Shallow Piezometer P-1	P-1	10/22/03	24.84	4.98	19.86
Shallow Piezometer P-1	P-1	03/12/04	24.84	4.86	19.98
Shallow Piezometer P-1	P-1	03/23/04	24.84	5.01	19.83
Shallow Piezometer P-1	P-1	03/24/04	24.84	4.97	19.87
Shallow Piezometer P-1	P-1	03/25/04	24.84	4.94	19.90
Shallow Piezometer P-1	P-1	03/26/04	24.84	4.94	19.90
Shallow Piezometer P-1	P-1	03/27/04	24.84	4.89	19.95
Shallow Piezometer P-1	P-1	03/28/04	24.84	7.86	16.98
Shallow Piezometer P-1	P-1	03/30/04	24.84	4.89	19.95
Shallow Piezometer P-1	P-1	04/01/04	24.84	4.89	19.95
Shallow Piezometer P-1	P-1	04/09/04	24.84	5.06	19.78
Shallow Piezometer P-1	P-1	05/06/04	24.84	5.35	19.49
Shallow Piezometer P-1	P-1	06/11/04	24.84	5.39	19.45
Shallow Piezometer P-2	P-2	03/12/02	24.55	5.1	19.45
Shallow Piezometer P-2	P-2	03/13/02	24.55	5.1	19.45
Shallow Piezometer P-2	P-2	03/21/02	24.55	4.95	19.60
Shallow Piezometer P-2	P-2	06/06/02	24.55	4.94	19.61
Shallow Piezometer P-2	P-2	10/04/02	24.55	4.78	19.77
Shallow Piezometer P-2	P-2	03/13/03	24.55	4.31	20.24
Shallow Piezometer P-2	P-2	04/21/03	24.55	4.43	20.12
Shallow Piezometer P-2	P-2	10/22/03	24.55	4.62	19.93
Shallow Piezometer P-2	P-2	03/12/04	24.55	4.57	19.98
Shallow Piezometer P-2	P-2	03/23/04	24.55	4.77	19.78
Shallow Piezometer P-2	P-2	03/24/04	24.55	4.78	19.77
Shallow Piezometer P-2	P-2	03/25/04	24.55	4.74	19.81
Shallow Piezometer P-2	P-2	03/26/04	24.55	4.74	19.81
Shallow Piezometer P-2	P-2	03/27/04	24.55	4.7	19.85
Shallow Piezometer P-2	P-2	03/28/04	24.55	4.86	19.69
Shallow Piezometer P-2	P-2	03/30/04	24.55	4.7	19.85
Shallow Piezometer P-2	P-2	04/01/04	24.55	4.74	19.81
Shallow Piezometer P-2	P-2	04/09/04	24.55	4.88	19.67
Shallow Piezometer P-2	P-2	05/06/04	24.55	5.16	19.39
Shallow Piezometer P-2	P-2	06/11/04	24.55	5.33	19.22
Shallow Piezometer P-3	P-3	11/05/02	25.39	19.06	6.33
Shallow Piezometer P-3	P-3	11/08/02	25.39	18.93	6.46
Shallow Piezometer P-3	P-3	11/08/02	25.39	18.85	6.54
Shallow Piezometer P-3	P-3	03/13/03	25.39	7.41	17.98
Shallow Piezometer P-3	P-3	04/21/03	25.39	7.09	18.30
Shallow Piezometer P-3	P-3	10/22/03	25.39	9.48	15.91
Shallow Piezometer P-3	P-3	12/23/03	25.39	7.82	17.57
Shallow Piezometer P-3	P-3	03/11/04	25.39	5.56	19.83

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Shallow Piezometer P-3	P-3	03/22/04	25.39	7.09	18.30
Shallow Piezometer P-3	P-3	03/23/04	25.39	7.27	18.12
Shallow Piezometer P-3	P-3	03/24/04	25.39	7.39	18.00
Shallow Piezometer P-3	P-3	03/25/04	25.39	7.31	18.08
Shallow Piezometer P-3	P-3	03/26/04	25.39	7.33	18.06
Shallow Piezometer P-3	P-3	03/28/04	25.39	7.26	18.13
Shallow Piezometer P-3	P-3	03/30/04	25.39	7.28	18.11
Shallow Piezometer P-3	P-3	04/01/04	25.39	7.5	17.89
Shallow Piezometer P-3	P-3	04/09/04	25.39	7.31	18.08
Shallow Piezometer P-3	P-3	05/06/04	25.39	8.35	17.04
Shallow Piezometer P-3	P-3	06/11/04	25.39	9.44	15.95
Shallow Piezometer P-4S	P-4S	11/05/02	32.21	16.47	15.74
Shallow Piezometer P-4S	P-4S	11/08/02	32.21	16.49	15.72
Shallow Piezometer P-4S	P-4S	11/08/02	32.21	16.48	15.73
Shallow Piezometer P-4S	P-4S	03/13/03	32.21	14.71	17.50
Shallow Piezometer P-4S	P-4S	04/21/03	32.21	14.19	18.02
Shallow Piezometer P-4S	P-4S	09/29/03	32.21	15.12	17.09
Shallow Piezometer P-4S	P-4S	10/03/03	32.21	15.17	17.04
Shallow Piezometer P-4S	P-4S	10/08/03	32.21	15.18	17.03
Shallow Piezometer P-4S	P-4S	10/10/03	32.21	15.12	17.09
Shallow Piezometer P-4S	P-4S	10/15/03	32.21	15.21	17.00
Shallow Piezometer P-4S	P-4S	10/22/03	32.21	15.18	17.03
Shallow Piezometer P-4S	P-4S	12/05/03	32.21	14.96	17.25
Shallow Piezometer P-4S	P-4S	12/23/03	32.21	14.83	17.38
Shallow Piezometer P-4S	P-4S	03/12/04	32.21	14.11	18.10
Shallow Piezometer P-4S	P-4S	03/22/04	32.21	14.06	18.15
Shallow Piezometer P-4S	P-4S	03/23/04	32.21	14.07	18.14
Shallow Piezometer P-4S	P-4S	03/24/04	32.21	14.06	18.15
Shallow Piezometer P-4S	P-4S	03/25/04	32.21	14.05	18.16
Shallow Piezometer P-4S	P-4S	03/26/04	32.21	14.05	18.16
Shallow Piezometer P-4S	P-4S	03/28/04	32.21	14.04	18.17
Shallow Piezometer P-4S	P-4S	03/30/04	32.21	14.04	18.17
Shallow Piezometer P-4S	P-4S	04/01/04	32.21	14.04	18.17
Shallow Piezometer P-4S	P-4S	04/09/04	32.21	14.03	18.18
Shallow Piezometer P-4S	P-4S	05/06/04	32.21	14.22	17.99
Shallow Piezometer P-4S	P-4S	06/11/04	32.21	14.52	17.69
Deep Piezometer P-4D	P-4D	11/05/02	31.77	28.18	3.59
Deep Piezometer P-4D	P-4D	11/08/02	31.77	27.84	3.93
Deep Piezometer P-4D	P-4D	11/08/02	31.77	27.89	3.88
Deep Piezometer P-4D	P-4D	03/13/03	31.77	16.2	15.57
Deep Piezometer P-4D	P-4D	09/29/03	31.77	23.43	8.34
Deep Piezometer P-4D	P-4D	10/03/03	31.77	19.93	11.84

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Deep Piezometer P-4D	P-4D	10/08/03	31.77	18.9	12.87
Deep Piezometer P-4D	P-4D	10/10/03	31.77	19.27	12.50
Deep Piezometer P-4D	P-4D	10/15/03	31.77	20.33	11.44
Deep Piezometer P-4D	P-4D	10/22/03	31.77	22.59	9.18
Deep Piezometer P-4D	P-4D	12/05/03	31.77	17.77	14.00
Deep Piezometer P-4D	P-4D	12/23/03	31.77	16.55	15.22
Deep Piezometer P-4D	P-4D	03/12/04	31.77	16.7	15.07
Deep Piezometer P-4D	P-4D	03/22/04	31.77	14.06	17.71
Deep Piezometer P-4D	P-4D	03/23/04	31.77	14.07	17.70
Deep Piezometer P-4D	P-4D	03/24/04	31.77	14.06	17.71
Deep Piezometer P-4D	P-4D	03/25/04	31.77	14.05	17.72
Deep Piezometer P-4D	P-4D	03/26/04	31.77	14.05	17.72
Deep Piezometer P-4D	P-4D	03/28/04	31.77	14.04	17.73
Deep Piezometer P-4D	P-4D	03/30/04	31.77	14.04	17.73
Deep Piezometer P-4D	P-4D	04/01/04	31.77	14.04	17.73
Deep Piezometer P-4D	P-4D	04/09/04	31.77	14.03	17.74
Deep Piezometer P-4D	P-4D	05/06/04	31.77	22.4	9.37
Deep Piezometer P-4D	P-4D	06/11/04	31.77	26.1	5.67
Shallow Piezometer P-5	P-5	04/21/03	28.79	10.77	18.02
Shallow Piezometer P-5	P-5	10/23/03	28.79	10.86	17.93
Shallow Piezometer P-5	P-5	12/23/03	28.79	10.87	17.92
Shallow Piezometer P-5	P-5	03/11/04	28.79	10.61	18.18
Shallow Piezometer P-5	P-5	03/22/04	28.79	10.57	18.22
Shallow Piezometer P-5	P-5	03/23/04	28.79	10.59	18.20
Shallow Piezometer P-5	P-5	03/24/04	28.79	10.56	18.23
Shallow Piezometer P-5	P-5	03/25/04	28.79	10.56	18.23
Shallow Piezometer P-5	P-5	03/26/04	28.79	10.55	18.24
Shallow Piezometer P-5	P-5	03/28/04	28.79	10.53	18.26
Shallow Piezometer P-5	P-5	03/30/04	28.79	10.53	18.26
Shallow Piezometer P-5	P-5	04/01/04	28.79	10.52	18.27
Shallow Piezometer P-5	P-5	04/02/04	28.79	10.52	18.27
Shallow Piezometer P-5	P-5	04/05/04	28.79	10.52	18.27
Shallow Piezometer P-5	P-5	04/08/04	28.79	10.48	18.31
Shallow Piezometer P-5	P-5	05/06/04	28.79	10.4	18.39
Shallow Piezometer P-5	P-5	06/11/04	28.79	10.44	18.35
Shallow Piezometer P-6	P-6	04/21/03	28.94	11.11	17.83
Shallow Piezometer P-6	P-6	07/30/03	28.94	11.11	17.83
Shallow Piezometer P-6	P-6	09/26/03	28.94	11.29	17.65
Shallow Piezometer P-6	P-6	09/28/03	28.94	11.25	17.69
Shallow Piezometer P-6	P-6	09/29/03	28.94	11.29	17.65
Shallow Piezometer P-6	P-6	10/03/03	28.94	11.3	17.64
Shallow Piezometer P-6	P-6	10/08/03	28.94	11.32	17.62

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Shallow Piezometer P-6	P-6	10/10/03	28.94	11.25	17.69
Shallow Piezometer P-6	P-6	10/15/03	28.94	11.36	17.58
Shallow Piezometer P-6	P-6	10/22/03	28.94	11.34	17.60
Shallow Piezometer P-6	P-6	12/05/03	28.94	11.41	17.53
Shallow Piezometer P-6	P-6	12/23/03	28.94	11.44	17.50
Shallow Piezometer P-6	P-6	03/11/04	28.94	11.21	17.73
Shallow Piezometer P-6	P-6	03/12/04	28.94	11.21	17.73
Shallow Piezometer P-6	P-6	03/22/04	28.94	11.17	17.77
Shallow Piezometer P-6	P-6	03/23/04	28.94	11.23	17.71
Shallow Piezometer P-6	P-6	03/24/04	28.94	11.19	17.75
Shallow Piezometer P-6	P-6	03/25/04	28.94	11.2	17.74
Shallow Piezometer P-6	P-6	03/26/04	28.94	11.2	17.74
Shallow Piezometer P-6	P-6	03/28/04	28.94	11.13	17.81
Shallow Piezometer P-6	P-6	03/30/04	28.94	11.15	17.79
Shallow Piezometer P-6	P-6	04/01/04	28.94	11.13	17.81
Shallow Piezometer P-6	P-6	04/02/04	28.94	11.18	17.76
Shallow Piezometer P-6	P-6	04/05/04	28.94	11.15	17.79
Shallow Piezometer P-6	P-6	04/08/04	28.94	11.11	17.83
Shallow Piezometer P-6	P-6	04/09/04	28.94	11.1	17.84
Shallow Piezometer P-6	P-6	05/06/04	28.94	11.05	17.89
Shallow Piezometer P-6	P-6	06/11/04	28.94	11.14	17.80
Shallow Piezometer P-7	P-7	04/21/03	28.81	10.92	17.89
Shallow Piezometer P-7	P-7	10/23/03	28.81	11.37	17.44
Shallow Piezometer P-7	P-7	12/05/03	28.81	11.35	17.46
Shallow Piezometer P-7	P-7	12/23/03	28.81	11.45	17.36
Shallow Piezometer P-7	P-7	03/11/04	28.81	11.07	17.74
Shallow Piezometer P-7	P-7	03/22/04	28.81	11.04	17.77
Shallow Piezometer P-7	P-7	03/23/04	28.81	11.13	17.68
Shallow Piezometer P-7	P-7	03/24/04	28.81	11.11	17.70
Shallow Piezometer P-7	P-7	03/25/04	28.81	11.11	17.70
Shallow Piezometer P-7	P-7	03/26/04	28.81	11.11	17.70
Shallow Piezometer P-7	P-7	03/28/04	28.81	11.03	17.78
Shallow Piezometer P-7	P-7	03/30/04	28.81	11.06	17.75
Shallow Piezometer P-7	P-7	04/01/04	28.81	11.06	17.75
Shallow Piezometer P-7	P-7	04/02/04	28.81	11.1	17.71
Shallow Piezometer P-7	P-7	04/08/04	28.81	11.05	17.76
Shallow Piezometer P-7	P-7	05/06/04	28.81	11	17.81
Shallow Piezometer P-7	P-7	06/11/04	28.81	11.15	17.66
Shallow Piezometer P-8	P-8	04/21/03	28.16	11.06	17.10
Shallow Piezometer P-8	P-8	10/23/03	28.16	12.17	15.99
Shallow Piezometer P-8	P-8	12/23/03	28.16	11.49	16.67
Shallow Piezometer P-8	P-8	03/11/04	28.16	10.4	17.76

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Shallow Piezometer P-8	P-8	03/22/04	28.16	10.46	17.70
Shallow Piezometer P-8	P-8	03/23/04	28.16	10.51	17.65
Shallow Piezometer P-8	P-8	03/24/04	28.16	10.53	17.63
Shallow Piezometer P-8	P-8	03/25/04	28.16	10.52	17.64
Shallow Piezometer P-8	P-8	03/26/04	28.16	10.51	17.65
Shallow Piezometer P-8	P-8	03/28/04	28.16	10.41	17.75
Shallow Piezometer P-8	P-8	03/30/04	28.16	10.38	17.78
Shallow Piezometer P-8	P-8	04/01/04	28.16	10.38	17.78
Shallow Piezometer P-8	P-8	04/02/04	28.16	10.35	17.81
Shallow Piezometer P-8	P-8	04/05/04	28.16	10.36	17.80
Shallow Piezometer P-8	P-8	04/08/04	28.16	10.35	17.81
Shallow Piezometer P-8	P-8	05/06/04	28.16	10.95	17.21
Shallow Piezometer P-8	P-8	06/11/04	28.16	11.43	16.73
Shallow Piezometer P-9	P-9	04/21/03	33.89	17.67	16.22
Shallow Piezometer P-9	P-9	06/11/03	33.89	19.08	14.81
Shallow Piezometer P-9	P-9	07/08/03	33.89	19.85	14.04
Shallow Piezometer P-9	P-9	07/21/03	33.89	20.37	13.52
Shallow Piezometer P-9	P-9	10/23/03	33.89	20.69	13.20
Shallow Piezometer P-9	P-9	12/23/03	33.89	18.1	15.79
Shallow Piezometer P-9	P-9	03/11/04	33.89	16.01	17.88
Shallow Piezometer P-9	P-9	03/22/04	33.89	16.82	17.07
Shallow Piezometer P-9	P-9	03/23/04	33.89	16.89	17.00
Shallow Piezometer P-9	P-9	03/24/04	33.89	16.99	16.90
Shallow Piezometer P-9	P-9	03/25/04	33.89	17.02	16.87
Shallow Piezometer P-9	P-9	03/26/04	33.89	17.05	16.84
Shallow Piezometer P-9	P-9	03/28/04	33.89	17.08	16.81
Shallow Piezometer P-9	P-9	03/30/04	33.89	17.03	16.86
Shallow Piezometer P-9	P-9	04/01/04	33.89	17.2	16.69
Shallow Piezometer P-9	P-9	04/02/04	33.89	17.19	16.70
Shallow Piezometer P-9	P-9	04/05/04	33.89	16.98	16.91
Shallow Piezometer P-9	P-9	04/08/04	33.89	16.95	16.94
Shallow Piezometer P-9	P-9	05/06/04	33.89	18.95	14.94
Shallow Piezometer P-9	P-9	06/11/04	33.89	20.19	13.70
Shallow Piezometer P-10	P-10	04/21/03	30.19	11.46	18.73
Shallow Piezometer P-10	P-10	10/23/03	30.19	12.1	18.09
Shallow Piezometer P-10	P-10	12/23/03	30.19	12.15	18.04
Shallow Piezometer P-10	P-10	03/11/04	30.19	11.73	18.46
Shallow Piezometer P-10	P-10	03/22/04	30.19	11.79	18.40
Shallow Piezometer P-10	P-10	03/23/04	30.19	11.8	18.39
Shallow Piezometer P-10	P-10	03/24/04	30.19	11.79	18.40
Shallow Piezometer P-10	P-10	03/26/04	30.19	11.8	18.39
Shallow Piezometer P-10	P-10	03/28/04	30.19	11.75	18.44

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Shallow Piezometer P-10	P-10	03/30/04	30.19	11.78	18.41
Shallow Piezometer P-10	P-10	04/01/04	30.19	11.76	18.43
Shallow Piezometer P-10	P-10	04/02/04	30.19	11.75	18.44
Shallow Piezometer P-10	P-10	04/05/04	30.19	11.72	18.47
Shallow Piezometer P-10	P-10	05/06/04	30.19	11.77	18.42
Shallow Piezometer P-10	P-10	06/11/04	30.19	11.8	18.39
Shallow Piezometer P-11A	P-11A	06/11/03	22.13	4.64	17.49
Shallow Piezometer P-11A	P-11A	07/08/03	22.13	4.66	17.47
Shallow Piezometer P-11A	P-11A	07/16/03	22.13	4.74	17.39
Shallow Piezometer P-11A	P-11A	07/22/03	22.13	4.73	17.40
Shallow Piezometer P-11A	P-11A	07/23/03	22.13	4.74	17.39
Shallow Piezometer P-11A	P-11A	07/23/03	22.13	4.77	17.36
Shallow Piezometer P-11A	P-11A	07/27/03	22.13	4.82	17.31
Shallow Piezometer P-11A	P-11A	09/28/03	22.13	4.8	17.33
Shallow Piezometer P-11A	P-11A	09/30/03	22.13	4.83	17.30
Shallow Piezometer P-11A	P-11A	10/20/03	22.13	5.05	17.08
Shallow Piezometer P-11A	P-11A	11/14/03	22.13	4.49	17.64
Shallow Piezometer P-11A	P-11A	12/05/03	22.13	4.56	17.57
Shallow Piezometer P-11A	P-11A	12/23/03	22.13	4.49	17.64
Shallow Piezometer P-11A	P-11A	03/12/04	22.13	4.27	17.86
Shallow Piezometer P-11A	P-11A	03/22/04	22.13	4.37	17.76
Shallow Piezometer P-11A	P-11A	03/22/04	22.13	4.41	17.72
Shallow Piezometer P-11A	P-11A	03/23/04	22.13	4.43	17.70
Shallow Piezometer P-11A	P-11A	03/24/04	22.13	4.43	17.70
Shallow Piezometer P-11A	P-11A	03/24/04	22.13	4.4	17.73
Shallow Piezometer P-11A	P-11A	03/25/04	22.13	4.4	17.73
Shallow Piezometer P-11A	P-11A	03/25/04	22.13	4.4	17.73
Shallow Piezometer P-11A	P-11A	03/26/04	22.13	4.39	17.74
Shallow Piezometer P-11A	P-11A	03/27/04	22.13	4.39	17.74
Shallow Piezometer P-11A	P-11A	03/28/04	22.13	4.4	17.73
Shallow Piezometer P-11A	P-11A	03/29/04	22.13	4.42	17.71
Shallow Piezometer P-11A	P-11A	03/30/04	22.13	4.44	17.69
Shallow Piezometer P-11A	P-11A	03/31/04	22.13	4.45	17.68
Shallow Piezometer P-11A	P-11A	04/01/04	22.13	4.46	17.67
Shallow Piezometer P-11A	P-11A	04/09/04	22.13	4.46	17.67
Shallow Piezometer P-11A	P-11A	05/06/04	22.13	4.76	17.37
Shallow Piezometer P-11A	P-11A	06/11/04	22.13	4.9	17.23
Intermediate Piezometer P-11B	P-11B	03/12/03	22.10	5.37	16.73
Intermediate Piezometer P-11B	P-11B	06/11/03	22.10	8.47	13.63
Intermediate Piezometer P-11B	P-11B	07/08/03	22.10	8.47	13.63
Intermediate Piezometer P-11B	P-11B	07/16/03	22.10	8.92	13.18
Intermediate Piezometer P-11B	P-11B	07/22/03	22.10	9.41	12.69

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Intermediate Piezometer P-11B	P-11B	07/22/03	22.10	9.73	12.37
Intermediate Piezometer P-11B	P-11B	07/23/03	22.10	9.88	12.22
Intermediate Piezometer P-11B	P-11B	07/23/03	22.10	10.02	12.08
Intermediate Piezometer P-11B	P-11B	07/27/03	22.10	9.96	12.14
Intermediate Piezometer P-11B	P-11B	09/28/03	22.10	9.83	12.27
Intermediate Piezometer P-11B	P-11B	09/30/03	22.10	9.84	12.26
Intermediate Piezometer P-11B	P-11B	10/20/03	22.10	8.65	13.45
Intermediate Piezometer P-11B	P-11B	11/14/03	22.10	10.27	11.83
Intermediate Piezometer P-11B	P-11B	12/05/03	22.10	7.78	14.32
Intermediate Piezometer P-11B	P-11B	12/23/03	22.36	6.68	15.68
Intermediate Piezometer P-11B	P-11B	03/12/04	22.10	5.37	16.73
Intermediate Piezometer P-11B	P-11B	03/22/04	22.10	5.66	16.44
Intermediate Piezometer P-11B	P-11B	03/22/04	22.10	5.73	16.37
Intermediate Piezometer P-11B	P-11B	03/23/04	22.10	5.81	16.29
Intermediate Piezometer P-11B	P-11B	03/24/04	22.10	5.96	16.14
Intermediate Piezometer P-11B	P-11B	03/24/04	22.10	5.95	16.15
Intermediate Piezometer P-11B	P-11B	03/25/04	22.10	5.75	16.35
Intermediate Piezometer P-11B	P-11B	03/25/04	22.10	5.73	16.37
Intermediate Piezometer P-11B	P-11B	03/26/04	22.10	5.07	17.03
Intermediate Piezometer P-11B	P-11B	03/27/04	22.10	4.62	17.48
Intermediate Piezometer P-11B	P-11B	03/28/04	22.10	4.22	17.88
Intermediate Piezometer P-11B	P-11B	03/29/04	22.10	4.02	18.08
Intermediate Piezometer P-11B	P-11B	03/30/04	22.10	3.75	18.35
Intermediate Piezometer P-11B	P-11B	03/31/04	22.10	3.55	18.55
Intermediate Piezometer P-11B	P-11B	04/01/04	22.10	3.44	18.66
Intermediate Piezometer P-11B	P-11B	04/09/04	22.10	5.9	16.20
Intermediate Piezometer P-11B	P-11B	05/06/04	22.10	9.08	13.02
Intermediate Piezometer P-11B	P-11B	06/11/04	22.10	10.91	11.19
Deep Piezometer P-11D	P-11D	06/11/03	22.13	14.3	7.83
Deep Piezometer P-11D	P-11D	07/08/03	22.13	13.53	8.60
Deep Piezometer P-11D	P-11D	07/16/03	22.13	15.51	6.62
Deep Piezometer P-11D	P-11D	07/22/03	22.13	22.61	-0.48
Deep Piezometer P-11D	P-11D	07/22/03	22.13	18.96	3.17
Deep Piezometer P-11D	P-11D	07/23/03	22.13	18.81	3.32
Deep Piezometer P-11D	P-11D	07/23/03	22.13	20.98	1.15
Deep Piezometer P-11D	P-11D	07/23/03	22.13	18.96	3.17
Deep Piezometer P-11D	P-11D	07/27/03	22.13	17.11	5.02
Deep Piezometer P-11D	P-11D	09/28/03	22.13	16.42	5.71
Deep Piezometer P-11D	P-11D	09/30/03	22.13	16.18	5.95
Deep Piezometer P-11D	P-11D	09/30/03	22.13	16.16	5.97
Deep Piezometer P-11D	P-11D	10/20/03	22.13	13.58	8.55
Deep Piezometer P-11D	P-11D	11/14/03	22.44	21.14	1.30
Deep Piezometer P-11D	P-11D	12/05/03	22.44	10.18	12.26

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Deep Piezometer P-11D	P-11D	03/02/04	22.13	4.43	17.70
Deep Piezometer P-11D	P-11D	03/12/04	22.13	6.06	16.07
Deep Piezometer P-11D	P-11D	03/18/04	22.13	6.1	16.03
Deep Piezometer P-11D	P-11D	03/22/04	22.13	6.86	15.27
Deep Piezometer P-11D	P-11D	03/22/04	22.13	6.44	15.69
Deep Piezometer P-11D	P-11D	03/23/04	22.13	6.73	15.40
Deep Piezometer P-11D	P-11D	03/24/04	22.13	7.41	14.72
Deep Piezometer P-11D	P-11D	03/24/04	22.13	7.49	14.64
Deep Piezometer P-11D	P-11D	03/24/04	22.13	4.68	17.45
Deep Piezometer P-11D	P-11D	03/24/04	22.13	4.25	17.88
Deep Piezometer P-11D	P-11D	03/25/04	22.13	1.07	21.06
Deep Piezometer P-11D	P-11D	03/25/04	22.13	0.73	21.40
Deep Piezometer P-11D	P-11D	03/26/04	22.13	-1.02	23.15
Deep Piezometer P-11D	P-11D	03/27/04	22.13	-2.24	24.37
Deep Piezometer P-11D	P-11D	03/28/04	22.13	-3.3	25.43
Deep Piezometer P-11D	P-11D	03/29/04	22.13	-4.1	26.23
Deep Piezometer P-11D	P-11D	03/30/04	22.13	-4.61	26.74
Deep Piezometer P-11D	P-11D	03/31/04	22.13	-4.84	26.97
Deep Piezometer P-11D	P-11D	04/01/04	22.13	-4.64	26.77
Deep Piezometer P-11D	P-11D	04/01/04	22.13	-4.64	26.77
Deep Piezometer P-11D	P-11D	04/09/04	22.13	7.95	14.18
Deep Piezometer P-11D	P-11D	05/06/04	22.13	15.87	6.26
Deep Piezometer P-11D	P-11D	06/11/04	22.13	19.1	3.03
Morgan Run Test Well	Test Well	07/22/03	25.93	21.32	4.61
Morgan Run Test Well	Test Well	07/23/03	25.93	20.95	4.98
Morgan Run Test Well	Test Well	07/23/03	25.93	21.32	4.61
Morgan Run Test Well	Test Well	07/23/03	25.93	20.97	4.96
Morgan Run Test Well	Test Well	07/23/03	25.93	38.29	-12.36
Morgan Run Test Well	Test Well	09/30/03	25.42	19.34	6.08
Rancho El Camino	7LA	12/15/97	50	NM	NM
Rancho El Camino	7LA	11/11/98	50.00	15.67	34.33
Rancho El Camino	7LA	04/15/99	50.00	15.24	34.76
Rancho El Camino	7LA	10/14/99	50.00	17.55	32.45
Rancho El Camino	7LA	06/05/01	50.00	15.85	34.15
Rancho El Camino	7LA	12/20/01	50.00	16.18	33.82
Rancho El Camino	7LA	06/06/02	50.00	17.10	32.90
Rancho El Camino	7LA	03/14/03	50.00	15.28	34.72
Rancho El Camino	7LA	10/23/03	50.00	15.91	34.09
Rancho El Camino	7LA	03/17/04	50.00	15.65	34.35
Rancho Paseana, South (east)	33PA	11/10/98	36.00	32.21	3.79
Rancho Paseana, South (east)	33PA	04/15/99	36.00	19.65	16.35

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Rancho Paseana, South (east)	33PA	10/14/99	36.00	42.48	-6.48
Rancho Paseana, South (east)	33PA	06/05/01	36.00	31.95	4.05
Rancho Paseana, South (east)	33PA	12/20/01	36.00	20.98	15.02
Rancho Paseana, South (east)	33PA	06/06/02	36.00	39.64	-3.64
Rancho Paseana, South (east)	33PA	03/13/03	36.00	21.88	14.12
Rancho Paseana, South (east)	33PA	10/22/03	36.00	35.49	0.51
Rancho Paseana, South (east)	33PA	03/12/04	36.00	23.43	12.57
Rancho Paseana, South (west)	33N2	11/10/98	35.81	32.00	3.81
Rancho Paseana, South (west)	33N2	04/15/99	35.81	19.45	16.36
Rancho Paseana, South (west)	33N2	10/14/99	35.81	42.2	-6.39
Rancho Paseana, South (west)	33N2	06/05/01	35.81	31.72	4.09
Rancho Paseana, South (west)	33N2	12/20/01	35.81	20.80	15.01
Rancho Paseana, South (west)	33N2	02/15/02	35.81	26.67	9.14
Rancho Paseana, South (west)	33N2	02/15/02	35.81	26.41	9.40
Rancho Paseana, South (west)	33N2	02/19/02	35.81	22.65	13.16
Rancho Paseana, South (west)	33N2	02/22/02	35.81	38.80	-2.99
Rancho Paseana, South (west)	33N2	02/27/02	35.81	22.80	13.01
Rancho Paseana, South (west)	33N2	03/21/02	35.81	20.57	15.24
Rancho Paseana, South (west)	33N2	04/18/02	35.81	28.30	7.51
Rancho Paseana, South (west)	33N2	06/06/02	35.81	39.45	-3.64
Rancho Paseana, South (west)	33N2	10/04/02	35.81	37.75	-1.94
Rancho Paseana, South (west)	33N2	03/13/03	35.81	21.62	14.19
Rancho Paseana, South (west)	33N2	10/22/03	35.81	35.27	0.54
Rancho Paseana, South (west)	33N2	03/12/04	35.81	23.08	12.73
Rancho Paseana, South (west)	33N2	03/24/04	35.81	24.50	11.31
Rancho Paseana, South (west)	33N2	03/25/04	35.81	22.78	13.03
Rancho Paseana, South (west)	33N2	03/26/04	35.81	20.70	15.11
Rancho Paseana, South (west)	33N2	03/27/04	35.81	19.03	16.78
Rancho Paseana, South (west)	33N2	03/28/04	35.81	17.81	18.00
Rancho Paseana, South (west)	33N2	03/29/04	35.81	17.16	18.65
Rancho Paseana, South (west)	33N2	03/30/04	35.81	16.60	19.21
Rancho Paseana, South (west)	33N2	03/31/04	35.81	16.19	19.62
Rancho Paseana, South (west)	33N2	04/01/04	35.81	18.40	17.41
Rancho Paseana, South (west)	33N2	04/09/04	35.81	24.10	11.71
Rancho Paseana, South (west)	33N2	05/24/04	35.81	45.82	-10.01
Rancho Paseana, South (west)	33N2	05/24/04	35.81	46.00	-10.19
RSF Polo Club No. 2 Replacement (2R)	5FC	06/05/01	24.27	65.00	-40.73
RSF Polo Club No. 2 Replacement (2R)	5FC	12/20/01	24.27	9.65	14.62
RSF Polo Club No. 2 Replacement (2R)	5FC	06/06/02	24.30	56.98	-32.68
RSF Polo Club No. 2 Replacement (2R)	5FC	03/13/03	24.30	8.81	15.49
RSF Polo Club No. 2 Replacement (2R)	5FC	03/11/04	24.30	7.81	16.49

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
RSF Polo Club No 1	5FA	06/06/02	24.32	6.72	17.60
RSF Polo Club No 2	5FB	12/15/97	22.79	13.22	9.57
RSF Polo Club No 2	5FB	05/14/98	22.79	12.07	10.72
RSF Polo Club No 2	5FB	11/10/98	22.79	14.32	8.47
RSF Polo Club No 2	5FB	04/15/99	22.79	7.66	15.13
RSF Polo Club No 2	5FB	10/14/99	22.79	72.20	-49.41
RSF Polo Club No 2	5FB	06/05/01	24.04	43.85	-19.81
RSF Polo Club No 2	5FB	07/10/01	22.73	45.22	-22.49
RSF Polo Club No 2	5FB	10/30/01	22.73	37.23	-14.50
RSF Polo Club No 2	5FB	12/20/01	22.73	8.28	14.45
RSF Polo Club No 2	5FB	03/21/02	22.73	36.90	-14.17
RSF Polo Club No 2	5FB	04/18/02	22.73	35.13	-12.40
RSF Polo Club No 2	5FB	06/06/02	22.73	39.58	-16.85
RSF Polo Club No 2	5FB	10/04/02	22.73	37.49	-14.76
RSF Polo Club No 2	5FB	03/13/03	22.73	7.25	15.48
RSF Polo Club No 2	5FB	09/29/03	22.73	13.90	8.83
RSF Polo Club No 2	5FB	09/29/03	22.73	13.92	8.81
RSF Polo Club No 2	5FB	10/03/03	22.73	35.98	-13.25
RSF Polo Club No 2	5FB	10/04/03	22.73	37.49	-14.76
RSF Polo Club No 2	5FB	10/10/03	22.73	12.58	10.15
RSF Polo Club No 2	5FB	10/22/03	22.73	11.57	11.16
RSF Polo Club No 2	5FB	03/11/04	22.73	6.42	16.31
RSF Polo Club No 2	5FB	03/12/04	22.73	6.64	16.09
RSF Polo Club No 2	5FB	03/23/04	22.73	7.25	15.48
RSF Polo Club No 2	5FB	03/24/04	22.73	7.43	15.30
RSF Polo Club No 2	5FB	03/24/04	22.73	7.43	15.30
RSF Polo Club No 2	5FB	03/25/04	22.73	7.06	15.67
RSF Polo Club No 2	5FB	03/26/04	22.73	6.18	16.55
RSF Polo Club No 2	5FB	03/27/04	22.73	5.53	17.20
RSF Polo Club No 2	5FB	03/28/04	22.73	4.85	17.88
RSF Polo Club No 2	5FB	03/29/04	22.73	4.52	18.21
RSF Polo Club No 2	5FB	03/30/04	22.73	4.04	18.69
RSF Polo Club No 2	5FB	03/31/04	22.73	3.75	18.98
RSF Polo Club No 2	5FB	04/01/04	22.73	25.07	-2.34
RSF Polo Club No 2	5FB	04/01/04	22.73	25.07	-2.34
RSF Polo Club No 2	5FB	04/09/04	22.73	33.42	-10.69
RSF Polo Club 5F1	5F1	12/15/97	25.25	9.3	15.95
RSF Polo Club 5F1	5F1	05/14/98	25.25	8.78	16.47
RSF Polo Club 5F1	5F1	11/10/98	25.25	9.45	15.80
RSF Polo Club 5F1	5F1	04/15/99	25.25	7.50	17.75
RSF Polo Club 5F1	5F1	10/14/99	25.25	34.44	-9.19
RSF Polo Club 5F1	5F1	06/05/01	25.25	31.87	-6.62

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
RSF Polo Club 5F1	5F1	12/20/01	25.25	7.78	17.47
RSF Polo Club 5F1	5F1	06/06/02	25.25	7.64	17.61
RSF Polo Club 5F1	5F1	03/13/03	25.25	6.90	18.35
RSF Polo Club 5F1	5F1	10/22/03	25.25	8.61	16.64
RSF Polo Club 5F1	5F1	03/11/04	25.25	7.04	18.21
RSF Polo Shallow Piezometer P-1	RSF P-1	04/08/02	31.52	8.46	23.06
RSF Polo Shallow Piezometer P-1	RSF P-1	04/18/02	31.52	8.55	22.97
RSF Polo Shallow Piezometer P-1	RSF P-1	06/06/02	31.52	8.62	22.90
RSF Polo Shallow Piezometer P-1	RSF P-1	10/04/02	31.52	9.79	21.73
RSF Polo Shallow Piezometer P-1	RSF P-1	03/13/03	31.52	7.99	23.53
RSF Polo Shallow Piezometer P-1	RSF P-1	04/18/03	31.52	8.55	22.97
RSF Polo Shallow Piezometer P-1	RSF P-1	09/28/03	31.52	9.98	21.54
RSF Polo Shallow Piezometer P-1	RSF P-1	10/03/03	31.52	10.00	21.52
RSF Polo Shallow Piezometer P-1	RSF P-1	10/08/03	31.52	10.19	21.33
RSF Polo Shallow Piezometer P-1	RSF P-1	10/10/03	31.52	10.05	21.47
RSF Polo Shallow Piezometer P-1	RSF P-1	10/15/03	31.52	9.84	21.68
RSF Polo Shallow Piezometer P-1	RSF P-1	10/22/03	31.52	9.60	21.92
RSF Polo Shallow Piezometer P-1	RSF P-1	03/11/04	31.52	8.28	23.24
RSF Polo Shallow Piezometer P-1	RSF P-1	03/23/04	31.52	8.35	23.17
RSF Polo Shallow Piezometer P-1	RSF P-1	03/24/04	31.52	8.36	23.16
RSF Polo Shallow Piezometer P-1	RSF P-1	03/25/04	31.52	8.40	23.12
RSF Polo Shallow Piezometer P-1	RSF P-1	03/26/04	31.52	8.40	23.12
RSF Polo Shallow Piezometer P-1	RSF P-1	03/28/04	31.52	8.39	23.13
RSF Polo Shallow Piezometer P-1	RSF P-1	03/30/04	31.52	8.40	23.12
RSF Polo Shallow Piezometer P-1	RSF P-1	03/31/04	31.52	8.41	23.11
RSF Polo Shallow Piezometer P-1	RSF P-1	04/01/04	31.52	8.40	23.12
RSF Polo Shallow Piezometer P-1	RSF P-1	04/05/04	31.52	8.40	23.12
RSF Polo Shallow Piezometer P-1	RSF P-1	04/08/04	31.52	8.44	23.08
RSF Polo Shallow Piezometer P-1	RSF P-1	05/06/04	31.52	8.74	22.78
RSF Polo Shallow Piezometer P-1	RSF P-1	06/11/04	31.52	9.68	21.84
RSF Polo Test Well	5GA	11/11/98	NA	17.85	NM
RSF Polo Test Well	5GA	04/15/99	26.98	11.31	15.67
RSF Polo Test Well	5GA	10/14/99	26.98	23.33	3.65
RSF Polo Test Well	5GA	06/05/01	26.98	18.66	8.32
RSF Polo Test Well	5GA	12/20/01	26.98	12.41	14.57
RSF Polo Test Well	5GA	06/06/02	26.98	21.11	5.87
Schoenfelder No 1 (north)	33FA	12/15/97	36.42	30.48	5.94
Schoenfelder No 1 (north)	33FA	04/22/98	36.42	18.32	18.10
Schoenfelder No 1 (north)	33FA	11/10/98	36.42	26.75	9.67
Schoenfelder No 1 (north)	33FA	04/15/99	36.42	19.15	17.27
Schoenfelder No 1 (north)	33FA	10/14/99	36.42	46.1	-9.68

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Schoenfelder No 1 (north)	33FA	06/05/01	36.42	33.13	3.29
Schoenfelder No 1 (north)	33FA	12/20/01	36.42	20.28	16.14
Schoenfelder No 1 (north)	33FA	06/06/02	36.42	42.28	-5.86
Schoenfelder No 1 (north)	33FA	03/13/03	36.42	20.66	15.76
Schoenfelder No 1 (north)	33FA	03/12/04	36.42	25.95	10.47
Via De Santa Fe Bridge		05/14/98	49.09	25.00	24.09
Via De Santa Fe Bridge		11/11/98	49.09	29.60	19.49
Via De Santa Fe Bridge		04/15/99	49.09	26.72	22.37
Via De Santa Fe Bridge		10/14/99	49.09	30.28	18.81
Via De Santa Fe Bridge		06/05/01	49.09	26.90	22.19
Via De Santa Fe Bridge		06/06/02	49.09	27.10	21.99
Via De Santa Fe Bridge		03/14/03	49.09	26.71	22.38
Via De Santa Fe Bridge		10/23/03	49.09	27.00	22.09
Via De Santa Fe Bridge		03/11/04	49.09	26.56	22.53
El Camino Real Bridge		05/15/98	27.96	18.55	9.41
El Camino Real Bridge		06/06/02	27.96	22.27	5.69
El Camino Real Bridge		03/14/03	27.96	21.80	6.16
El Camino Real Bridge		10/23/03	27.96	21.97	5.99
El Camino Real Bridge		03/11/04	27.96	21.57	6.39
Morgan Run North Bridge		04/01/04	29.23	11.32	17.91
Morgan Run North Bridge		04/09/04	29.23	11.26	17.97
Morgan Run North Bridge		05/07/04	29.23	11.8	17.43
Morgan Run South Bridge		05/14/98	26.39	8.73	17.66
Morgan Run South Bridge		11/11/98	26.39	11.61	14.78
Morgan Run South Bridge		10/14/99	26.39	11.7	14.69
Morgan Run South Bridge		06/05/01	26.39	11.6	14.79
Morgan Run South Bridge		05/21/02	26.39	11.75	14.64
Morgan Run South Bridge		06/06/02	26.39	11.65	14.74
Morgan Run South Bridge		03/13/03	26.39	10.86	15.53
Morgan Run South Bridge		10/23/03	26.39	11.71	14.68
Morgan Run South Bridge		12/31/03	26.39	11	15.39
Morgan Run South Bridge		03/12/04	26.39	10.72	15.67
Morgan Run South Bridge		03/22/04	26.39	10.83	15.56
Morgan Run South Bridge		03/23/04	26.39	10.87	15.52
Morgan Run South Bridge		03/24/04	26.39	10.93	15.46
Morgan Run South Bridge		03/25/04	26.39	10.93	15.46
Morgan Run South Bridge		03/26/04	26.39	10.94	15.45
Morgan Run South Bridge		03/28/04	26.39	11	15.39
Morgan Run South Bridge		03/30/04	26.39	11.02	15.37
Morgan Run South Bridge		04/01/04	26.39	11.1	15.29

TABLE A-1
MANUAL WATER LEVEL DATA

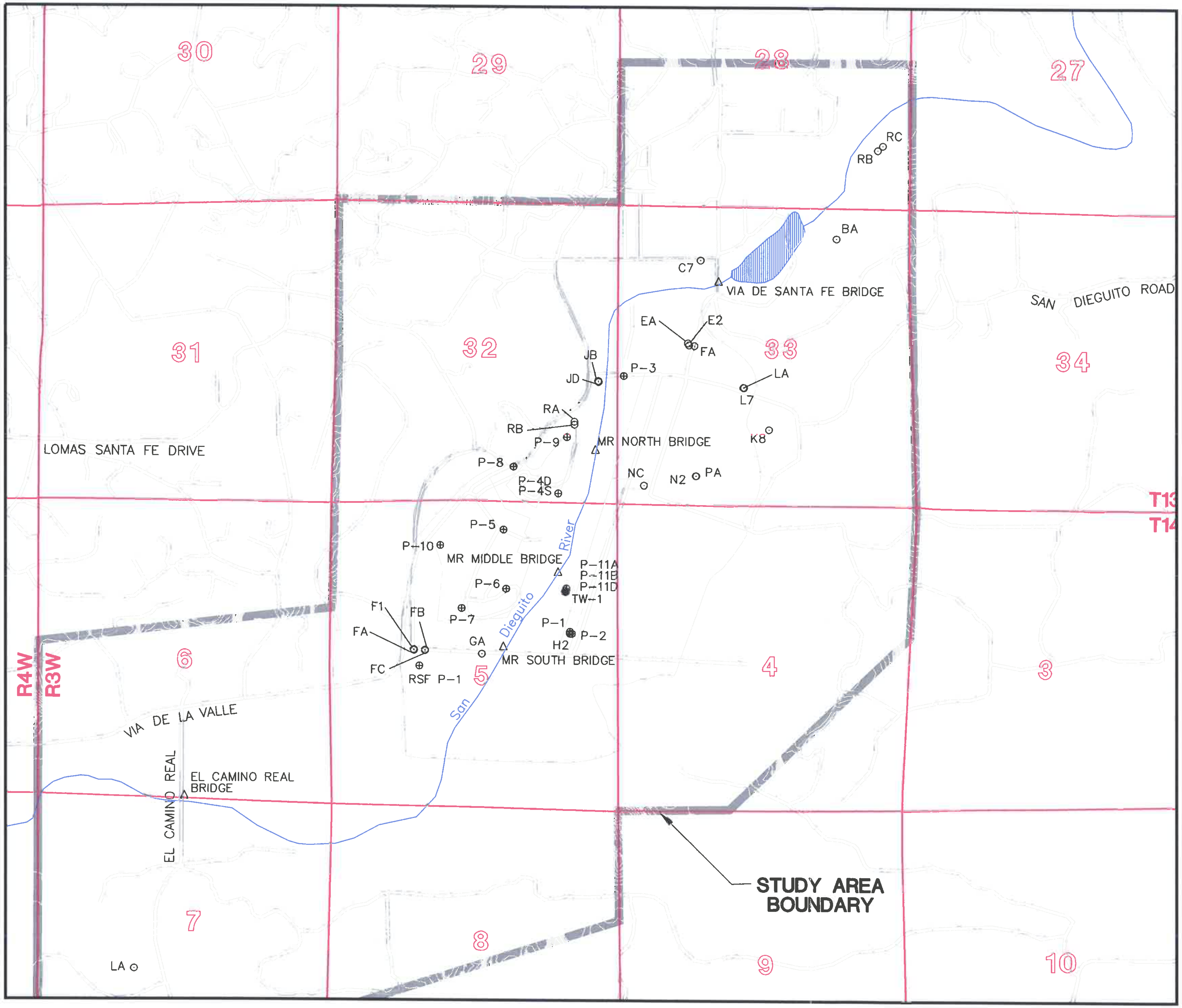
Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Morgan Run South Bridge		04/09/04	26.39	11.01	15.38
Morgan Run South Bridge		05/07/04	26.39	11.62	14.77
Morgan Run South Bridge		06/11/04	26.39	11.72	14.67
Morgan Run Middle Bridge		09/28/03	26.86	11.62	15.24
Morgan Run Middle Bridge		09/30/03	26.86	11.59	15.27
Morgan Run Middle Bridge		10/01/03	26.86	11.61	15.25
Morgan Run Middle Bridge		10/02/03	26.86	11.62	15.24
Morgan Run Middle Bridge		10/03/03	26.86	11.6	15.26
Morgan Run Middle Bridge		10/04/03	26.86	11.6	15.26
Morgan Run Middle Bridge		10/05/03	26.86	11.6	15.26
Morgan Run Middle Bridge		10/06/03	26.86	11.6	15.26
Morgan Run Middle Bridge		10/07/03	26.86	11.6	15.26
Morgan Run Middle Bridge		10/08/03	26.86	11.61	15.25
Morgan Run Middle Bridge		10/09/03	26.86	11.58	15.28
Morgan Run Middle Bridge		10/10/03	26.86	11.58	15.28
Morgan Run Middle Bridge		10/15/03	26.86	11.64	15.22
Morgan Run Middle Bridge		10/20/03	26.86	11.63	15.23
Morgan Run Middle Bridge		10/23/03	26.86	11.59	15.27
Morgan Run Middle Bridge		11/04/03	26.86	11.47	15.39
Morgan Run Middle Bridge		11/04/03	26.86	11.44	15.42
Morgan Run Middle Bridge		11/05/03	26.86	11.54	15.32
Morgan Run Middle Bridge		11/06/03	26.86	11.52	15.34
Morgan Run Middle Bridge		11/07/03	26.86	11.53	15.33
Morgan Run Middle Bridge		11/08/03	26.86	11.36	15.50
Morgan Run Middle Bridge		11/09/03	26.86	11.39	15.47
Morgan Run Middle Bridge		11/10/03	26.86	11.35	15.51
Morgan Run Middle Bridge		11/11/03	26.86	10.74	16.12
Morgan Run Middle Bridge		11/12/03	26.86	10.81	16.05
Morgan Run Middle Bridge		11/13/03	26.86	10.82	16.04
Morgan Run Middle Bridge		11/14/03	26.86	10.46	16.40
Morgan Run Middle Bridge		12/05/03	26.86	11.1	15.76
Morgan Run Middle Bridge		12/23/03	26.86	10.94	15.92
Morgan Run Middle Bridge		12/26/03	26.86	10.84	16.02
Morgan Run Middle Bridge		03/12/04	26.86	10.62	16.24
Morgan Run Middle Bridge		03/22/04	26.86	10.83	16.03
Morgan Run Middle Bridge		03/23/04	26.86	10.87	15.99
Morgan Run Middle Bridge		03/24/04	26.86	10.93	15.93
Morgan Run Middle Bridge		03/25/04	26.86	10.93	15.93
Morgan Run Middle Bridge		03/26/04	26.86	10.94	15.92
Morgan Run Middle Bridge		03/28/04	26.86	11	15.86
Morgan Run Middle Bridge		03/30/04	26.86	11.02	15.84
Morgan Run Middle Bridge		04/01/04	26.86	11.1	15.76
Morgan Run Middle Bridge		04/09/04	26.86	11.01	15.85

TABLE A-1
MANUAL WATER LEVEL DATA

Well Identifier	Project Well Number	Date	Reference Point Elevation (feet msl)	Depth to Water (feet)	Water Level Elevation (feet msl)
Morgan Run Middle Bridge		05/06/04	26.86	11.68	15.18
Morgan Run Middle Bridge		06/11/04	26.86	11.62	15.24
Morgan Run Middle Bridge		11/04/04	26.86	11.44	15.42
Morgan Run Middle Bridge		11/06/04	26.86	11.52	15.34

* Approximate
NM = Not Measured
msl = Mean Sea Level

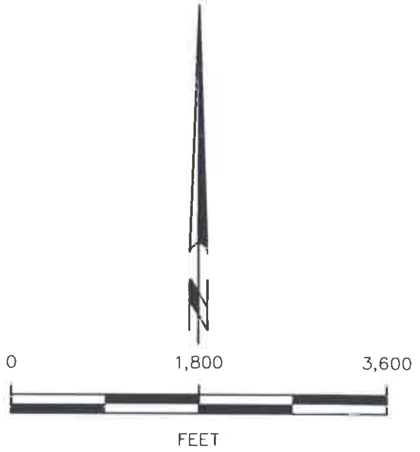
Note: Project well numbers ending in numbers are an abbreviation of the State well number. Well numbers ending in letters have not been assigned a State well number, but were designated by Hargis + Associates, Inc. based on a similar identifier scheme.



EXPLANATION

P-1 ⊕	PIEZOMETER
TW-1 ●	TEST WELL
GA ○	ACTIVE OR INACTIVE PRODUCTION WELL
△	SAN DIEGUITO RIVER LEVEL MONITORING LOCATION

NOTE: WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.



SAN DIEGUITO GROUNDWATER BASIN

WATER LEVEL MONITORING LOCATIONS

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering
08/04

FIGURE A-1

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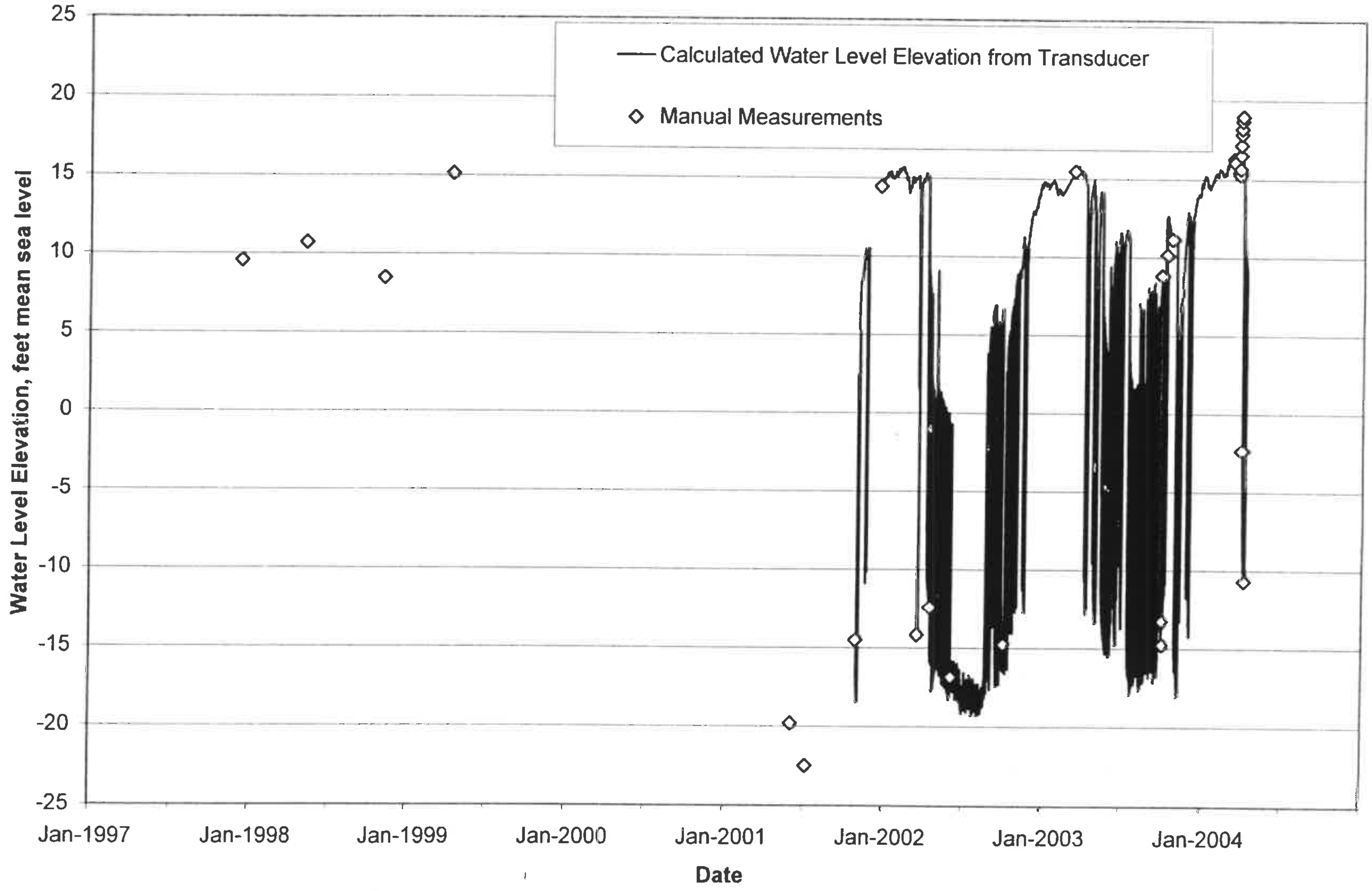


FIGURE A-2. WATER LEVEL HYDROGRAPH,
WELL 5-FB (RSF POLO CLUB NO. 2)

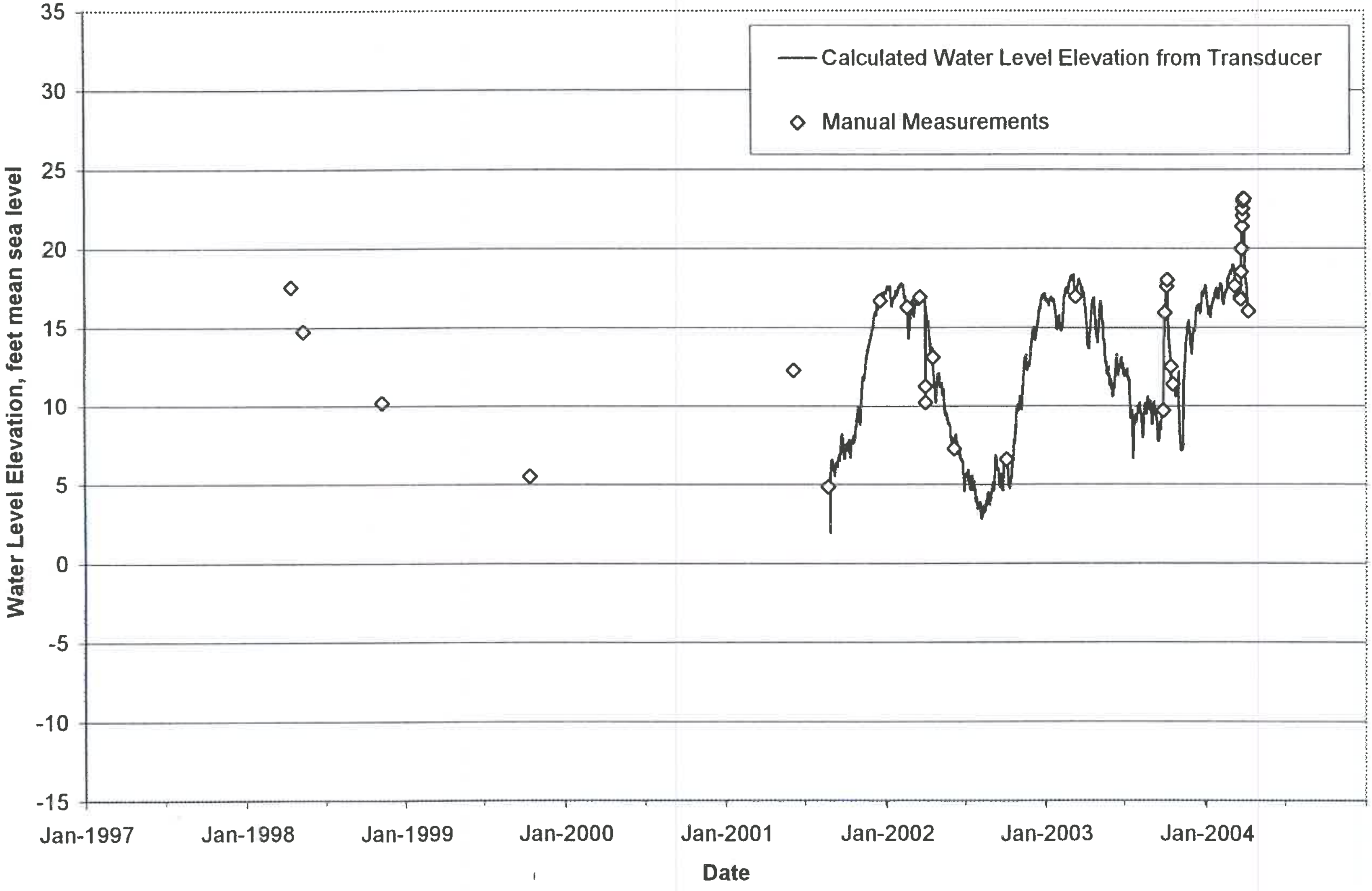


FIGURE A-3. WATER LEVEL HYDROGRAPH, WELL 5-H2 (MORGAN RUN FAIRWAY 2)

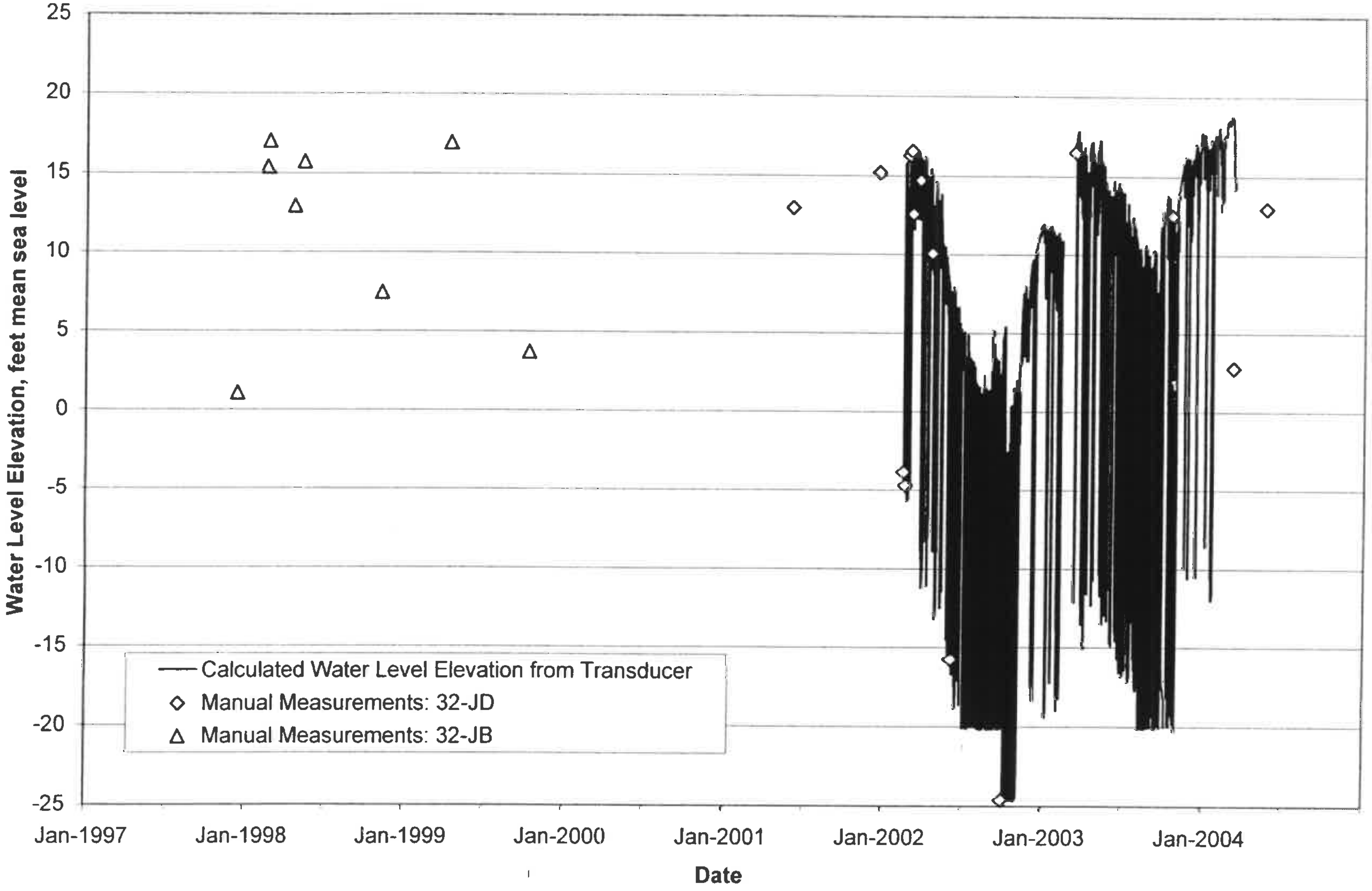


FIGURE A-4. WATER LEVEL HYDROGRAPH,
WELLS 32-JB/32-JD (MORGAN RUN "THE GUN")

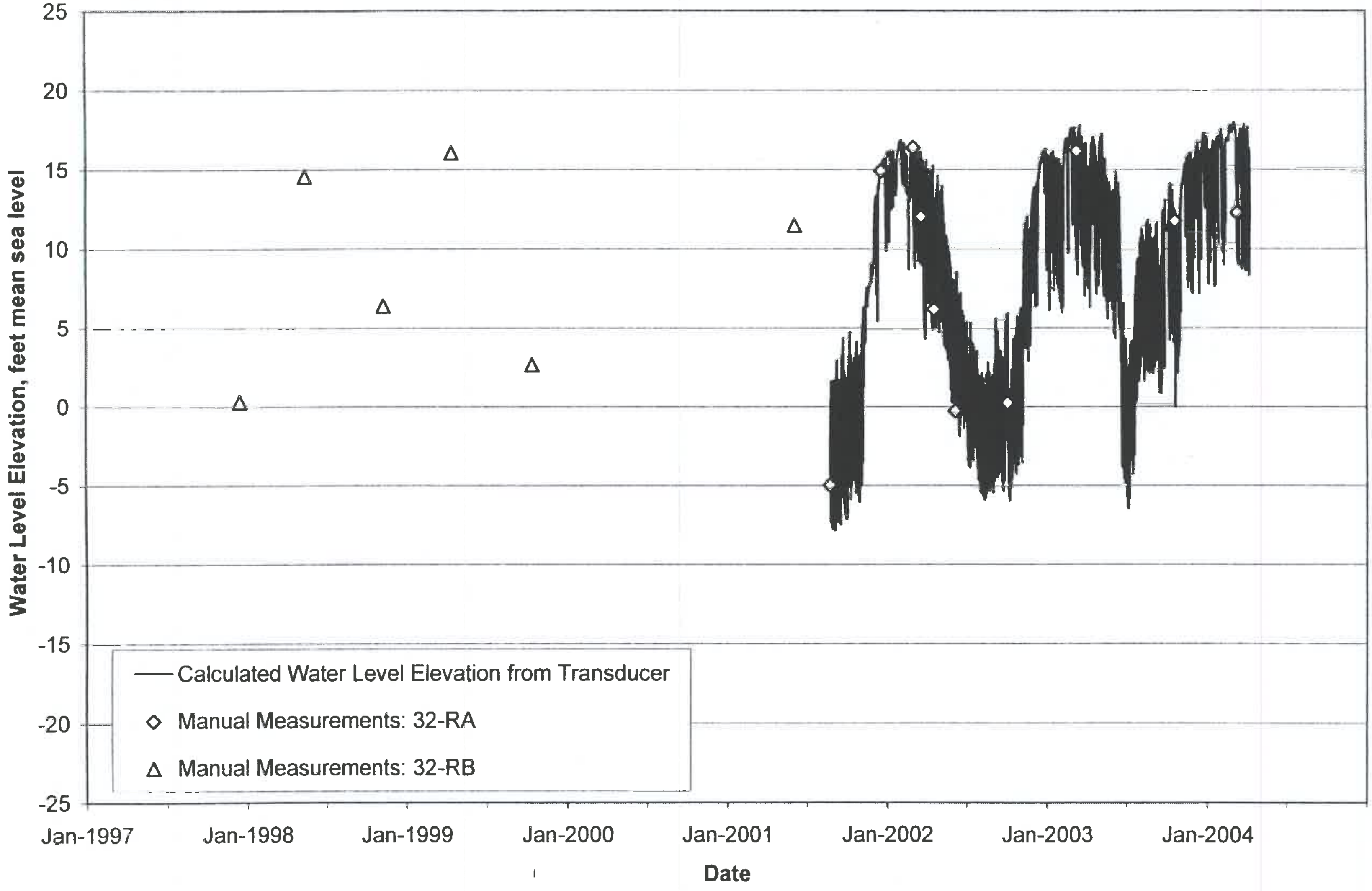


FIGURE A-5. WATER LEVEL HYDROGRAPH, WELLS 32-RA/32-RB (MORGAN RUN NO. 3 GREEN NORTH)

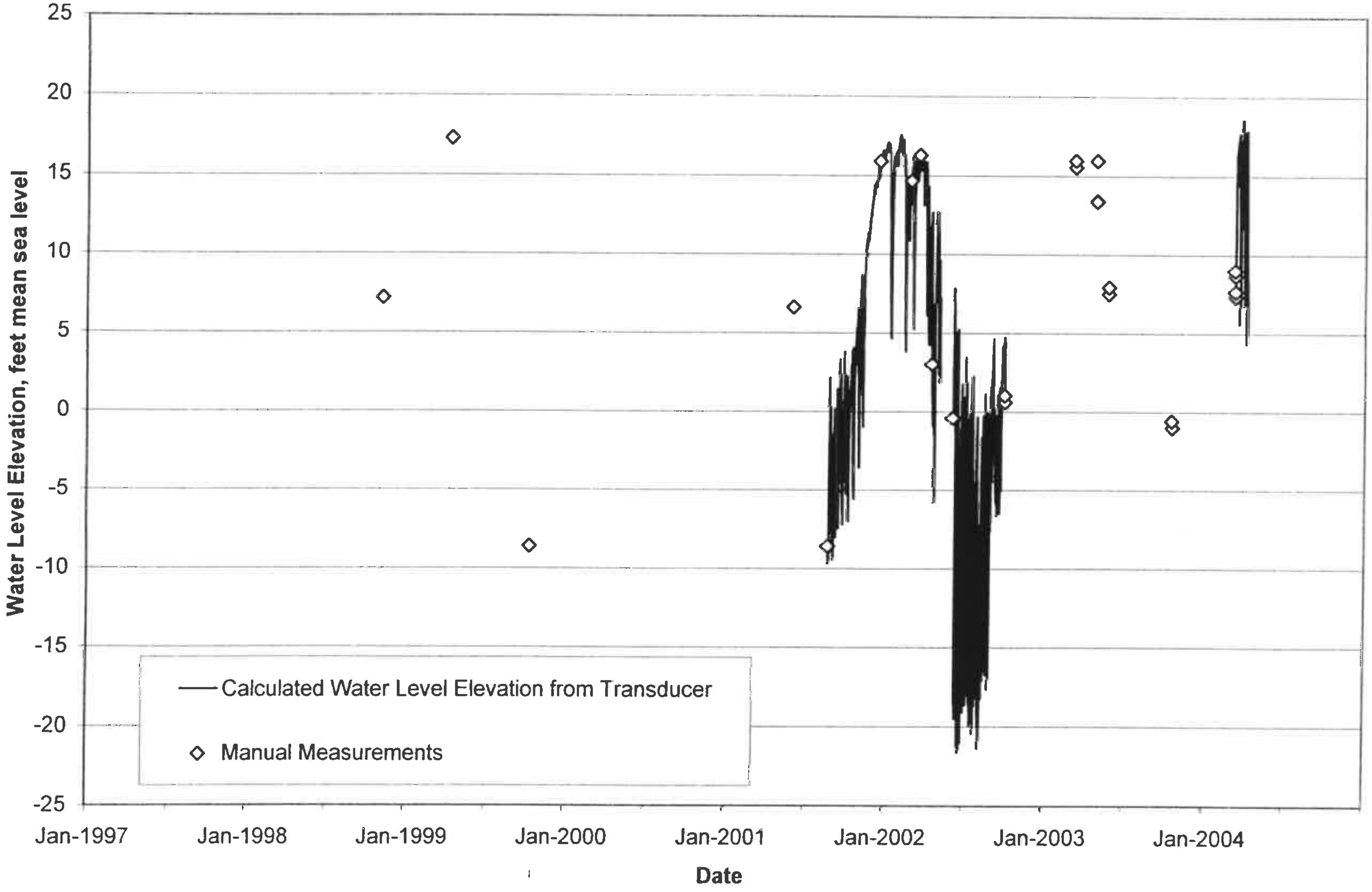


FIGURE A-6. WATER LEVEL HYDROGRAPH,
WELL 33-EA (McFARLANE NORTH)

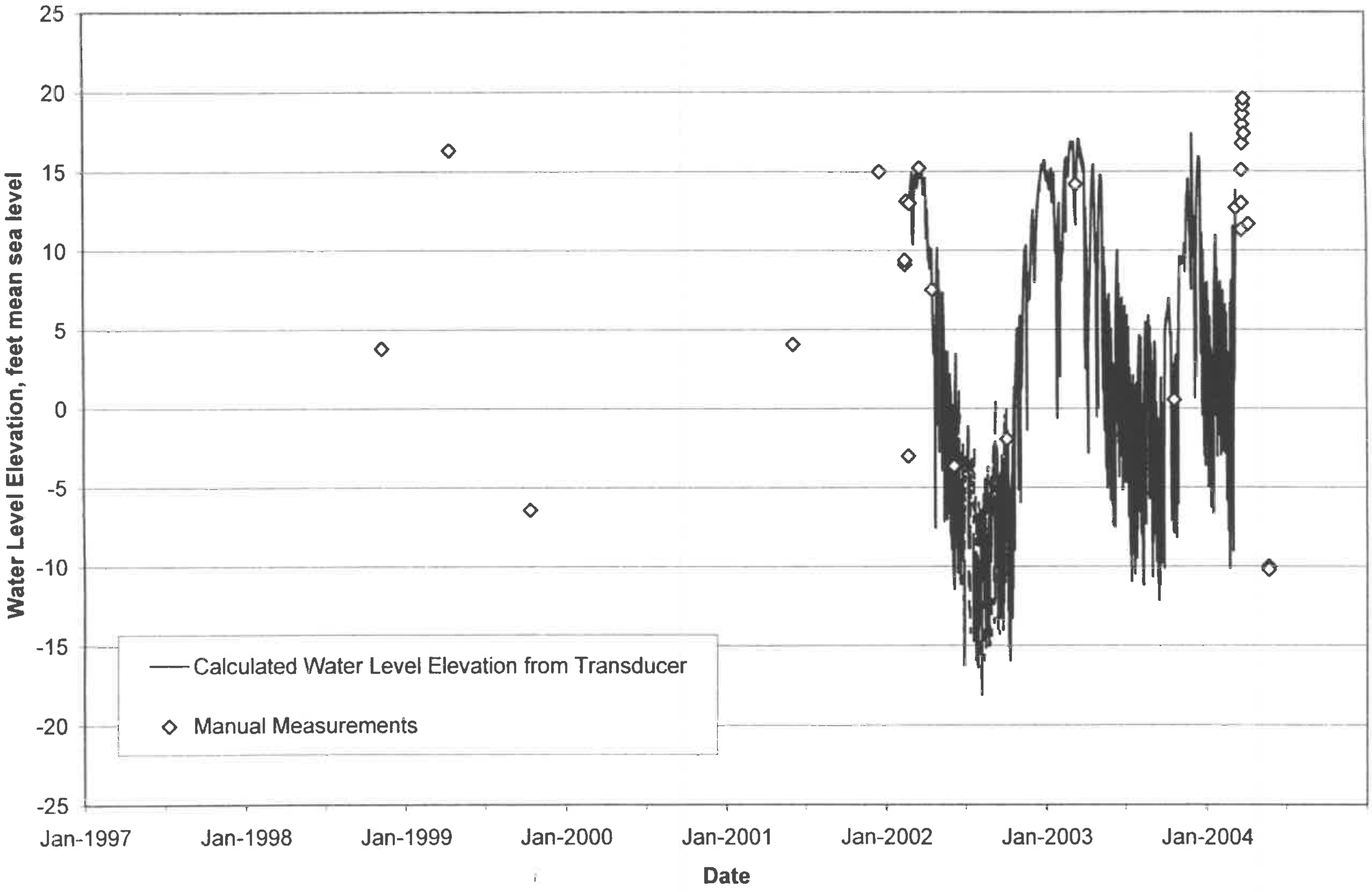


FIGURE A-7. WATER LEVEL HYDROGRAPH,
WELL 33-N2 (RANCHO PASEANA SOUTH INACTIVE)

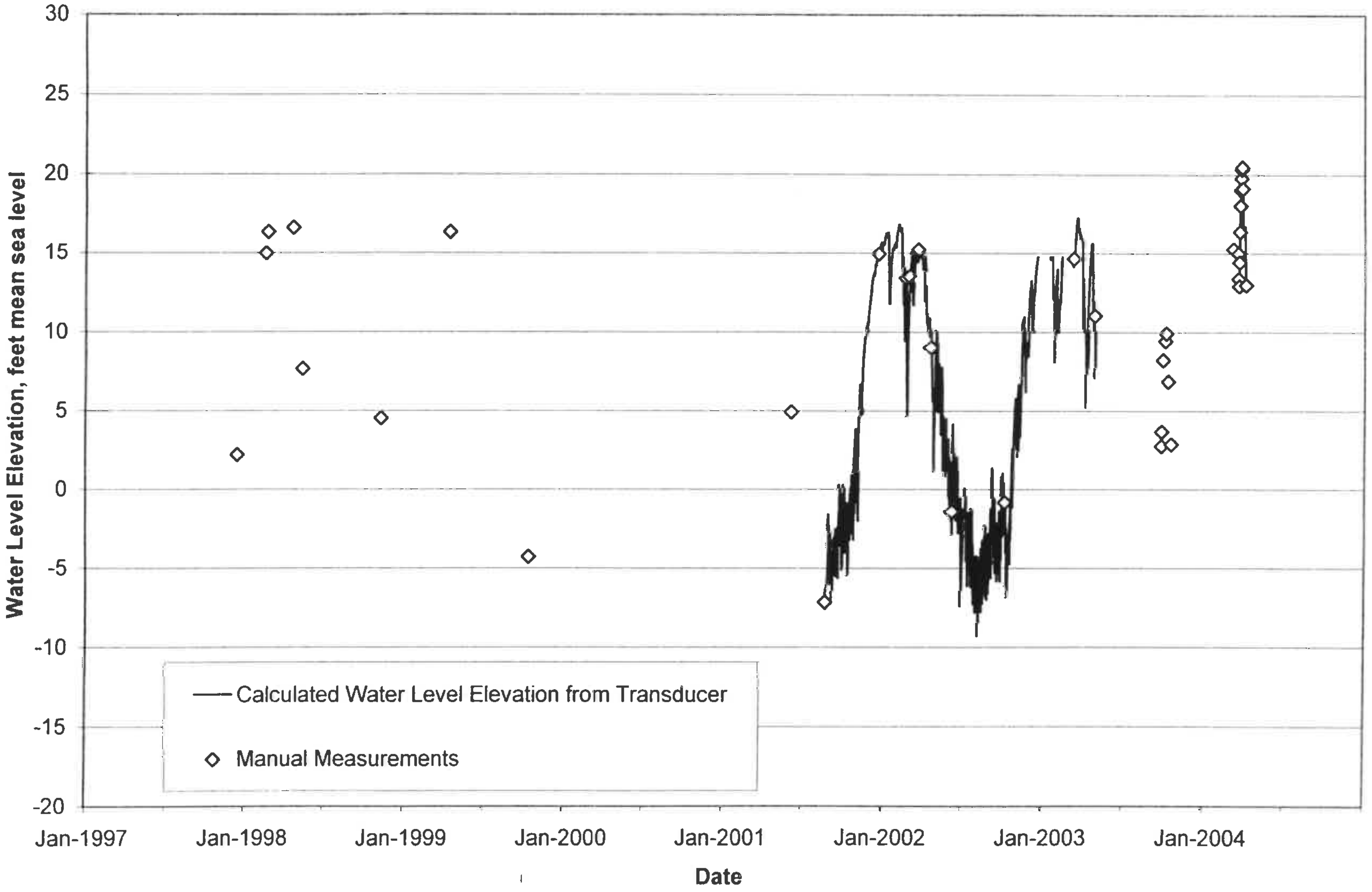


FIGURE A-8. WATER LEVEL HYDROGRAPH,
WELL 33-NC (MORGAN RUN EAST)

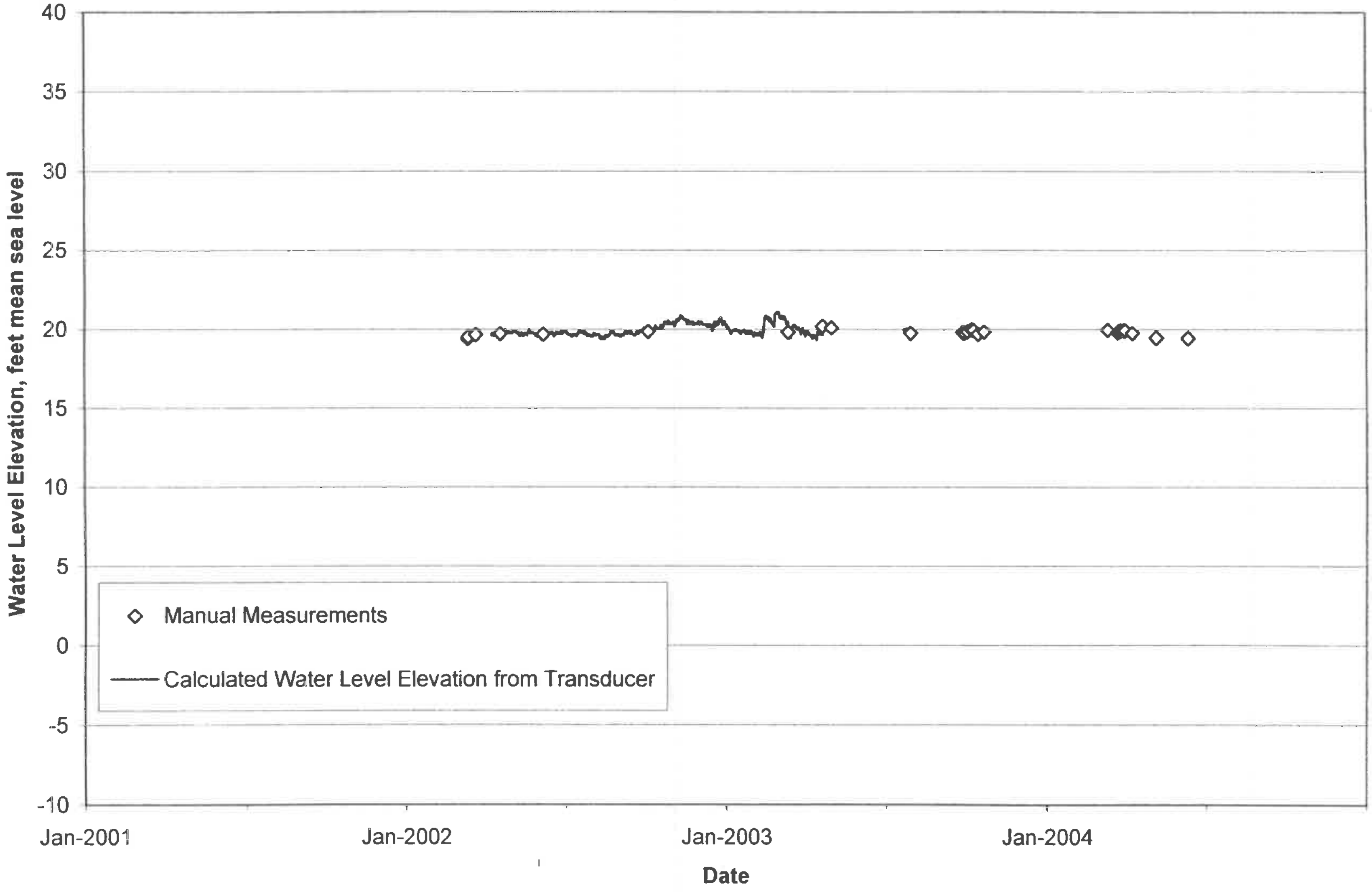


FIGURE A-9. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-1

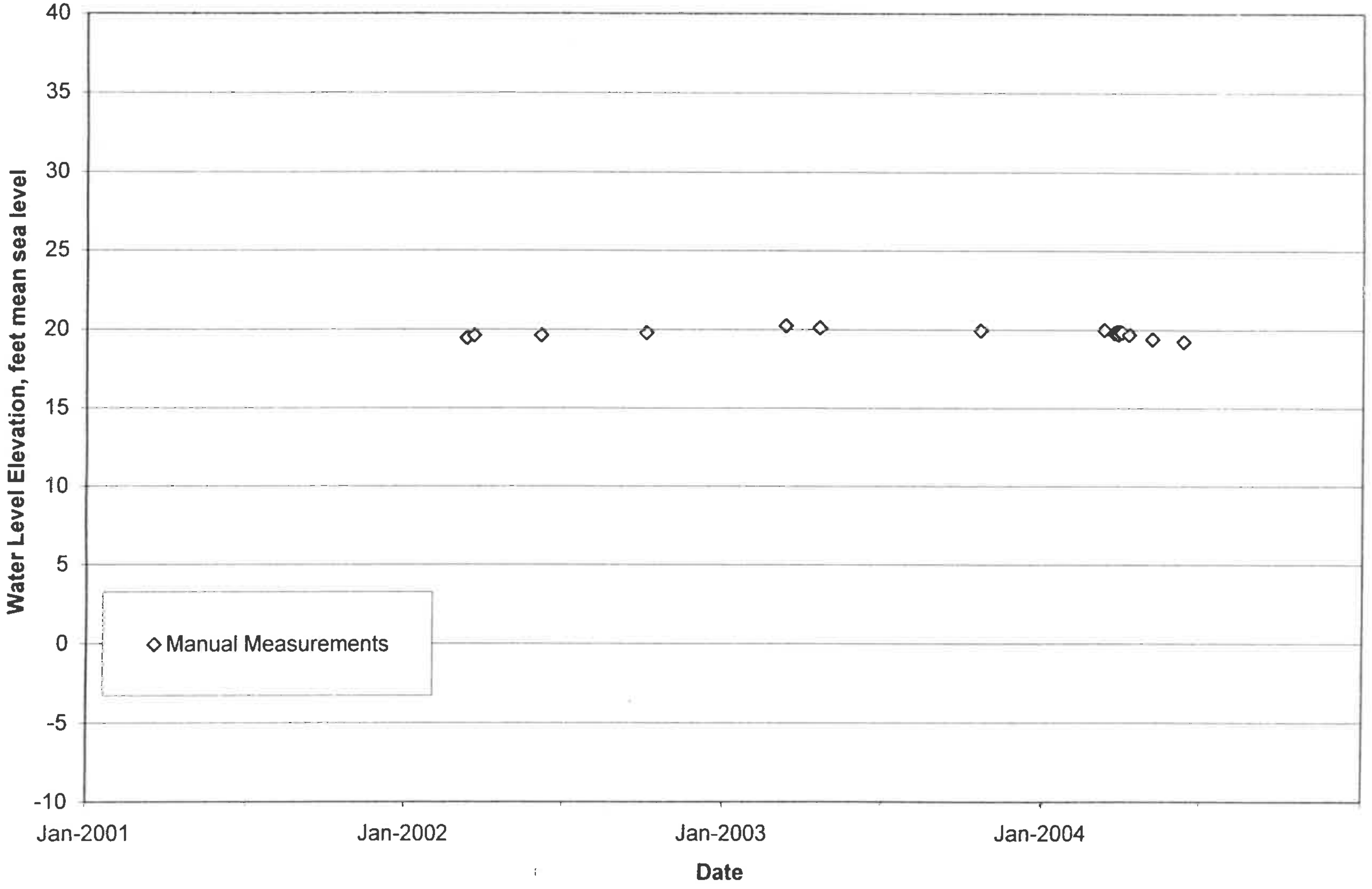


FIGURE A-10. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-2

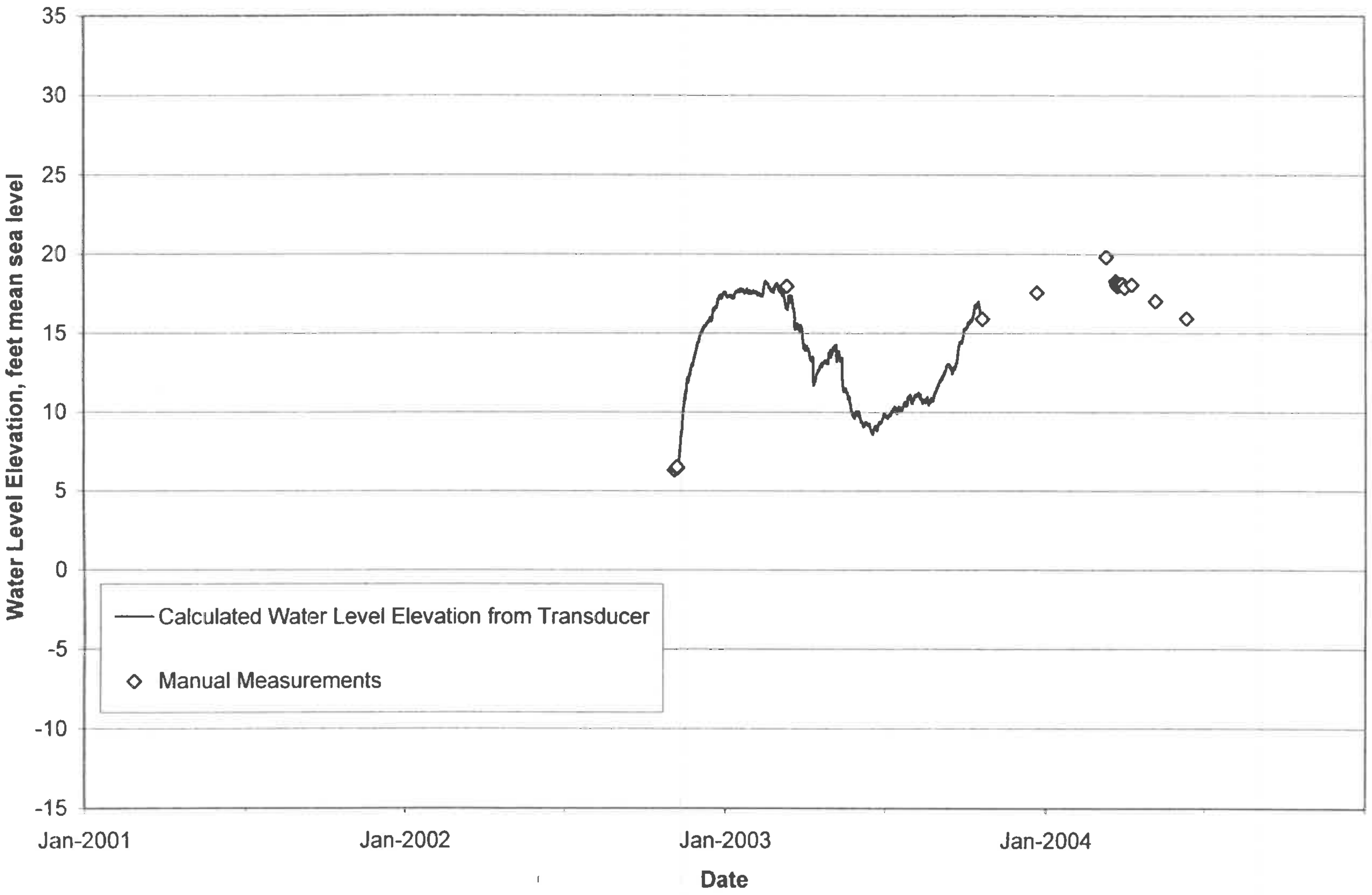


FIGURE A-11. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-3

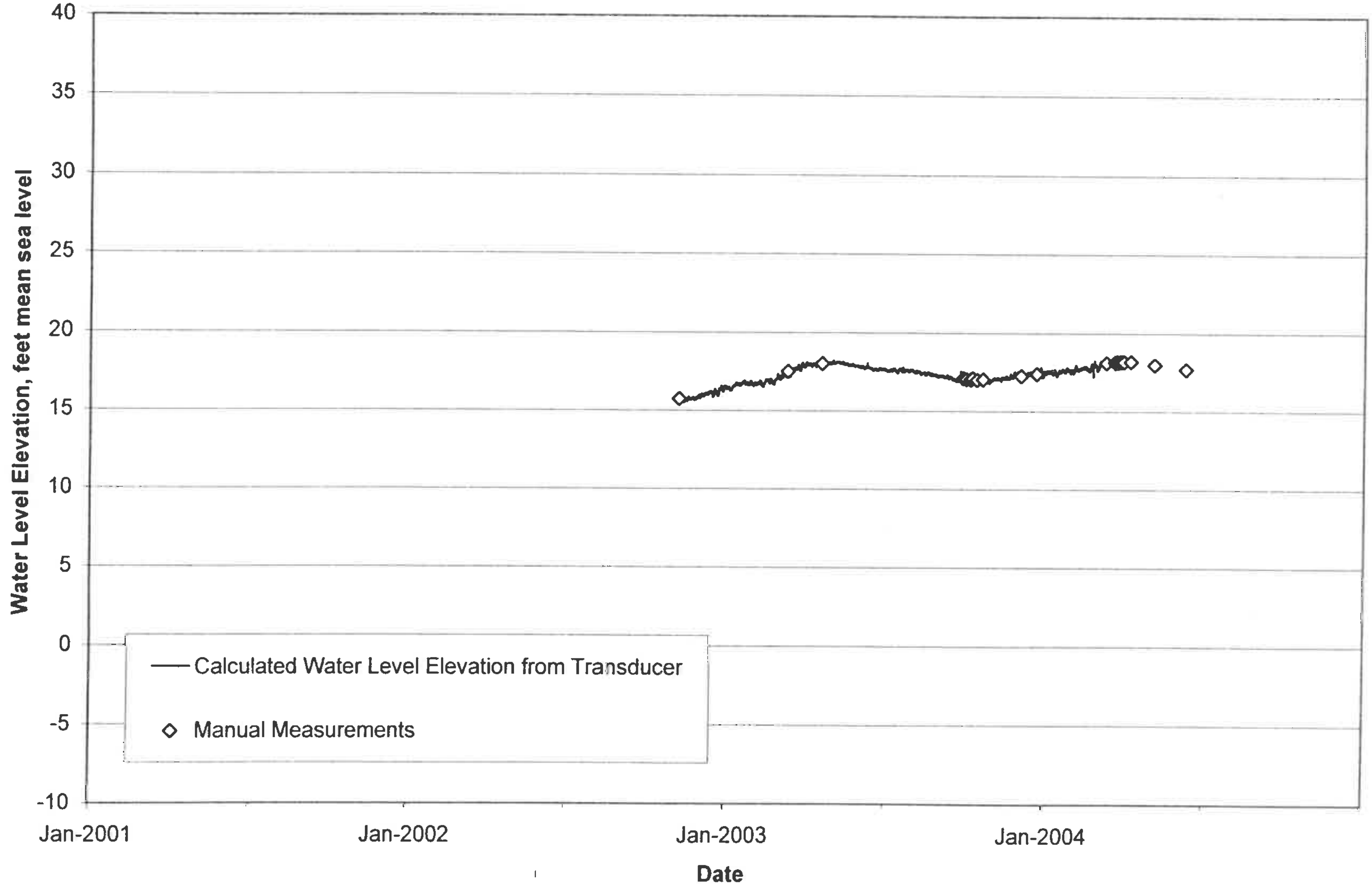


FIGURE A-12. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-4S

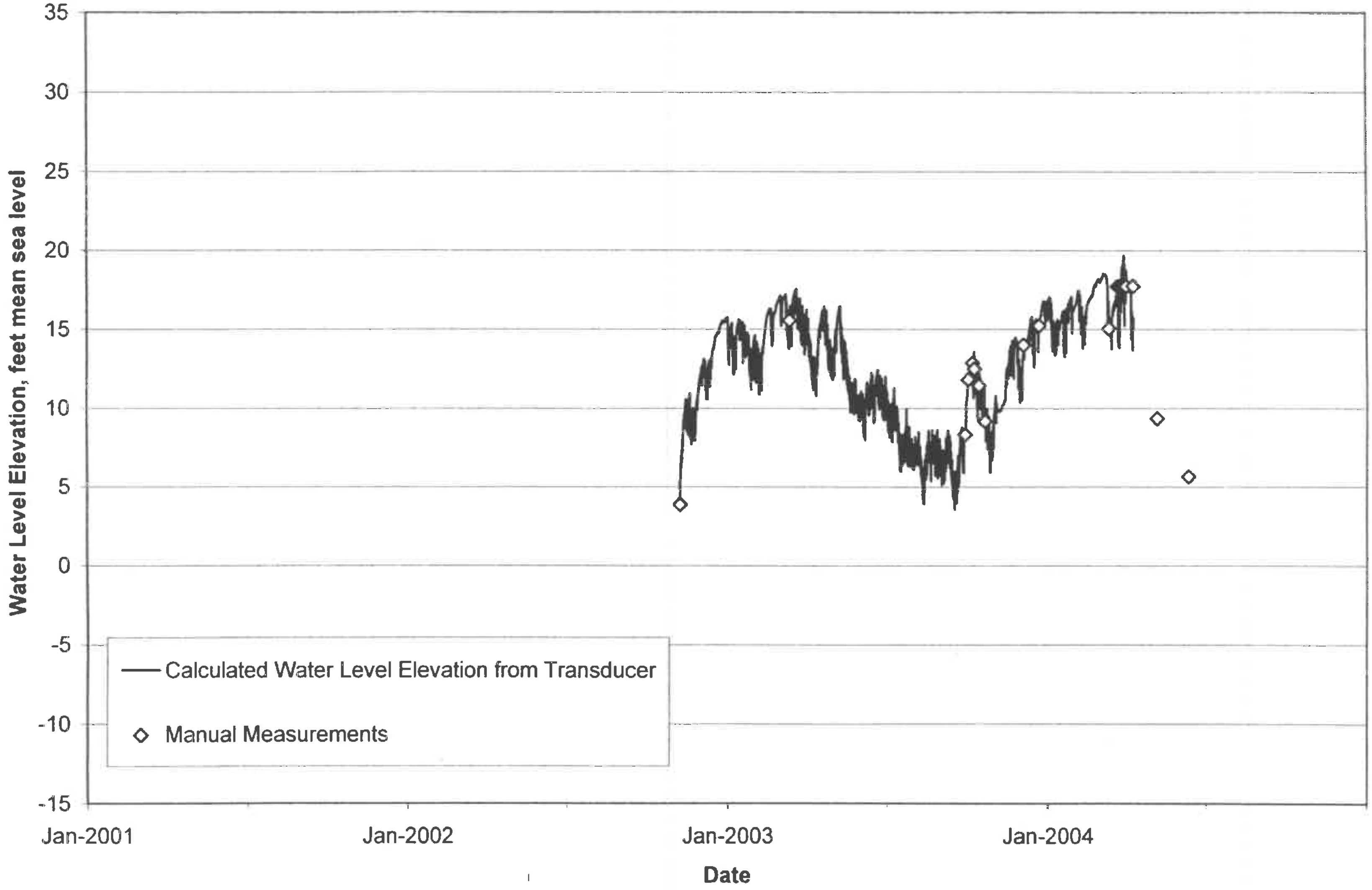


FIGURE A-13. WATER LEVEL HYDROGRAPH,
DEEP PIEZOMETER P-4D

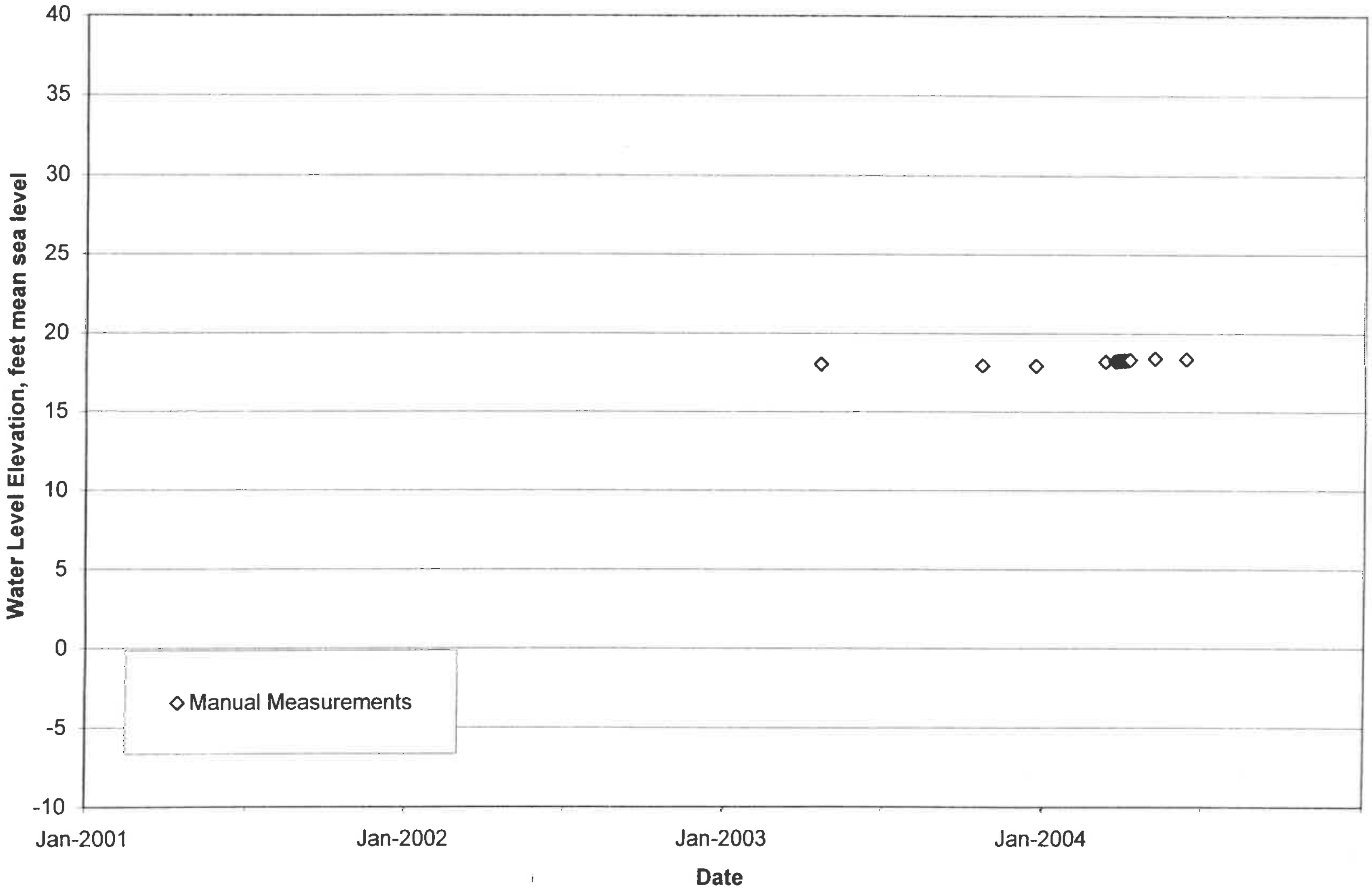


FIGURE A-14. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-5

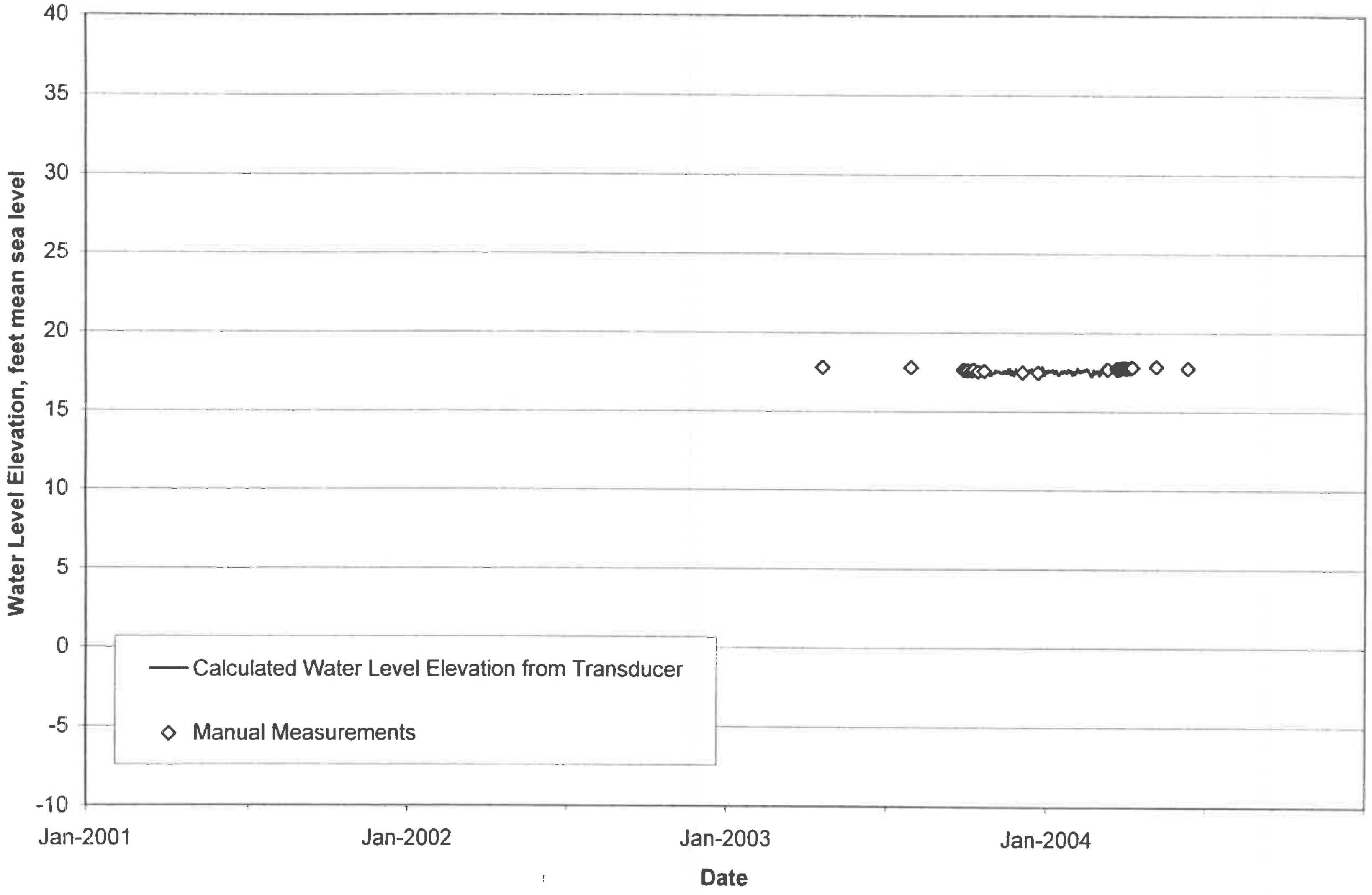


FIGURE A-15. WATER LEVEL HYDROGRAPH, SHALLOW PIEZOMETER P-6

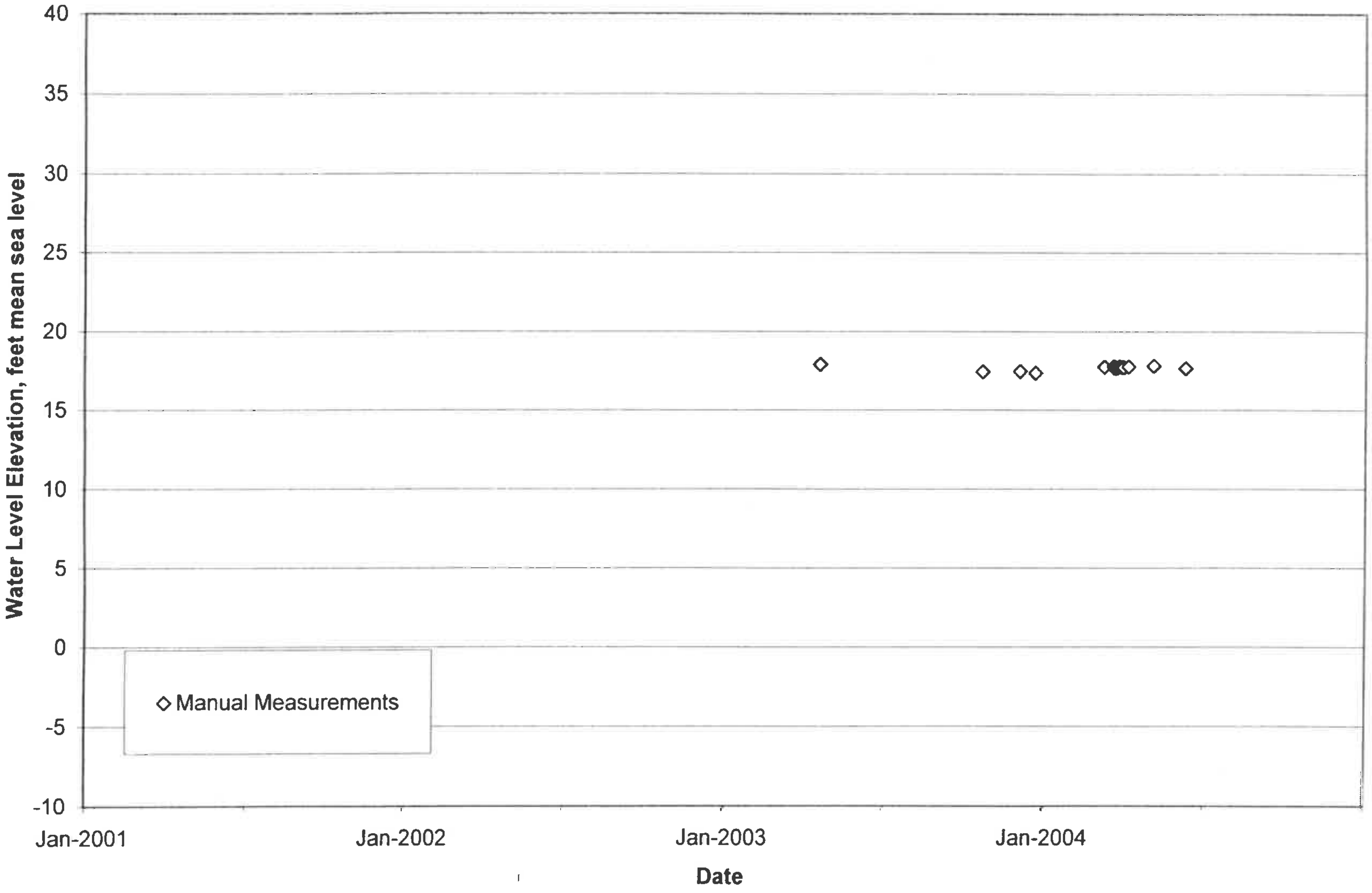


FIGURE A-16. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-7

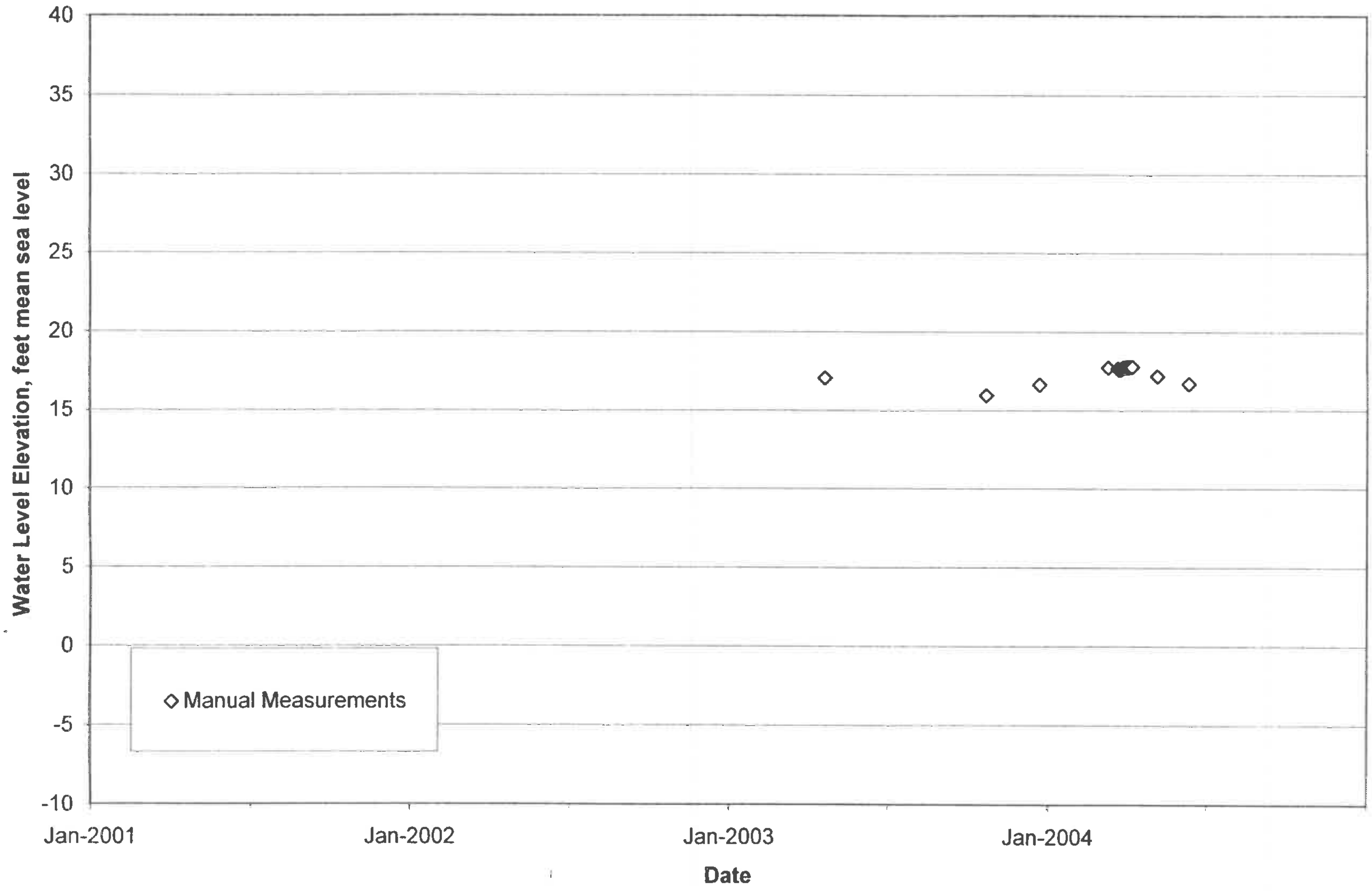


FIGURE A-17. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-8

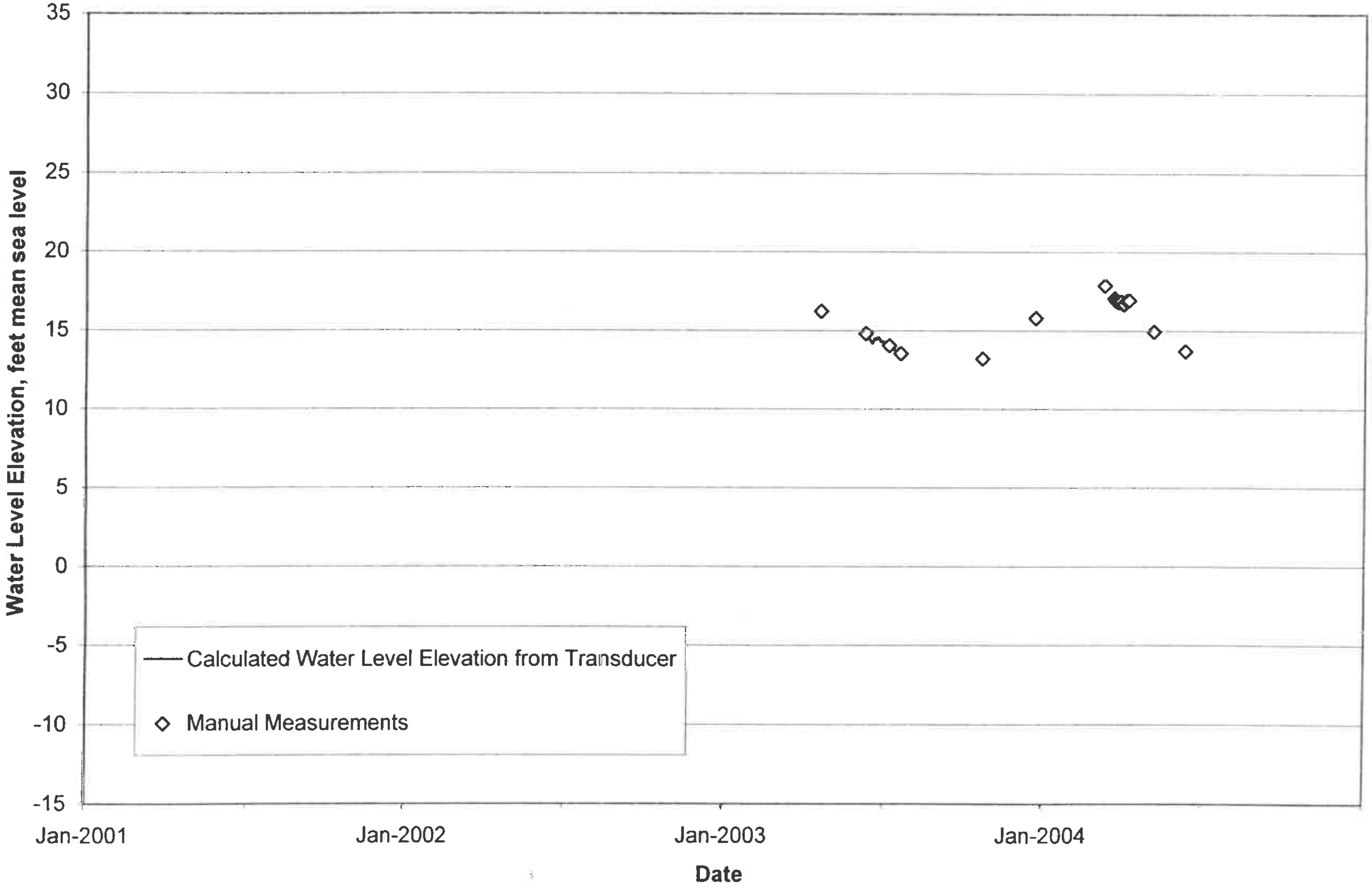


FIGURE A-18. WATER LEVEL HYDROGRAPH, SHALLOW PIEZOMETER P-9

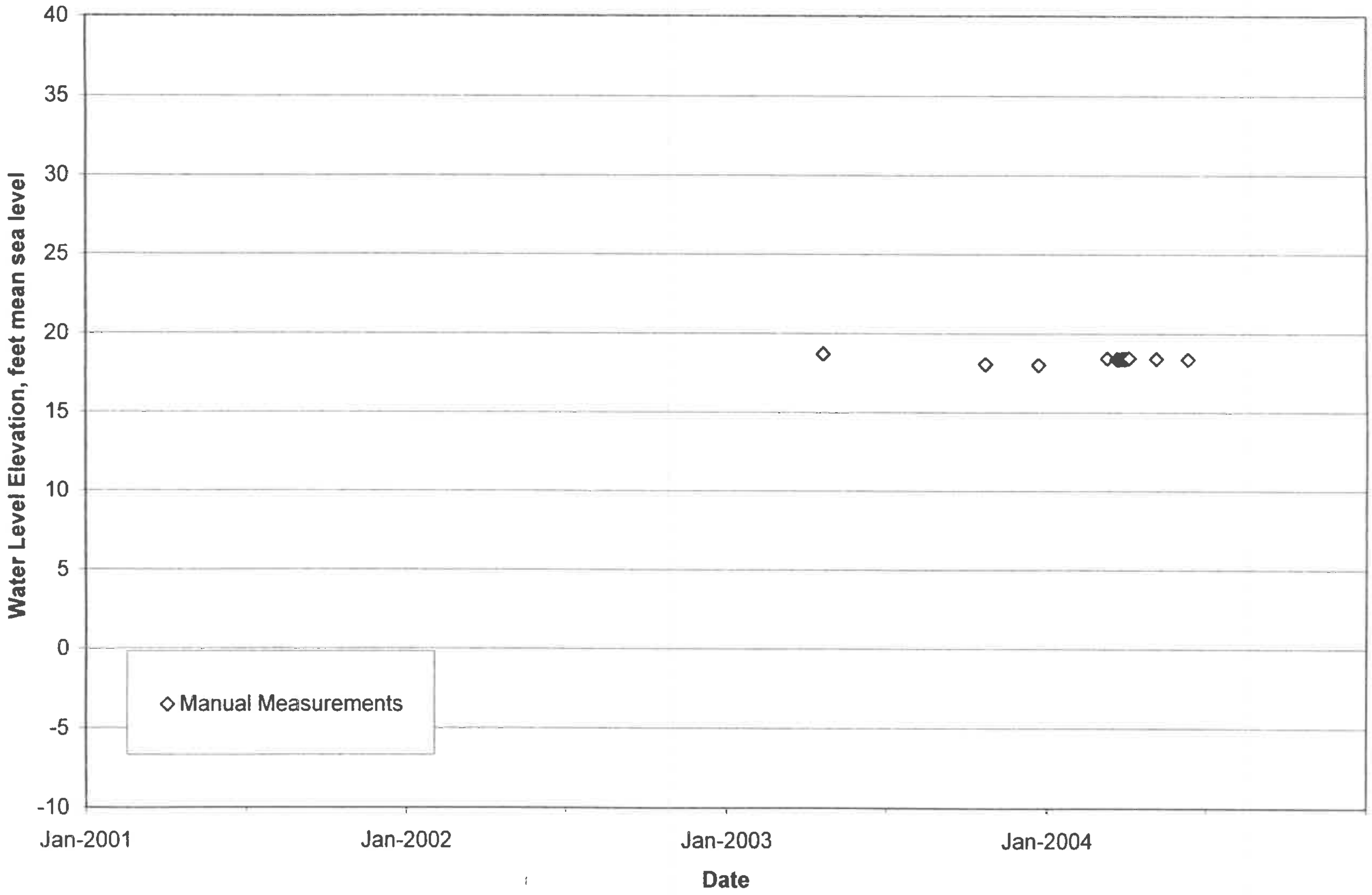


FIGURE A-19. WATER LEVEL HYDROGRAPH,
SHALLOW PIEZOMETER P-10

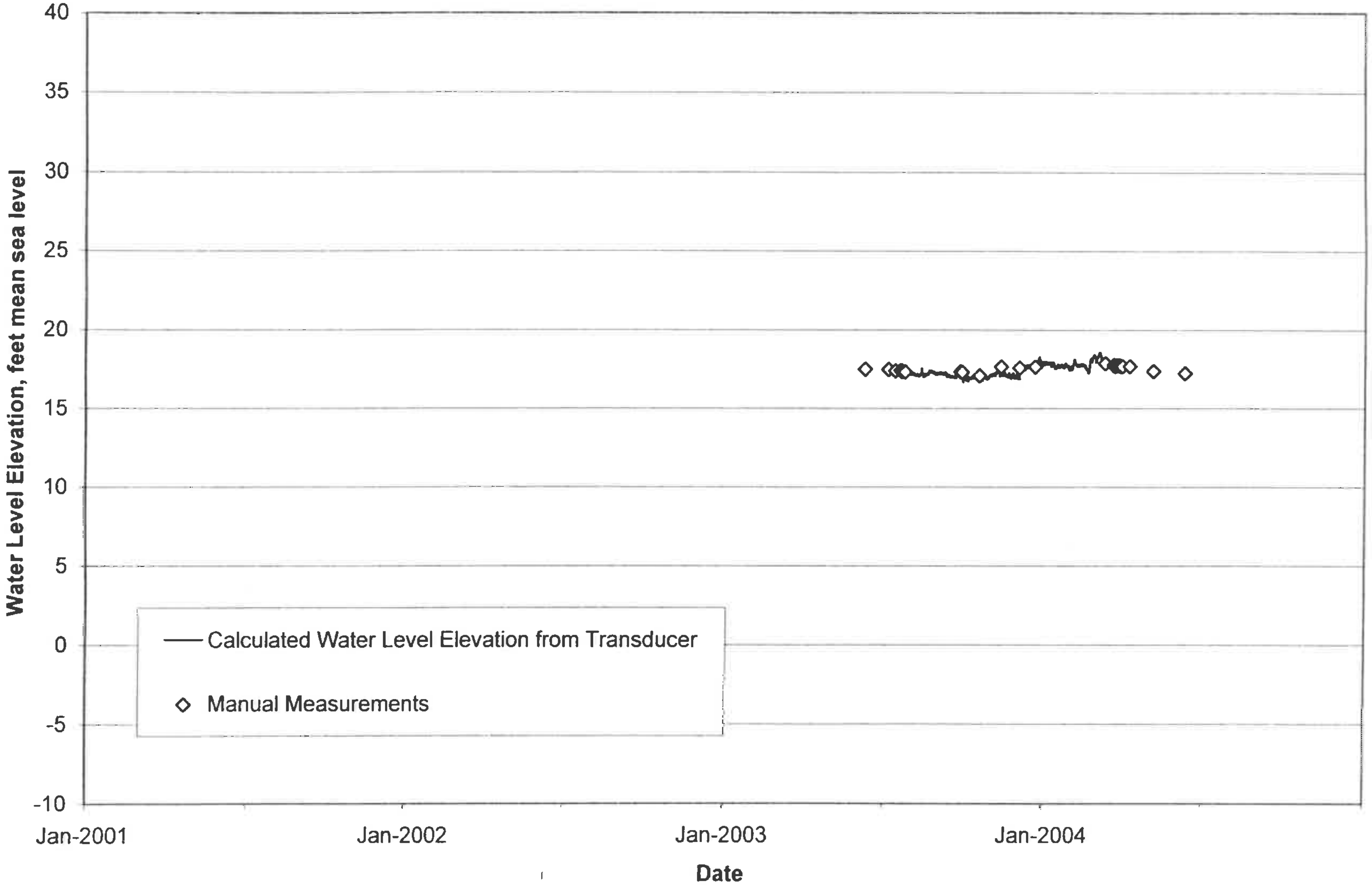


FIGURE A-20. WATER LEVEL HYDROGRAPH, SHALLOW PIEZOMETER P-11A

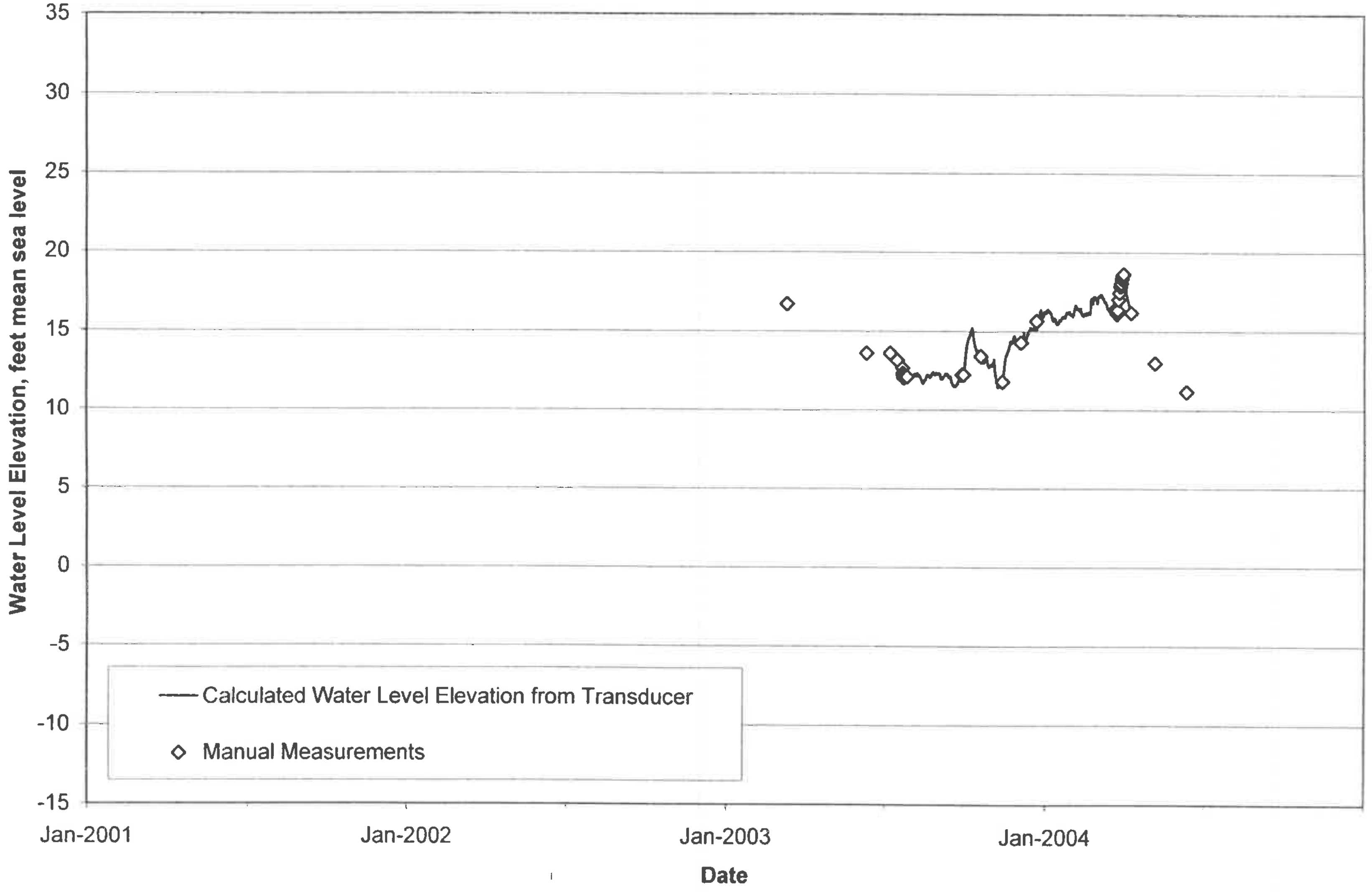


FIGURE A-21. WATER LEVEL HYDROGRAPH,
INTERMEDIATE PIEZOMETER P-11B

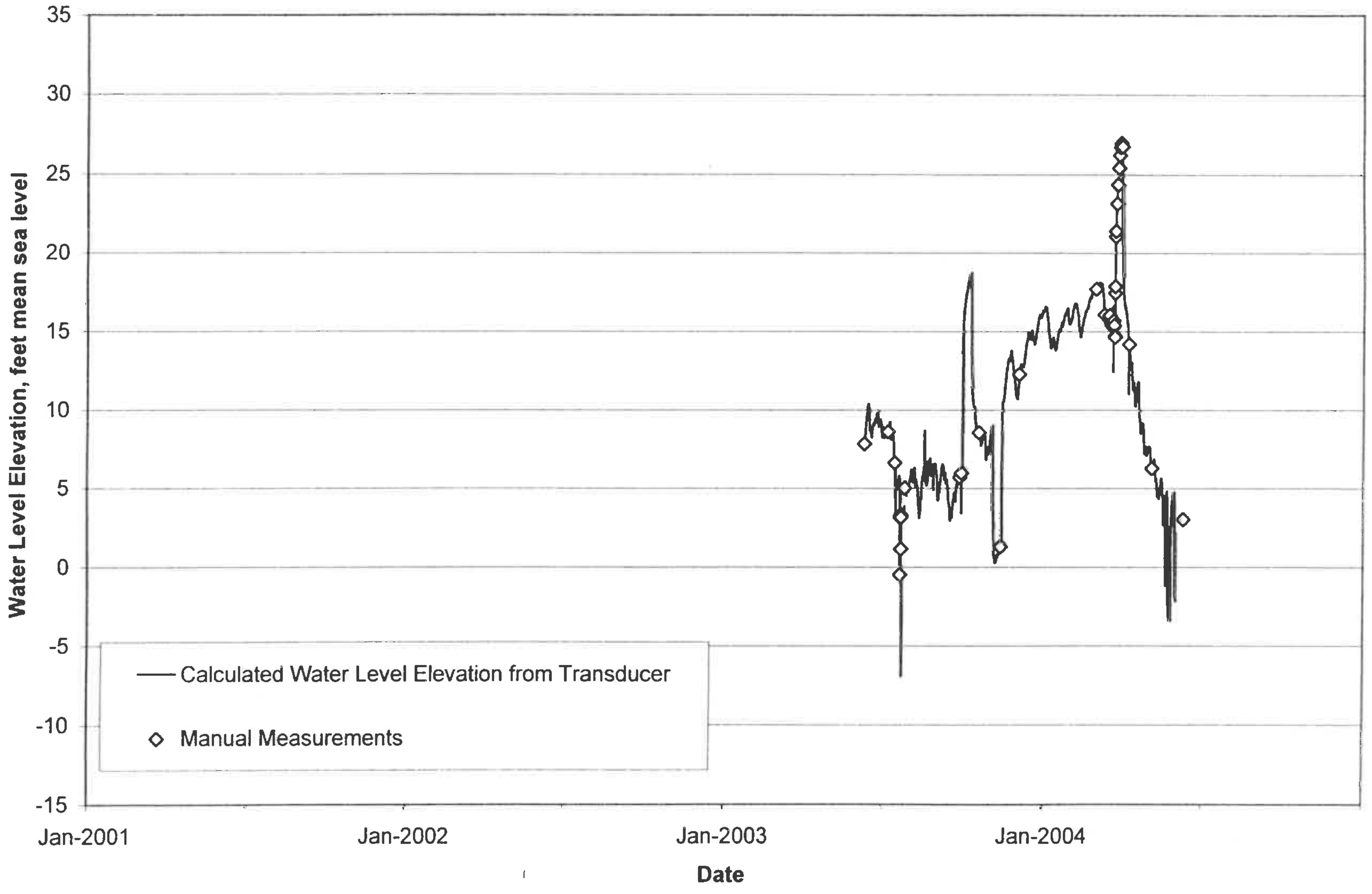


FIGURE A-22. WATER LEVEL HYDROGRAPH, DEEP PIEZOMETER P-11D

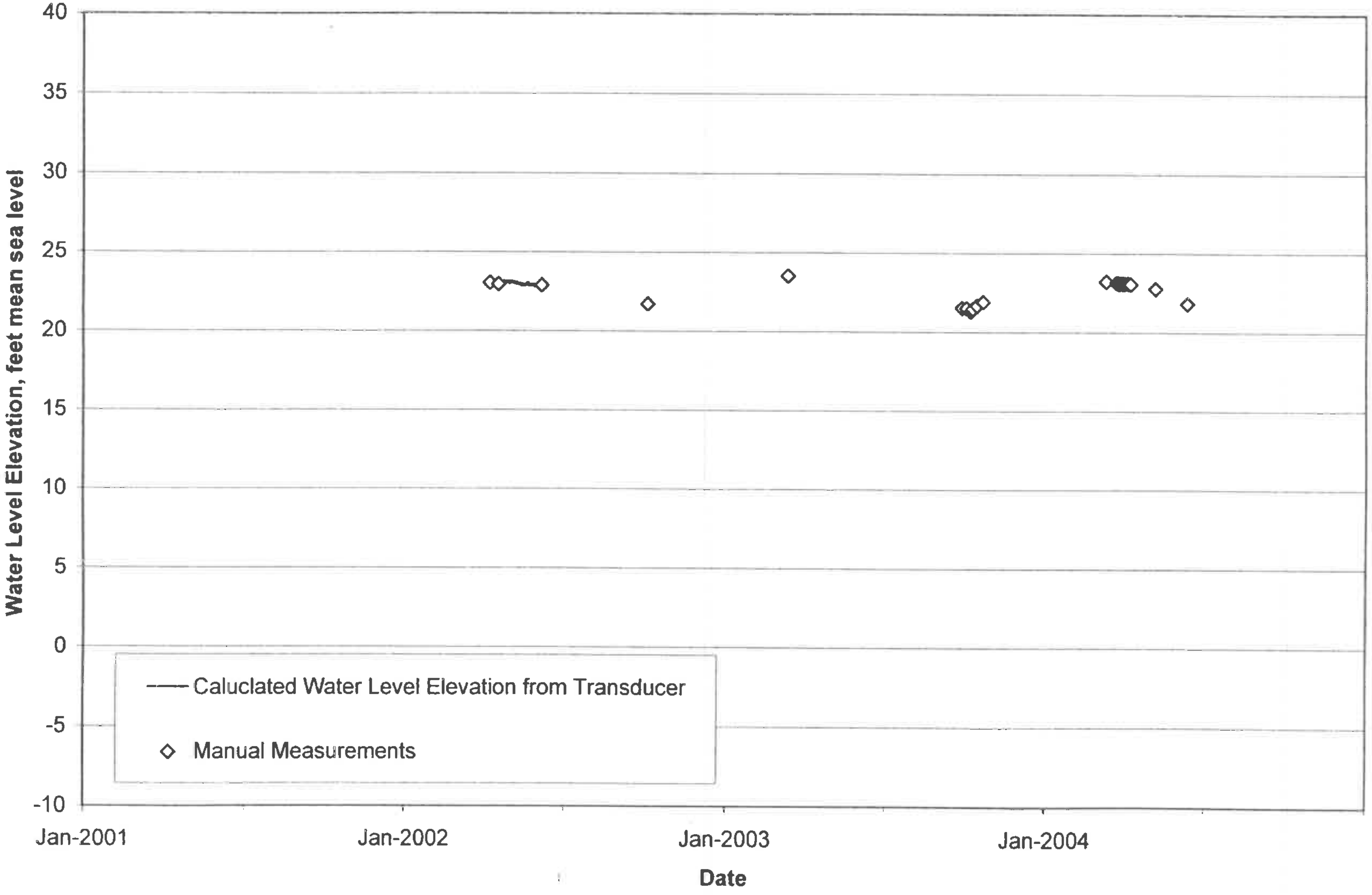


FIGURE A-23. WATER LEVEL HYDROGRAPH, RSF POLO CLUB SHALLOW PIEZOMETER P-1

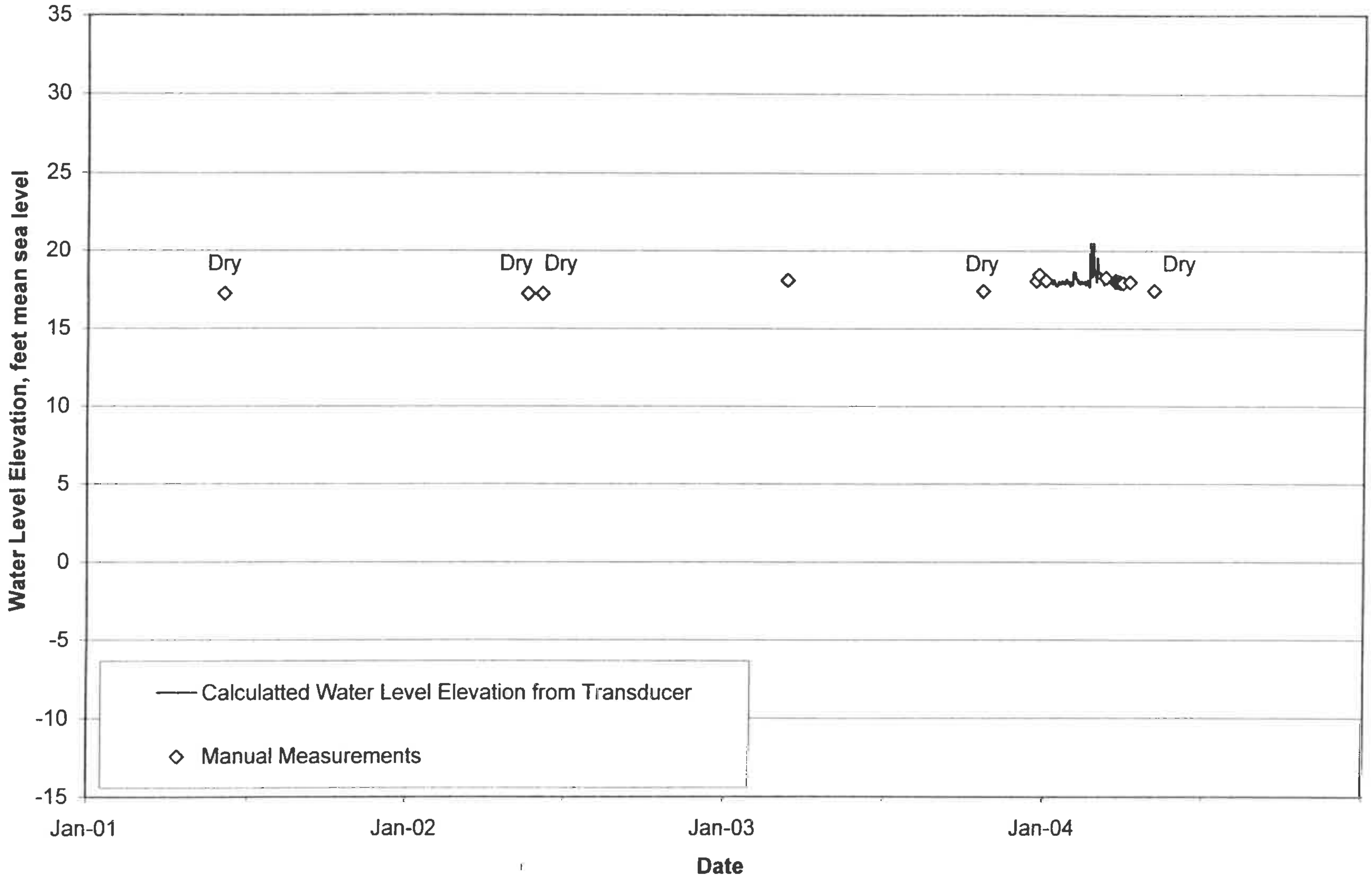


**FIGURE A-24. WATER LEVEL HYDROGRAPH,
MORGAN RUN NORTH BRIDGE**

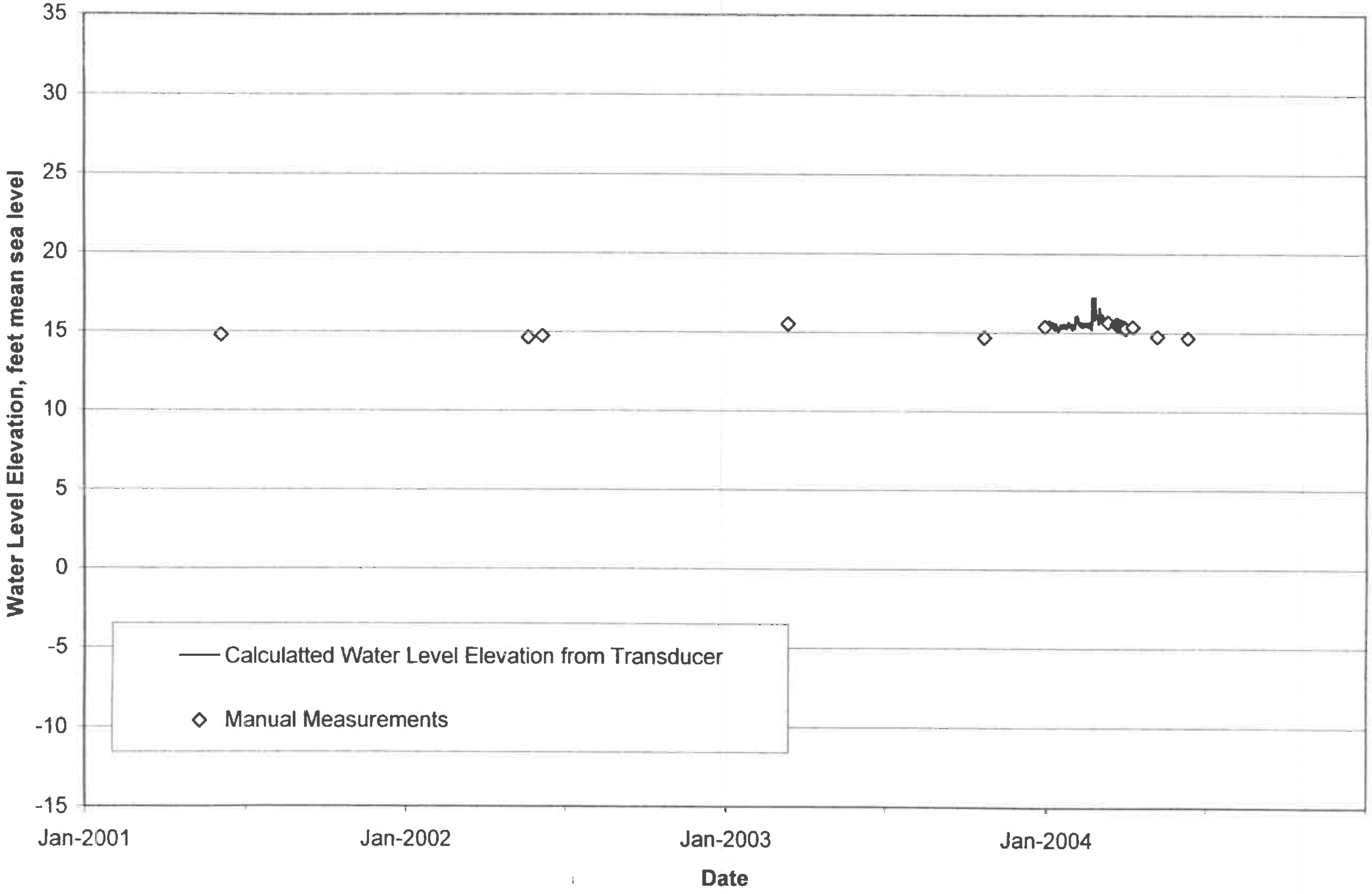


FIGURE A-25. WATER LEVEL HYDROGRAPH,
MORGAN RUN SOUTH BRIDGE

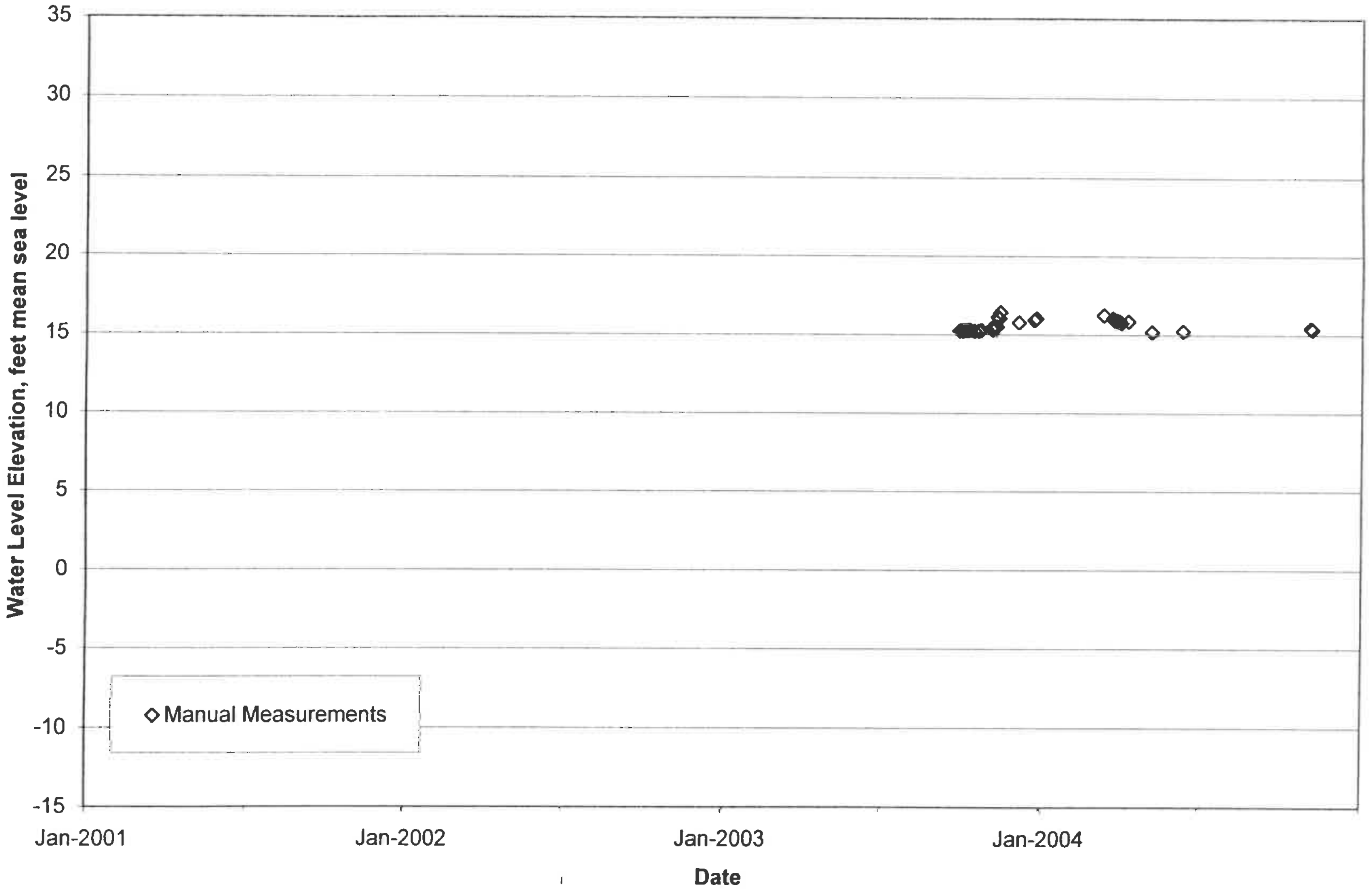
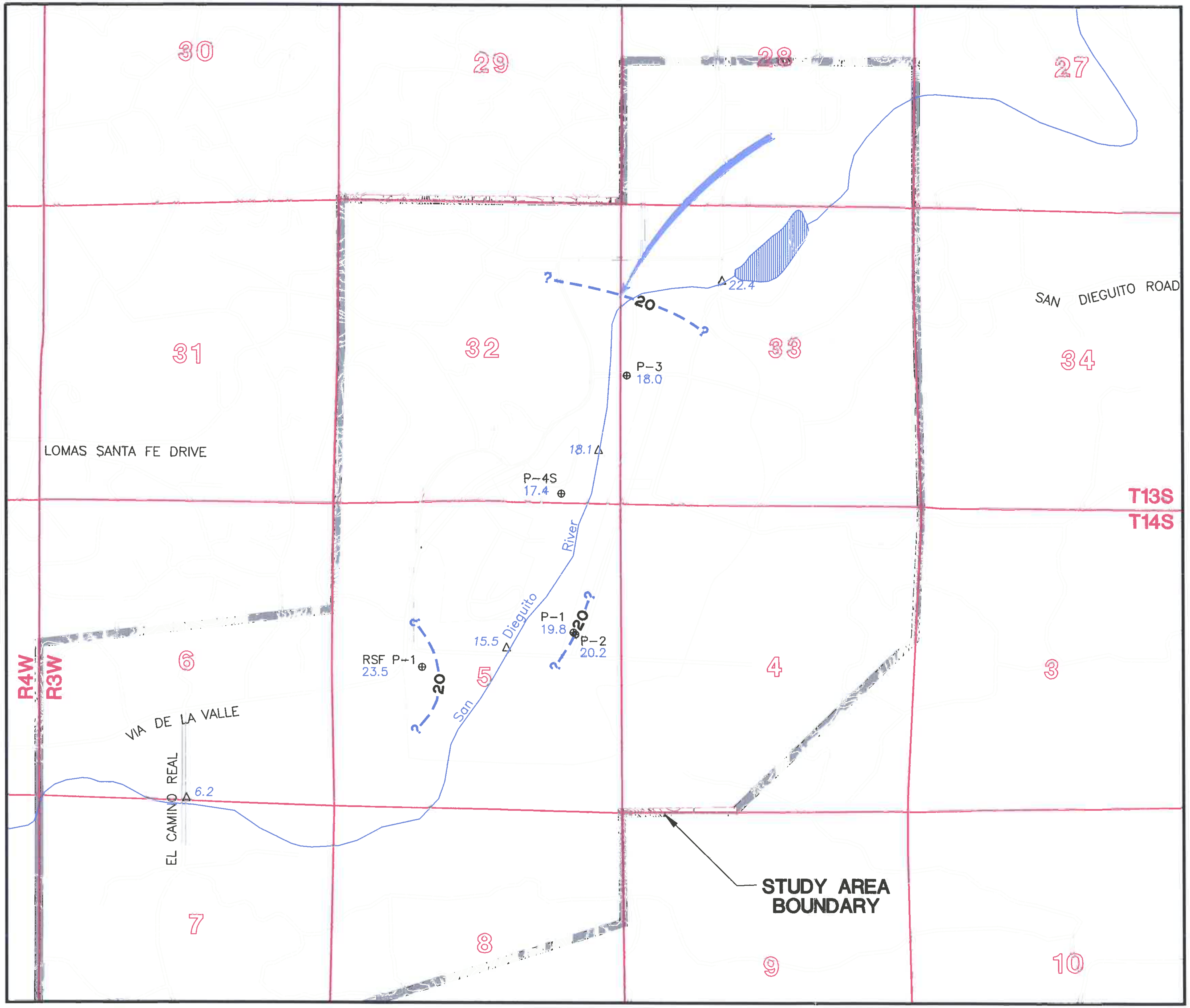


FIGURE A-26. WATER LEVEL HYDROGRAPH, MORGAN RUN MIDDLE BRIDGE



EXPLANATION

15.5 △	SURFACE WATER ELEVATION, SAN DIEGUITO RIVER
P–1 ⊕	SHALLOW PIEZOMETER
19.8	WATER LEVEL ELEVATION, IN FEET MEAN SEA LEVEL
(23.5)	WATER LEVEL ELEVATION NOT CONTOURED

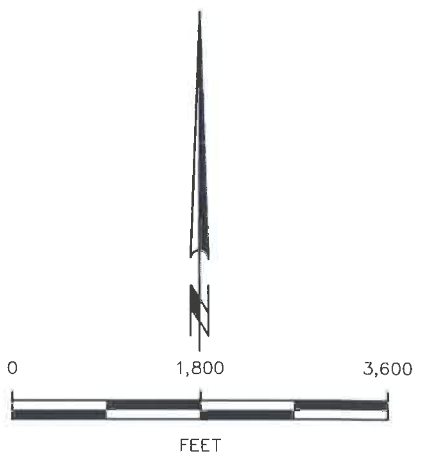
?———— 20 – – – – – – ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION
IN FEET MEAN SEA LEVEL,
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

INDICATES DIRECTION OF
GROUNDWATER FLOW

NOTES: WATER LEVELS MEASURED ON MARCH 13–14, 2003

WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.



SAN DIEGUITO GROUNDWATER BASIN

WATER TABLE ELEVATIONS
MARCH 2003

HARGIS + ASSOCIATES, INC
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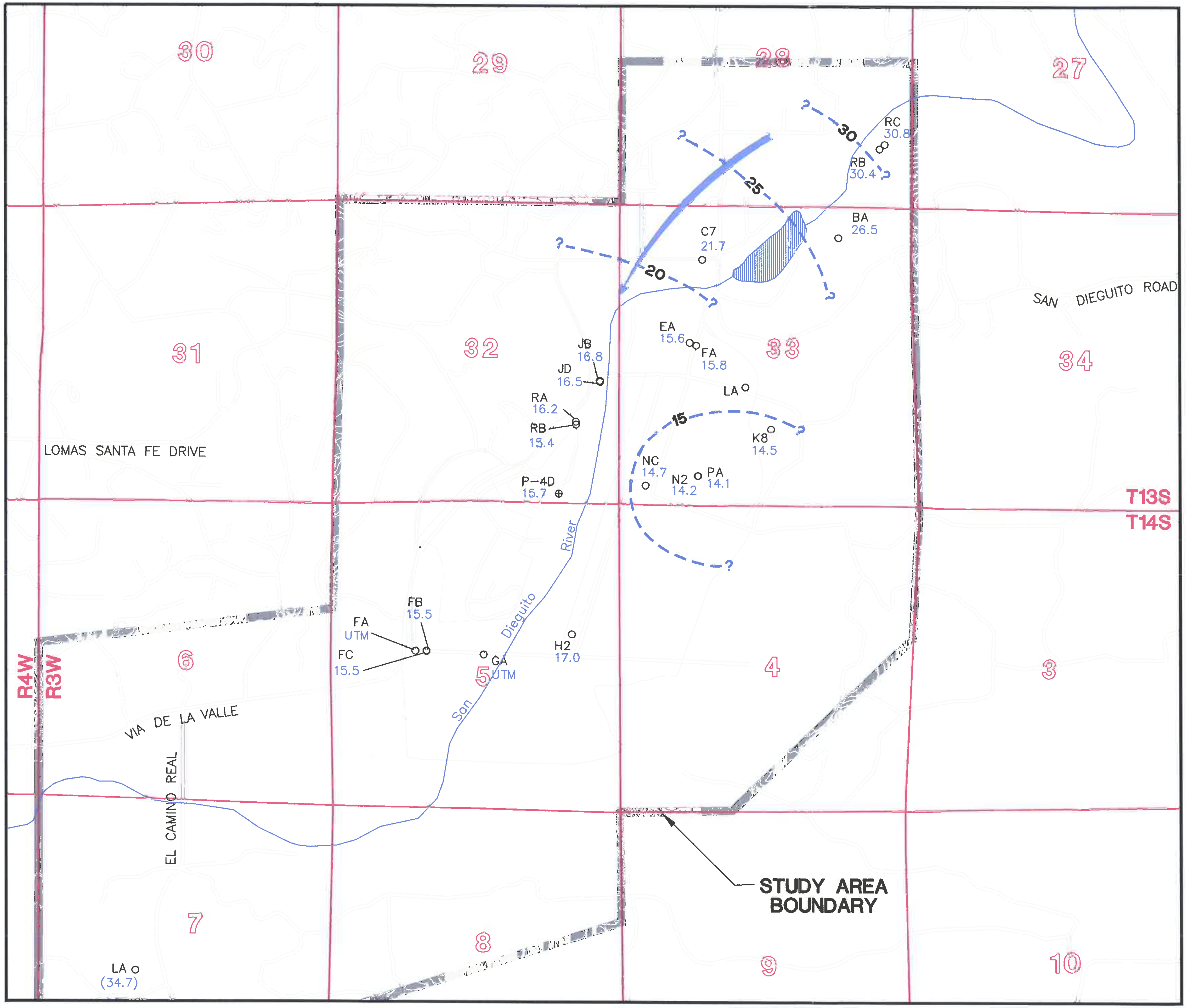
FIGURE A-27

PREP BY GTC REV BY RAN RPT NO. 689.1 220-1495 C



EXPLANATION

P-4D ⊕	DEEP PIEZOMETER
EA ○	WATER LEVEL MONITORING WELL
15.6	WATER LEVEL ELEVATION, IN FEET MEAN SEA LEVEL
UTM	UNABLE TO MEASURE
(23.5)	WATER LEVEL ELEVATION NOT CONTOURED

? 20 ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

INDICATES DIRECTION OF GROUNDWATER FLOW

NOTES: WATER LEVELS MEASURED ON MARCH 13-14, 2003

WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.

N

0 1,800 3,600

FEET

SAN DIEGUITO GROUNDWATER BASIN

DEEP WATER LEVEL ELEVATIONS
MARCH 2003

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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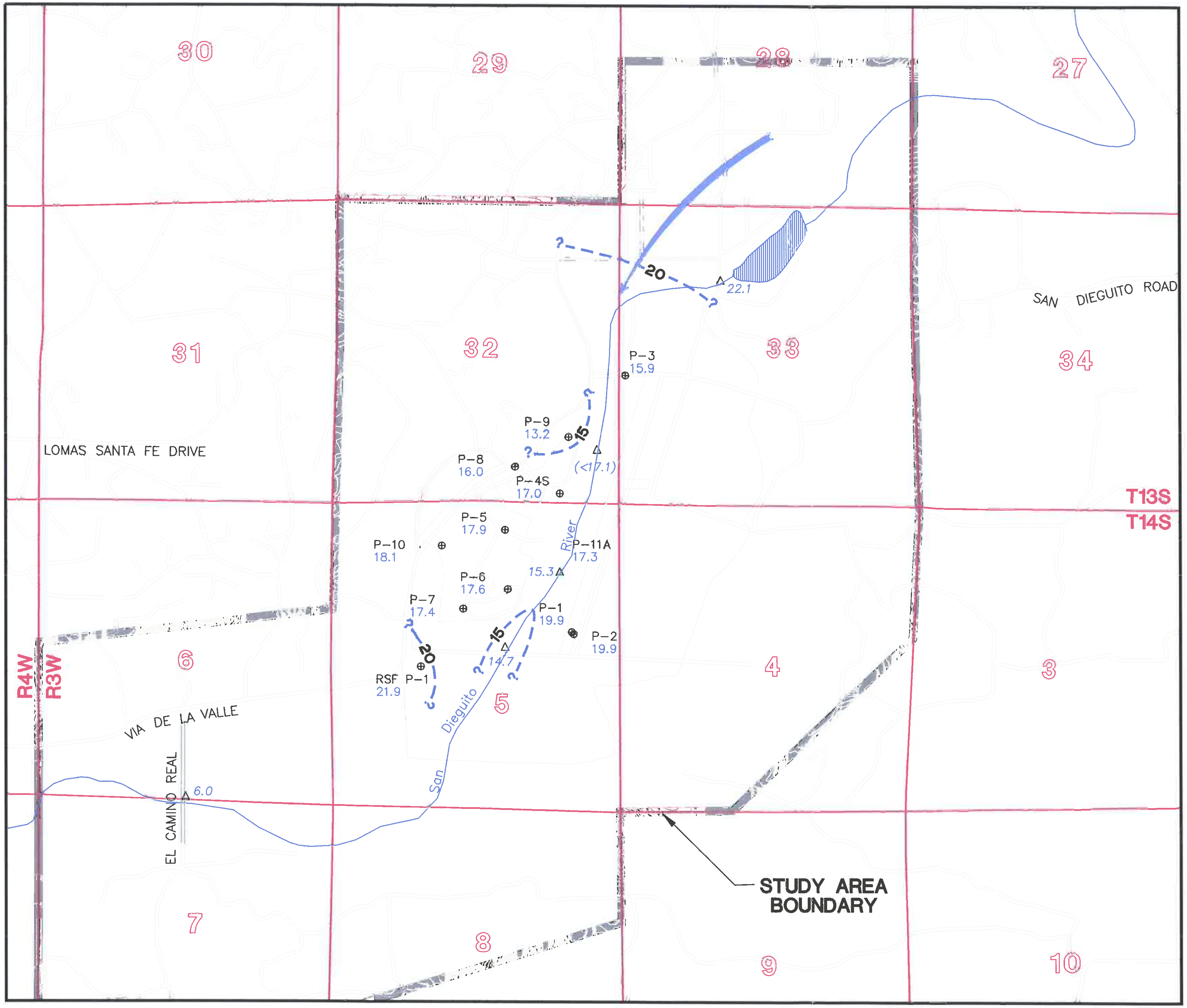
FIGURE A-28

PREP BY GTC REV BY RAN RPT NO. 689.1 220-1494 C



EXPLANATION

15.5 △	SURFACE WATER ELEVATION, SAN DIEGUITO RIVER
P-1 ⊕	SHALLOW PIEZOMETER
19.9	WATER LEVEL ELEVATION, IN FEET MEAN SEA LEVEL
(23.5)	WATER LEVEL ELEVATION NOT CONTOURED

?———20 - - - - - - -?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

INDICATES DIRECTION OF GROUNDWATER FLOW

NOTES: WATER LEVELS MEASURED ON OCTOBER 22–23, 2003

WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.

0 1,800 3,600

FEET

SAN DIEGUITO GROUNDWATER BASIN

WATER TABLE ELEVATIONS
OCTOBER 2003

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

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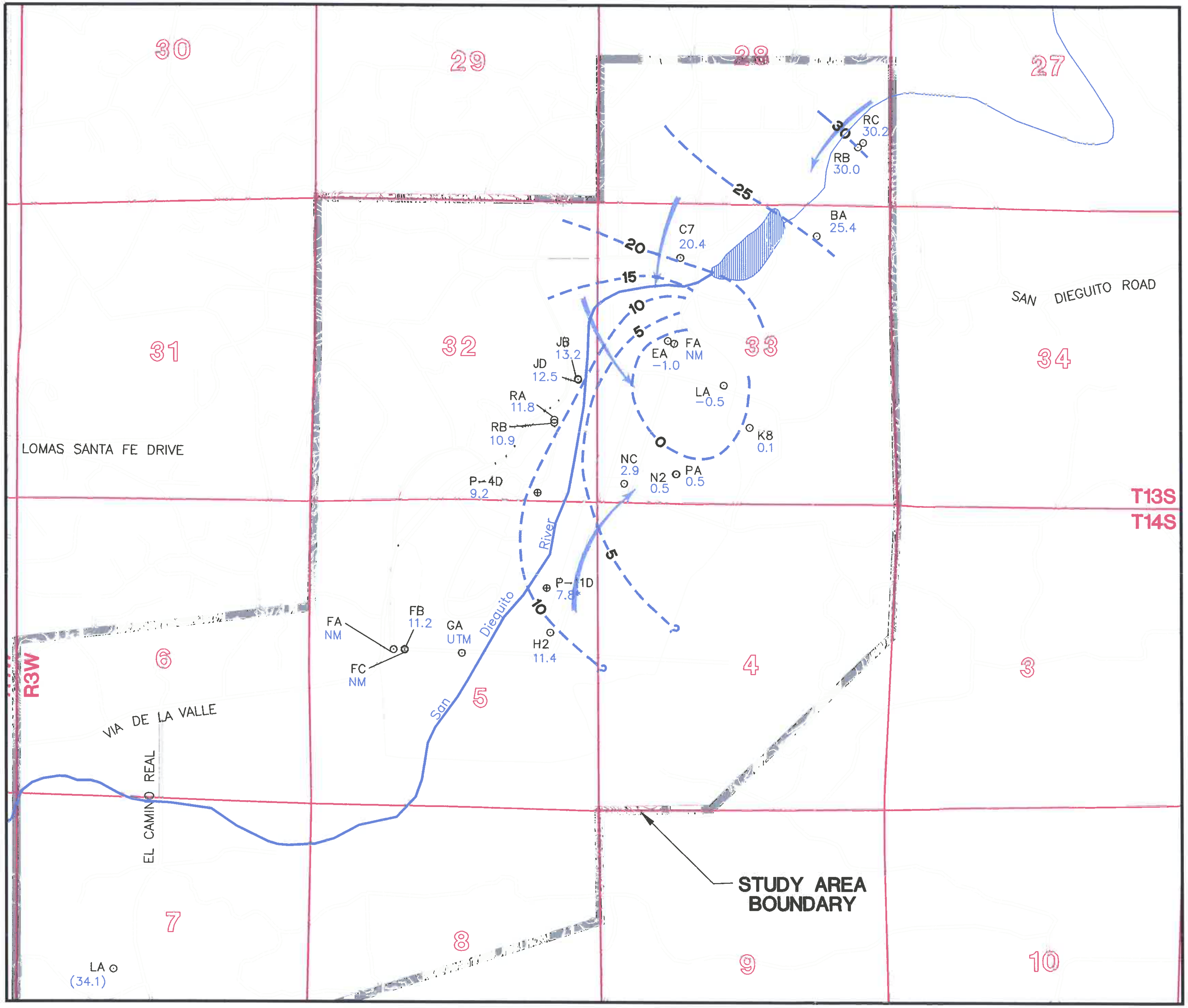
FIGURE A-29

PREP BY GTC REV BY RAN RPT NO. 689.1 220-1544 A



EXPLANATION

P–4D ⊕	DEEP PIEZOMETER
RC ○	WATER LEVEL MONITORING WELL
30.2	WATER LEVEL ELEVATION, IN FEET MEAN SEA LEVEL
(34.1)	WATER LEVEL ELEVATION NOT CONTOURED
*	WATER LEVEL RECORDED BY TRANSDUCER
NM	NOT MEASURED

?——20– – – –?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

INDICATES DIRECTION OF GROUNDWATER FLOW

NOTES: WATER LEVELS MEASURED ON OCTOBER 22–23, 2003

WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.

0 1,800 3,600

FEET

SAN DIEGUITO GROUNDWATER BASIN

DEEP WATER LEVEL ELEVATIONS
OCTOBER 2003

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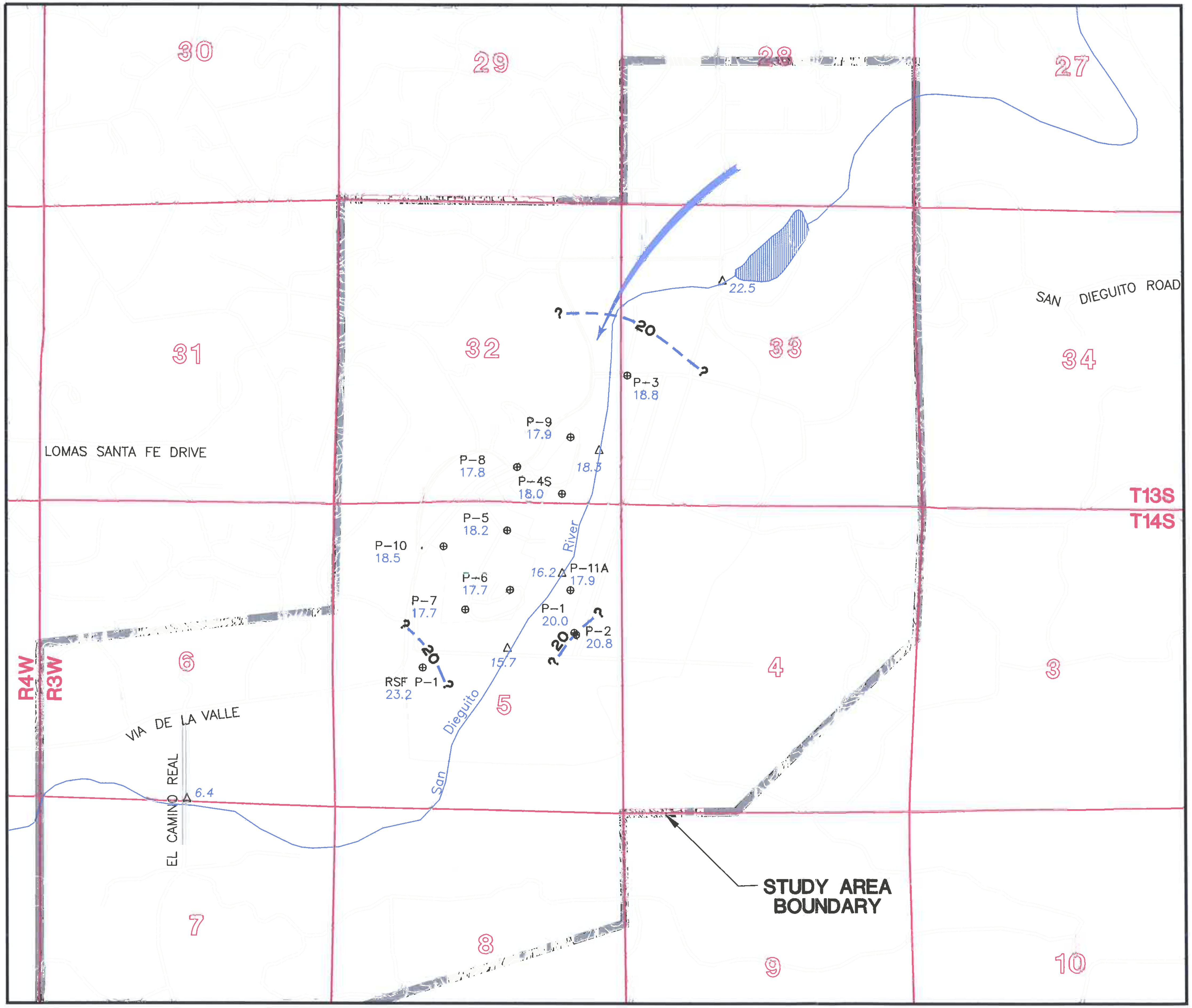
FIGURE A-30

PREP BY GTC REV BY RAN RPT NO. 689.09 220-1545 A



EXPLANATION

15.5 △	SURFACE WATER ELEVATION, SAN DIEGUITO RIVER
P-1 ⊕	SHALLOW PIEZOMETER
20.0	WATER LEVEL ELEVATION, IN FEET MEAN SEA LEVEL
(23.5)	WATER LEVEL ELEVATION NOT CONTOURED

?———— 20 - - - - - -?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

INDICATES DIRECTION OF GROUNDWATER FLOW

NOTES: WATER LEVELS MEASURED ON MARCH 11–12, 2004

WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.

N

0 1,800 3,600

FEET

SAN DIEGUITO GROUNDWATER BASIN

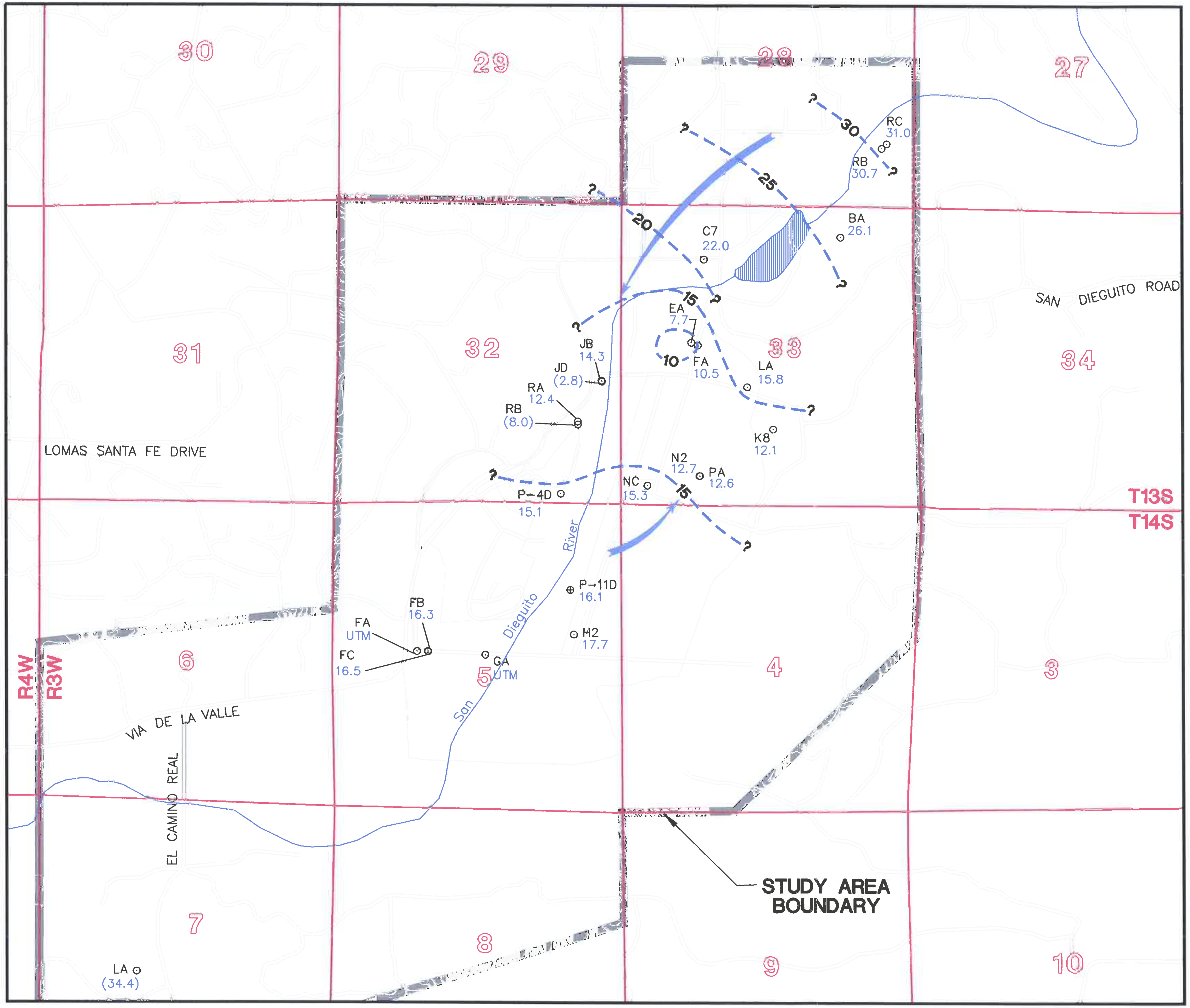
WATER TABLE ELEVATIONS
MARCH 2004

HARGIS+ASSOCIATES, INC
Hydrogeology/Engineering

08/04

FIGURE A-31

PREP BY GTC REV BY RAN RPT NO. 689.1 220-1546 A



EXPLANATION

P-11D ⊕	DEEP PIEZOMETER
EA ○	WATER LEVEL MONITORING WELL
7.7	WATER LEVEL ELEVATION, IN FEET MEAN SEA LEVEL
UTM	UNABLE TO MEASURE
(8.0)	WATER LEVEL ELEVATION NOT CONTOURED

?——— 20 – – – – ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

INDICATES DIRECTION OF GROUNDWATER FLOW

NOTES: WATER LEVELS MEASURED ON MARCH 11–12, 2004

WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.

N

0 1,800 3,600

FEET

SAN DIEGUITO GROUNDWATER BASIN

DEEP WATER LEVEL ELEVATIONS
MARCH 2004

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

08/04

FIGURE A-32

PREP BY GTC REV BY RAN RPT NO. 689.1 220-1547 A

APPENDIX B

GROUNDWATER SAMPLING DATA

APPENDIX B

GROUNDWATER SAMPLING DATA

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Section Page

TABLES

Table

APPENDIX B

GROUNDWATER SAMPLING DATA

1.0 SUMMARY OF GROUNDWATER SAMPLING

As part of the groundwater monitoring program, groundwater samples were collected during 2001 and 2002 from selected wells within the basin (Table B-1; Figure B-1). The 2001 groundwater sampling program involved the collection of samples from eight active production wells and four inactive wells. Four of the active wells were sampled again in 2002 as part of the aquifer-testing program. In addition, a groundwater sample was collected following the construction and development of the project Test Well in July 2003.

Prior to sample collection each well was purged until parameters stabilized, as noted in Table B-1, to ensure a representative sample. In most cases, the wells had been pumping due to owner operation (or aquifer testing in 2002), resulting in much more than three casing volumes purged. Groundwater samples for all wells were submitted to Del Mar Analytical, Irvine, California, for analysis of the following constituents:

- Cations (Calcium, Magnesium, Potassium, Sodium); Iron; Manganese;
- Anions (Bromide, Chloride, Fluoride, Nitrate, Nitrite, Phosphate, Sulfate); total dissolved solids (TDS); and
- EC, pH.

In addition, the 2001 groundwater samples were analyzed for boron, bromide, dissolved oxygen (DO), temperature, and oxidation-reduction potential (ORP). The 2002 and 2003 groundwater samples were also analyzed for silicon, bicarbonate, hardness, aluminum, barium, and turbidity.

2.0 SUMMARY OF FIELD ELECTRICAL CONDUCTIVITY MEASUREMENTS

Differences in groundwater quality can generally be characterized based on the TDS concentration in the water, which can in turn be estimated based on a field measurement of the EC of a water sample. During December 2004, as part of the monitoring program, field measurements of EC were made on groundwater samples collected from 13 piezometers and a shallow drainage sump to characterize the distribution of water quality within the shallow groundwater system in the vicinity of Morgan Run (Table B-3; Figure B-2). Field EC measurements were also made at nine locations along the San Dieguito River to allow comparison of the river quality with that of the shallow groundwater (Table B-4; Figure B-2).

The TDS of the groundwater and surface water was estimated based on the temperature corrected field EC data using the following formula:

$$\text{TDS (mg/l)} = \text{EC (umhos/cm)} * 0.65$$

Note: mg/l = milligrams per liter
umhos/cm = micromho per centimeter

Estimated TDS concentrations for groundwater and river water monitoring locations are summarized in Tables B-3 and B-4, respectively.

TABLE B-1
SUMMARY OF GROUNDWATER SAMPLING

					Field Parameters				
WELL IDENTIFIER	PROJECT WELL NUMBER	Date Sampled	Purge Method	Laboratory Sample ID	Temperature (Degrees Celcius)	pH	EC (umhos/cm)	Oxidation/ Reduction Potential (mV)	Dissolved Oxygen (mg/l)
RSF Polo Club No. 2R	5FC	08/27/01	a	5-FA	23.7	6.88	7,080	-80	3.35
RSF Polo Club No. 2R	5FC	04/11/02	a	RSF2R041102	25	7.12	6,660	<-50	0.94
Schoenfelder No 1 (North)	33FA	08/27/01	a	33-FA	25.4	7.37	1,854	-130	6.17
RSF Polo Club Test Well	5GA	08/27/01	b	5-GA	24	7.31	4,000	-125	1.38
Morgan Run East Well	33NC	08/27/01	b	East-Well	21.9	7.42	1,891	-155	1.24
Morgan Run Fairway 2	5H2	08/27/01	b	5-H2	21.3	7.7	5,905	-190	1.44
Morgan Run GunR	32JD	08/28/01	a	32-JE	21.4	6.84	3,700	87	4.16
Morgan Run GunR	32JD	02/28/02	a	GunR022802	19.8	6.82	3,850	115	4.3
Morgan Run No. 3 Green North	32RB	08/28/01	a	No.3 GRN.N.	21.8	7.03	3,880	100	3.23
Morgan Run No. 3 Green North	32RB	03/07/02	a	3GreenN030702	19.7	6.84	4,090	220	0.8
Rancho Del Mar	7BA	08/28/01	c	7-BA	23.9	7.1	7,540	45	2.09
H. Woodward Animal Center (North)	33K8	08/28/01	c	33-K8	23.5	7.22	6,490	-118	1.79
Fairbanks Country Day School	33PB	08/28/01	a	33-PB	25	6.93	3,570	-105	1.76
FBR Homeowners No 2 (West)	33LA	08/28/01	d	33-LD	21.6	7.04	4,690	-52	1.62
Rancho Paseanna, South (East)	33PA	09/14/01	d	RCHO PAS SO ACT	20.6	7.25	4,600	-15	1.4
Rancho Paseanna, South (East)	33PA	02/22/02	a	RPSA 022202	21.9	7.12	4,550	50	1.32
OMWD Test Well	-	7/23/2003	a	INJ-1	21.0	7.14	6,965	-124	-

Purge Methods

a	In place pump - pumping continuously
b	Temporary submersible pump placed in well; pumped until parameters verified to be stable
c	In place pump - pumping cyclically
d	In place pump - pumped until parameters verified to be stable

FOOTNOTES

umhos/cm = micromho per centimeter

mV = Millivolts

mg/l = Milligrams per liter

Note: Project well numbers ending in numbers are an abbreviation of the State well number. Well numbers ending in letters have not been assigned a State well number, but were designated by Hargis + Associates, Inc. based on a similar identifier scheme.

TABLE B-2

GROUNDWATER MONITORING
GENERAL MINERAL AND PHYSICAL ANALYSIS RESULTS

YEAR SAMPLED		2001	2002	2001	2001	2001	2001	2002	2001	2002	2001	2001	2001	2001	2001	2001	2002	2003			
	PROJECT WELL NUMBER	5-FA	5-FA	5-GA	5-H2	7-BA	32-JD*	32-JD	32-RB	32-RB	33-FA	33-K8	33-LA**	33-PB	33-NC	33-PA	33PA				
	WELL IDENTIFIER	RSF Polo Club No. 2R	RSF Polo Club No. 2R	RSF Polo Club Test Well	Morgan Run Fairway 2	Rancho Del Mar	Morgan Run Newest Gun R	Morgan Run Newest Gun R	Morgan Run No. 3 Green North	Morgan Run No. 3 Green North	Schoenfelder No. 1 North	Helen Woodward New	Fairbanks HOA El Apajo W. #2	Fairbanks Country Day School	Morgan Run East Well	Rancho Paseana South Active	Rancho Paseana South Active	OMWD Test Well			
COMPOUND	UNITS																		MINIMUM	MAXIMUM	AVERAGE
Aluminum	mg/l	NA	<0.050	NA	NA	NA	NA	<0.050	NA	NA	NA	NA	NA	NA	NA	NA	0.056	<0.050	<0.050	0.056	NA
Barium	mg/l	NA	0.27	NA	NA	NA	NA	0.32	NA	0.15	NA	NA	NA	NA	NA	NA	0.27	NA	0.15	0.32	0.25
Boron	mg/l	0.93	NA	1.1	0.76	2.7	0.22	NA	0.25	NA	0.24	1.3	0.28	0.20	0.41	0.38	NA	0.57	0.20	1.1	0.70
Calcium	mg/l	290	290	380	170	390	220	240	220	240	150	220	300	230	96	200	190	320	96	390	241
Iron	mg/l	2.0	0.21	470	18	<0.080	<0.040	0.044	0.049	<0.040	2.5	4.8	1.3	5.3	25	2.6	<0.040	0.280	<0.040	470	31.3(1)
Magnesium	mg/l	190	140	320	290	93	110	130	130	130	78	170	170	120	61	120	110	190	61	320	152
Manganese	mg/l	1.6	1.4	9.1	0.48	0.97	0.89	0.99	0.97	1.0	1.3	1.5	2.5	3.4	0.96	1.4	1.3	1.5	0.48	9.1	2.2
Potassium	mg/l	50	53	200	19	18	12	13	11	11	9.3	62	18	17	14	24	28	52	9.3	200	42
Sodium	mg/l	1,200	1,000	630	920	1,400	410	400	460	490	310	1,100	440	350	390	660	660	930	310	1,400	681
Bromide	mg/l	5.0	NA	<2.5	<2.5	<5.0	<5.0	NA	<5.0	NA	1.0	<5.0	<5.0	<2.5	<1.0	<5.0	NA	NA	<1.0	5.0	3.0(2)
Chloride	mg/l	2,300	1,800	1,000	1,700	2,400	1,000	880	940	860	600	1,900	1,400	930	490	1,400	1,100	1,600	490	2,300	1,268
Fluoride	mg/l	<2.5	<5.0	<2.5	<2.5	<5.0	<5.0	<2.5	<5.0	<2.5	<1.0	<5.0	<5.0	<2.5	<1.0	<5.0	<2.5	<2.5	<1.0	<5.0	ND
Zinc	mg/l	NA	0.14	NA	NA	NA	NA	0.084	NA	0.024	NA	NA	NA	NA	NA	NA	0.033	0.056	0.024	0.14	0.08
Nitrate-N	mg/l	<0.55	<1.1	<0.55	<0.55	<1.1	1.7	2.0	2.8	1.4	<0.22	<1.1	<1.1	<0.55	0.22	<1.1	<0.55	<0.55	<0.22	2.8	1.6(2)
Nitrite-N	mg/l	<7.5	<1.50	<0.75	<3.0	<7.5	<3.0	<1.5	<3.0	<0.750	<1.5	<3.0	<3.0	<1.5	<0.75	<1.5	<0.75	<0.75	<0.75	<7.5	ND
Orthophosphate	mg/l	<2.5	0.56	<2.5	<2.5	<5.0	<5.0	<0.050	<5.0	0.097	<1.0	<5.0	<5.0	<5.0	<1.0	<5.0	<0.050	NA	<1.0	<5.0	NA
Sulfate	mg/l	770	610	530	840	920	510	440	570	510	410	650	510	470	430	580	400	610	410	920	573
TDS	mg/l	4,600	4,400	2,500	3,700	5,100	2,600	2,400	2,500	2,600	1,600	4,200	3,000	2,300	1,600	3,100	2,800	4,400	1,600	5,100	3,082
EC	umhos/cm	7,080	7,100	4,000	5,905	7,540	3,700	4,000	3,880	4,200	1,854	6,490	4,690	3,570	1,891	4,600	4,800	6,700	1,891	7,540	4,687
DO	mg/l	3.35	NA	1.38	1.44	2.09	4.16	NA	3.23	NA	6.17	1.79	1.62	1.76	1.24	1.4	NA		1.24	6.17	2.59
pH	pH units	6.88	7.59	7.31	7.7	7.10	6.84	7.14	7.03	6.91	7.37	7.22	7.04	6.93	7.42	7.25	7.29	7.37	6.84	7.7	7.22
Temperature	°C	23.7	NA	24.0	21.3	23.9	21.4	NA	21.8	NA	25.4	23.5	21.6	25.0	21.9	20.6	NA	21	20.6	25.4	22.68
Redox Potential	mv	-80	NA	-125	-190	45	87	NA	100	NA	-130	-118	-52	-105	-155	-15	NA		-190	100	-58
Odor	T.O.N.	NA	NA	NA	<1.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	--	--	--
Turbidity	NTU	NA	14	NA	180	NA	NA	<1.0	NA	<1.0	NA	NA	NA	NA	NA	NA	26	NA	<1.0	180	NA
MBAS	mg/l	NA	NA	NA	<0.10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--
Color	Color units	NA	NA	NA	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--
Silicon	mg/l	NA	32	NA	NA	NA	NA	31	NA	30	NA	NA	NA	NA	NA	NA	29	33	29	32	31
Bicarbonate	mg/l	NA	330	NA	NA	NA	NA	260	NA	340	NA	NA	NA	NA	NA	NA	420	380	260	420	344
Hardness	mg/l	NA	1,300	NA	NA	NA	NA	1,100	NA	1,100	NA	NA	NA	NA	NA	NA	1,000	1,600	1,000	1,300	1,191

FOOTNOTES

(1) Average calculated using detected and non-detected values.
(2) Average calculated using only detected values.

mg/l = Milligrams per liter
NA = Not analyzed
(<) = Less than
TDS = Total dissolved solids
EC = Electrical conductivity
DO = Dissolved oxygen
MBAS = Methylene Blue – Activated Substances
ND = Non-detect
umhos/cm = Micromhos per centimeter
°C = Degrees centigrade
mv = Millivolts
T.O.N. = Threshold Odor Number
NTU = Nephalometric turbidity units
NA = Not analyzed
(--) = Not applicable
* = Well ID revised during well inventory, Lab Report indicates former Well ID: 32-JE
** = Well ID revised during well inventory, Lab Report indicates former Well ID: 33-LD

TABLE B-3
SUMMARY OF ELECTRICAL CONDUCTIVITY MEASUREMENTS IN PIEZOMETERS

LOCATION	DATE	EC (umhos/cm)	Estimated TDS (mg/l)
P-1	12/26/2003	7,000	4,550
P-3	12/23/2003	6,200	4,030
P4-S	12/23/2003	6,600	4,290
P-4D	12/23/2003	3,900	2,535
P-5	12/23/2003	3,000	1,950
P-6	12/23/2003	3,900	2,535
P-7	12/23/2003	3,300	2,145
P-8	12/23/2003	6,800	4,420
P-9	12/23/2003	2,800	1,820
P-10	12/23/2003	2,600	1,690
P-11A	12/26/2003	4,600	2,990
P-11B	12/26/2003	3,400	2,210
Rancho Paseana Sump	12/23/2003	9,200	5,980
RSF Polo Club RSF P-1	12/23/2003	7,800	5,070

FOOTNOTES:

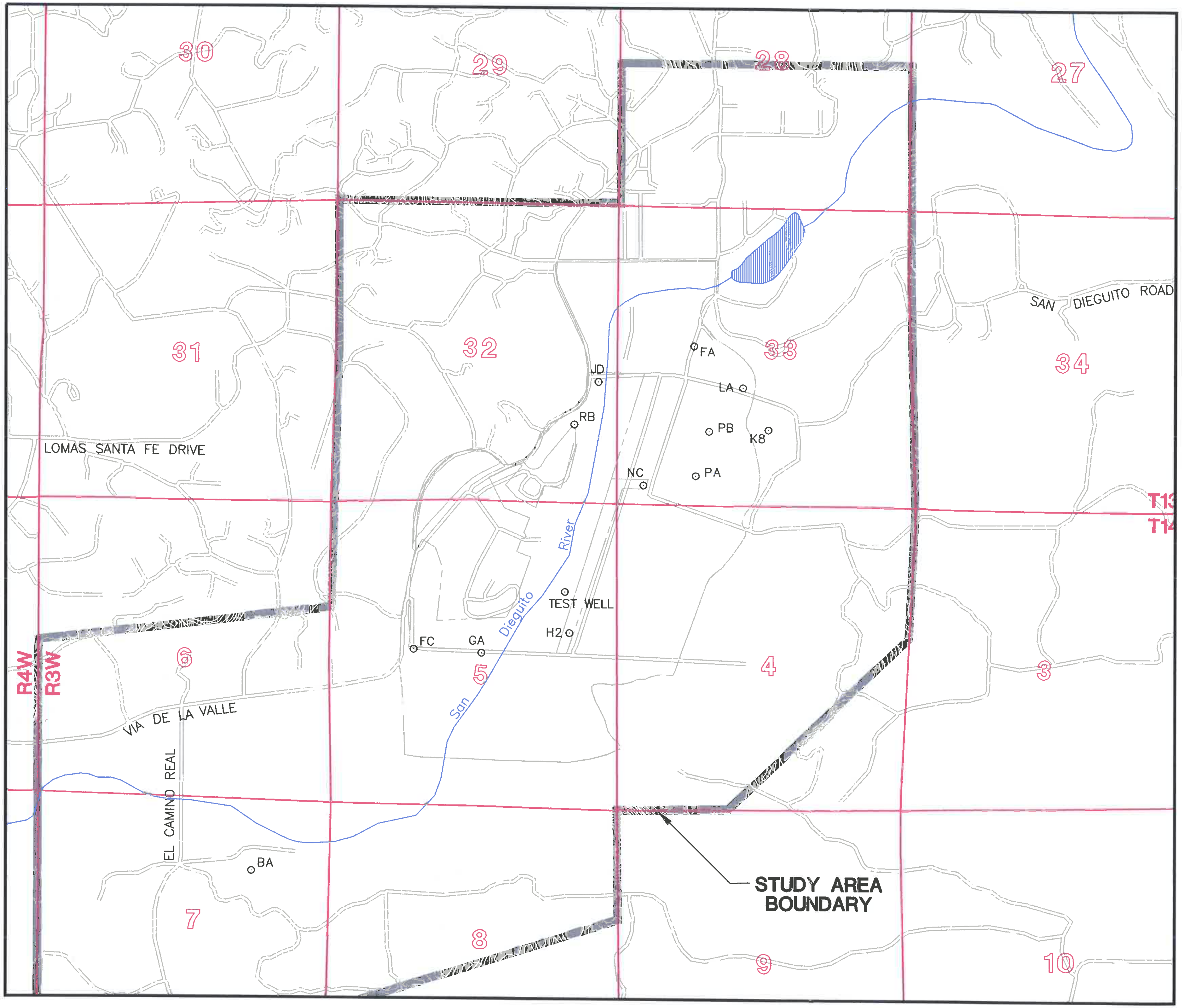
EC = Electrical conductivity
umhos/cm = Micromhos per centimeter
TDS = Total dissolved solids
mg/l = Milligrams per liter

TABLE B-4
SUMMARY OF ELECTRICAL CONDUCTIVITY MEASUREMENTS
SURFACE WATER

LOCATION	DATE	EC (umhos/cm)	Estimated TDS (mg/l)	COMMENTS
San Dieguito River Monitoring Station ID				
SD River 1	12/23/2003	2,700	1,755	Concrete River Crossing with corrogated pipes
SD River -2	12/23/2003	4,400	2,860	Concrete River Crossing with corrogated pipes
Via De Santa Fe Bridge	12/23/2003	4,000	2,600	
MEC River Mon Station	12/23/2003	3,900	2,535	Water depth = 2 feet
Morgan Run North Bridge	12/23/2003	3,900	2,535	
Morgan Run North Bridge	12/26/2003	3,800	2,470	Day after rain
Morgan Run Middle Bridge	12/23/2003	4,000	2,600	
Morgan Run Middle Bridge	12/26/2003	3,740	2,431	Day after rain
Morgan Run South Bridge	12/23/2003	4,100	2,665	
Morgan Run South Bridge	12/26/2003	3,400	2,210	Day after rain
El Camnino Bridge East Bank	12/23/2003	5,400	3,510	E. Bank Shallow (6" depth)
El Camnino Bridge	12/23/2003	7,500	4,875	Shallow Depth (Upper 4")
El Camnino Bridge	12/23/2003	9,500	6,175	Mid Depth (1 foot)
El Camnino Bridge	12/23/2003	11,200	7,280	Deep (2 feet)
SD Riv 3, SW Corner Equestrian Facility	12/23/2003	17,000	11,050	Shallow Depth (Upper 4")
SD Riv 3, SW Corner Equestrian Facility	12/23/2003	37,000	24,050	Mid Depth (1 foot)
SD Riv 3, SW Corner Equestrian Facility	12/23/2003	47,000	30,550	Deep (1.5 foot)

FOOTNOTES:

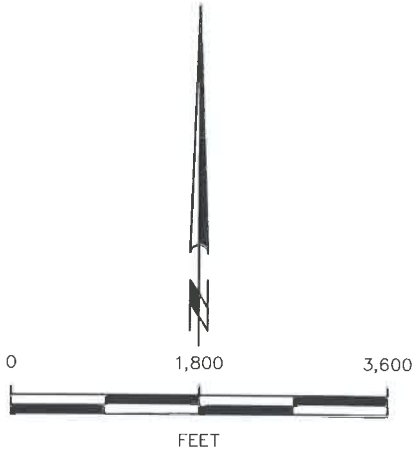
EC = Electrical conductivity
umhos/cm = Micromhos per centimeter
TDS = Total dissolved solids
mg/l = Milligrams per liter



EXPLANATION

GA ○ GROUNDWATER SAMPLE LOCATION WITH WELL IDENTIFIER

NOTE: WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.



SAN DIEGUITO GROUNDWATER BASIN

GROUNDWATER SAMPLING LOCATIONS

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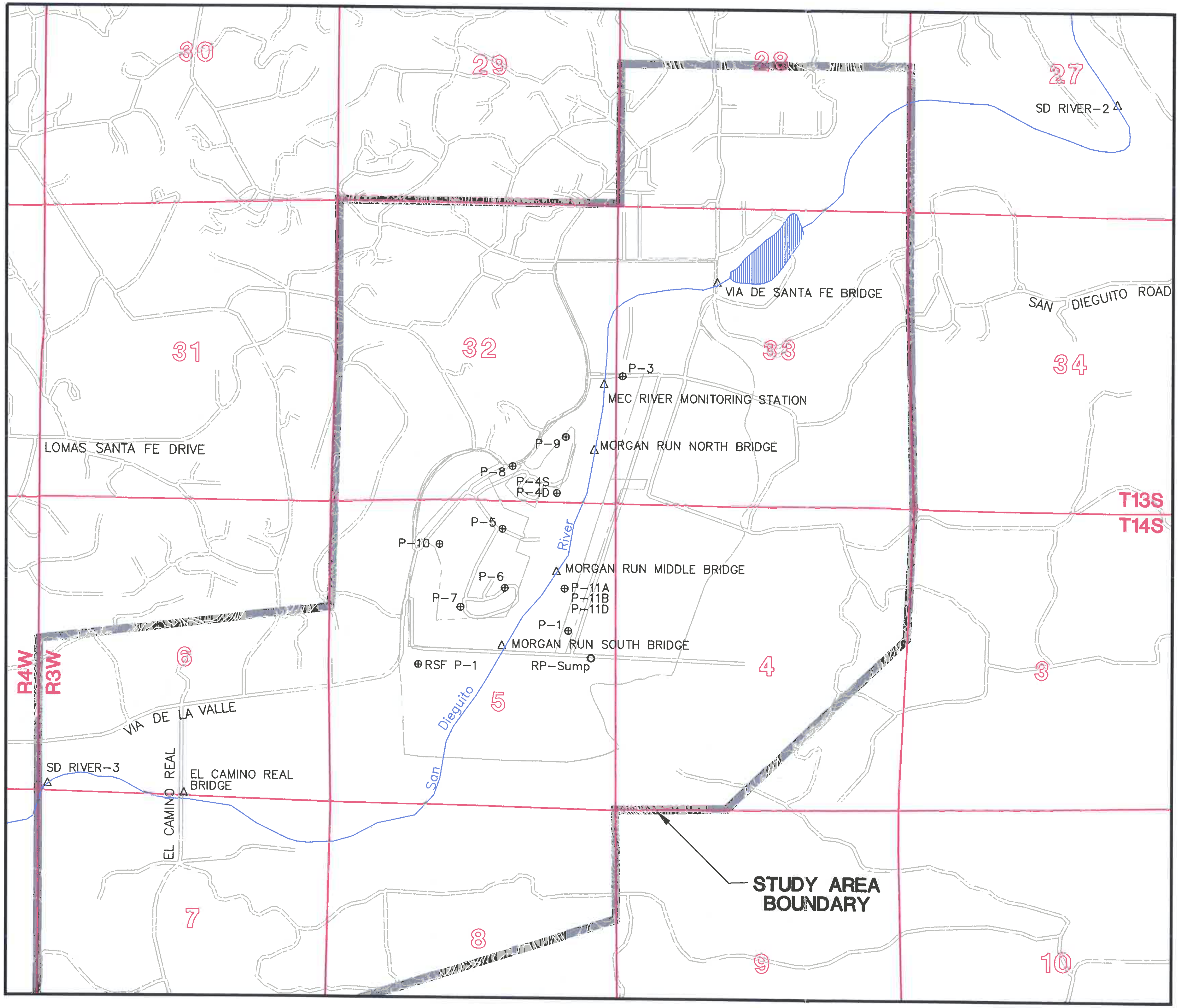
FIGURE B-1

PREP BY GTC REV BY RAN RPT NO. 689.09 410-4867 A



EXPLANATION

△	SURFACE WATER MONITORING LOCATION SAN DIEGUITO RIVER
P-1 ⊕	PIEZOMETER
○	SUMP

NOTE: MONITORING LOCATION SD RIVER-1 IS NOT SHOWN. LOCATION IS 2.6 MILES UPSTREAM FROM SD RIVER-2

N

0 1,800 3,600

FEET

SAN DIEGUITO GROUNDWATER BASIN

FIELD EC
MONITORING LOCATIONS

HARGIS+ASSOCIATES, INC
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FIGURE B-2

PREP BY SLB REV BY RAN RPT NO. 689.1 410-4868 A

ATTACHMENT B-1

GROUNDWATER SAMPLING LABORATORY DATA

(CD-ROM)

APPENDIX C

GEOCHEMICAL EVALUATION

APPENDIX C

GEOCHEMICAL EVALUATION

1.0 INTRODUCTION

A preliminary geochemical evaluation was performed to assess whether injected water is compatible with native groundwater and to what extent precipitation of minerals would be expected. Geochemical simulations using the USGS model PHREEQC were performed to calculate equilibrium conditions between dissolved constituents in solution to assess the potential for in situ mineral precipitation which may result in a reduction in aquifer permeability, ASR efficiency, or recovered water quality.

phases at or near saturation were identified and were flagged for output in subsequent mixing simulations.

2) Inorganic water chemistry data for North City was then entered into PHREEQC and a simulation was performed to simulate mixing of North City water and monitor well 5-H2 water at a ratio of 50/50. Mineral phases at or near saturation were identified and were flagged for output in subsequent mixing simulations.

3) A model run was setup to perform mixing calculations for North City water and water from monitor well 5-H2 in a series of mixing steps in 10 percent increments. The saturation indices of the previously identified mineral phases were output at each of the mixing increments. In other words, the percentage of North City water in the mixing simulations was increased by 10 percent in each subsequent simulations while the percentage of monitor well 5-H2 water was decreased by 10 percent, such that the initial simulation started out with 100 percent monitor well 5-H2 water and the final simulation ended with 100 percent North City water.

4) Saturation indices for mineral phases previously identified were plotted for each of the mixing steps. The resulting plots show whether individual mineral phases become more or less soluble as the two water types are mixed in varying proportions.

5) Steps 2) through 4) were also performed using expected 4S water chemistry data instead of North City water chemistry.

4.0 MODEL LIMITATIONS

The modeling effort is subject to several limitations, both in the initial data quality and in the model itself. Analytical data used in the model may not be representative of conditions across the site. Additionally, bicarbonate and silica were not measured in the field. Bicarbonate concentrations were estimated using a charge balance approach. Silica concentrations are expected to be relatively low and precipitation of minerals containing silica is likely to be kinetically limited.

The equilibrium approach utilized in this modeling effort does not account for kinetically controlled reactions. Equilibrium conditions may not exist for all mineral phases and aqueous species modeled. Adsorption reactions were not simulated during this modeling study because they are not likely to significantly alter mineral precipitation.

One of the most difficult aspects of this type of modeling is identifying mineral phases that may control the water chemistry. The saturation indices of mineral phases near saturation were evaluated during this modeling effort, but no mineralogical analyses were available for site soils, and, therefore, mineral phases were not included in the model simulations. The presence of these minerals may control the solubility of constituents dissolved in groundwater and could, therefore, affect predictions of the potential changes in aqueous concentrations or saturation indices as the water types are mixed in the presence of these minerals. However, this type of analyses is beyond the scope of this screening level modeling effort.

TABLE C-1

WATER QUALITY COMPARISON

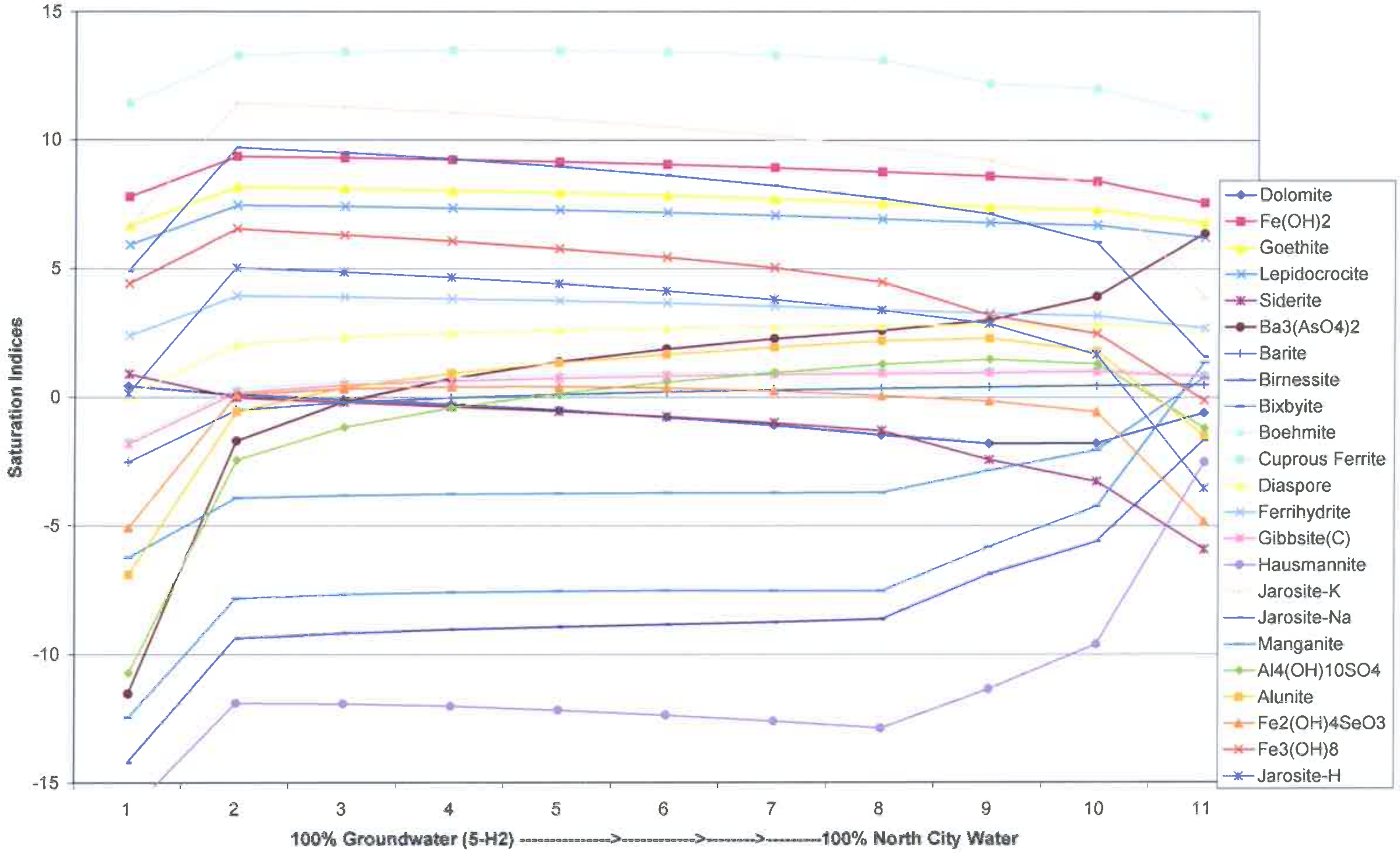
		NORTH CITY RECLAMATION PLANT(1)	4S WWTP EXPECTED EFFLUENT(2)	MONITOR WELL 5-H2
COMPOUND	UNITS	AVERAGE		
Boron	mg/l	0.508	0.51	0.76
Calcium	mg/l	57.6	NA	170
Iron	mg/l	0.153	0.07	18
Magnesium	mg/l	23.1	NA	290
Manganese	mg/l	0.074	0.05	0.48
Potassium	mg/l	11.0	NA	19
Sodium	mg/l	147	NA	920
% Sodium	mg/l/%	59	49	NA
Bromide	mg/l	NA	NA	<2.5
Chloride	mg/l	187	175	1,700
Fluoride	mg/l	0.4	0.4	<2.5
Nitrate-N	mg/l	NA	NA	<0.55
Nitrite-N	mg/l	NA	NA	<3.0
Orthophosphate	mg/l	NA	NA	<2.5
Sulfate	mg/l	226	246	840
TDS	mg/l	772	906	3,700
EC	µmhos/cm	NA	NA	5,905
DO	mg/l	NA	NA	1.44
PH	pH units	7.42	6.5 – 8.5	7.7
Temperature	°C	NA	NA	21.3
Redox Potential	mv	NA	NA	-190
Odor	T.O.N.	NA	NA	21.0
Turbidity	NTU	1.5	2	180
MBAS	mg/l	0.17	0.08	<0.10
Color	Color units	NA	NA	20

FOOTNOTES

(1) Average of data from April – December 2000.
(2) From Table 2-2 of Montgomery Watson report.

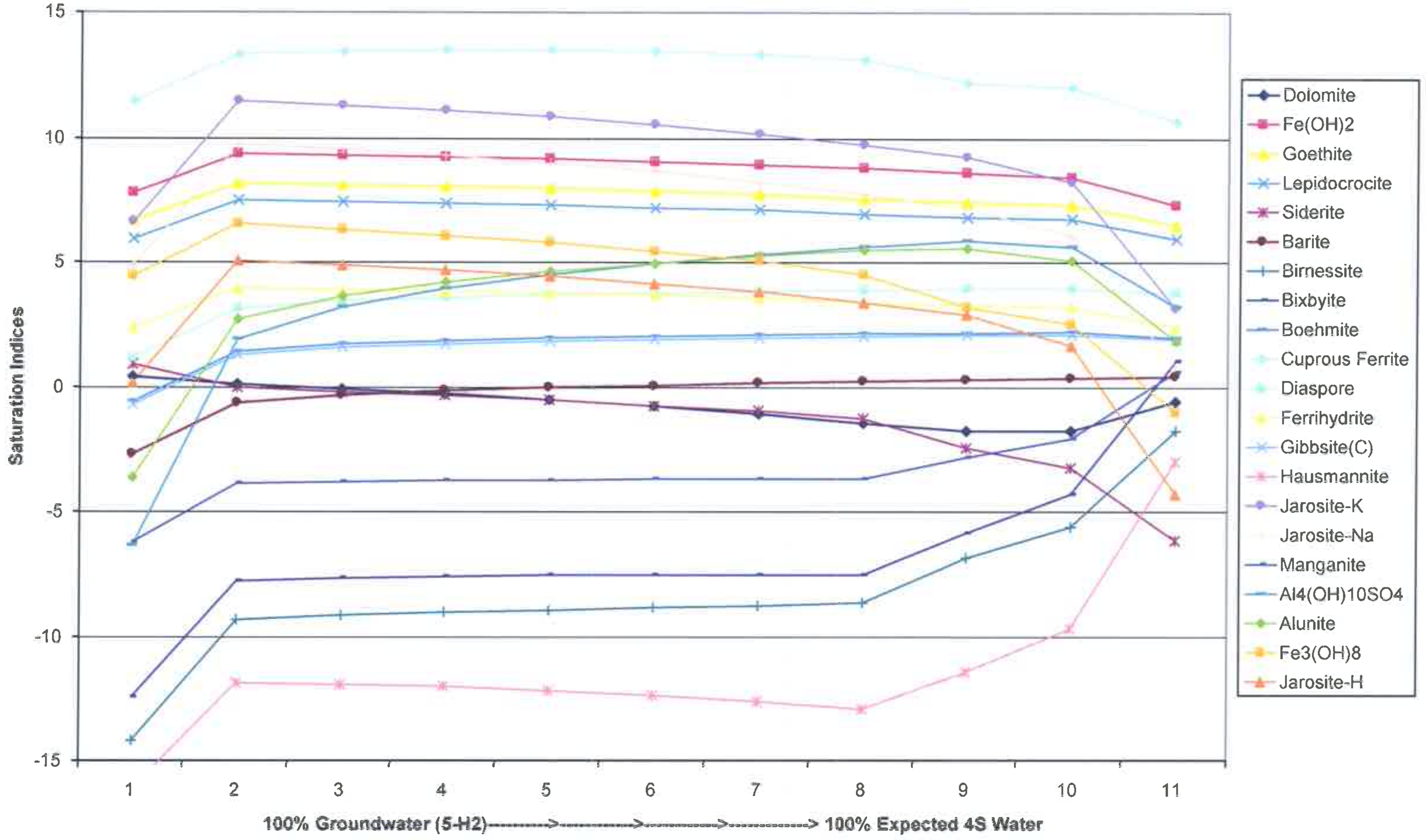
mg/l = Micrograms per liter
(<) = Less than
% Sodium = Na ÷ (Na + Ca + Mg + K) x 100%
TDS = Total dissolved solids
EC = Electrical conductivity
DO = Dissolved oxygen
MBAS = Methylene Blue – Activated Substances
µmhos/cm = Micromhos per centimeter
°C = Degrees centigrade
mv = Millivolts
T.O.N. = Threshold Odor Number
NTU = Nephalometric turbidity units
NA = Not analyzed
WWTP = Waste Water Treatment Plant

Figure C-1. Saturation Indices for North City Injection into 5-H2



689.2002-2 Fig c1
10/16/2002

Figure C-2. Saturation Indices for Expected 4S Injection into 5-H2



689.2002-2 Fig c2
10/16/2002

APPENDIX D

AQUIFER TESTING RESULTS

APPENDIX D

AQUIFER TESTING RESULTS

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APPENDIX D

AQUIFER TESTING RESULTS

1.0 INTRODUCTION

An aquifer testing program was conducted in the San Dieguito groundwater basin in the vicinity of the Morgan Run to obtain site-specific estimates of aquifer parameters. Constant rate aquifer pumping tests were performed on four active production wells located in the vicinity of the proposed Aquifer Storage and Recovery Program (ASR). Aquifer tests were conducted on RSF Polo Club No. 2R (5FC), Morgan Run No. 3 Green North (32RB), Morgan Run GunR (32JD), and Rancho Paseana South (East) (33PA).

An aquifer test scheduled for the Morgan Run Fairway 2 well (5H2) could not be completed. When the well was pumped using a temporary test pump installed in the well, it was found that the pumping level rapidly drew down to the pump intake. This response indicated that the well had become plugged and could no longer yield water at a sufficient rate to conduct the planned test.

In addition to the planned aquifer tests, useful drawdown and recovery data were obtained from the MacFarlane N. well (33EA) in response to pumping at the Schoenfelder No. 2 (south) well (33FB). Locations of pumping and observation wells utilized in the aquifer testing program are shown in Figure D-1.

2.0 AQUIFER TEST PROCEDURES

Details of the aquifer tests are summarized in Table D-1. Aquifer test duration ranged from 47 to 218 hours and was often controlled by owner water demands.

Drawdown and recovery water level data were recorded in the pumped and observation wells using a combination of pressure transducers and manual water level measurements. The discharge rate for planned aquifer tests was measured with in-line flow meters and verified periodically with totalizer readings. The discharge rate for the unplanned Schoenfelder No. 2 (South) well pumping event was determined from a well water consumption report obtained from the water user.

3.0 RESULTS

Aquifer test data were initially evaluated for effects of regional water level changes and barometric pressure effects, which would require a correction be applied to the data. None of the water level data used for analysis required correction for regional or barometric effects.

Review of the RSF Polo Club No. 2R aquifer test transducer data indicated that the pump temporarily went off for approximately 80 minutes each night for the duration of the test. It appears that when the pump subsequently resumed pumping each night, the water level quickly returned to the level prior to the pump shutting off. This suggests that data analysis can be performed, ignoring the recovery data from each night, as if the well was pumped continuously for the duration of the pumping period at the lower, averaged flowrate. The average flowrate for the duration of the test was recalculated based on totalizer readings.

3.1 DATA ANALYSIS METHODOLOGY

The computer application AquiferWin32 (Envirionmental Simulations Inc., 1999) was used to assist in drawdown and recovery data analysis of the aquifer tests (Figures D-2 thru D-14). The method of analysis used to estimate the transmissivity and storage coefficient (observation wells only) from pumped well and observation well drawdown data was the Cooper-Jacob straight line method (Cooper and Jacob, 1946). The equations used to solve for transmissivity and storage coefficient in the Cooper-Jacob method are:

$$T = 2.3Q/(4\pi\Delta s)$$

and

$$S = 2.25Tt_0/r^2$$

where

T = transmissivity

Q = constant well discharge rate

Δs = change in water level drawdown during one log cycle of time

t_0 = intercept time at which the drawdown is extrapolated to be 0.0

r = radial distance from the pumped well to the observation well

Recovery data were analyzed using the Theis Recovery method of analysis in pumped wells and observation wells, where applicable. A straight line was fit to the appropriate portion of each data set on a semi-log plot, and transmissivity was calculated. The equation used to solve for transmissivity in the Theis Recovery analysis method is:

$$T = 2.3Q/(4\pi\Delta s)$$

where

T = transmissivity

Q = constant well discharge rate

Δs = change in residual drawdown during one log cycle of time

3.2 DATA ANALYSIS RESULTS

Results of aquifer test data analysis are shown on Figures D-2 thru D-14, and summarized in Table D-2.

4.0 REFERENCES

Environmental Simulations, Inc., 1999. AquiferWin32 Professional Version 2.0.

Cooper, H.H. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well field history. Am. Geophys. Union Trans. Vol. 27, pp. 526-534.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. Trans. Amer. Geophys. Union, Vol. 16, pp. 519-524.

TABLE D-1

AQUIFER TEST SUMMARY

Pumped Well Owner Name/Well Identifier	Pumped Well Project Well Number	Date of Pump Test	Average Discharge Rate (gpm)	Duration of Pumping (hours)	Observation Well(s) (With Transducers)
RSF Polo Club No. 2R	5FC	April 9, 2002 - April 18, 2002	141	218	RSF Polo Club No. 2 (5FB), RSF Polo Club Test Well (5GA)
Morgan Run No. 3 Green North	32RB	March 4, 2002 - March 9, 2002	775	69	Morgan Run No. 3 Green North (Old 2) (32RA), Morgan Run GunR (32JD)
Morgan Run GunR	32JD	February 27, 2002 - March 3, 2002	384	47	Morgan Run No. 3 Green North (Old 2) (32RA)
Rancho Paseana South (East)	33PA	February 19, 2002 - February 25, 2002	675	66.5	Rancho Paseana South (West) (33N2), Morgan Run East Well (33NC)
Schoenfelder No. 2 (South)	33FB	January 11, 2002 - January 22, 2002[1]	727[2]	65.3	MacFarlane N. (33EA)
Morgan Run Fairway 2	5H2	April 2, 2002	Drawdown to pump after 1 minute - Aquifer Test Discontinued		

Footnotes

1 Not a controlled pumping period

2 Pumping rate determined from a well water consumption report obtained from the water user

gpm = gallons per minute

TABLE D-2

SUMMARY OF AQUIFER TEST ANALYSIS RESULTS

Pumped Well	Analyzed Well	Transmissivity (ft^2/day) Recovery Data	Transmissivity (ft^2/day) Drawdown Data Cooper-Jacob	Storage Coefficient
RSF Polo Club No. 2R (5FC)	RSF Polo Club No. 2 (5FB)	Not Available[1]	1,900	Not Calculated
	RSF Polo Club Test Well (5GA)	Not Available[1]	1,700	0.00095
Morgan Run No. 3 Green North (32RB)	Morgan Run No. 3 Green North (Old 2) (32RA)	11,000	13,000	0.011
	Morgan Run GunR (32JD)	12,000	13,000	0.00036
Morgan Run GunR (32JD)	Morgan Run No. 3 Green North (Old 2) (32RA)	7,200	9,400	0.00041
	Morgan Run GunR (32JD)	7,400	NA	NA
Rancho Paseana South (East) (33PA)	Rancho Paseana South (West) (33N2)	2,500	3,500	Not Calculated
	Morgan Run East Well (33NC)	2,600	2,900	0.0021
Schoenfelder No. 2 (South) (33FB)	MacFarlane N. (33EA)	2,600	3,700	0.027

1 Recovery data not available due to well owner water demands
NA Not Applicable to pumped well drawdown data

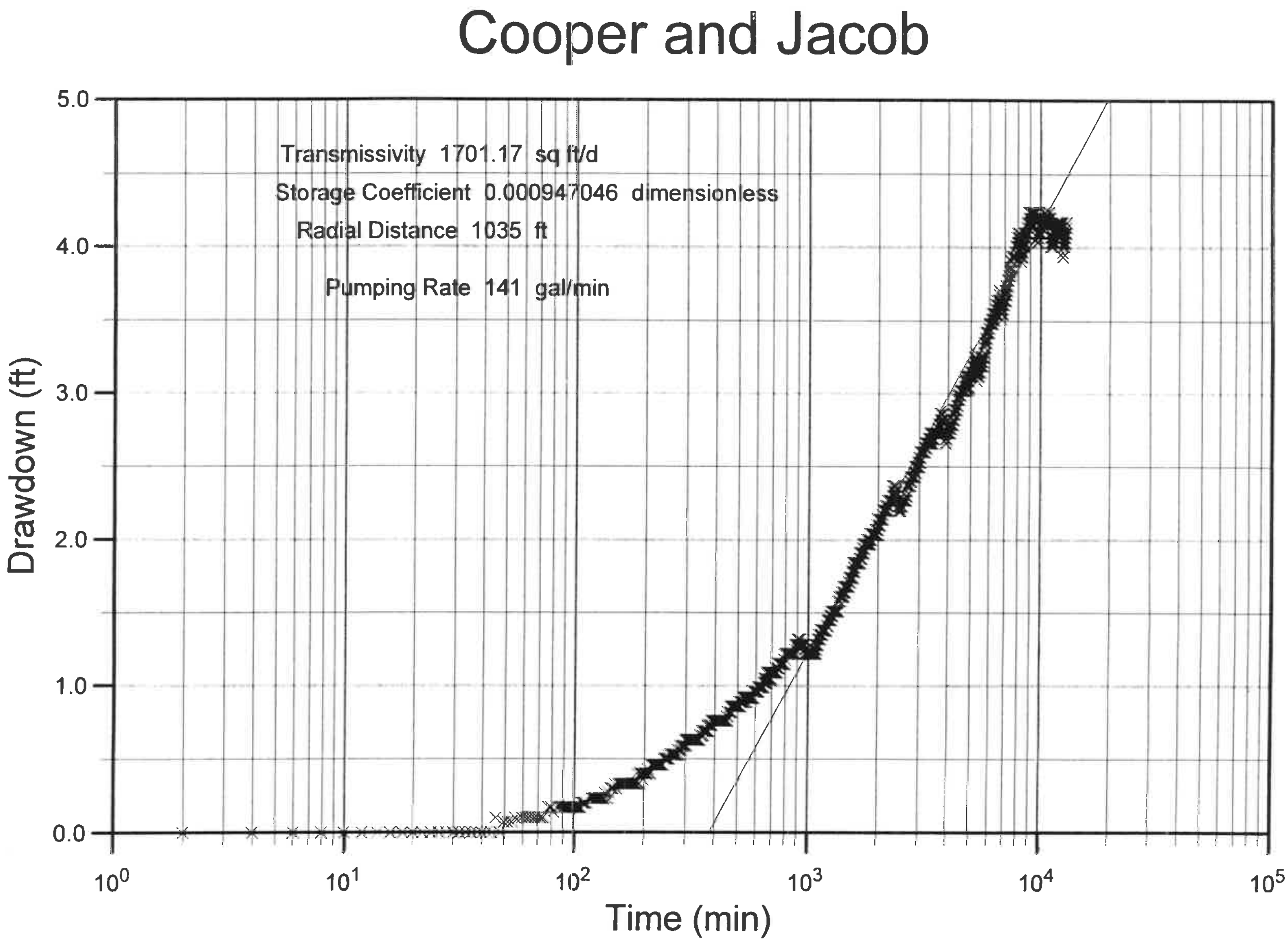

Figure D-2. Observation Well RSF Polo Club Test Well Cooper Jacob Analysis for RSF Polo Club No. 2R Aquifer Test

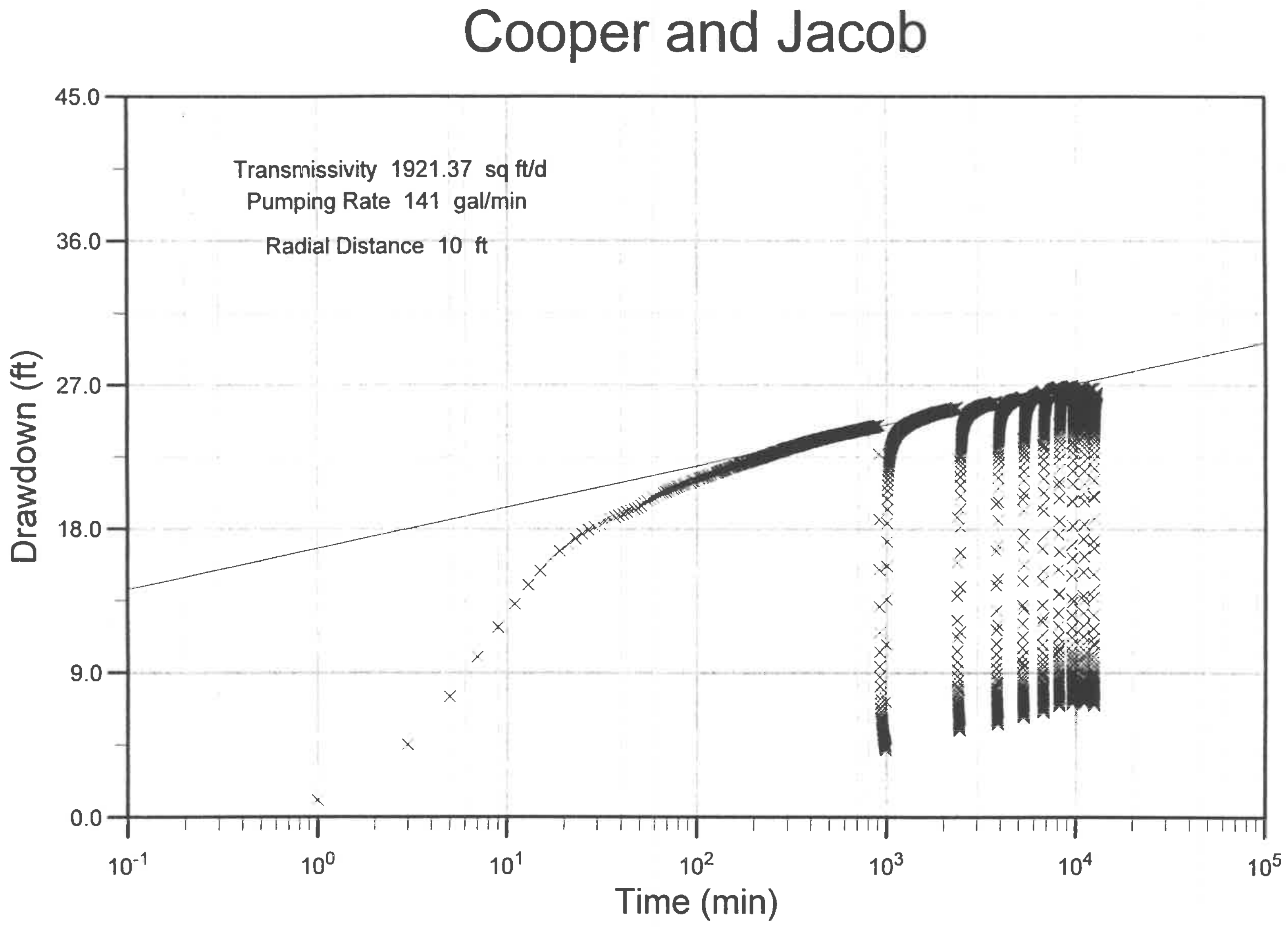

Figure D-3. Observation Well RSF Polo Club No. 2 Cooper-Jacob Analysis for RSF Polo Club No. 2R Aquifer Test

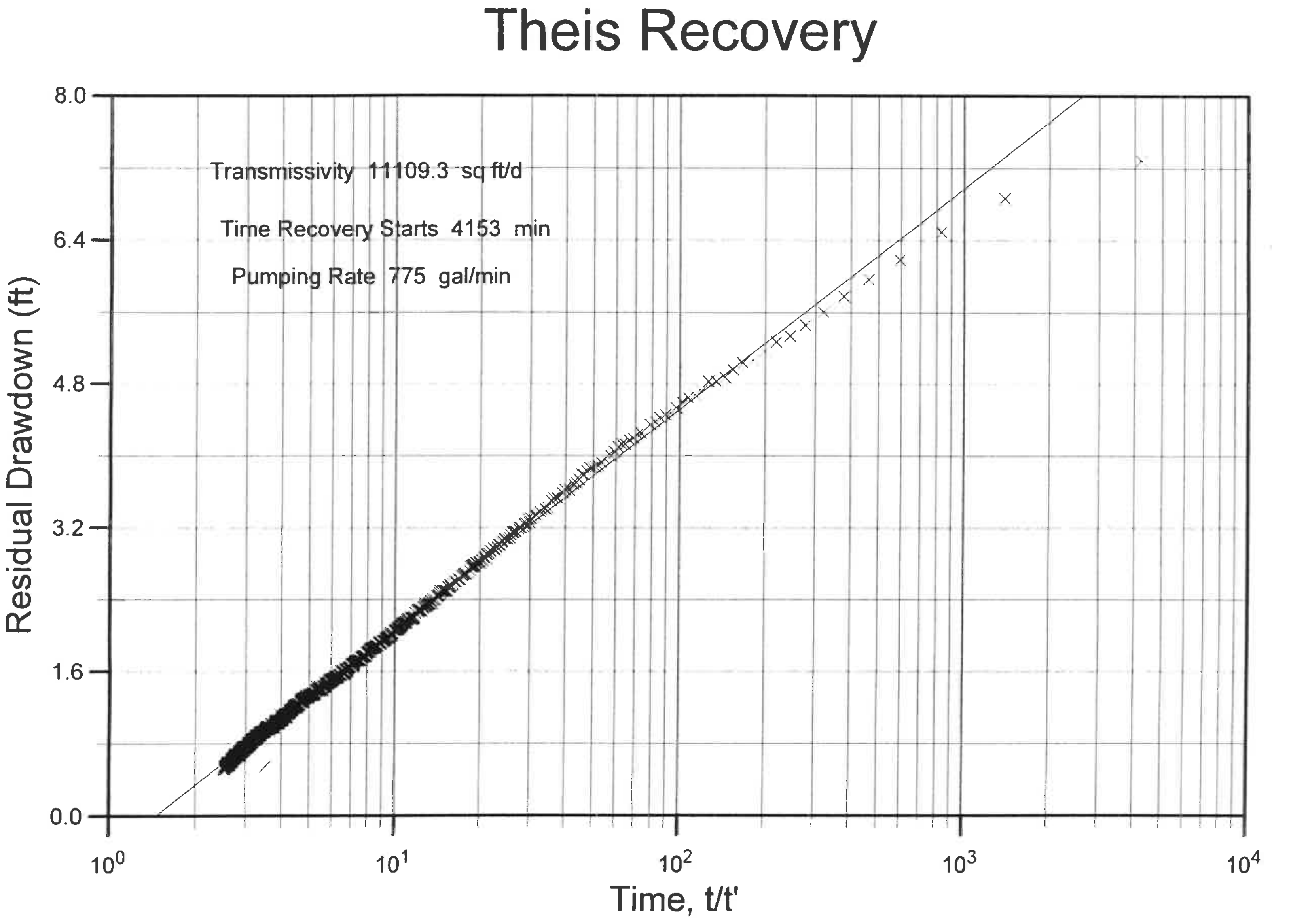

Figure D-4. Observation Well Mogan Run No. 3 Green North (Old 2) Recovery Analysis for Morgan Run No. 3 Green North Aquifer Test

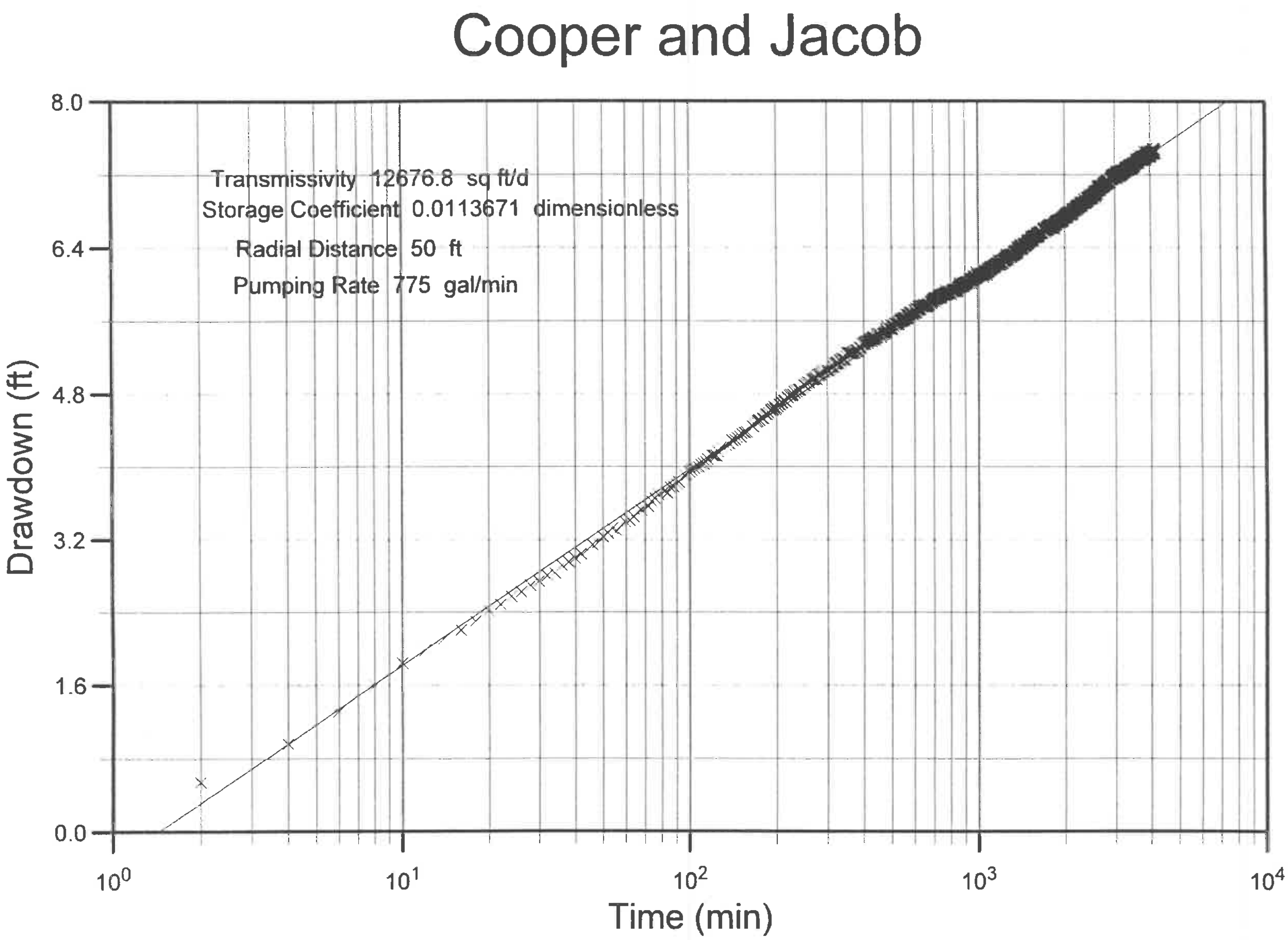

Figure D-5. Observation Well Morgan Run No. 3 Green North (Old 2) Cooper-Jacob Analysis for Morgan Run No. 3 Green North Aquifer Test

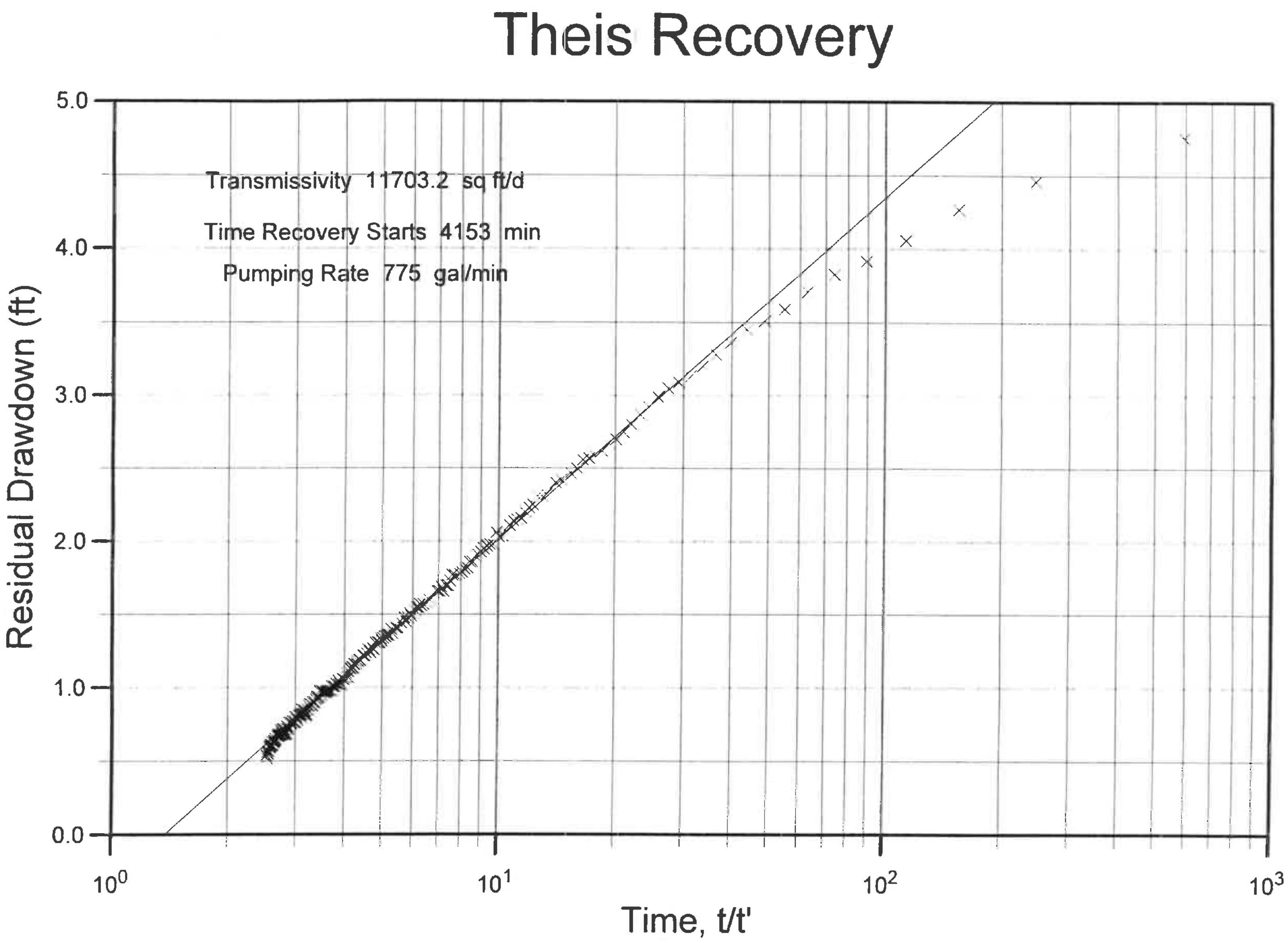

Figure D-6. Observation Well Morgan Run GunR Recovery Analysis for Morgan Run No. 3 Green North Aquifer Test

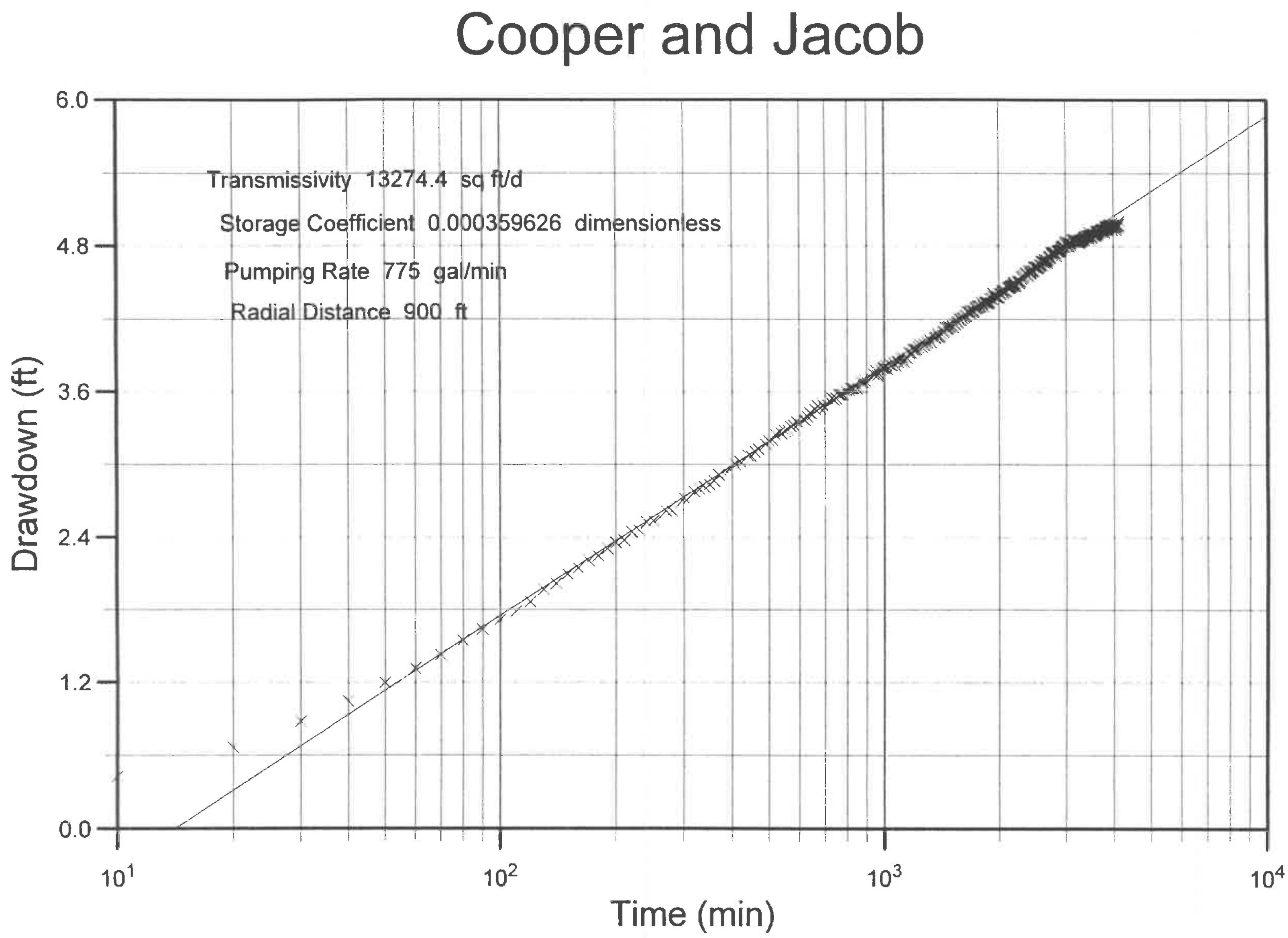

Figure D-7. Observation Well Morgan Run GunR Cooper-Jacob Analysis for Morgan Run No. 3 Green North Aquifer Test

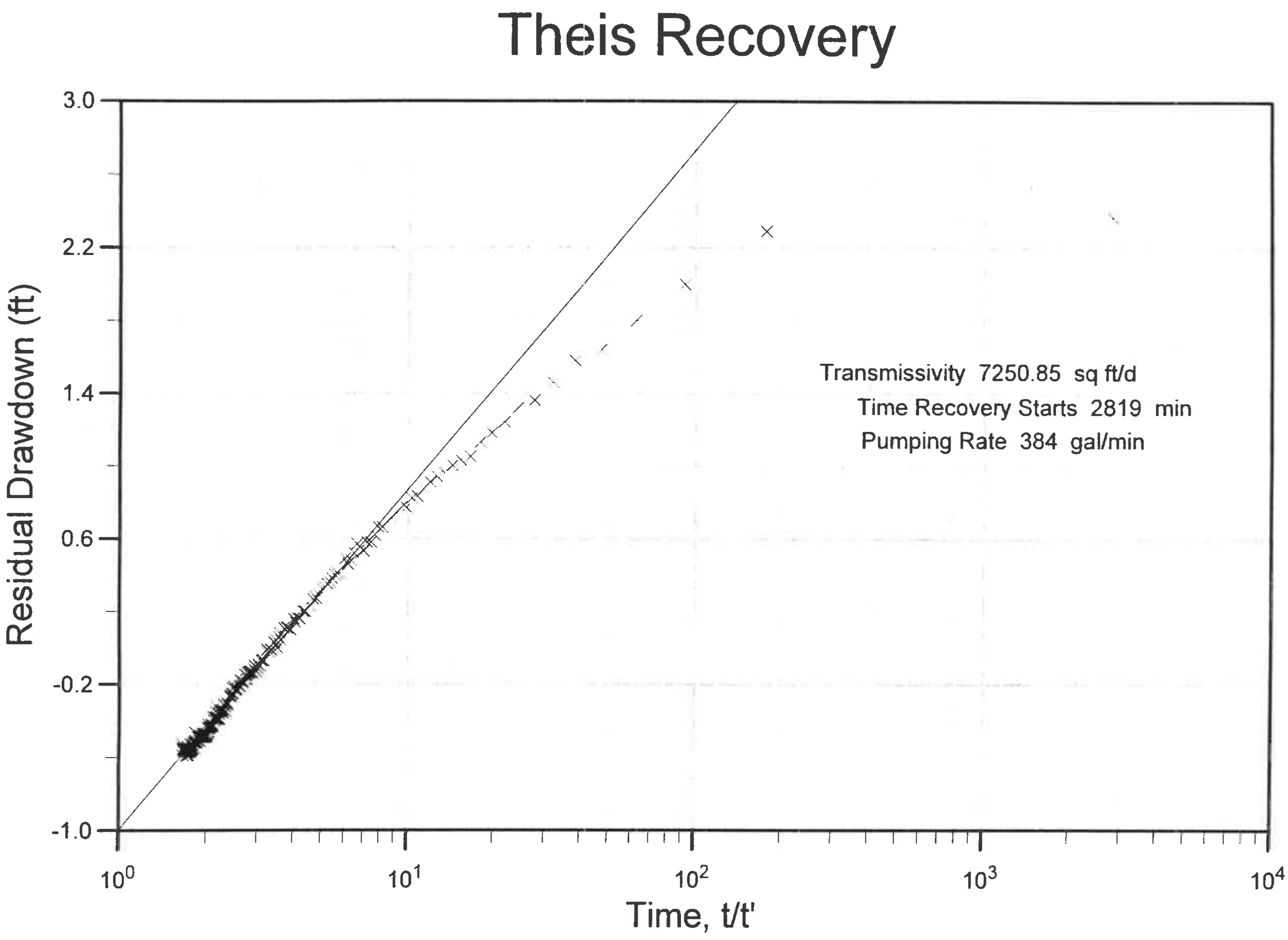

Figure D-8. Observation Well Morgan Run No. 3 Green North Old 2 Recovery Analysis for Morgan Run GunR Aquifer Test

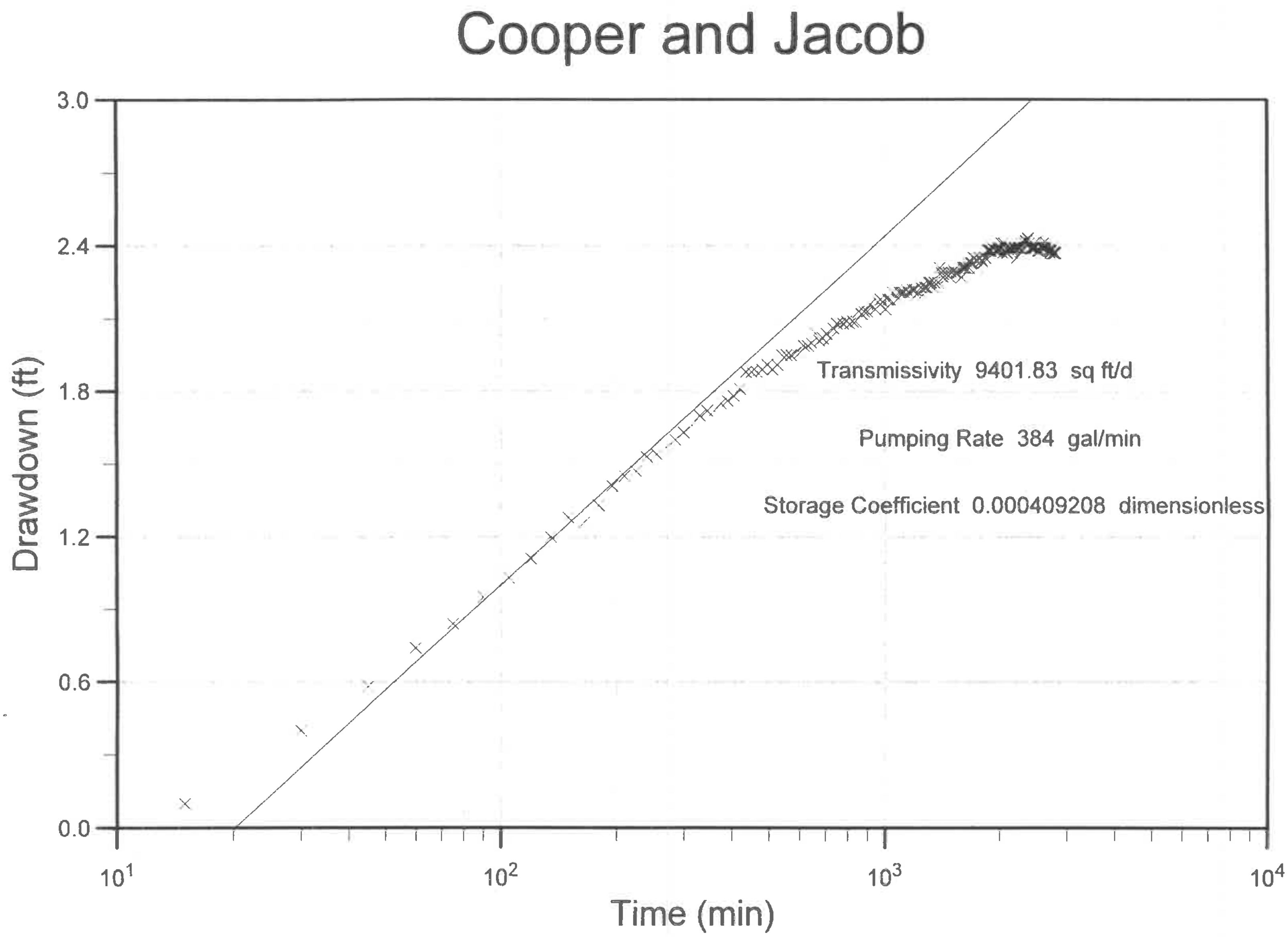

Figure D-9. Observation Well Morgan Run No. 3 Green North (Old 2) Cooper-Jacob Analysis for Morgan Run GunR Aquifer Test

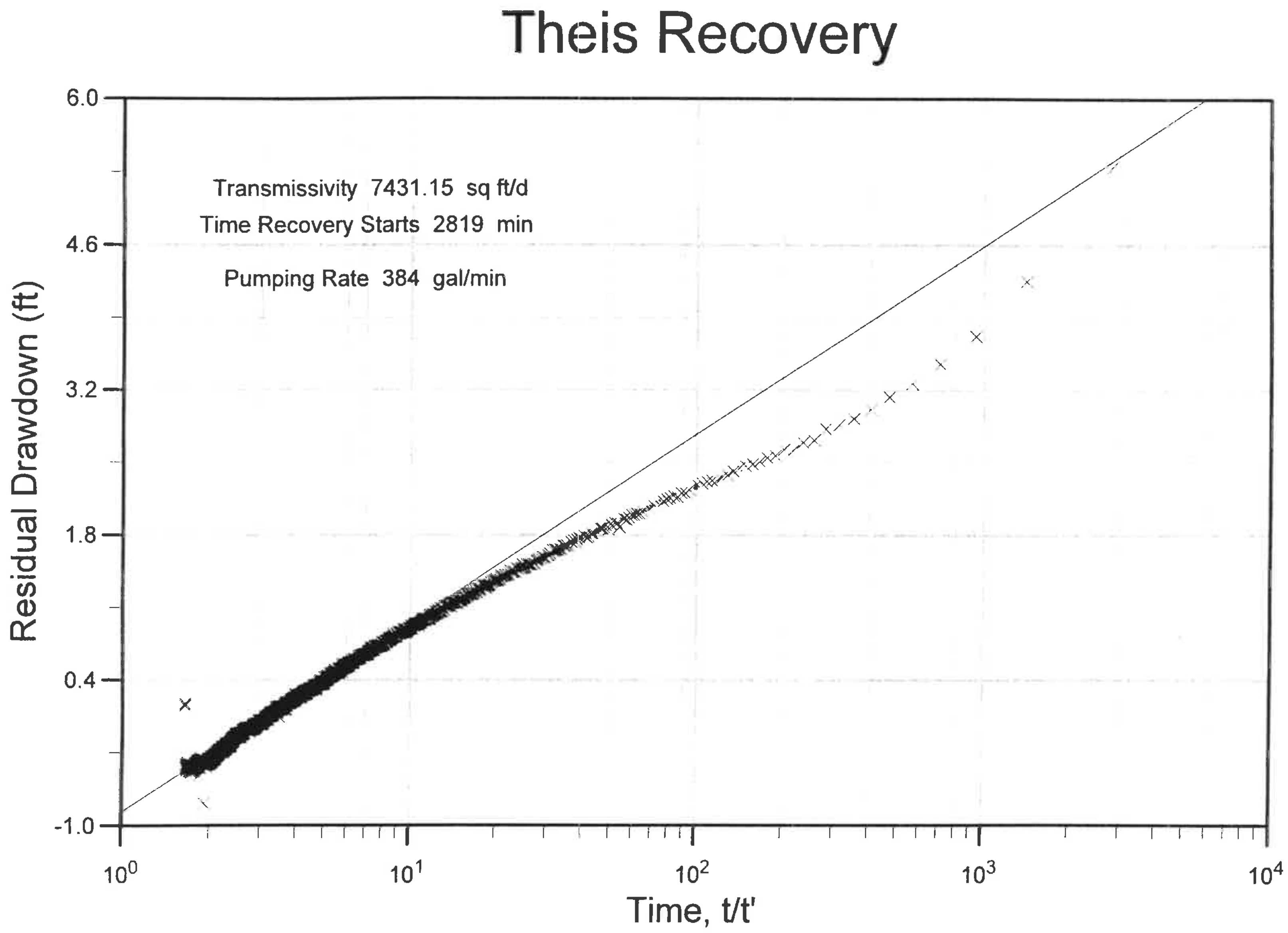

Figure D-10. Pumping Well Morgan Run GunR Recovery Analysis for Morgan Run GunR Aquifer Test

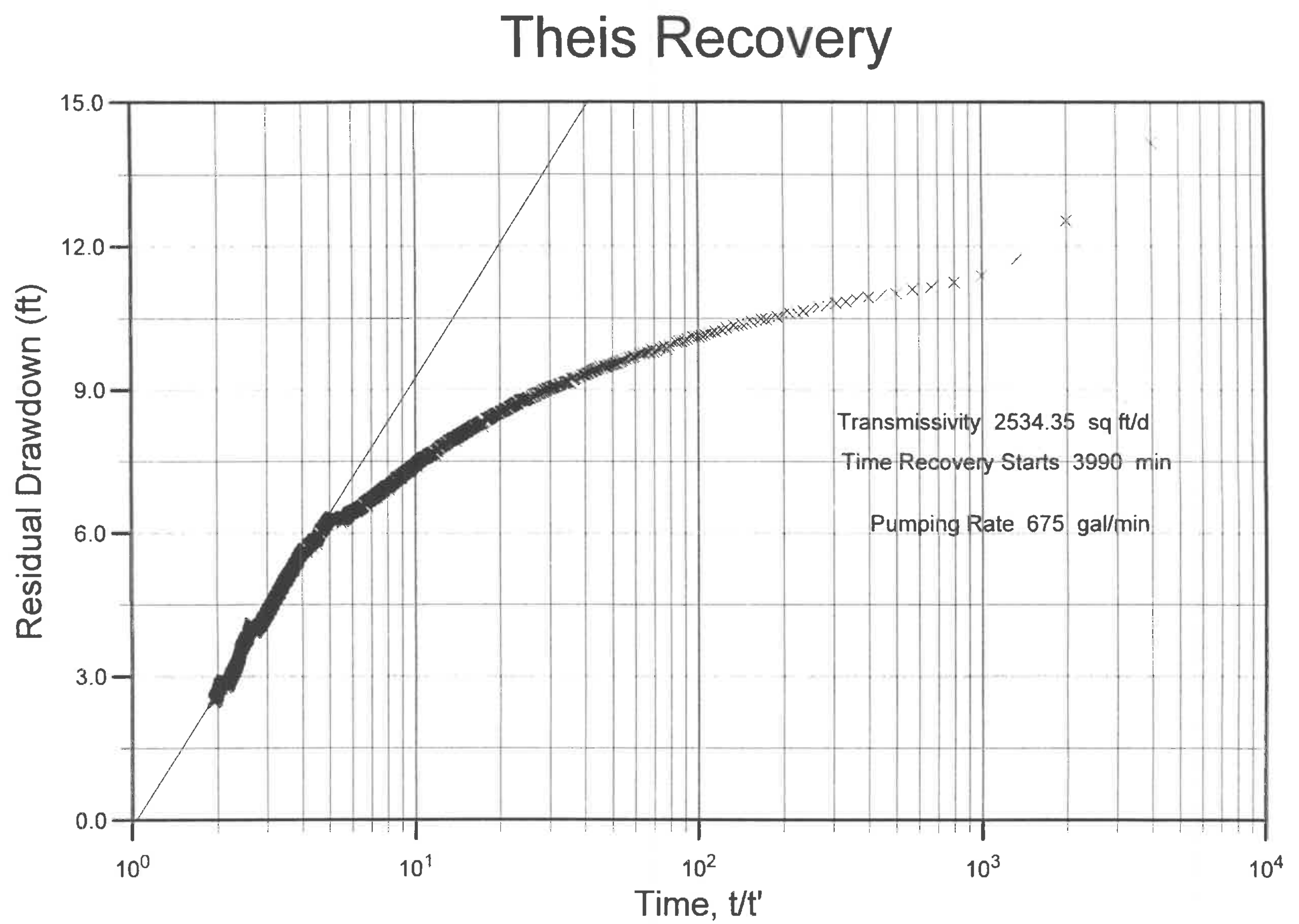

Figure D-11. Observation Well Rancho Paseana South (West) Recovery Analysis for Rancho Paseana South (East) Aquifer Test

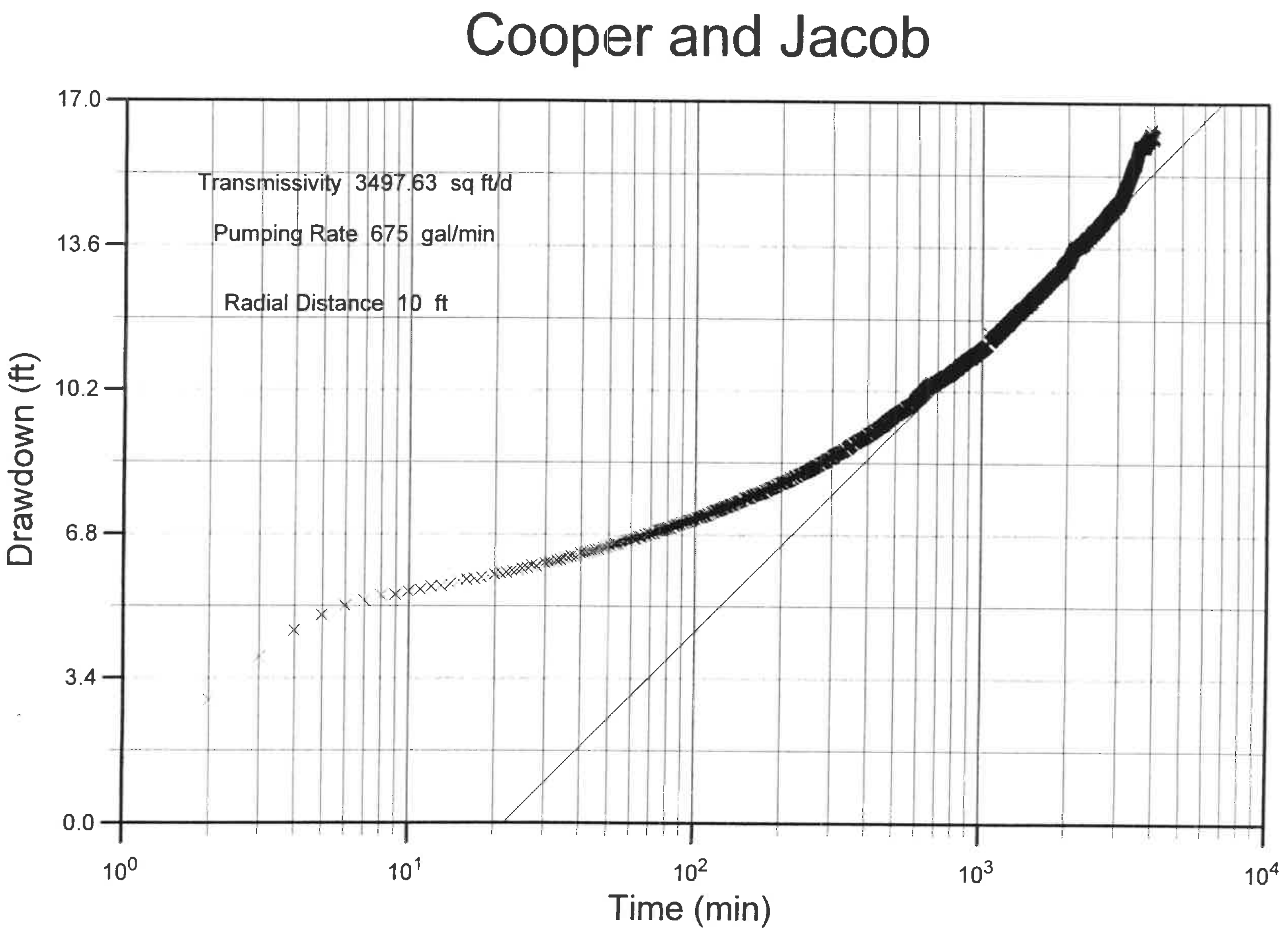

Figure D-12. Observation Well Rancho Paseana South (West) Cooper-Jacob Analysis for Rancho Paseana South (East) Aquifer Test

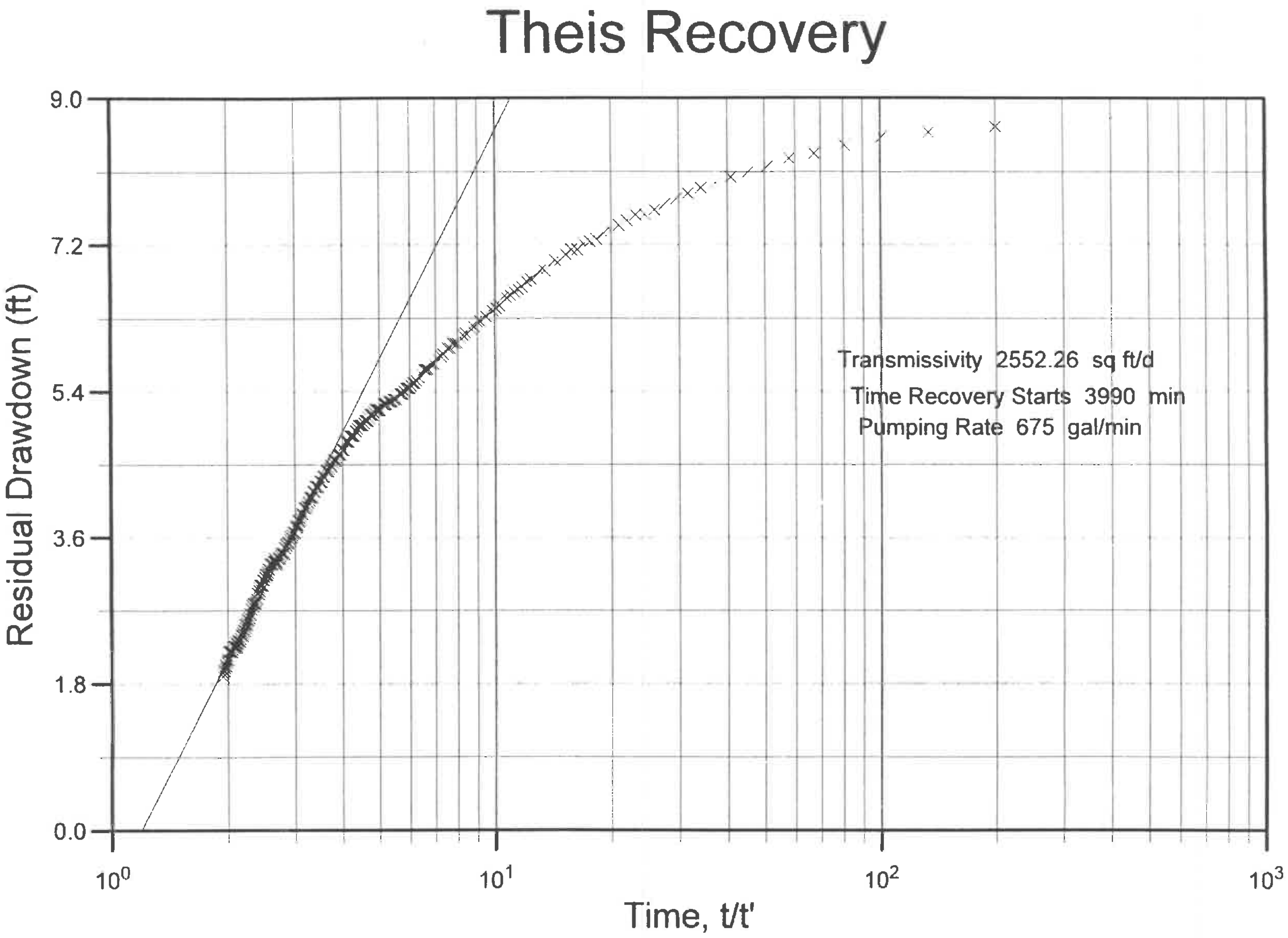

Figure D-13. Observation Well Morgan Run East Well Recovery Analysis for Rancho Paseana South (East) Aquifer Test

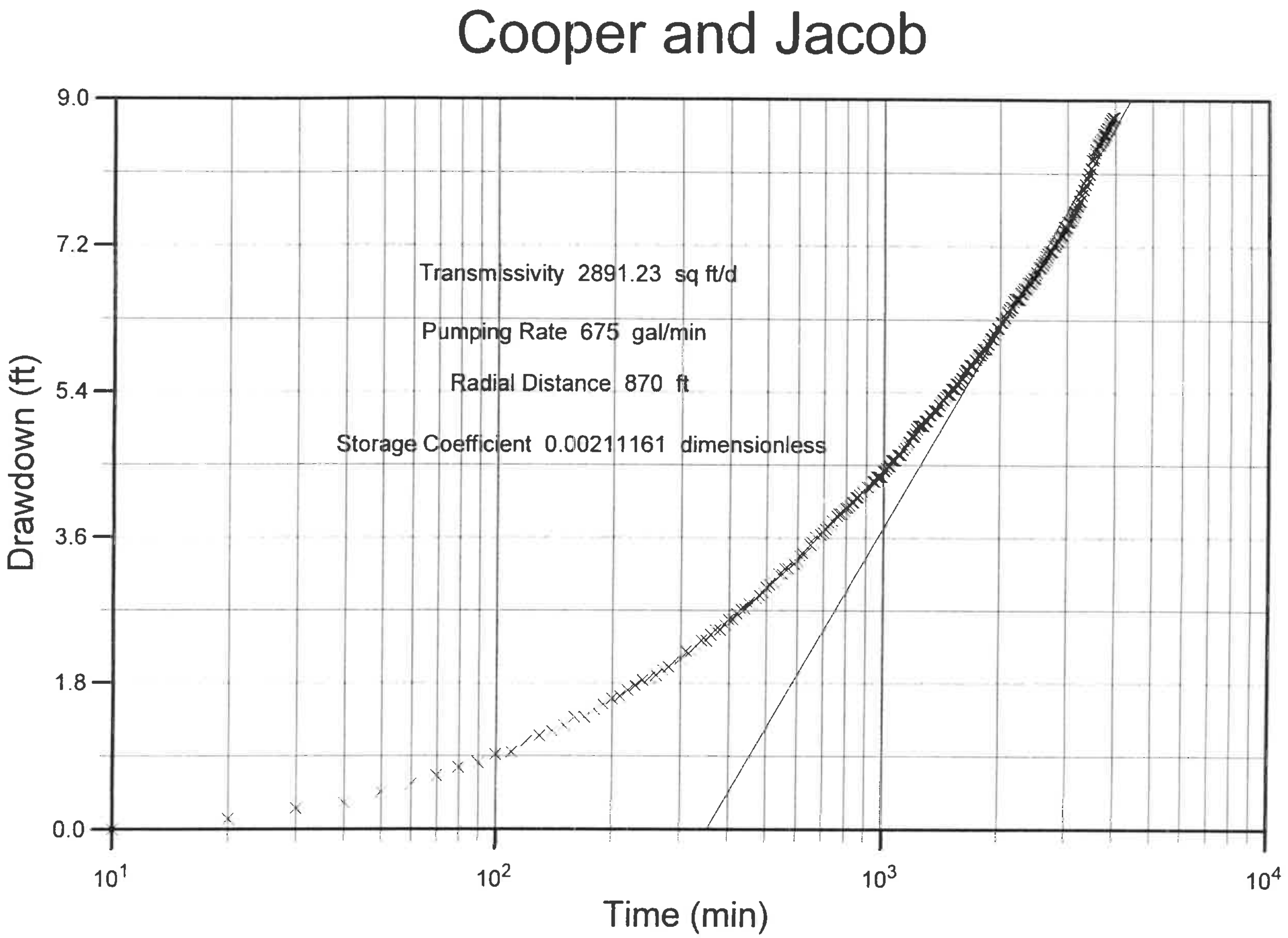

Figure D-14. Observation Well Morgan Run East Well Cooper-Jacob Analysis for Rancho Paseana South (East) Aquifer Test

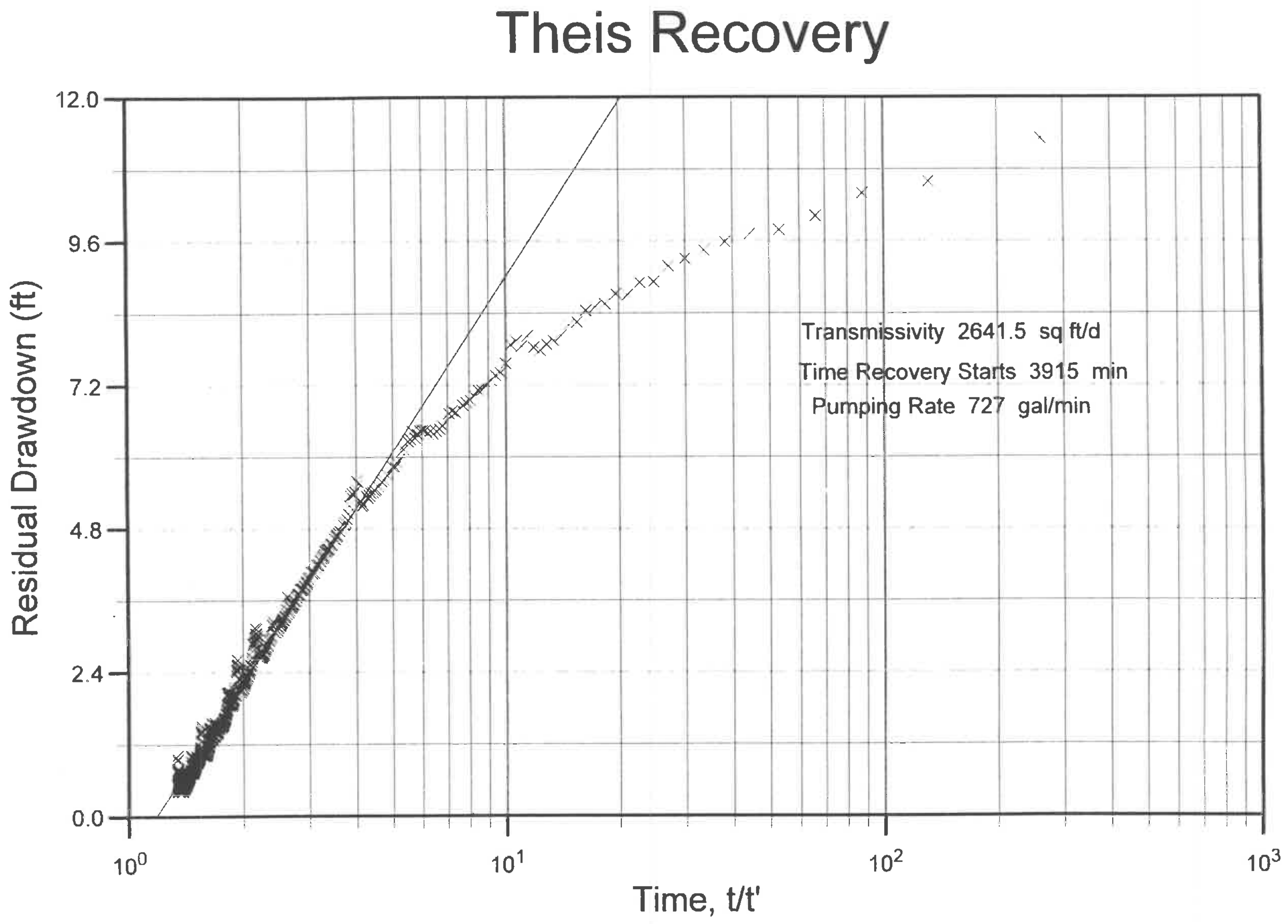

Figure D-15. Observation Well MacFarlane N. Recovery Analysis for Schoenfelder No. 2 (South) pumping episode

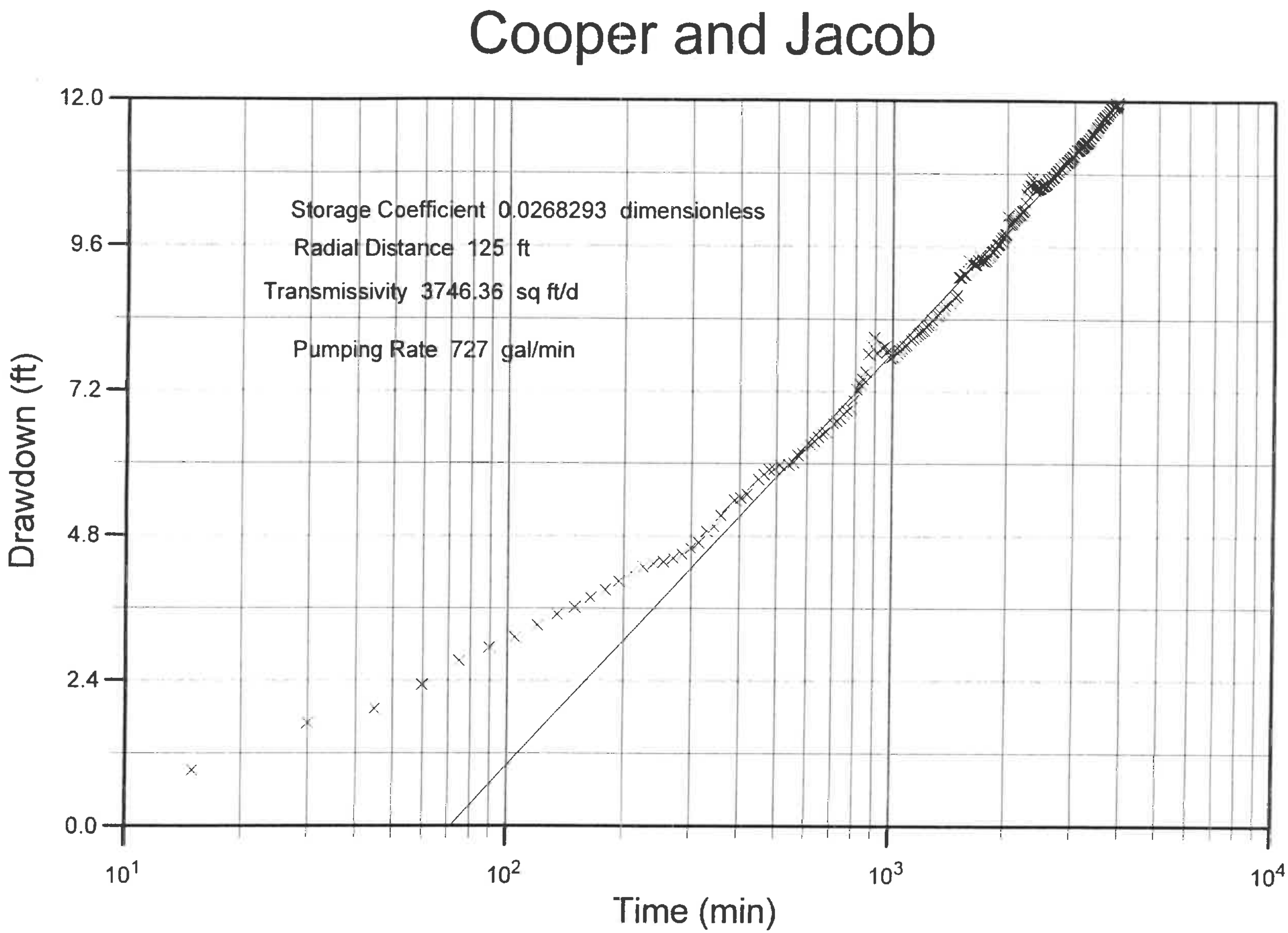

Figure D-16. Observation Well MacFarlane N. Cooper-Jacob Analysis for Schoenfelder No. 2 (South) pumping episode

APPENDIX E

CONE PENETRATION TEST INVESTIGATION

APPENDIX E

CONE PENETRATION TEST INVESTIGATION

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CONE PENETRATION TEST INVESTIGATION

1.0 SUMMARY OF CONE PENETRATION TEST INVESTIGATION

Detailed lithologic data were obtained in the project vicinity and surrounding area using direct-push Cone Penetrometer Testing (CPT) equipment. Rounds I and II included the advancement of CPT borings at 27 locations (Figure E-1). Round I included 12 locations at the Morgan Run, Rancho Paseana, Rancho Santa Fe Polo Club, and Fairbanks Ranch Country Club; and Round II included 15 locations at Morgan Run. CPT logs and a description of CPT methodology are included in Attachment E-1.

Prior to CPT advancement, Underground Service Alert (USA) was contacted and the proposed CPT locations were approved by all participating utilities. The total depth of the CPT borings ranged from approximately 10 feet to 155 feet (Table E-1). Most CPT holes were advanced until refusal. CPT-13 and CPT-26 were terminated prior to refusal, when the depth was sufficient to obtain the required information. After removal of the CPT probe, each hole was subsequently filled with bentonite grout.

During Round I, pore pressure dissipation tests were conducted in coarse-grained zones at several of the CPT locations (Appendix F). During Round II, pore pressure dissipation tests were conducted within fine-grained zones at eight of the CPT locations for use in estimating permeability (Appendix F).

Round I also included the installation of two shallow piezometers (MR P1 and MR P2) by direct push technology. The piezometers were installed adjacent to the existing Morgan Run Fairway 2 well (5-H2) to monitor water table response (Figure E-1). Prior to installation of the piezometers, USA was contacted and the proposed piezometer locations were approved by all participating utilities. Both wells were pushed to a depth of 23 feet and screened across the water table. Construction details of the piezometers are summarized in Table E-1 and Figure E-2.

HARGIS + ASSOCIATES, INC.

Table E-1

CONE PENETROMETER TESTS (CPT) SUMMARY

	IDENTIFIER	DATE INSTALLED	TOTAL DEPTH (feet bls)
Round I	CPT-1	03/11/02	111.38
	CPT-2	03/11/02	140.09
	CPT-3	03/11/02	126.64
	CPT-4	03/11/02	112.37
	CPT-5	03/11/02	82.18
	CPT-6	03/11/02	102.69
	CPT-7	03/12/02	128.12
	CPT-8	03/12/02	97.6
	CPT-9	03/12/02	119.26
	CPT-10	03/12/02	122.05
	CPT-11	03/13/02	80.22
	CPT-12	03/13/02	155.02
Round II	CPT-13	09/17/02	110.07
	CPT-14	09/17/02	44.78
	CPT-15	09/17/02	77.26
	CPT-16	09/17/02	55.94
	CPT-17	09/17/02	10.83
	CPT-17A	09/17/02	10.17
	CPT-18	09/18/02	145.01
	CPT-19	09/18/02	84.64
	CPT-20	09/18/02	72.34
	CPT-21	09/18/02	90.39
	CPT-22	09/18/02	132.71
	CPT-23	09/19/02	119.59
	CPT-24	09/19/02	104.17
	CPT-25	09/19/02	84.97
	CPT-26	09/19/02	100.06
	CPT-27	09/19/02	72.18

FOOTNOTE

bls = Below land surface

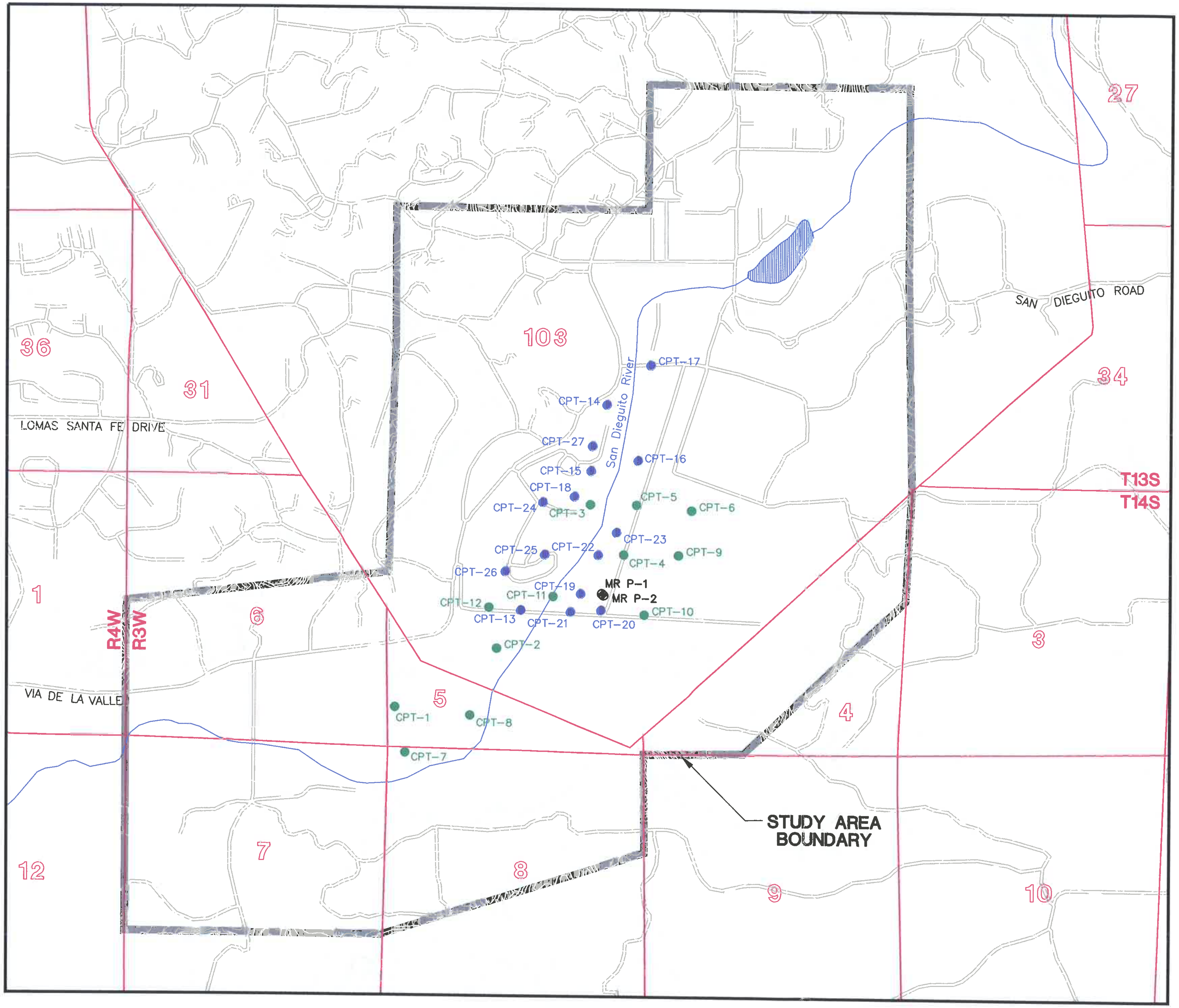
TABLE E-2

PIEZOMETER WELL CONSTRUCTION DATA

WELL IDENTIFIER	DATE INSTALLED	TOTAL DEPTH OF BOREHOLE (feet bls)[a]	PERFORATED INTERVAL (feet bls)	SCREEN SLOT SIZE (inches)	CASING DIAMETER (inches)[b]	FILTER PACK INTERVAL (feet bls)	FILTER PACK SAND SIZE	BENTONITE CHIP SEAL (feet bls)	CEMENT SEAL (feet bls)
MR P-1	03/12/02	23	8.0 - 23.0	0.01	1	4.0 - 23.0	1-C	3.0 - 4.0	0.0 - 3.0
MR P-2	03/12/02	23	8.0 - 23.0	0.01	1	4.0 - 23.0	1-C	3.0 - 4.0	0.0 - 3.0

FOOTNOTES

msl = Mean sea level
bls = Below land surface at time of well installation
a = 2 inch diameter borehole
b = Schedule 40 polyvinyl chloride screen and casing



EXPLANATION

⊕ PIEZOMETER LOCATION

● ROUND I CPT LOCATION

● ROUND II CPT LOCATION

CPT = CONE PENETROMETER TESTING

N

0 2,000 4,000

FEET

SAN DIEGUITO GROUNDWATER BASIN

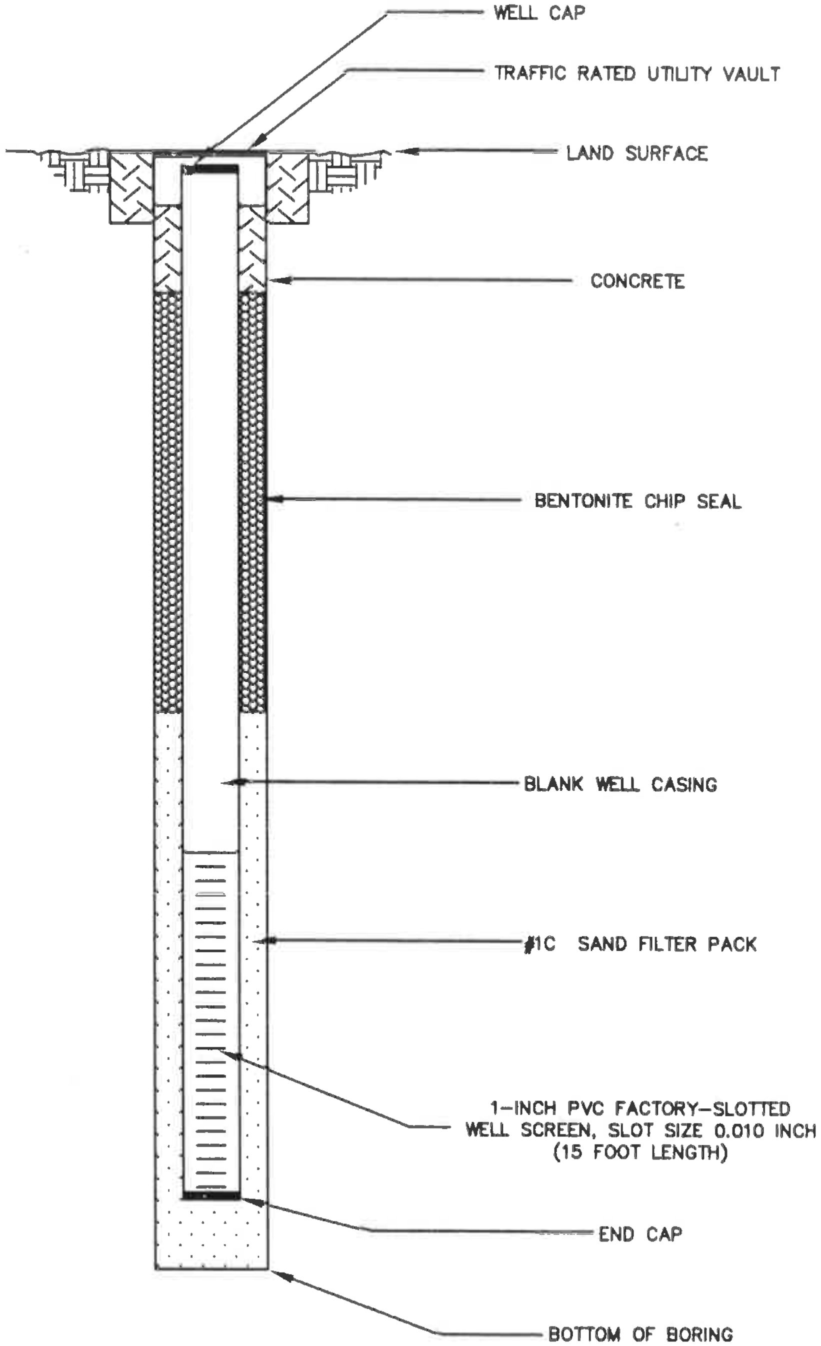
CPT AND PIEZOMETER LOCATIONS
ROUNDS I AND II

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

10/02

FIGURE E-1

PREP BY SLB REV BY RAN RPT NO. 689.20 410-3807 A



NOT TO SCALE

HARGIS + ASSOCIATES, INC

10/02	RPT NO. 689.09	710-0342	A

FIGURE E-2. SCHEMATIC CONSTRUCTION DIAGRAM
PIEZOMETERS P1 AND P2

ATTACHMENT E-1

PRESENTATION OF CONE PENETRATION TEST DATA

PRESENTATION OF CONE PENETRATION TEST DATA

OMWD SAN DIEGUITO

DEL MAR, CALIFORNIA

Prepared for:

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San Diego, California

Prepared by:

GREGG IN SITU, INC.
Signal Hill, California
02-236sh

Prepared on:

September 23, 2002

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PRESENTATION OF CONE PENETRATION TEST DATA

1.0 INTRODUCTION

This report presents the results of a Cone Penetration Testing (CPT) program carried out at the OMWD San Dieguito site located in Del Mar, CA. The work was performed on September 17th, 18th and 19th, 2002. The scope of work was performed as directed by Hargis + Associates personnel.

2.0 FIELD EQUIPMENT & PROCEDURES

The Cone Penetration Tests (CPT) were carried out by GREGG IN SITU, INC. of Signal Hill, CA using an integrated electronic cone system. The CPT soundings were performed in accordance with ASTM standards (D 5778-95). A 20 ton capacity cone was used for all of the soundings (figure 1). This cone has a tip area of 15 cm^2 and friction sleeve area of 225 cm^2. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.85.

The cones used during the program recorded the following parameters at 5 cm depth intervals:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (U)

The above parameters were printed simultaneously on a printer and stored on a computer diskette for future analysis and reference.

The pore water pressure element was located directly behind the cone tip. The pore water pressure element was 5.0 mm thick and consisted of porous plastic. Each of the elements were saturated in silicon oil under vacuum pressure prior to penetration. Pore pressure dissipations were recorded at 5 second intervals when appropriate during pauses in the penetration.

A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

The cones were pushed using GREGG IN SITU's CPT rig, having a down pressure capacity of approximately 25 tons. Sixteen CPT soundings were performed. The penetration tests were carried to depths of approximately 145 feet below ground surface. Test locations and depths were determined in the field by Hargis + Associates personnel.

The CPT sample holes were grouted using our support rig. The grouting procedure consists of pushing a hollow CPT rod with a "knock out" plug back down the hole to the test hole termination depth. Grout is then pumped under pressure as the tremie pipe is pulled from the hole.

3.0 CONE PENETRATION TEST DATA & INTERPRETATION

The cone penetration test data is presented in graphical form. Penetration depths are referenced to existing ground surface. This data includes CPT logs of measured soil parameters and a computer tabulation of interpreted soil types along with additional geotechnical parameters and pore pressure dissipation data.

The stratigraphic interpretation is based on relationships between cone bearing (qc), sleeve friction (fs), and penetration pore pressure (U). The friction ratio (Rf), which is sleeve friction divided by cone bearing, is a calculated parameter which is used to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone bearing and generate large excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little in the way of excess pore water pressures.

Pore Pressure Dissipation Tests (PPDT's) were taken at various intervals in order to measure hydrostatic water pressures and approximate depth to groundwater table. In addition, the PPDT data can be used to estimate the horizontal permeability (k_h) of the soil. The correlation to permeability is based on the time required for 50 percent of the measured dynamic pore pressure to dissipate (t_{50}). The PPDT correlation figure (figure 2) is provided in the Appendix.

The interpretation of soils encountered on this project was carried out using recent correlations developed by Robertson et al, 1988. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and U. In these situations, experience and judgement and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. The soil classification chart (figure 3) used to interpret soil types based on qc and Rf is provided in the Appendix.

Interpreted output requires that depth of water be entered for calculation purposes, where depth to water is unknown an arbitrary depth in excess of 10 feet of the deepest sounding is entered as the groundwater depth.

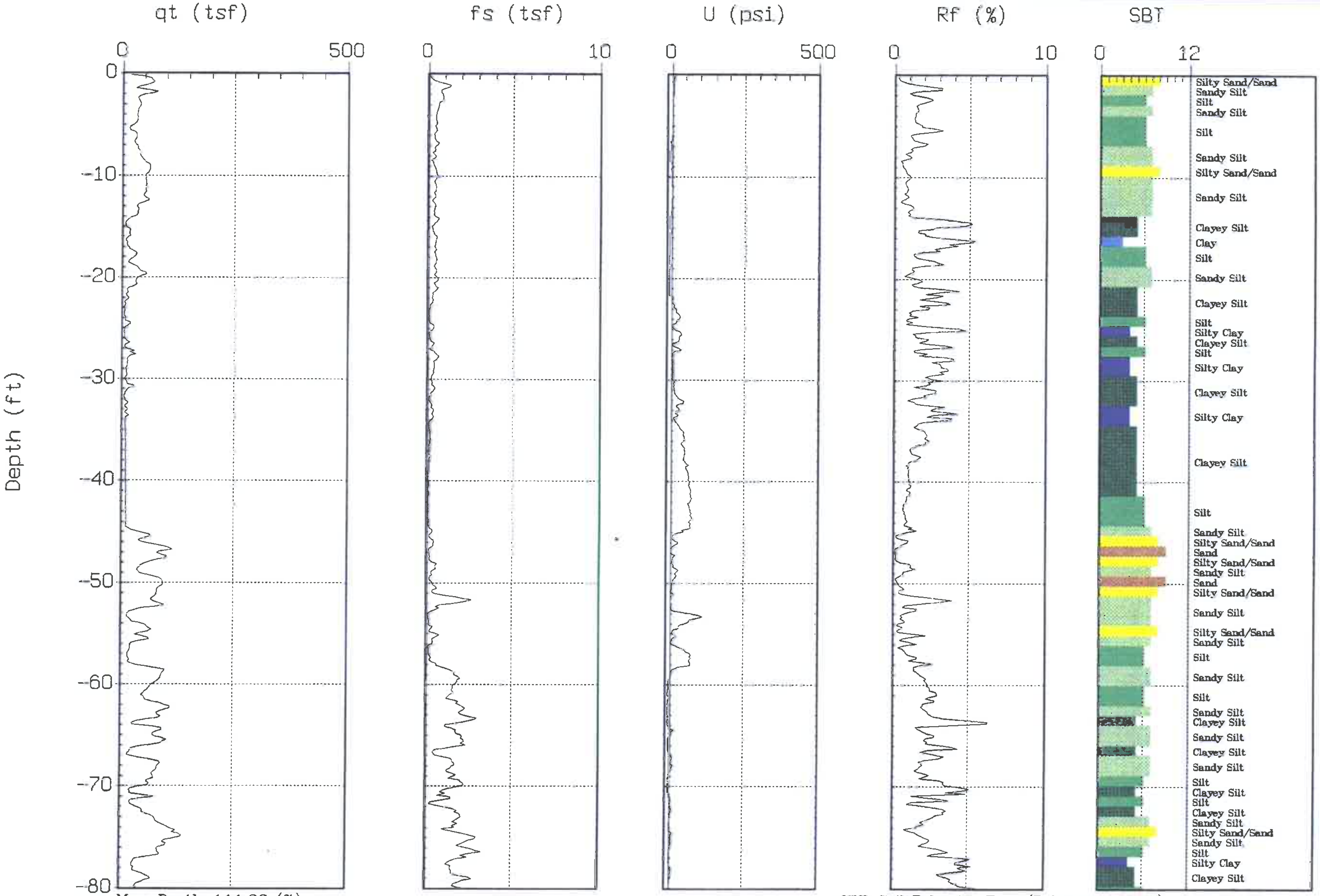
3.1 CPT PLOTS

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-1

Geologist : S. BERRYMAN
Date : 03:11:02 20:26



Max. Depth: 111.38 (ft)

Depth Inc.: 0.164 (ft)

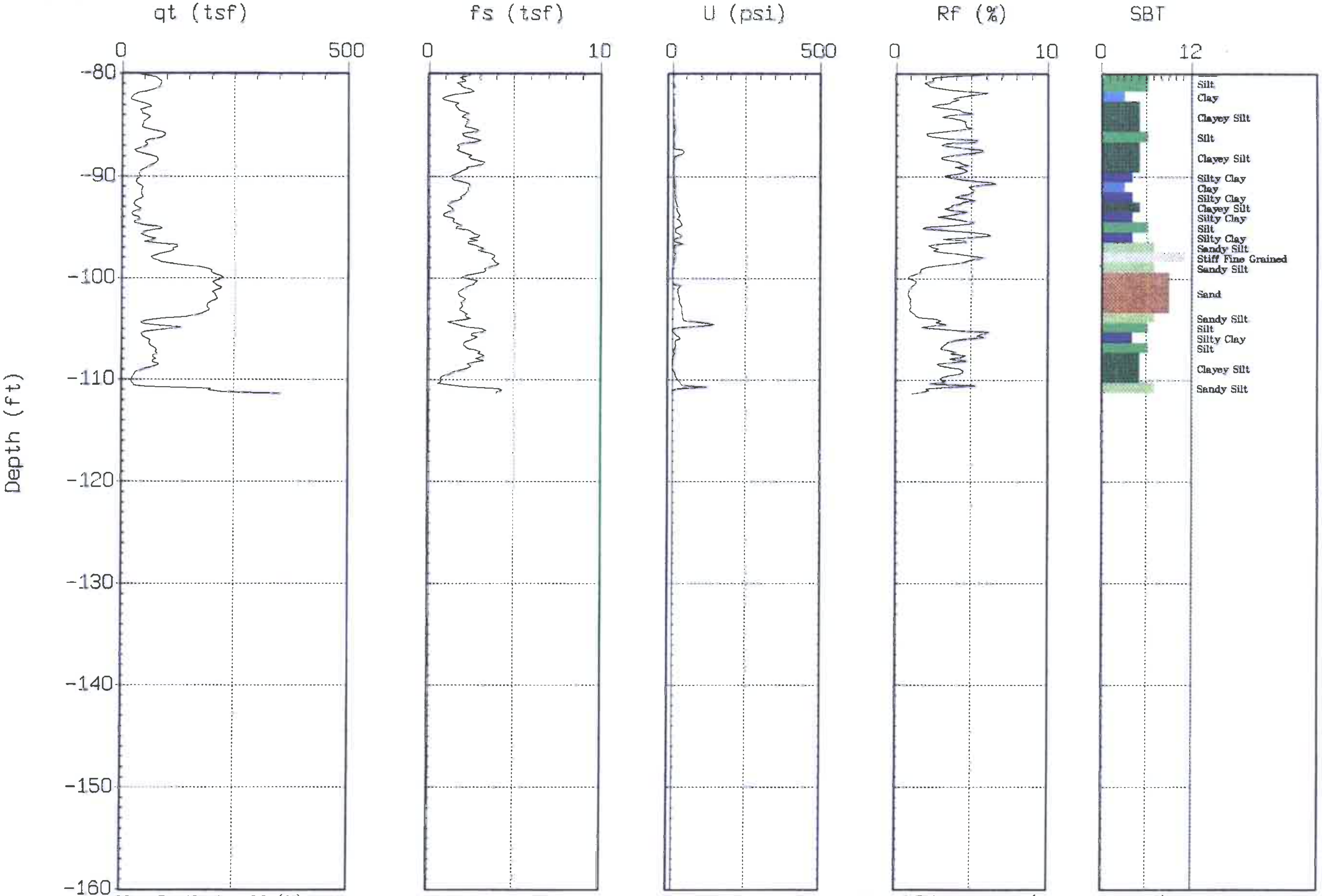
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-1

Geologist : S. BERRYMAN
Date : 03:11:02 20:26



Max. Depth: 111.38 (ft)

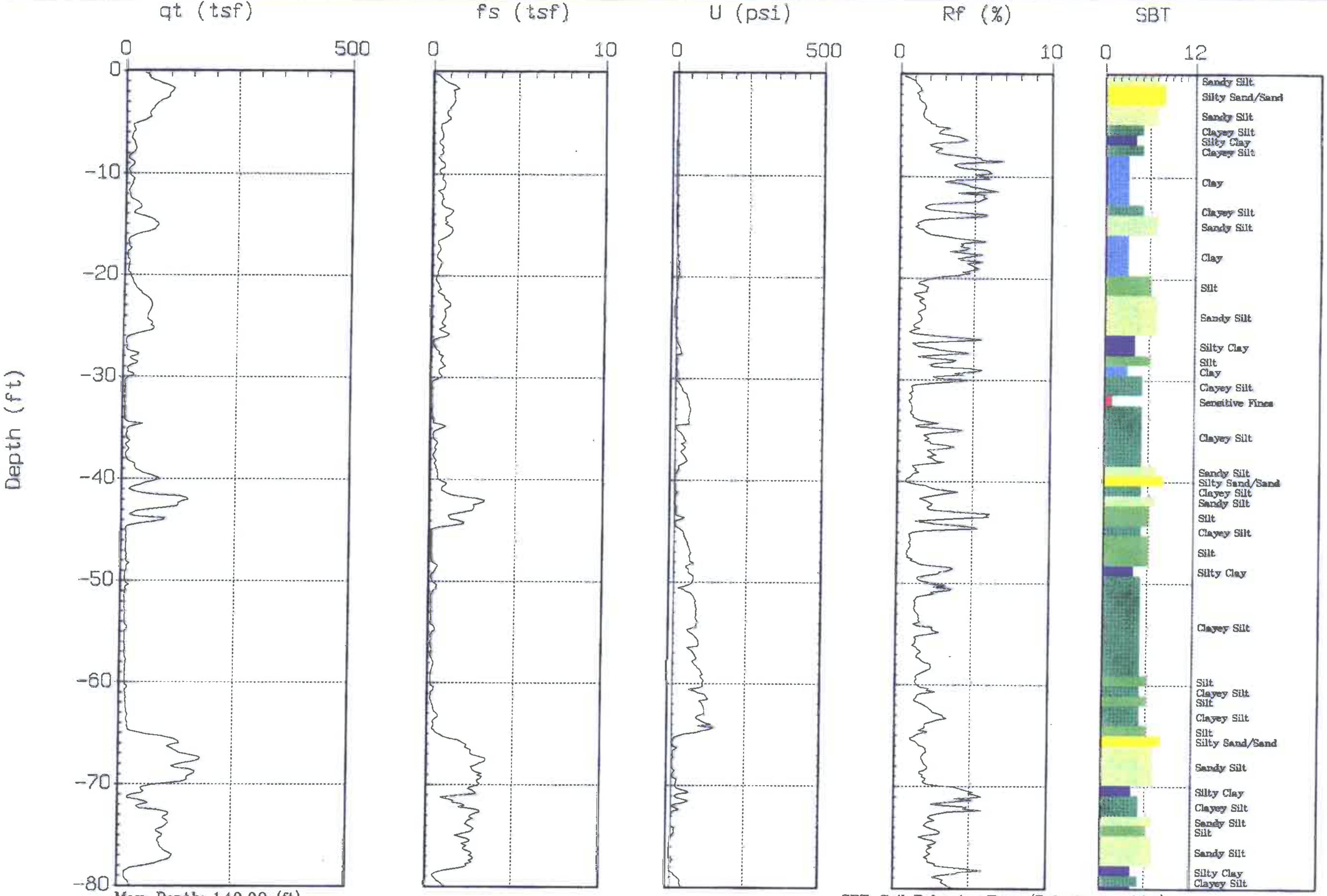
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG | **HARGIS + ASSOCIATES**

Site : OMWD SAN DIEGUITO
Location : CPT-2

Geologist : S. BERRYMAN
Date : 03:11:02 21:30



Max. Depth: 140.09 (ft)

Depth Inc.: 0.164 (ft)

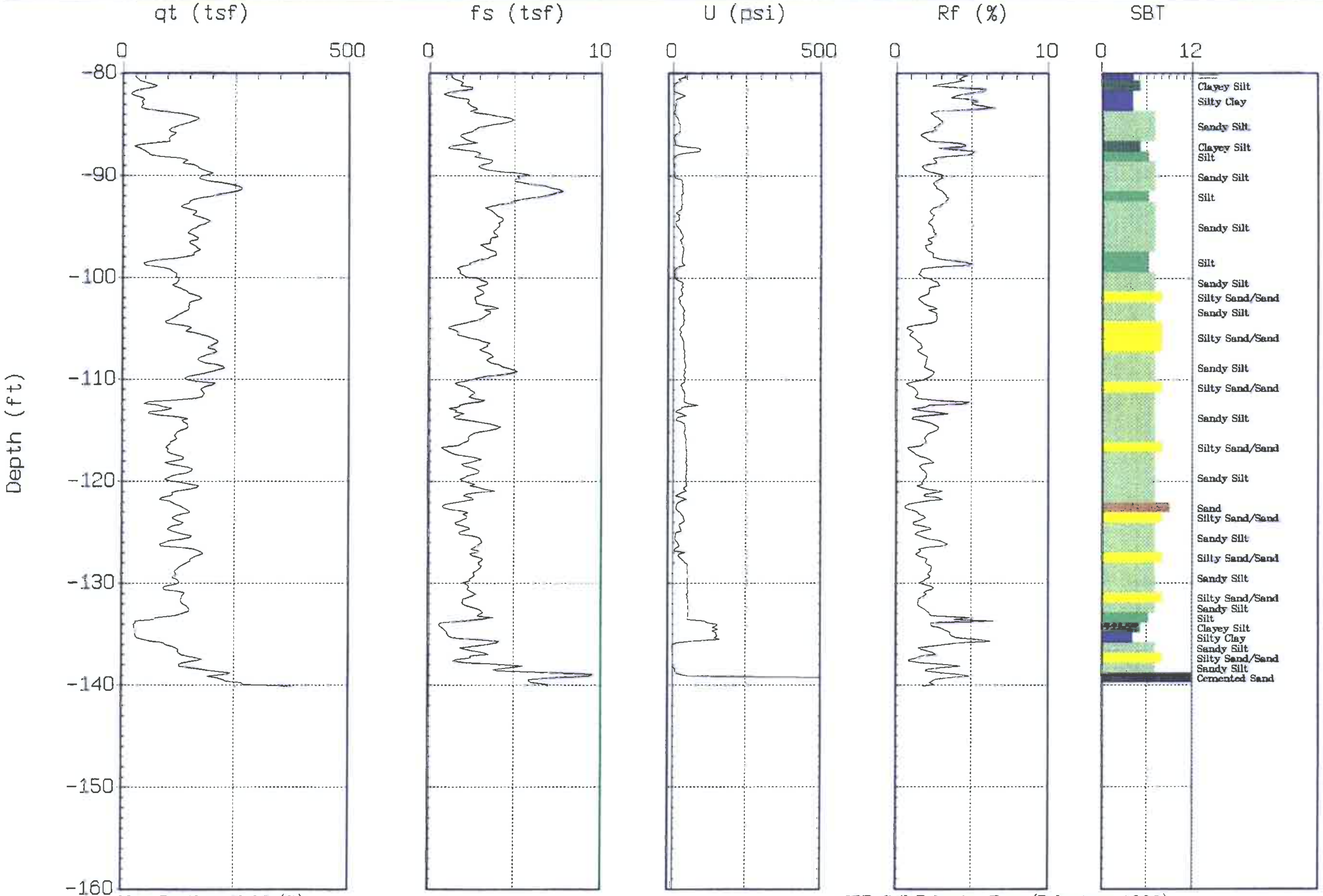
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-2

Geologist : S. BERRYMAN
Date : 03:11:02 21:30



Max. Depth: 140.09 (ft)

Depth Inc.: 0.164 (ft)

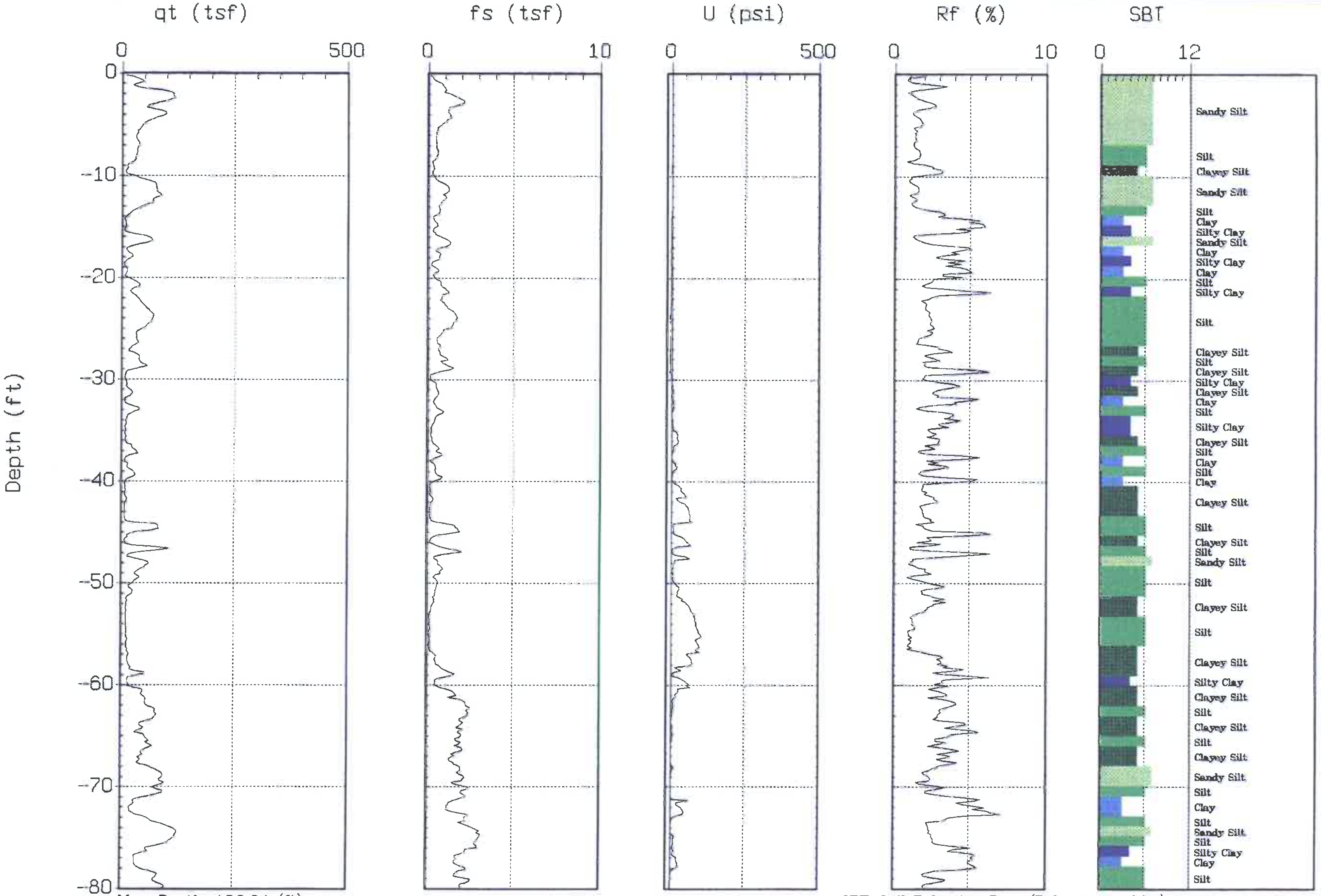
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-3

Geologist : S. BERRYMAN
Date : 03:11:02 23:04



Max. Depth: 126.64 (ft)

Depth Inc.: 0.164 (ft)

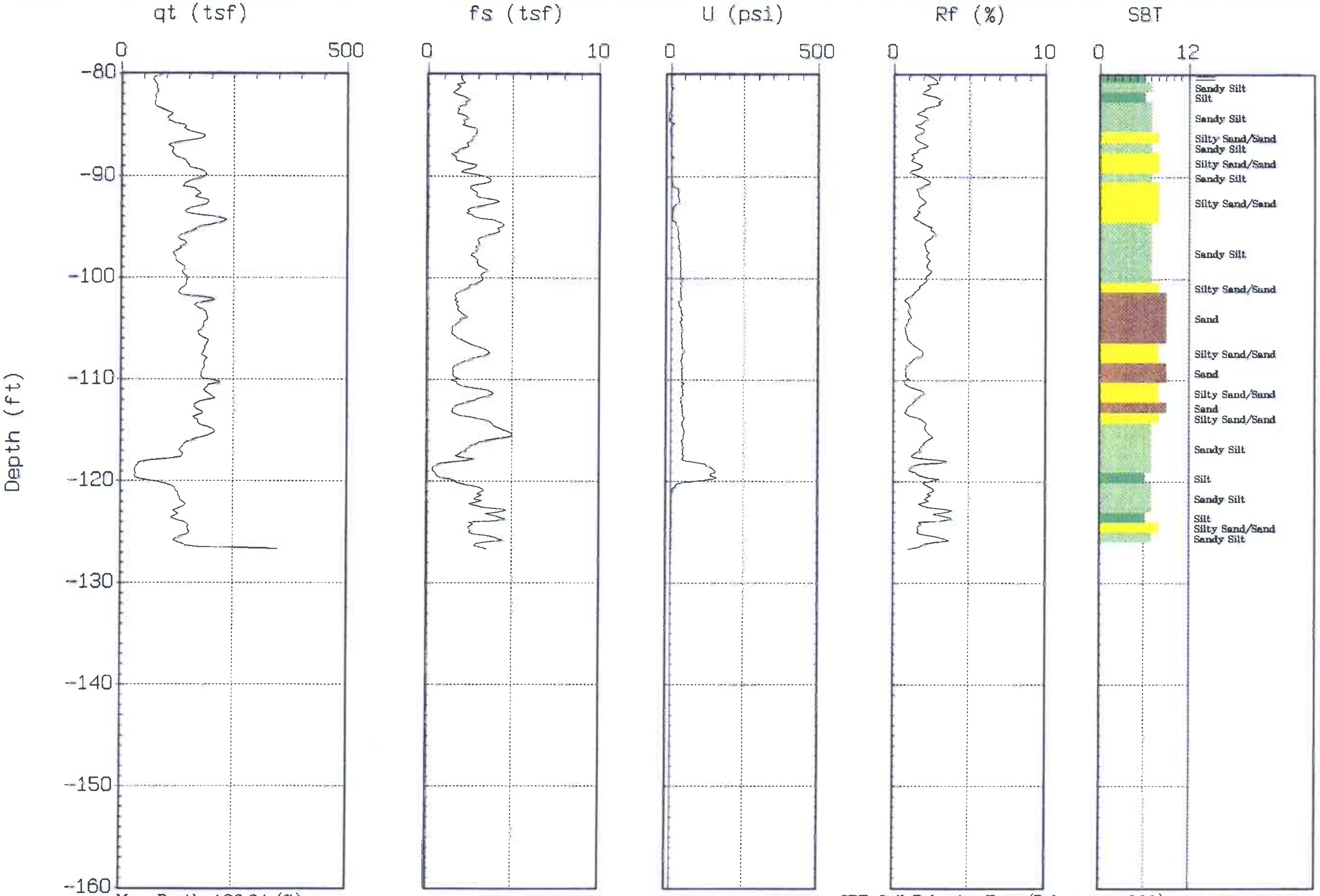
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-3

Geologist : S. BERRYMAN
Date : 03:11:02 23:04



Max. Depth: 126.64 (ft)

Depth Inc.: 0.164 (ft)

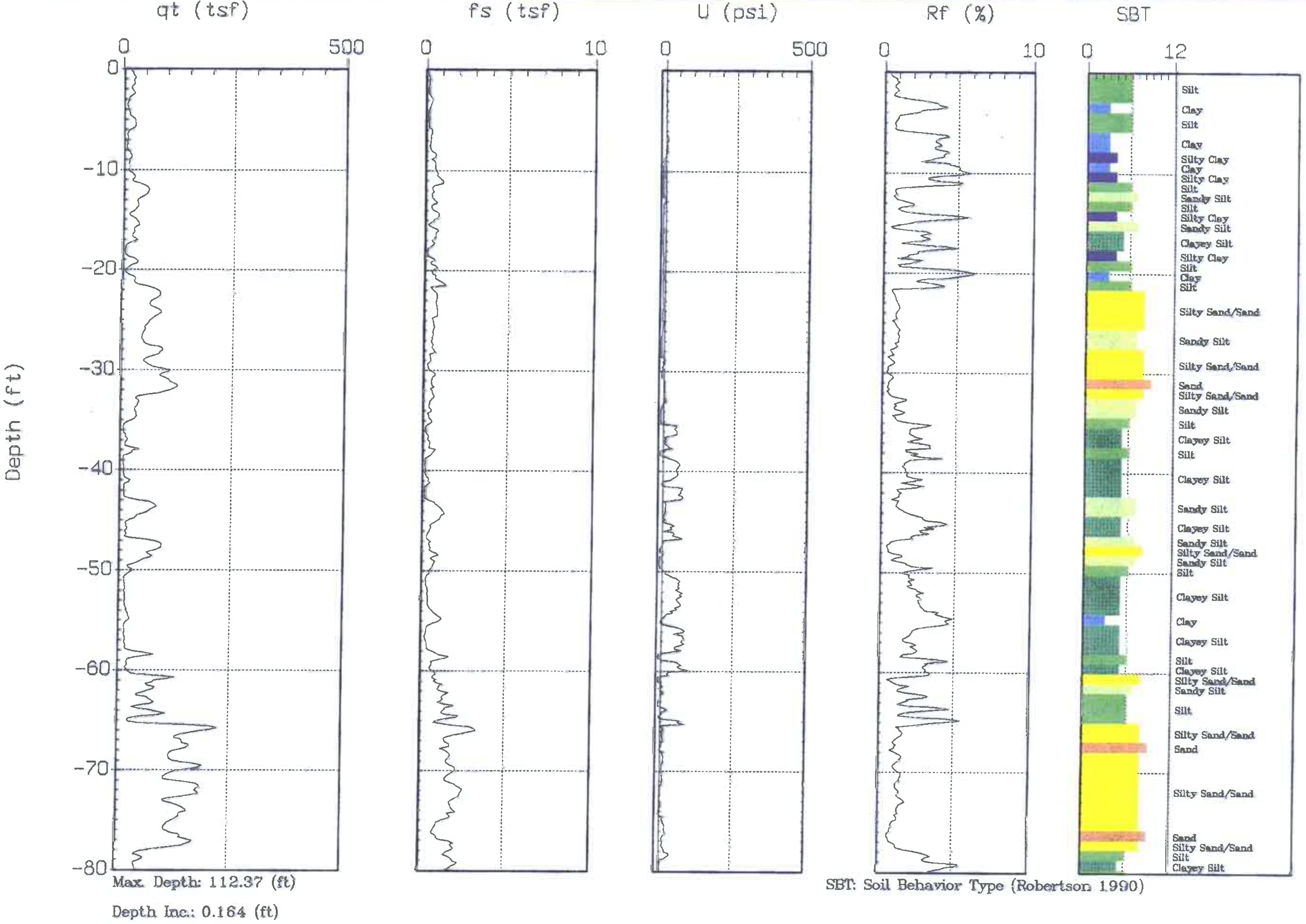
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-4

Geologist : S. BERRYMAN
Date : 03:12:02 01:18

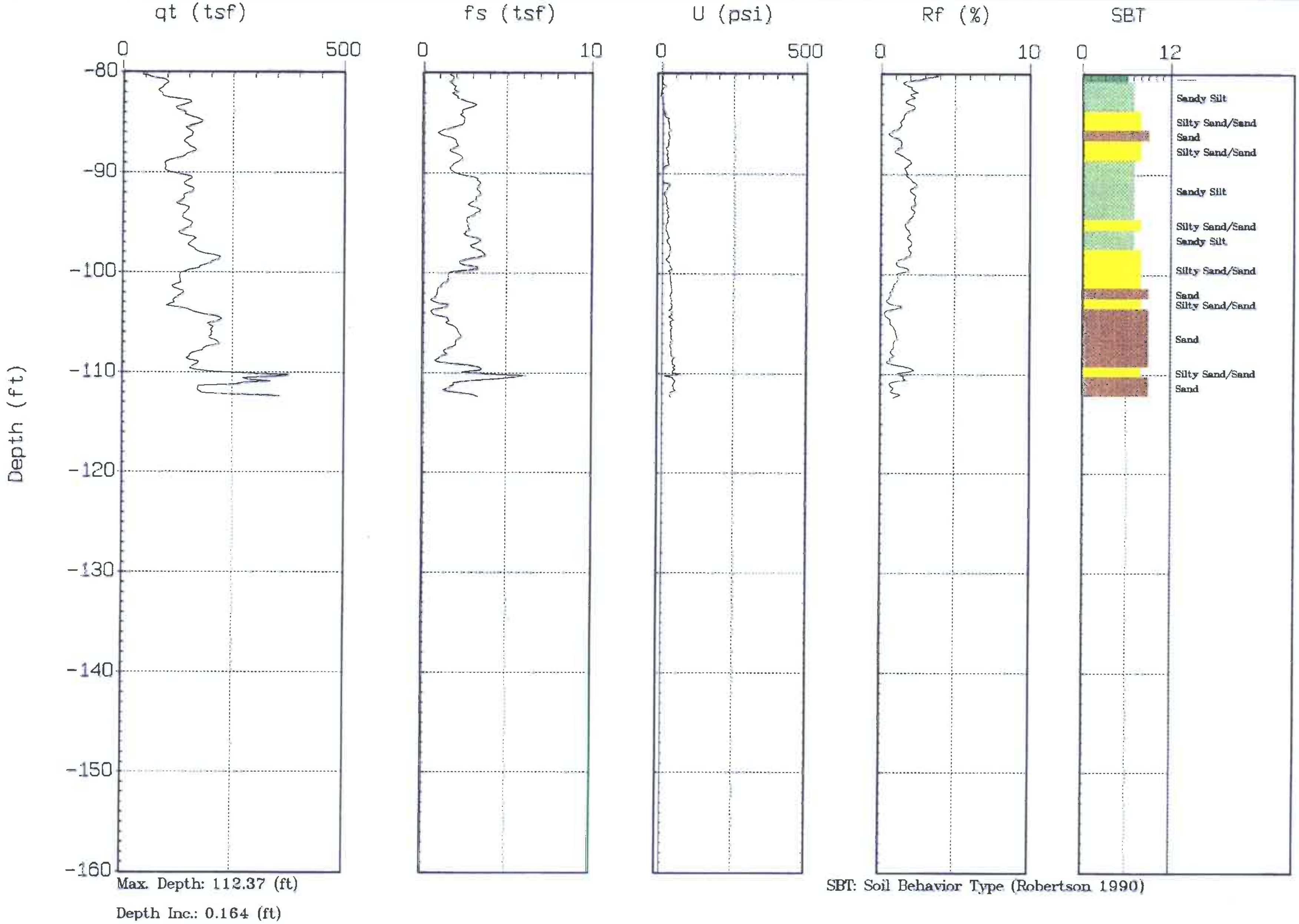


GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-4

Geologist : S. BERRYMAN
Date : 03:12:02 01:18



Max. Depth: 112.37 (ft)

Depth Inc.: 0.164 (ft)

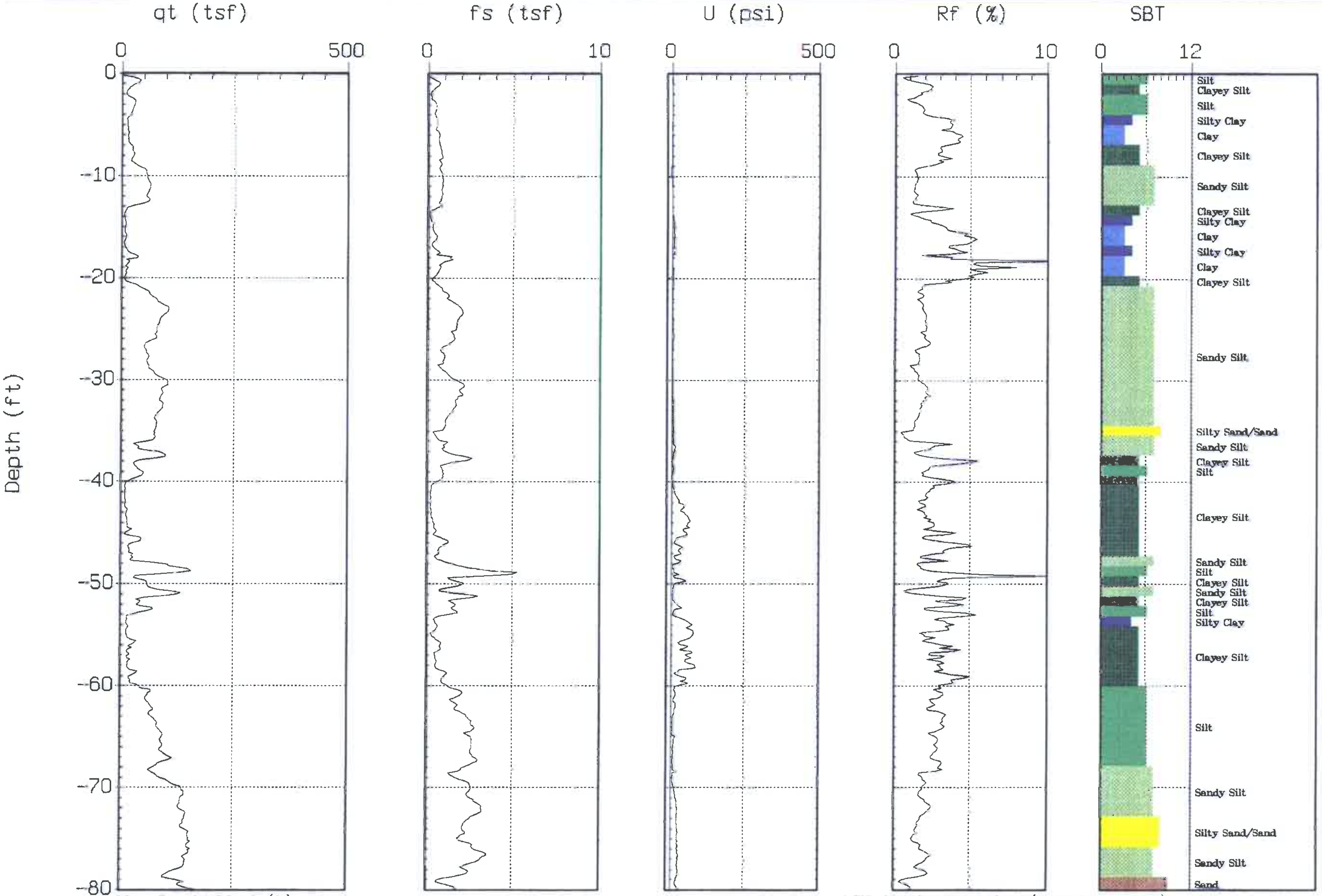
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-5

Geologist : S. BERRYMAN
Date : 03:12:02 02:15



Max. Depth: 82.18 (ft)

Depth Inc.: 0.164 (ft)

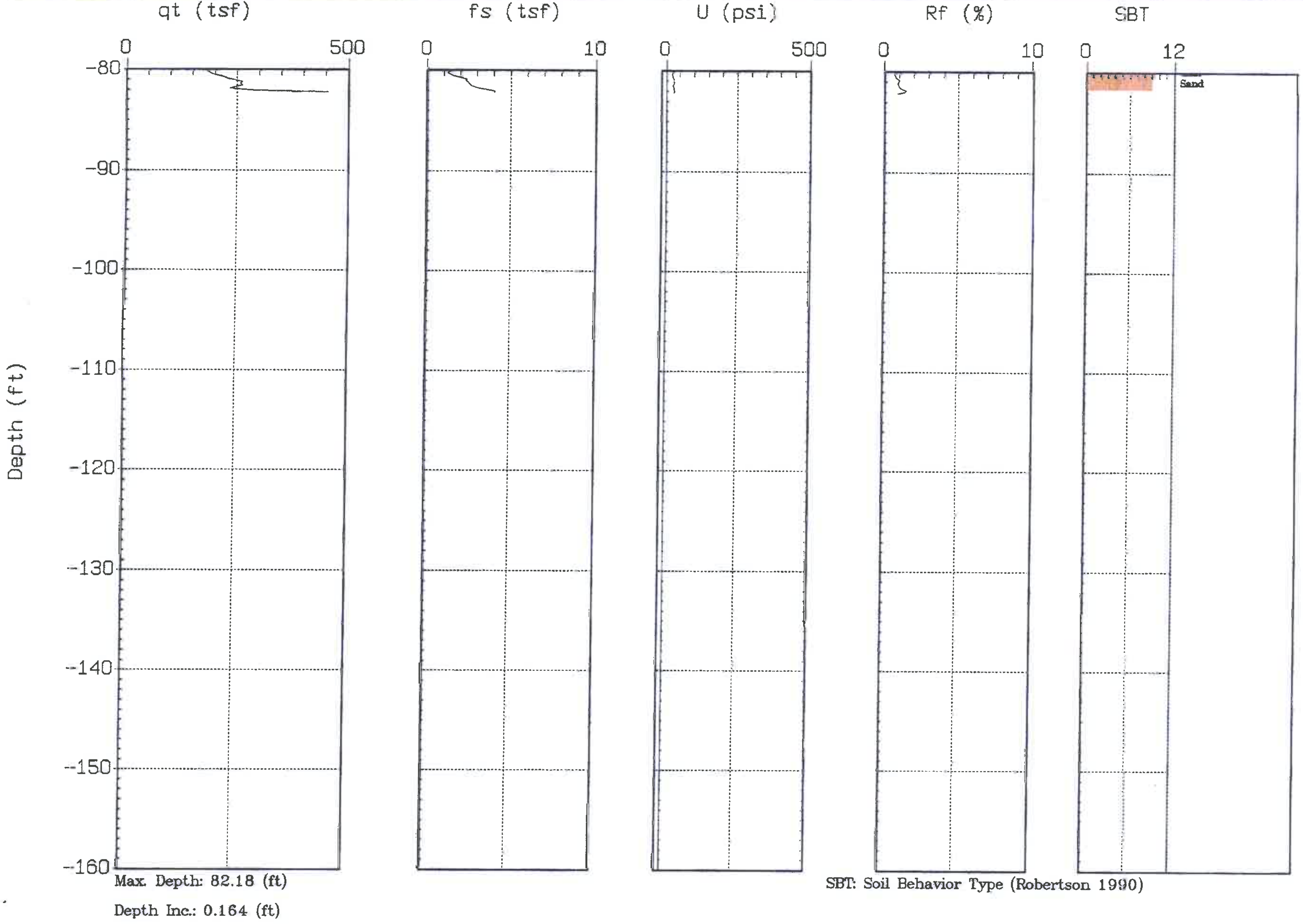
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-5

Geologist : S. BERRYMAN
Date : 03:12:02 02:15



Max. Depth: 82.18 (ft)
Depth Inc.: 0.164 (ft)

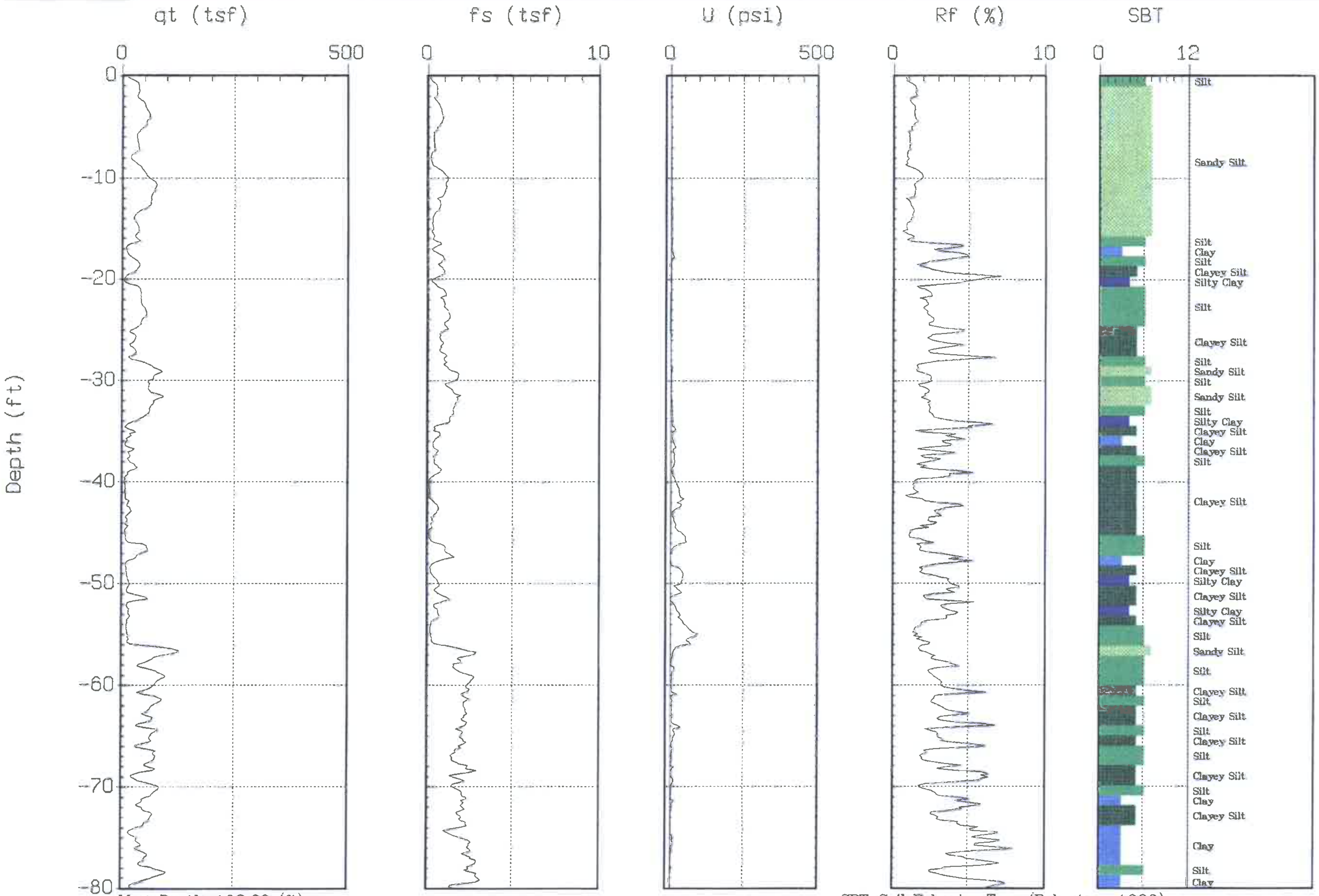
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-6

Geologist : S. BERRYMAN
Date : 03:12:02 03:12



Max. Depth: 102.69 (ft)

Depth Inc.: 0.164 (ft)

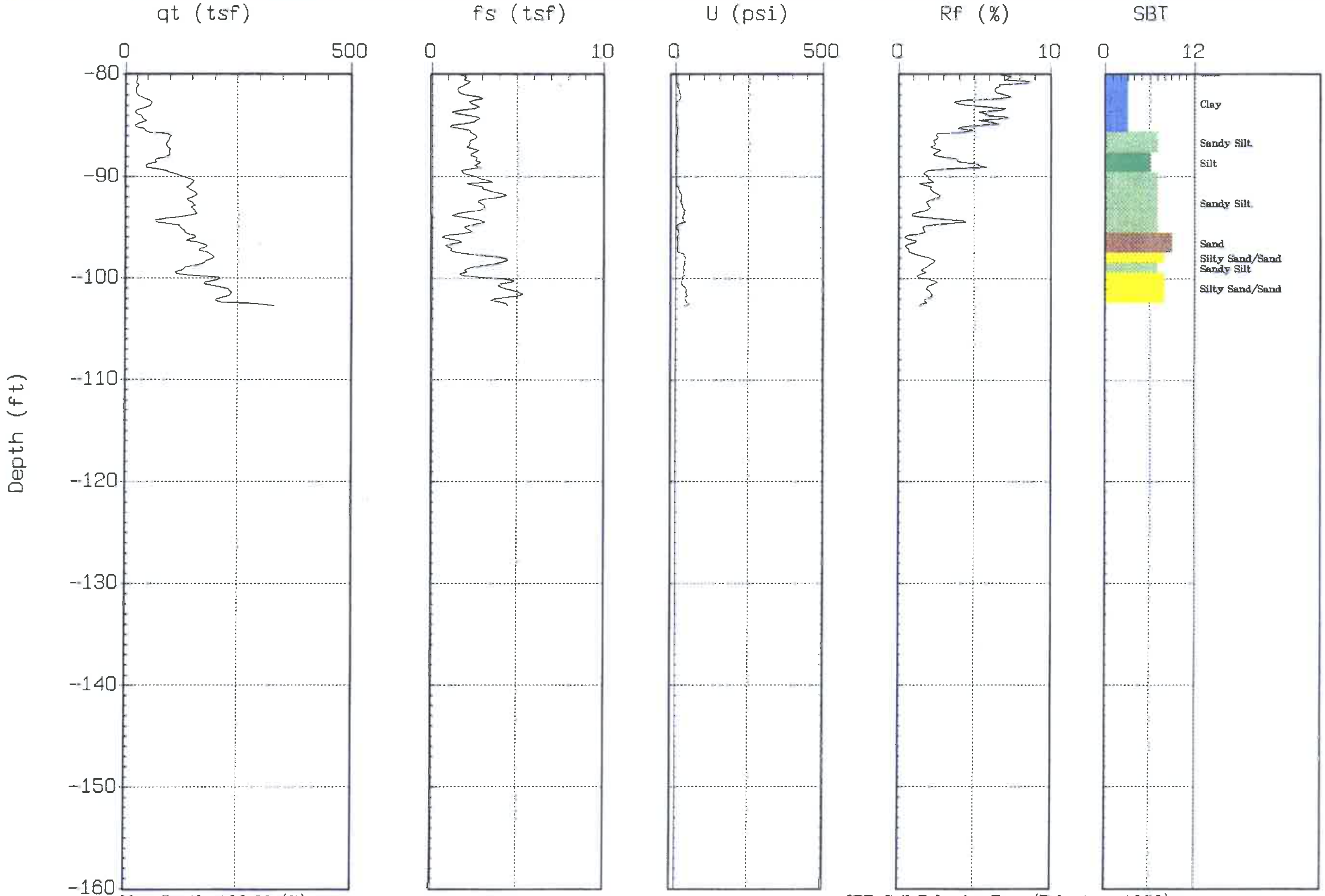
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-6

Geologist : S. BERRYMAN
Date : 03:12:02 03:12



Max. Depth: 102.69 (ft)

Depth Inc.: 0.164 (ft)

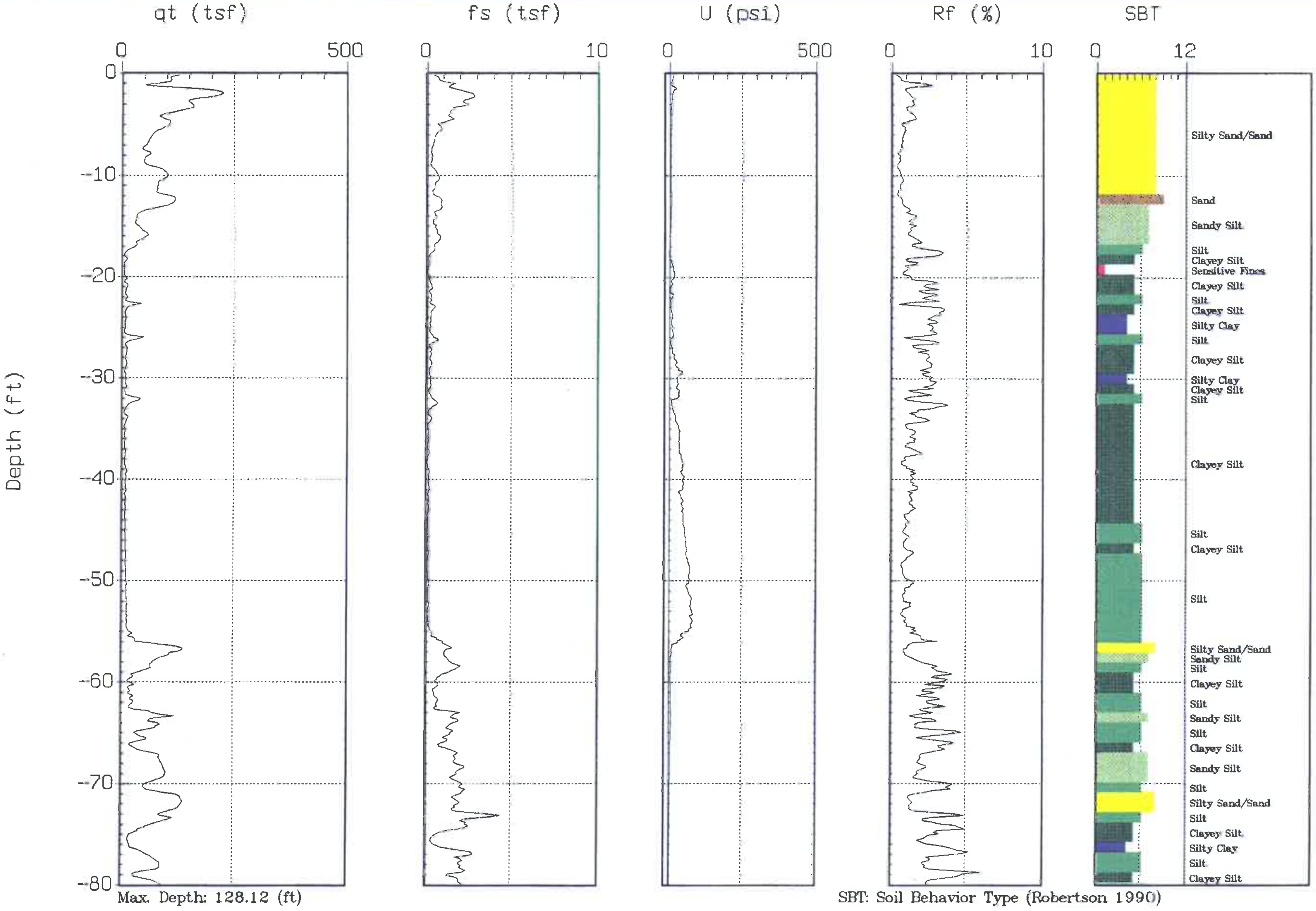
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-7

Geologist : S. BERRYMAN
Date : 03:12:02 20:26



Max. Depth: 128.12 (ft)

Depth Inc.: 0.164 (ft)

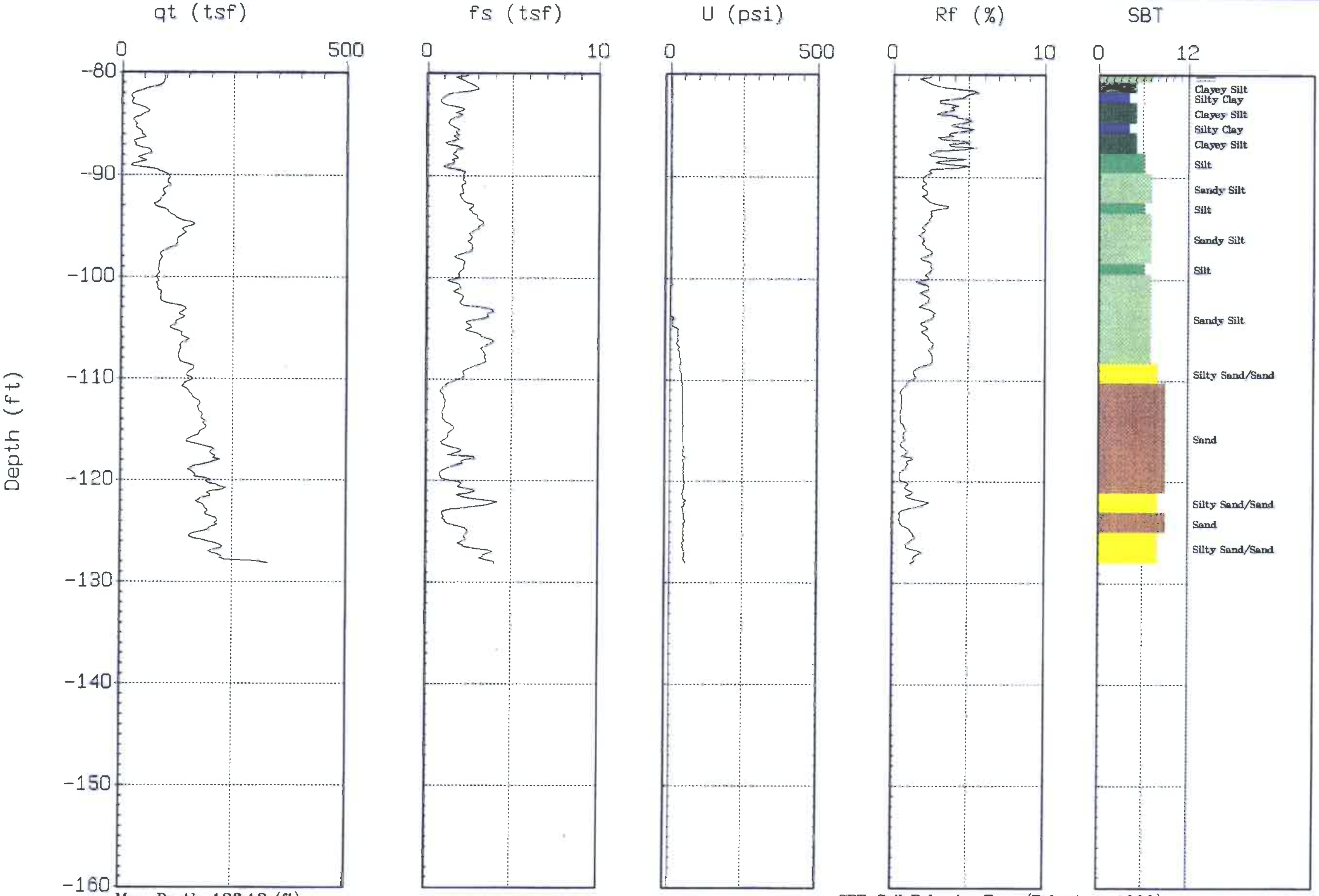
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-7

Geologist : S. BERRYMAN
Date : 03:12:02 20:26



Max. Depth: 128.12 (ft)

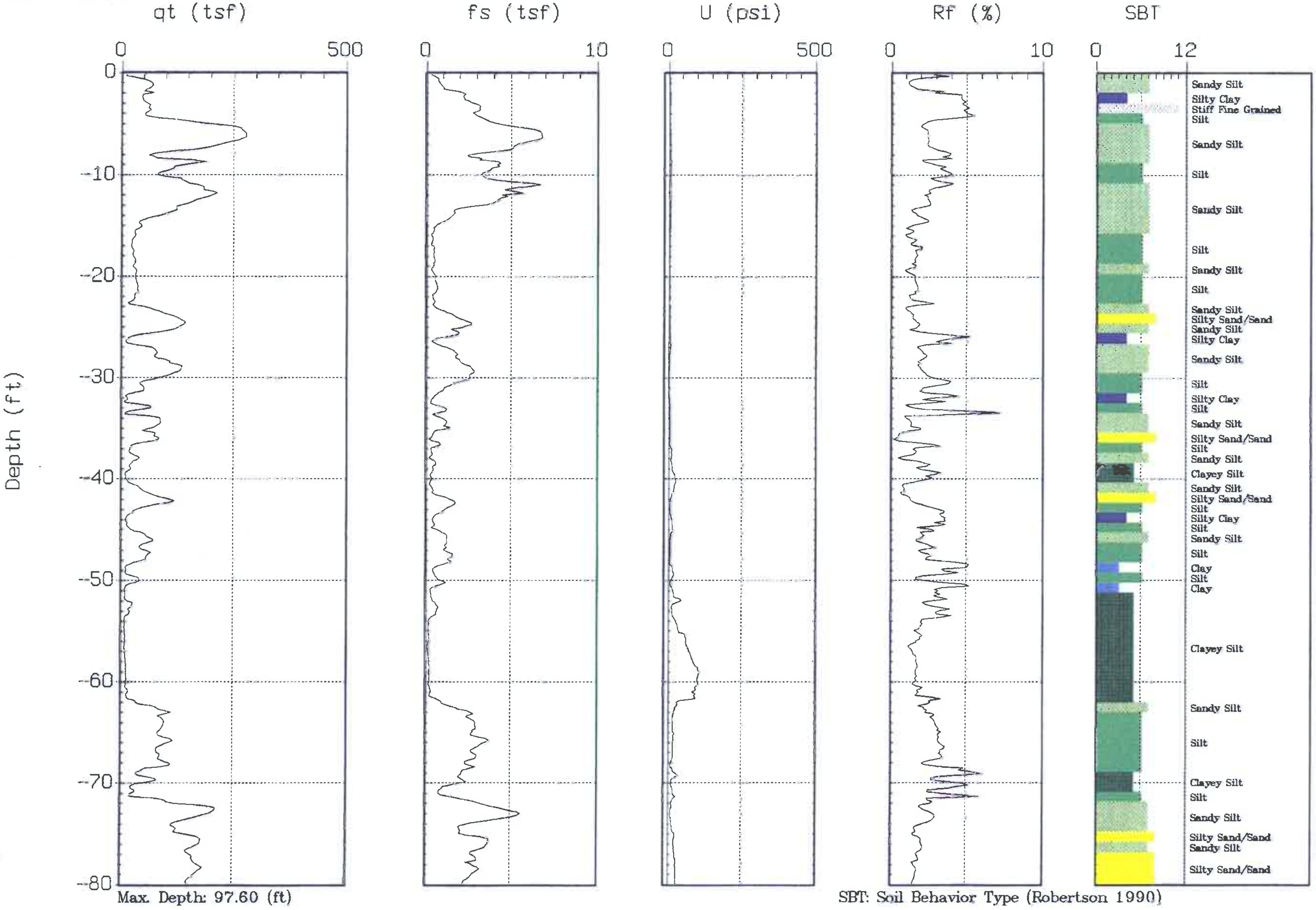
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-8

Geologist : S. BERRYMAN
Date : 03:12:02 21:35



Max. Depth: 97.60 (ft)

Depth Inc.: 0.164 (ft)

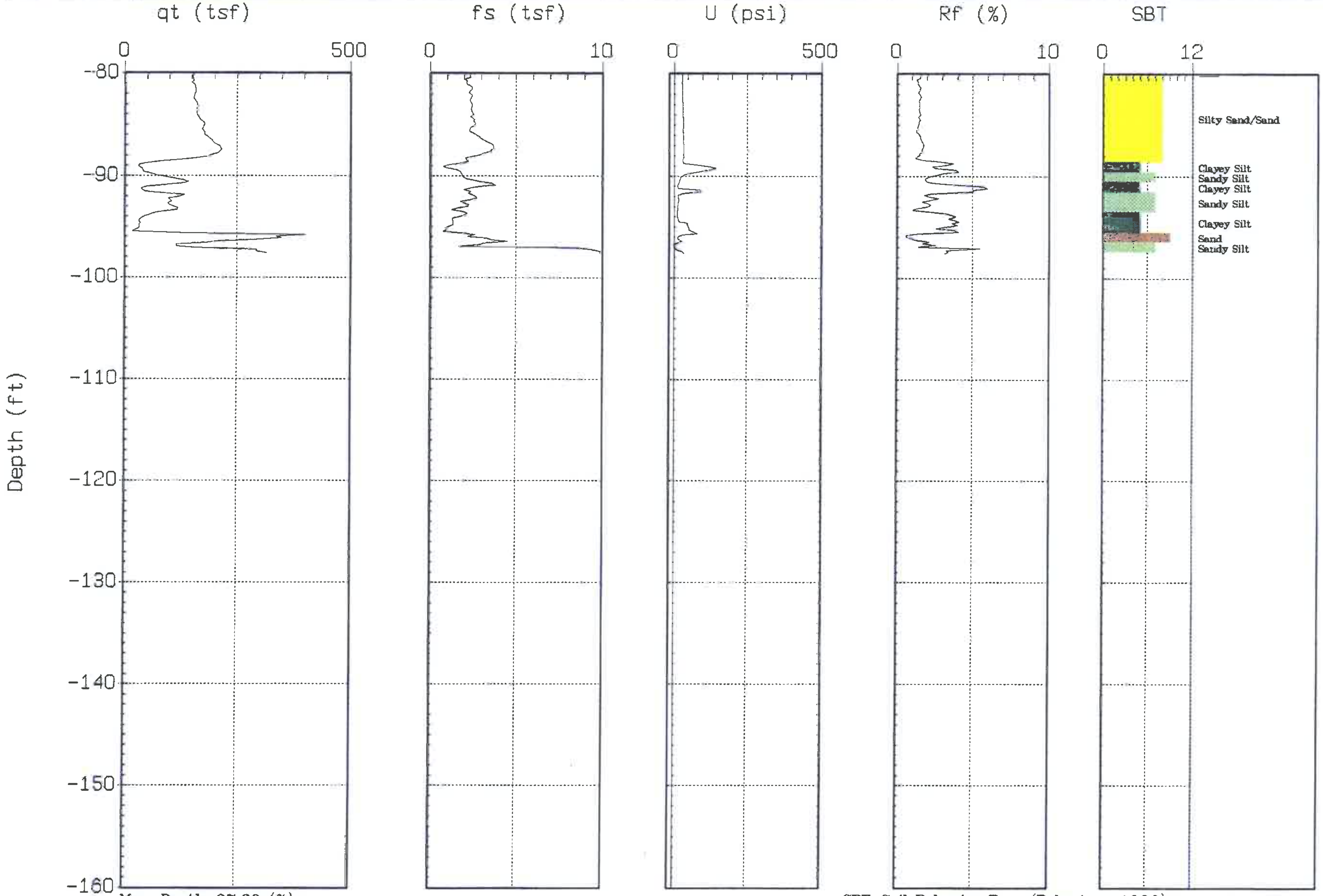
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : CMWD SAN DIEGUITO
Location : CPT-8

Geologist : S. BERRYMAN
Date : 03:12:02 21:35



Max. Depth: 97.60 (ft)

Depth Inc.: 0.164 (ft)

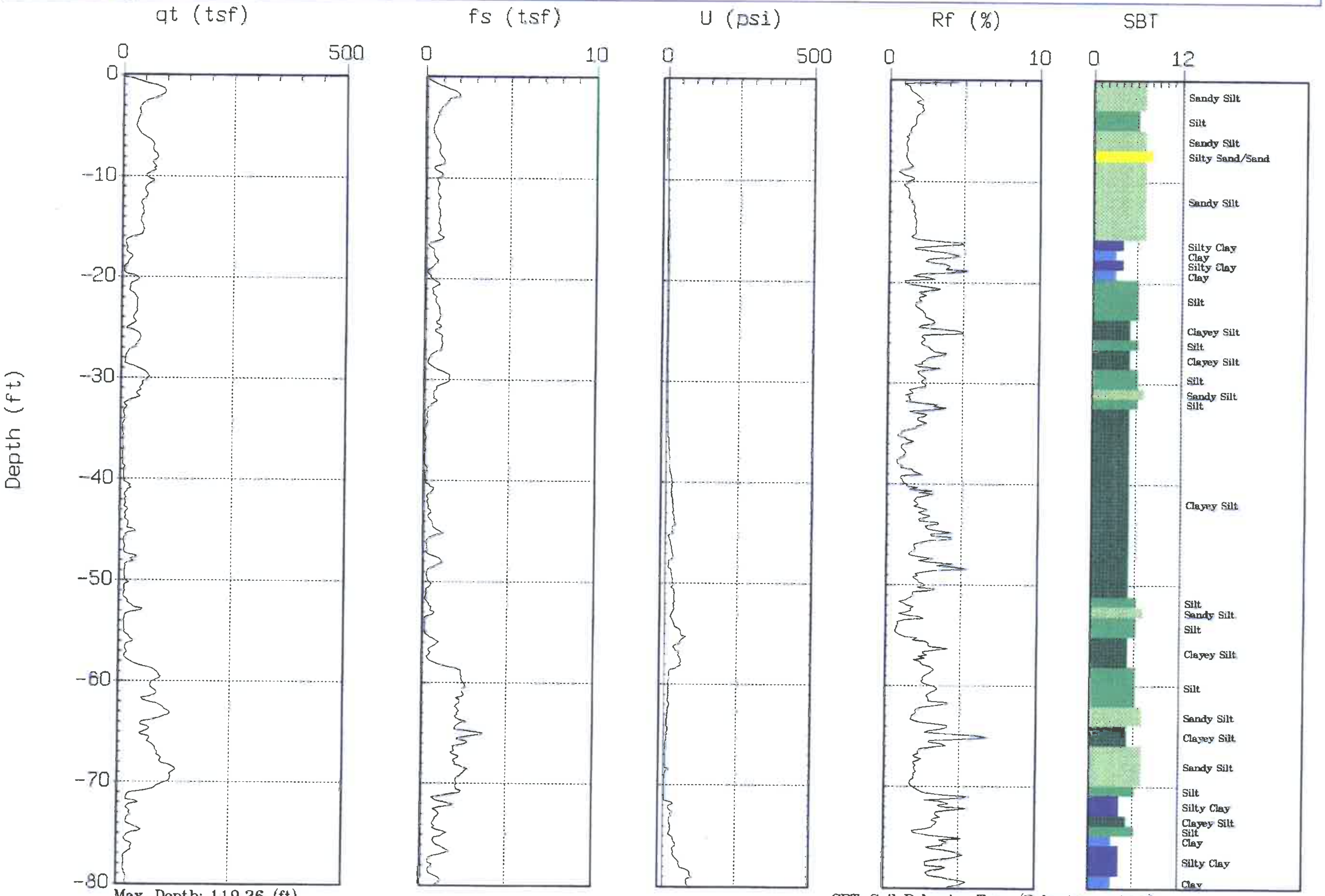
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-9

Geologist : S. BERRYMAN
Date : 03:12:02 23:06



Max. Depth: 119.26 (ft)

Depth Inc.: 0.164 (ft)

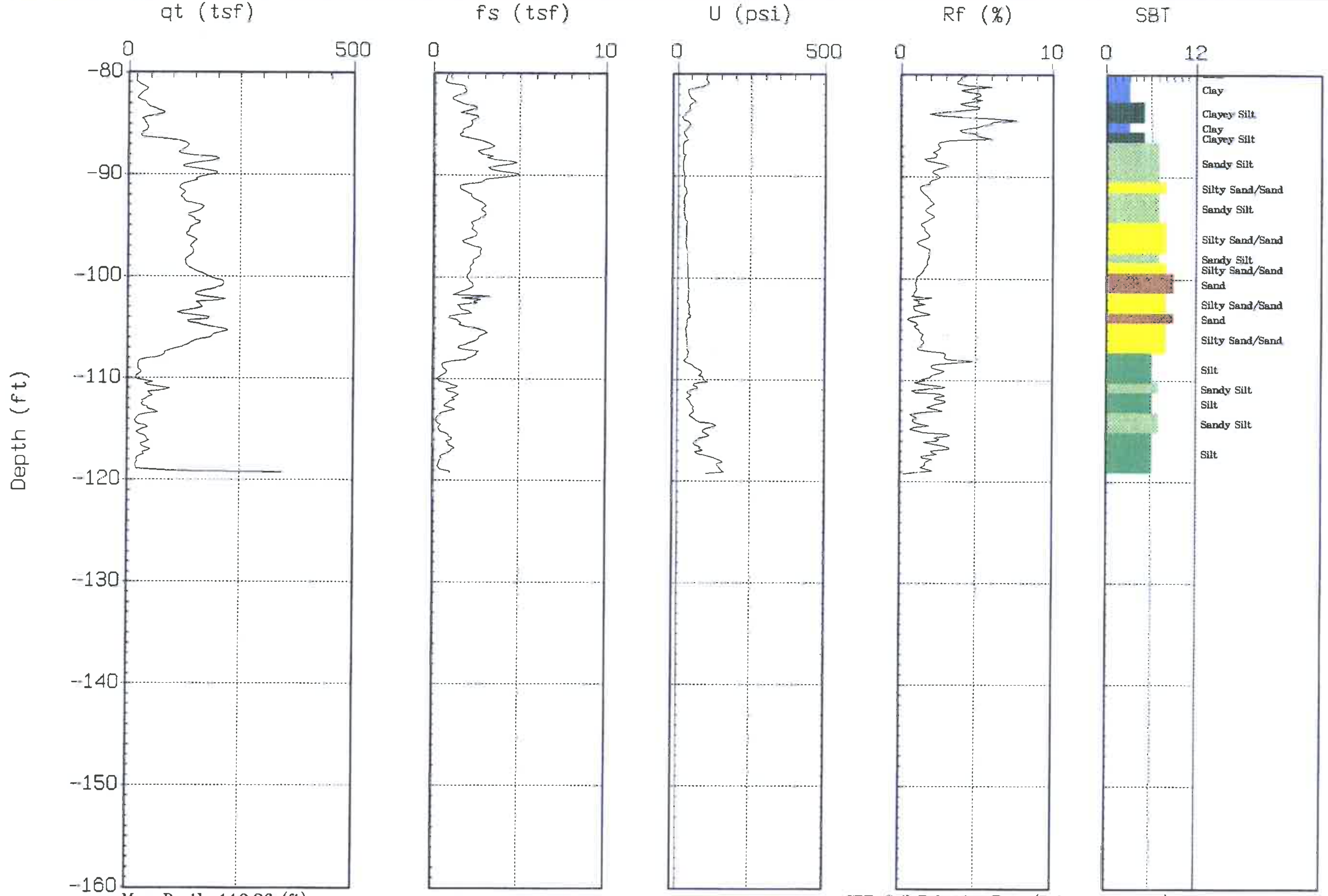
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-9

Geologist : S. BERRYMAN
Date : 03:12:02 23:06



Max. Depth: 119.26 (ft)

Depth Inc.: 0.164 (ft)

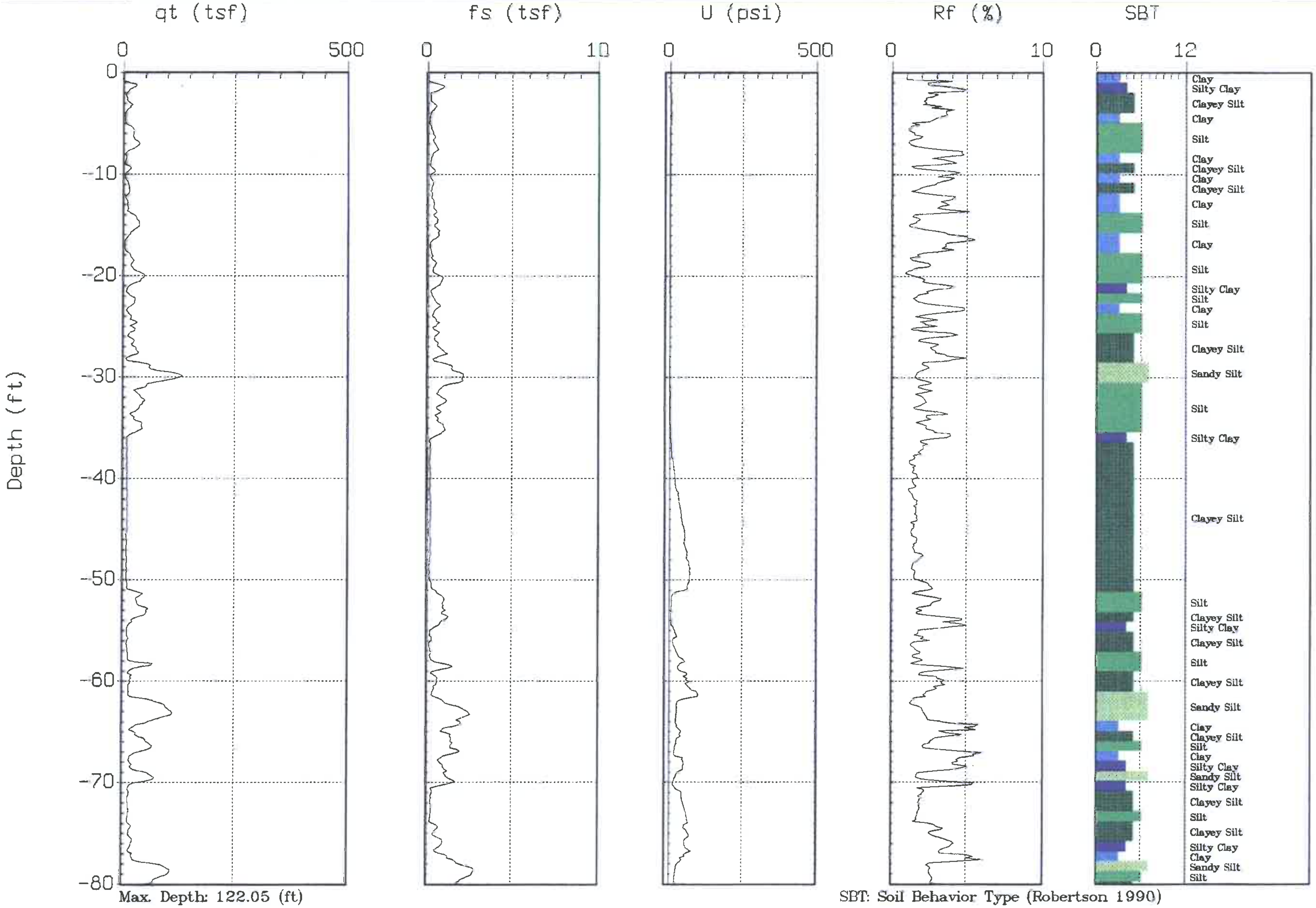
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-10

Geologist : S. BERRYMAN
Date : 03:13:02 01:10



Max. Depth: 122.05 (ft)

Depth Inc.: 0.164 (ft)

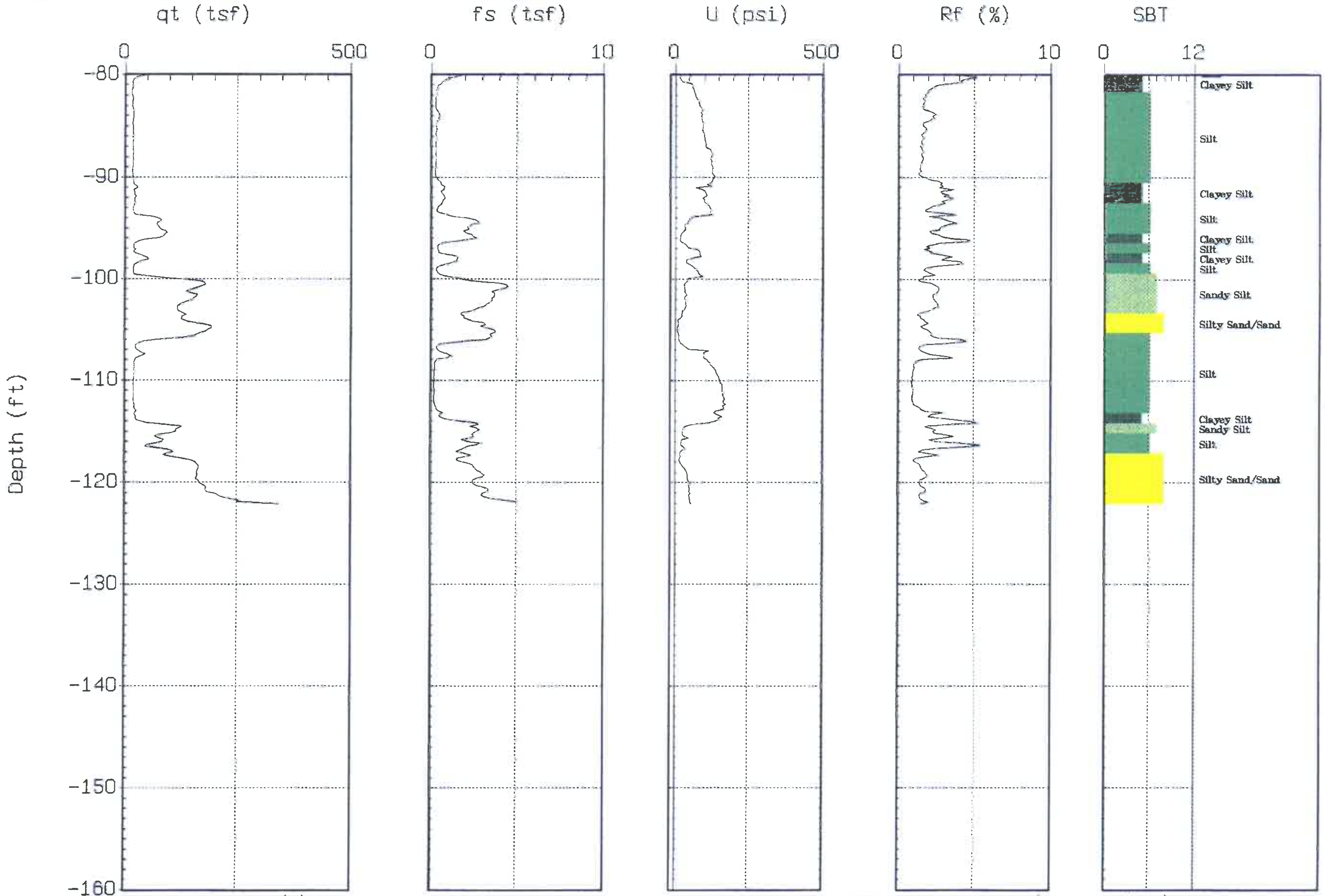
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-10

Geologist : S. BERRYMAN
Date : 03:13:02 01:10



Max. Depth: 122.05 (ft)
Depth Inc.: 0.164 (ft)

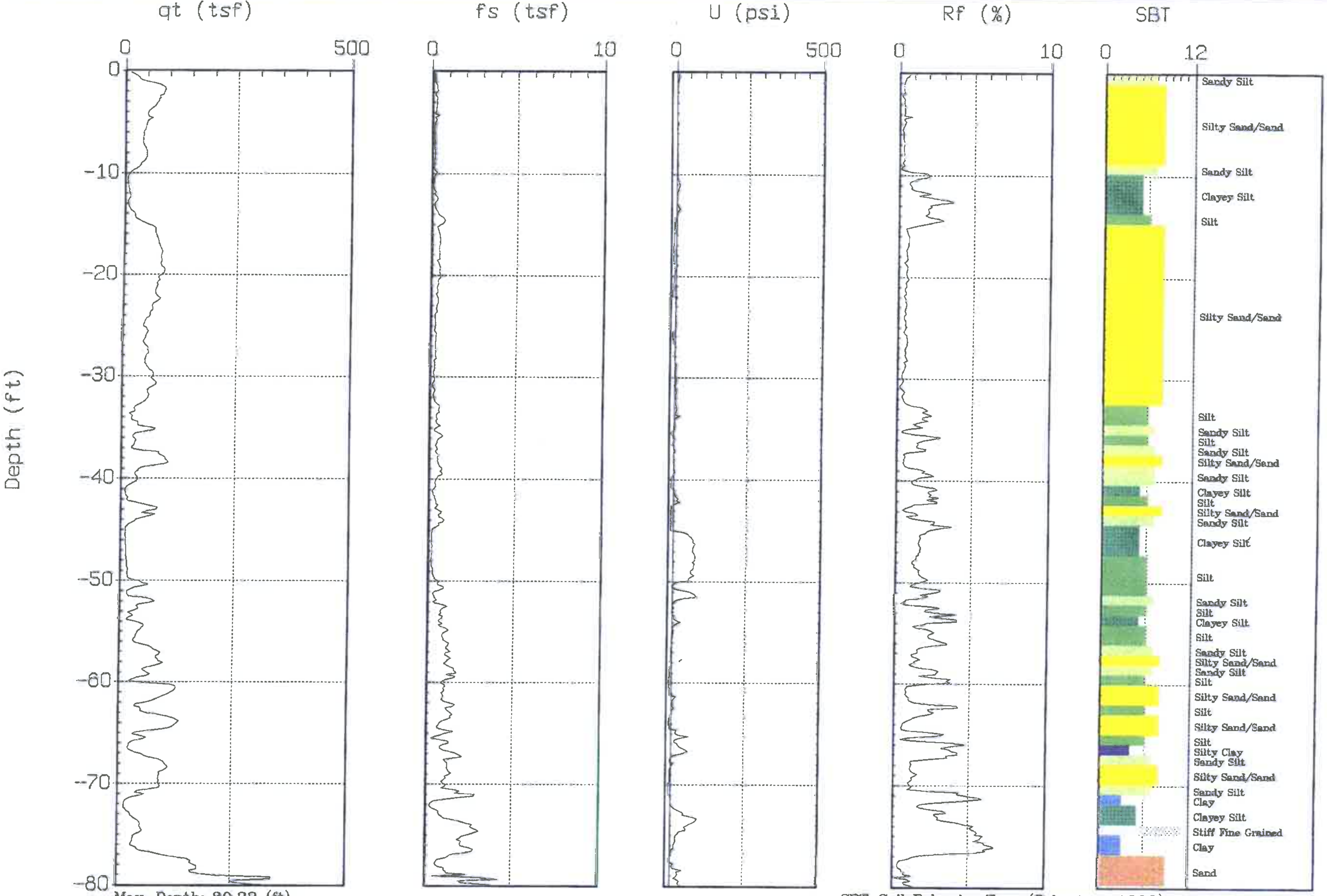
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-11

Geologist : S. BERRYMAN
Date : 03:13:02 21:06



Max. Depth: 80.22 (ft)

Depth Inc.: 0.164 (ft)

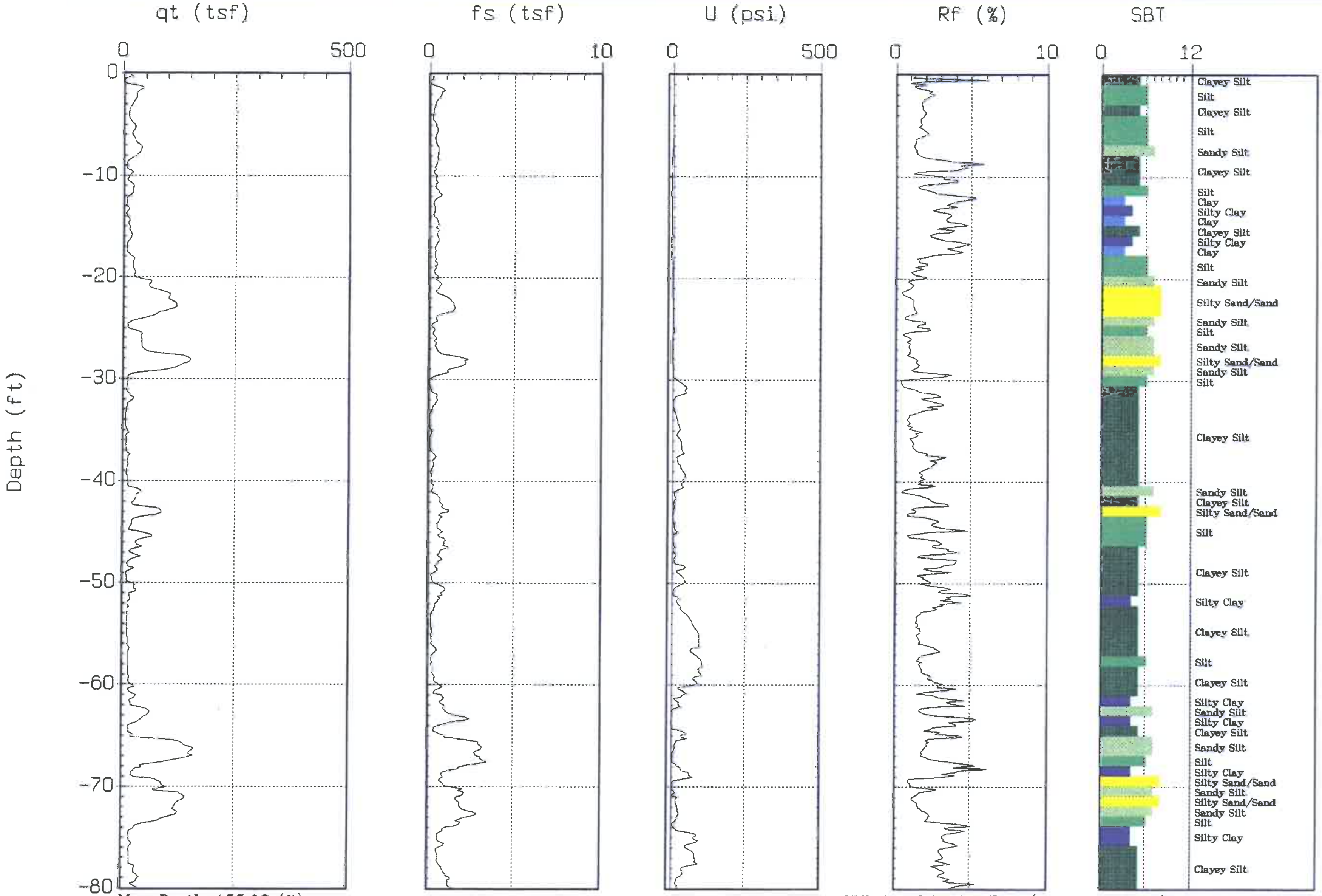
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-12

Geologist : S. BERRYMAN
Date : 03:13:02 22:24



Max. Depth: 155.02 (ft)

Depth Inc.: 0.164 (ft)

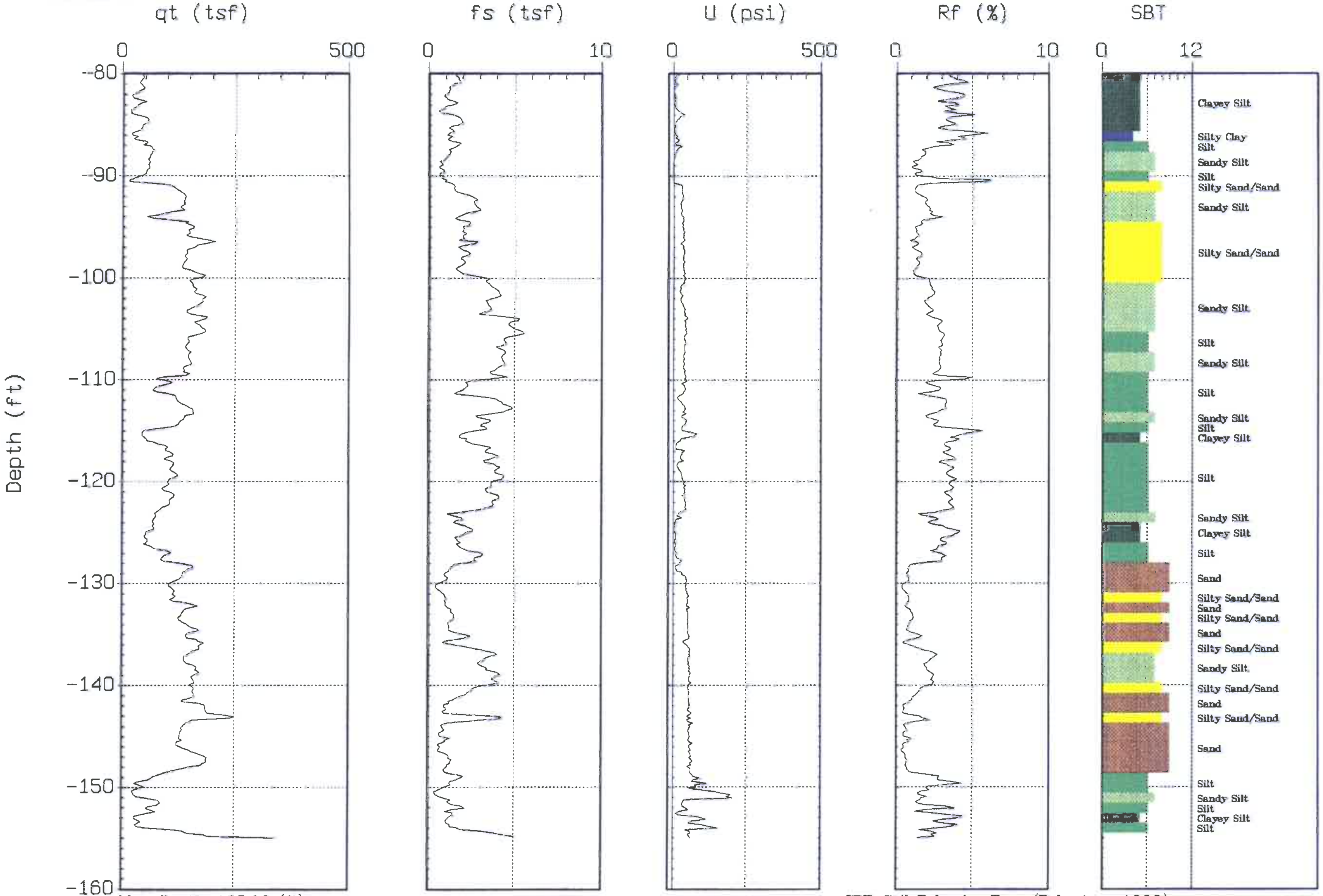
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD SAN DIEGUITO
Location : CPT-12

Geologist : S. BERRYMAN
Date : 03:13:02 22:24



Max. Depth: 155.02 (ft)

Depth Inc.: 0.164 (ft)

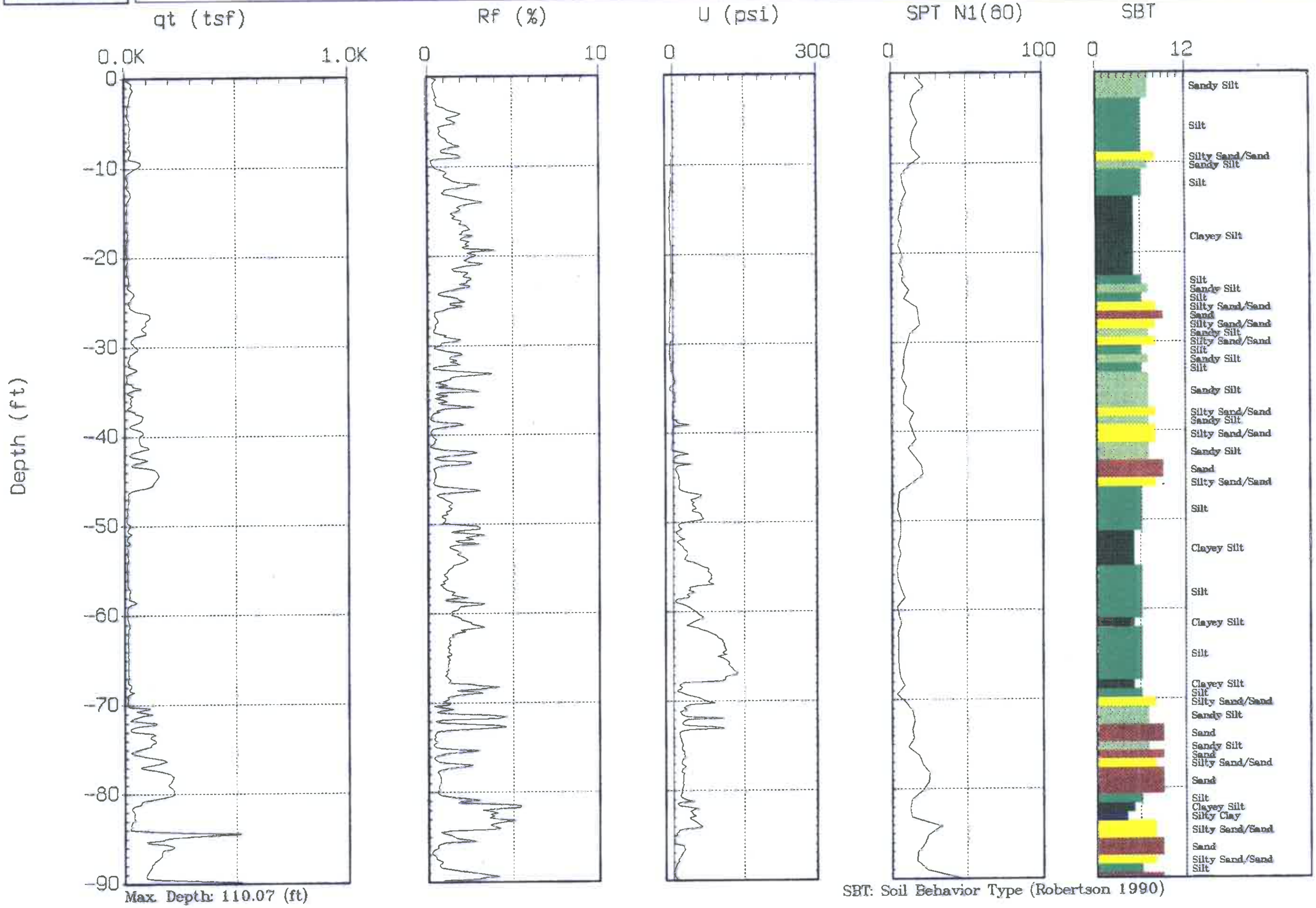
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-13

Geologist : S. BERRYMAN
Date : 09:17:02   12:20



Max. Depth: 110.07 (ft)

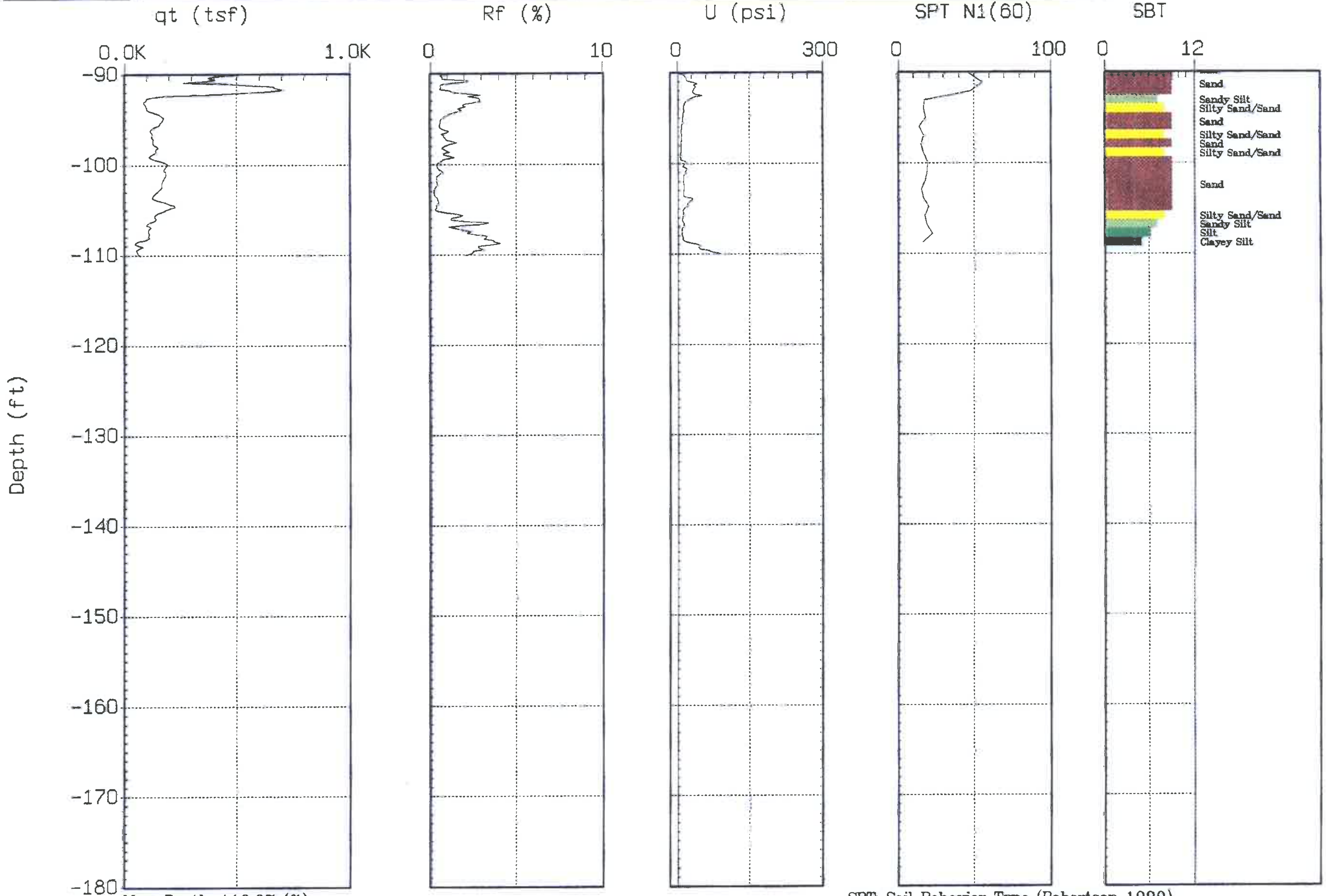
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-13

Geologist : S. BERRYMAN
Date : 09:17:02 12:20



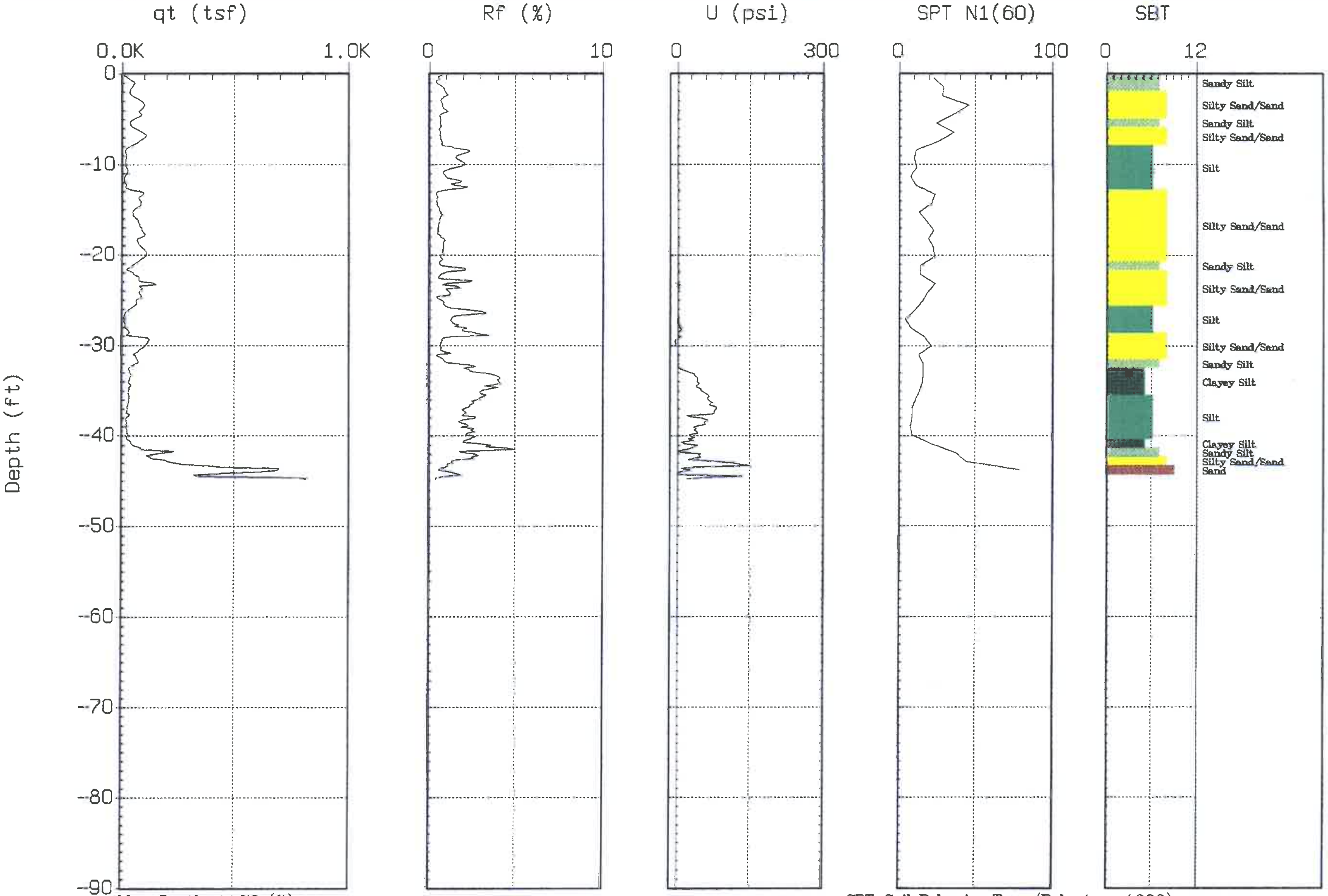
Max. Depth: 110.07 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-14

Geologist : S. BERRYMAN
Date : 09:17:02 13:47



Max. Depth: 44.78 (ft)

Depth Inc.: 0.164 (ft)

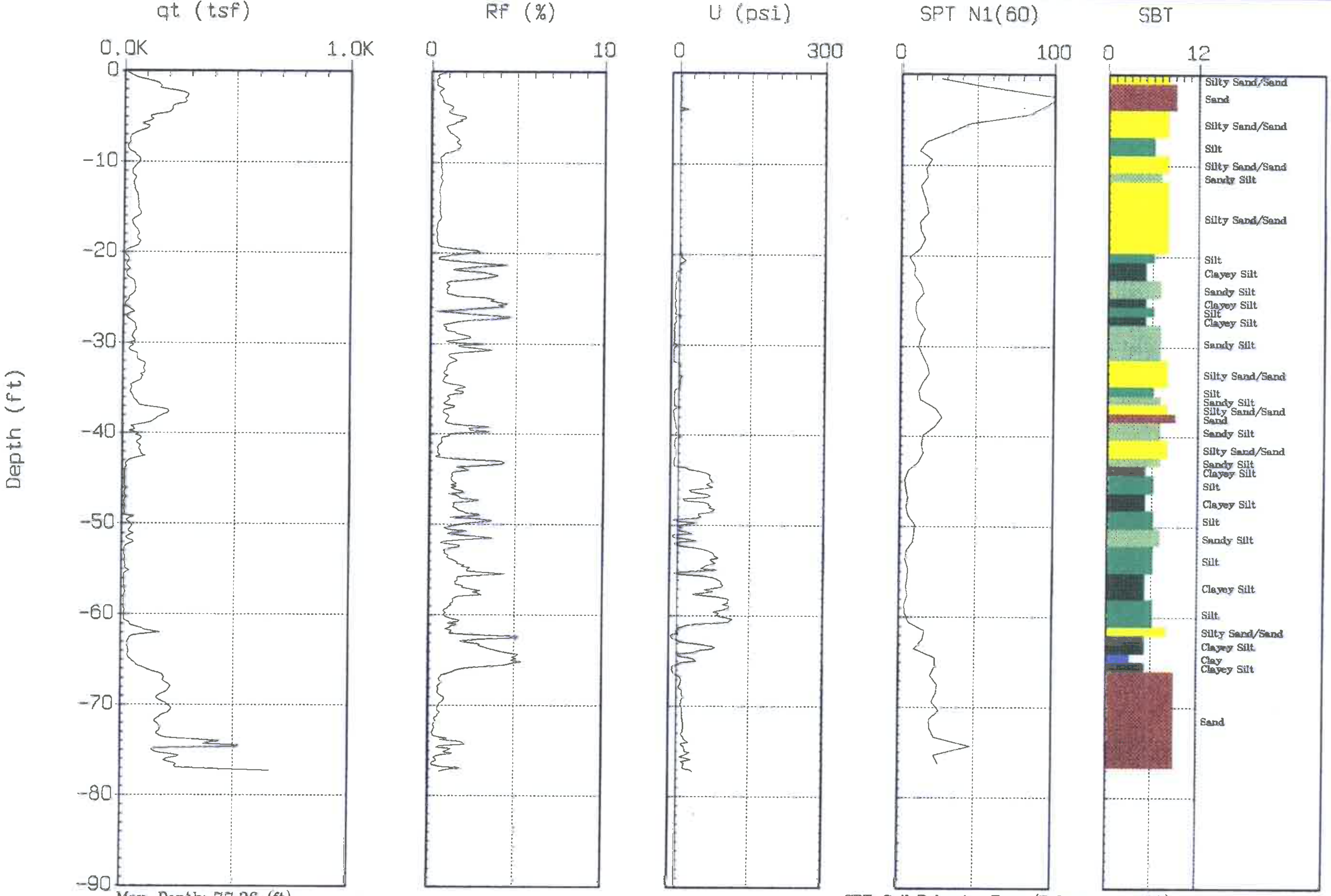
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-15

Geologist : S. BERRYMAN
Date : 09:17:02 14:33



Max. Depth: 77.26 (ft)

Depth Inc.: 0.164 (ft)

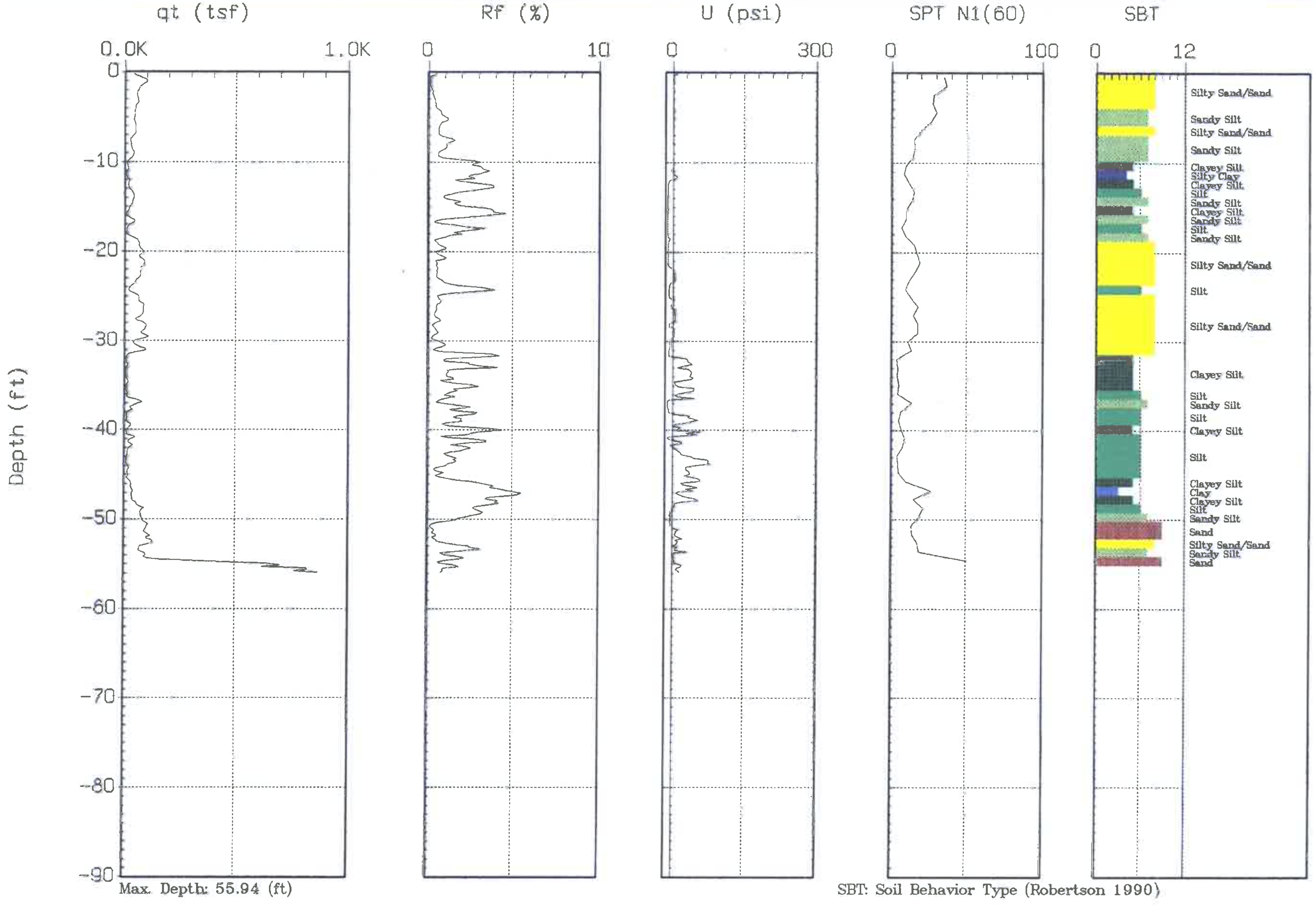
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-16

Geologist : S. BERRYMAN
Date : 09:17:02 15:44



Max. Depth: 55.94 (ft)

Depth Inc.: 0.164 (ft)

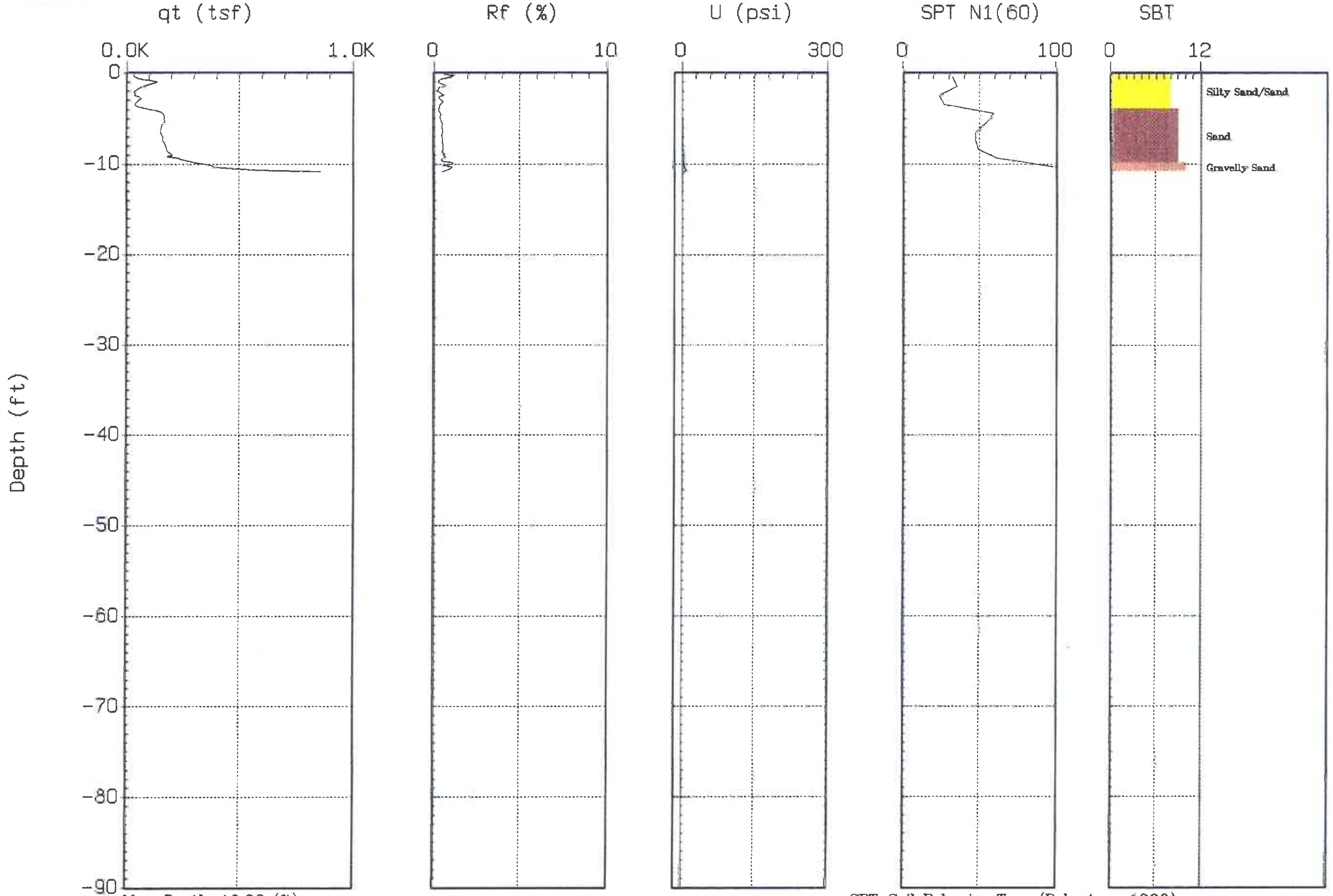
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-17

Geologist : S. BERRYMAN
Date : 09:17:02 17:02



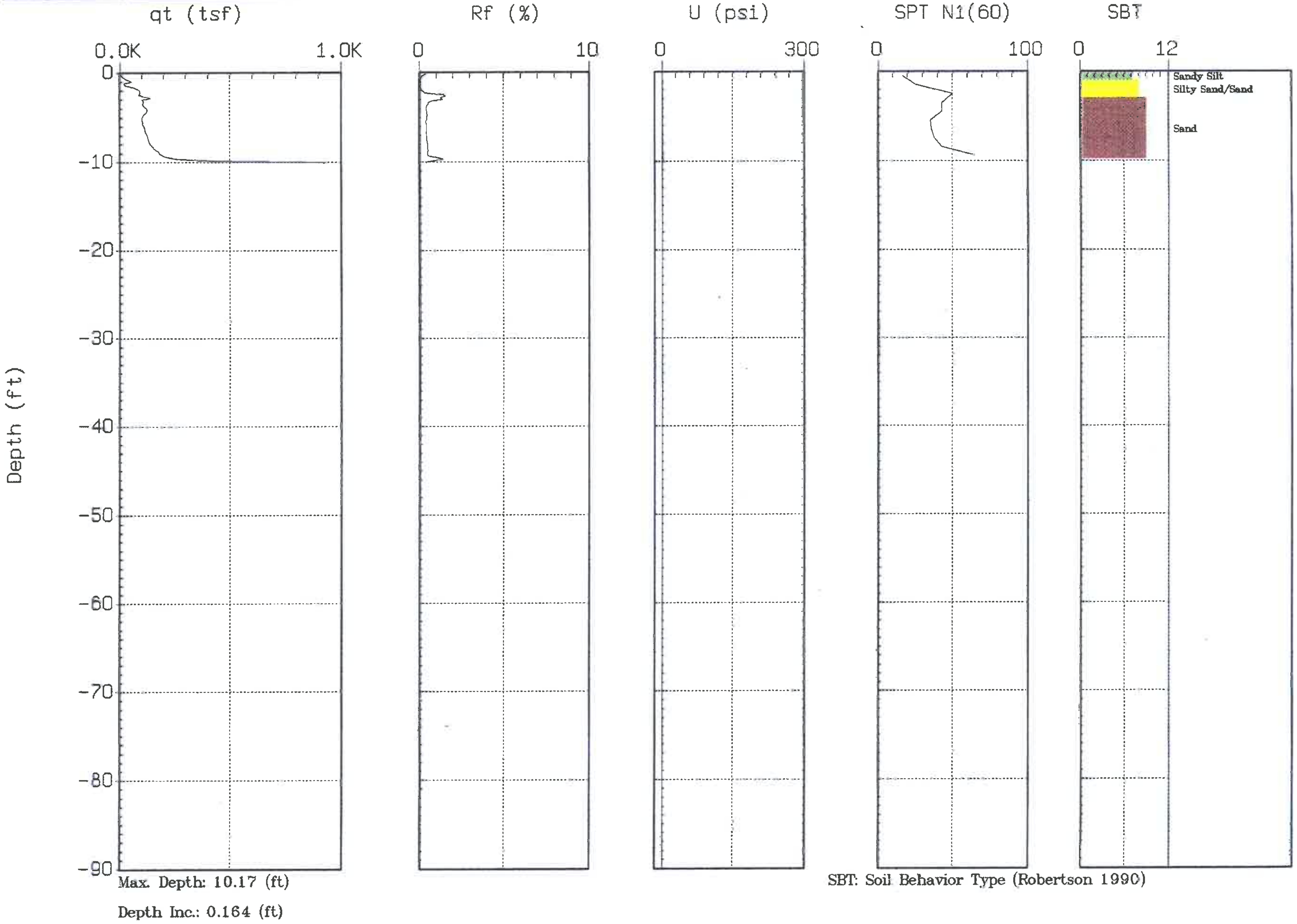
Max. Depth: 10.83 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : QMWD S.D.
Location : CPT-17A

Geologist : S. BERRYMAN
Date : 09:17:02 17:12



Max. Depth: 10.17 (ft)
Depth Inc.: 0.164 (ft)

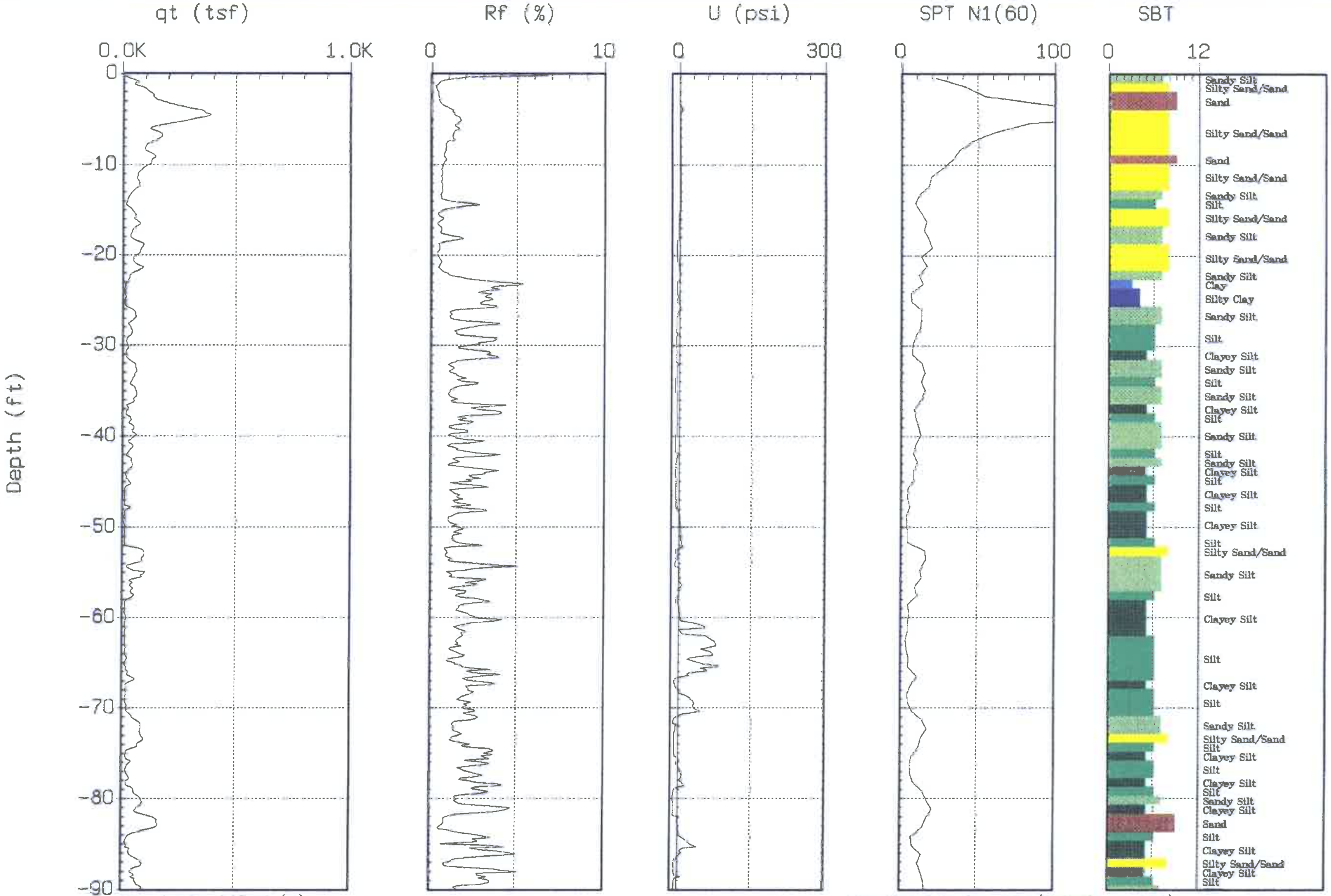
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-18

Geologist : S. BERRYMAN
Date : 09:18:02 08:20



Max. Depth: 145.01 (ft)

Depth Inc.: 0.164 (ft)

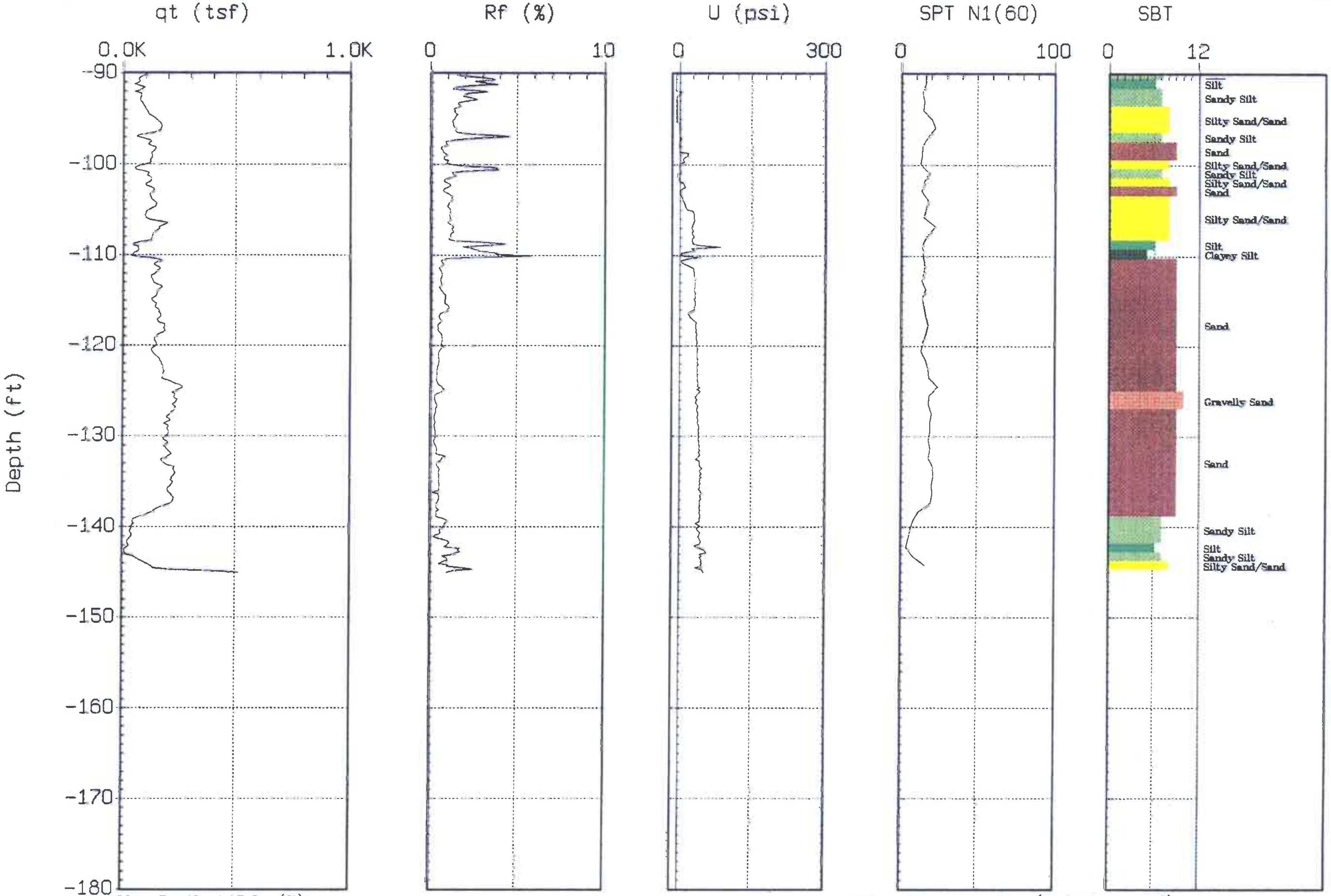
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-18

Geologist : S. BERRYMAN
Date : 09:18:02 08:20



Max. Depth: 145.01 (ft)

Depth Inc.: 0.164 (ft)

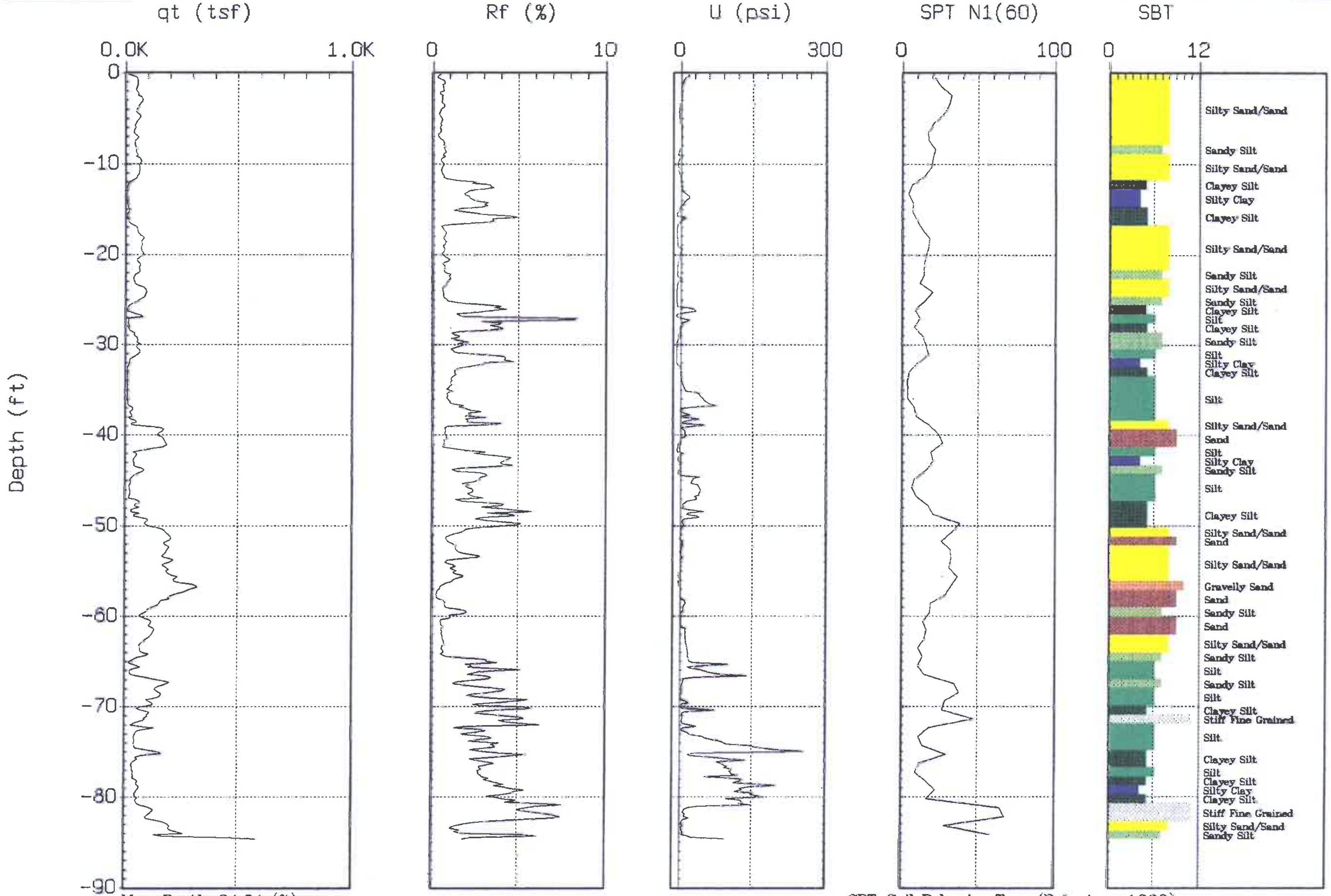
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-19

Geologist : S. BERRYMAN
Date : 09:18:02 11:20



Max. Depth: 84.64 (ft)

Depth Inc.: 0.164 (ft)

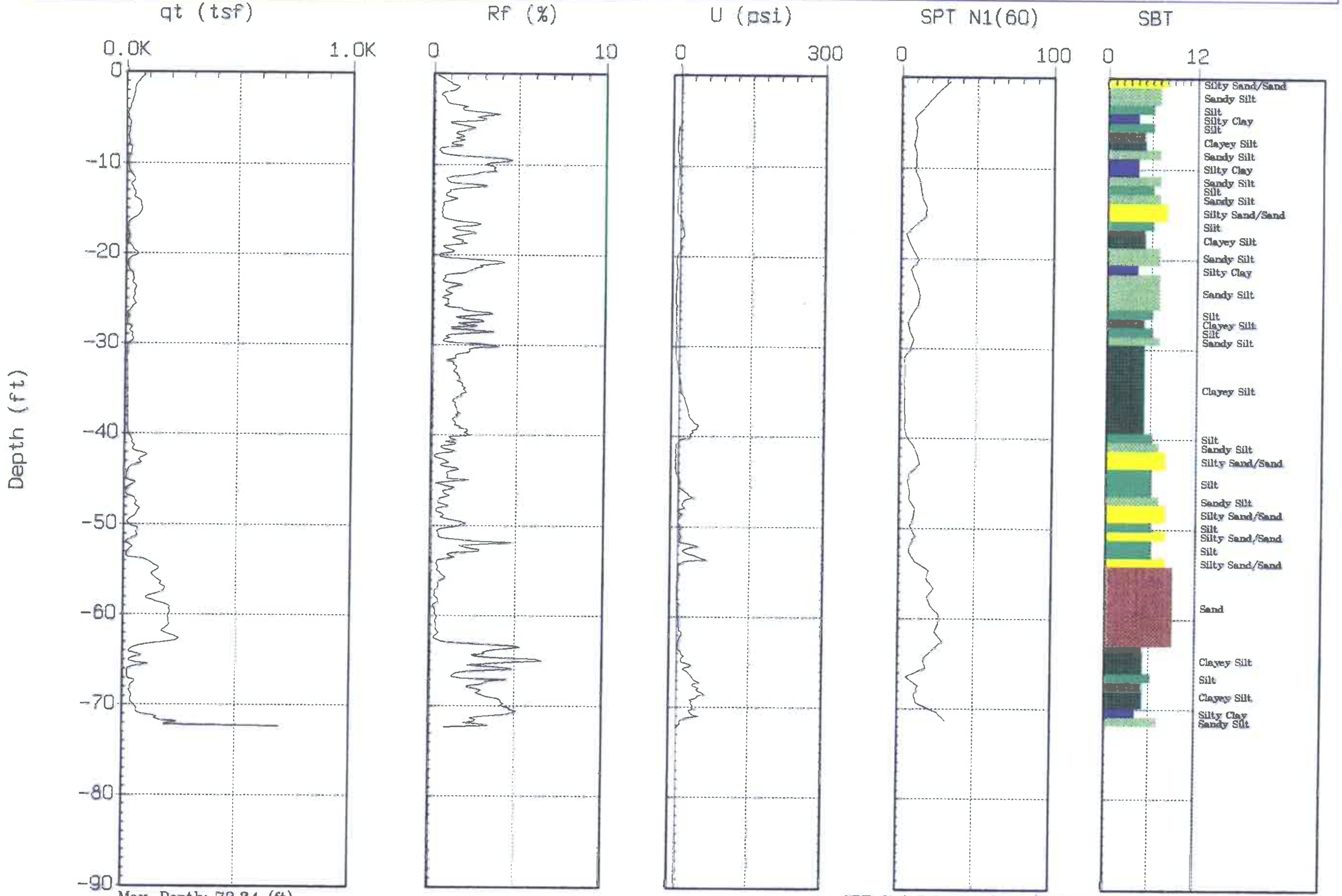
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-20

Geologist : S. BERRYMAN
Date : 09:18:02 12:13



Max. Depth: 72.34 (ft)

Depth Inc.: 0.164 (ft)

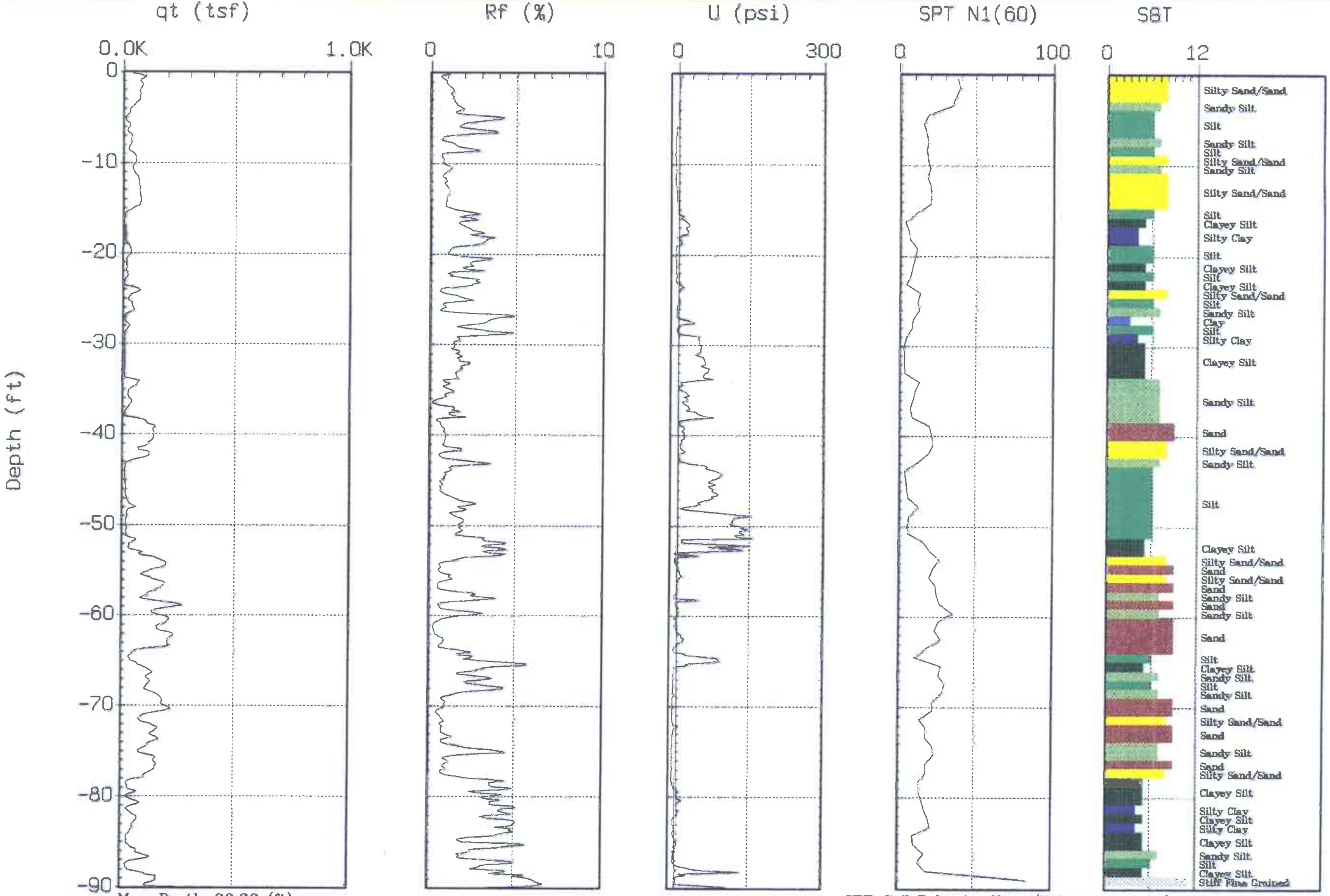
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-21

Geologist : S. BERRYMAN
Date : 09:18:02 13:11



Max. Depth: 90.39 (ft)

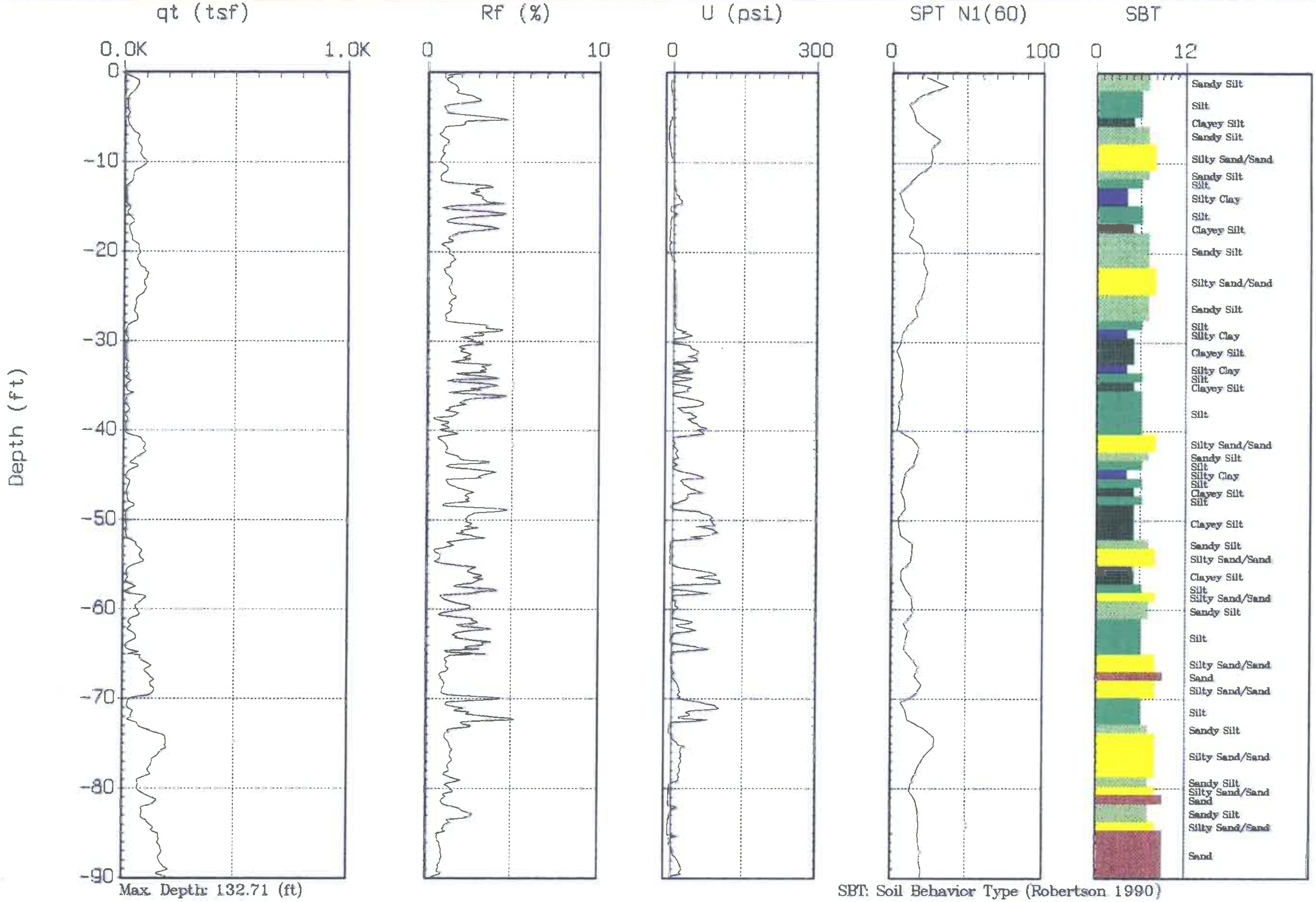
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-22

Geologist : S. BERRYMAN
Date : 09:18:02 15:26



Max. Depth: 132.71 (ft)

Depth Inc.: 0.164 (ft)

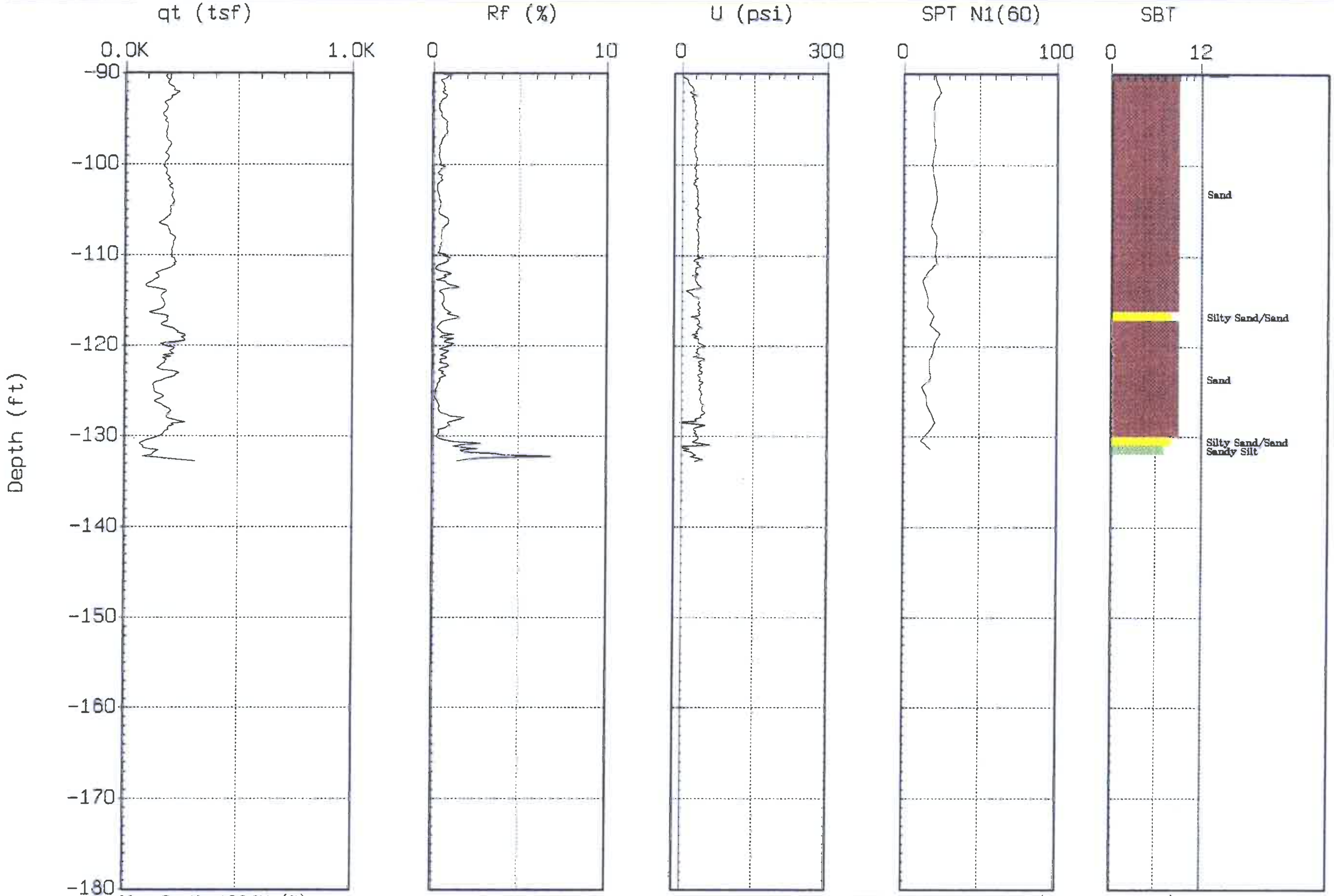
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-22

Geologist : S. BERRYMAN
Date : 09:18:02 15:26



Max. Depth: 132.71 (ft)

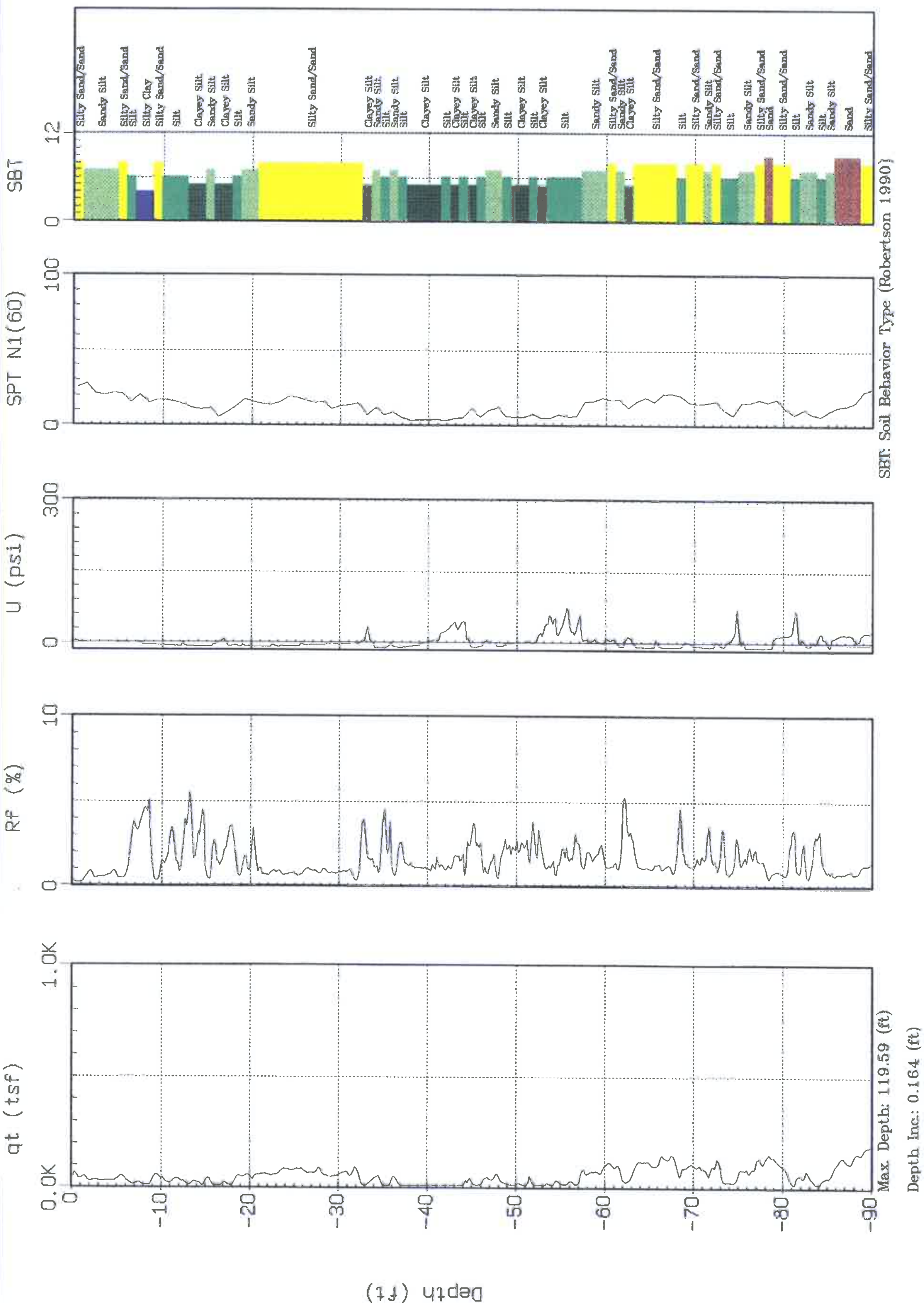
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-23

Geologist : S. BERRYMAN
Date : 09:19:02 07:45

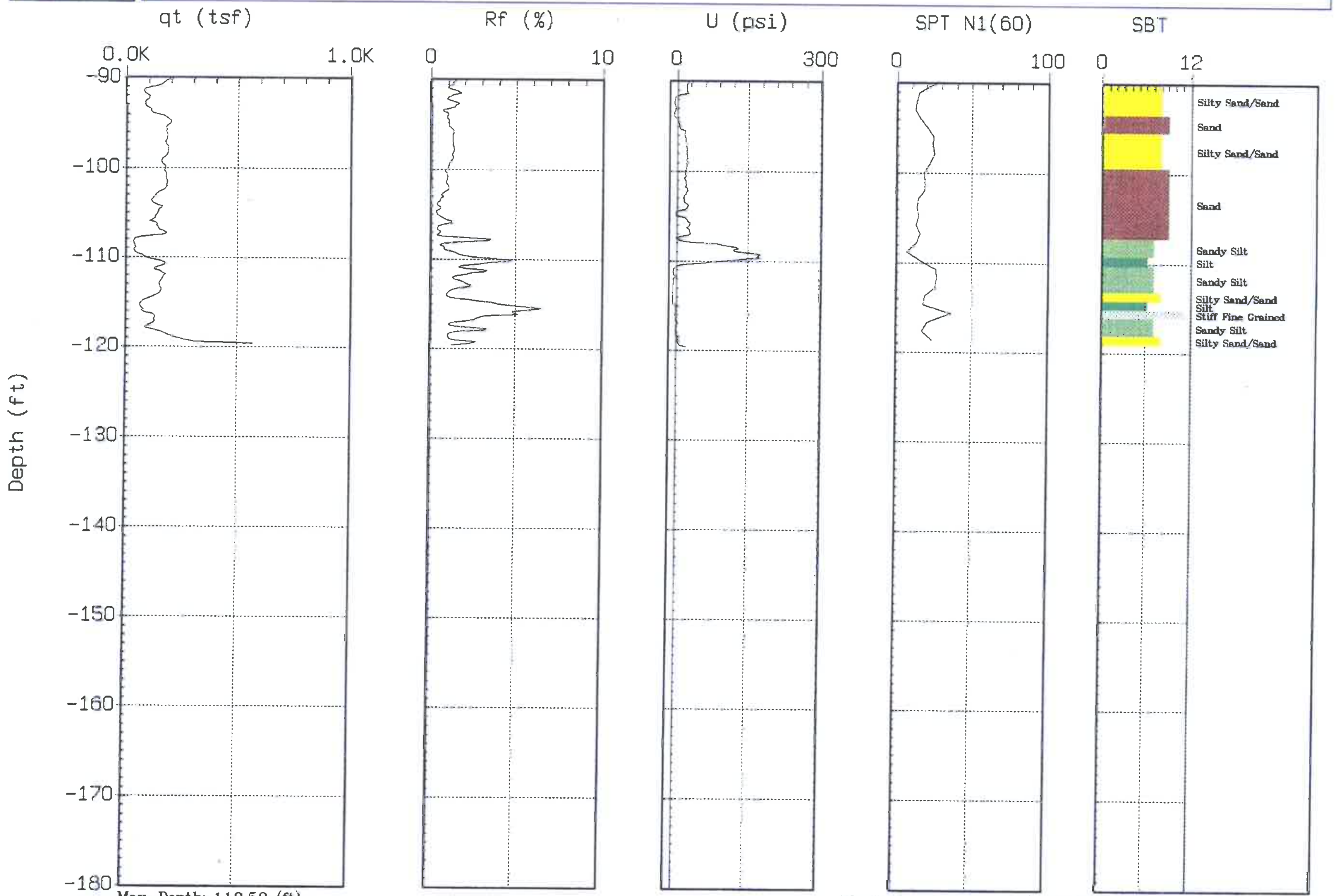


GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-23

Geologist : S. BERRYMAN
Date : 09:19:02 07:45



Max. Depth: 119.59 (ft)

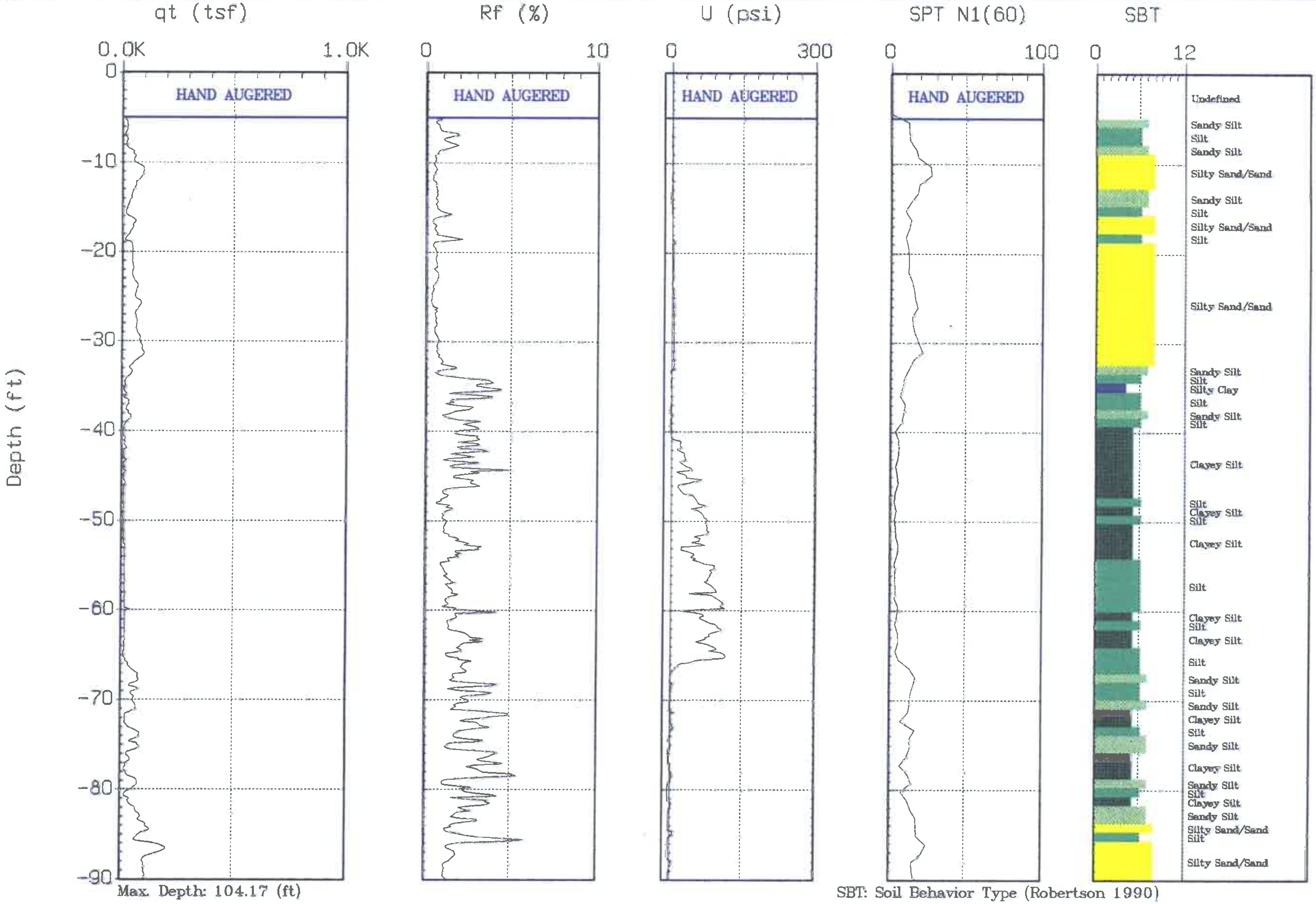
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-24

Geologist : S. BERRYMAN
Date : 09:19:02 09:59



Max. Depth: 104.17 (ft)

Depth Inc.: 0.164 (ft)

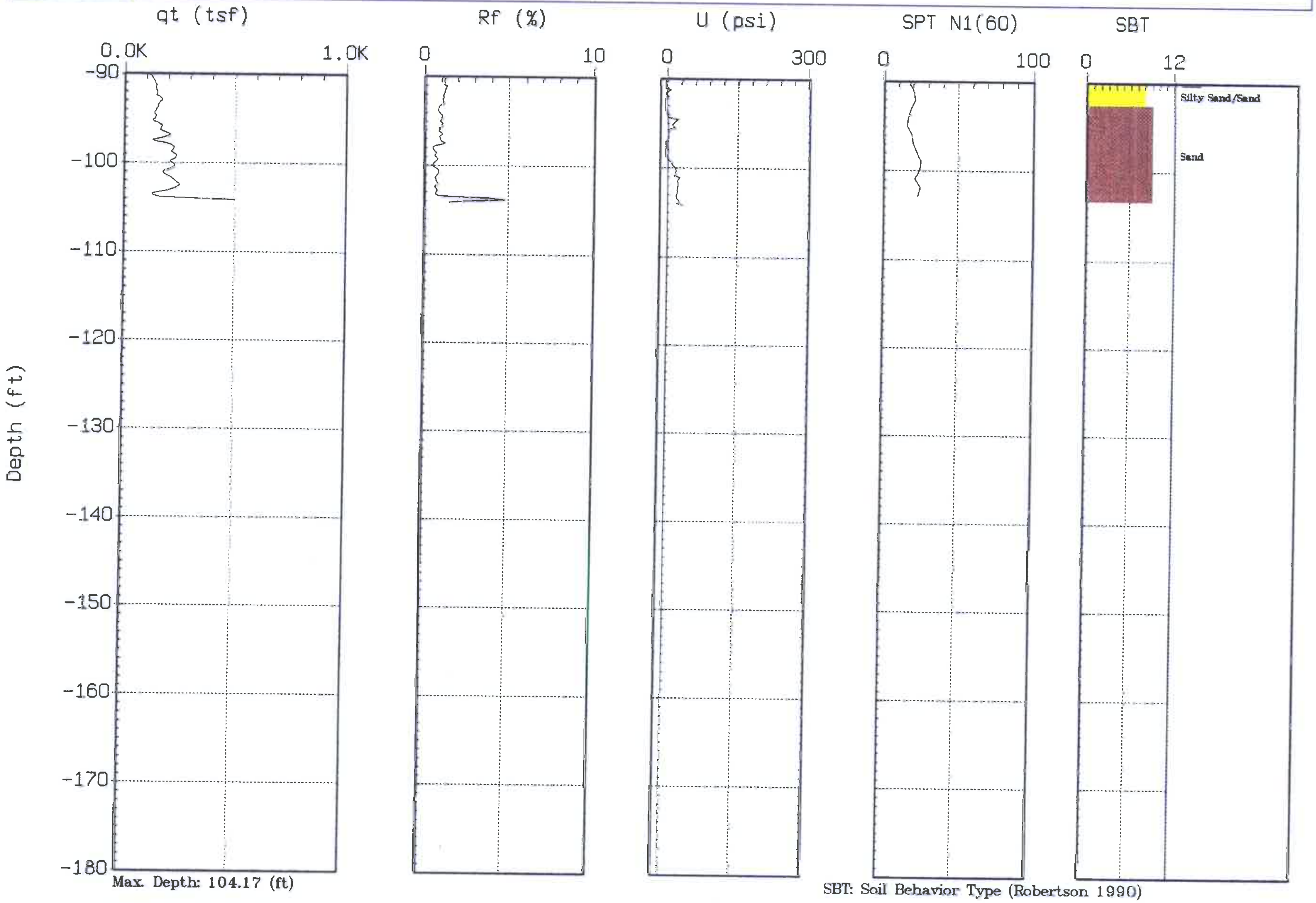
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-24

Geologist : S. BERRYMAN
Date : 09:19:02 09:59



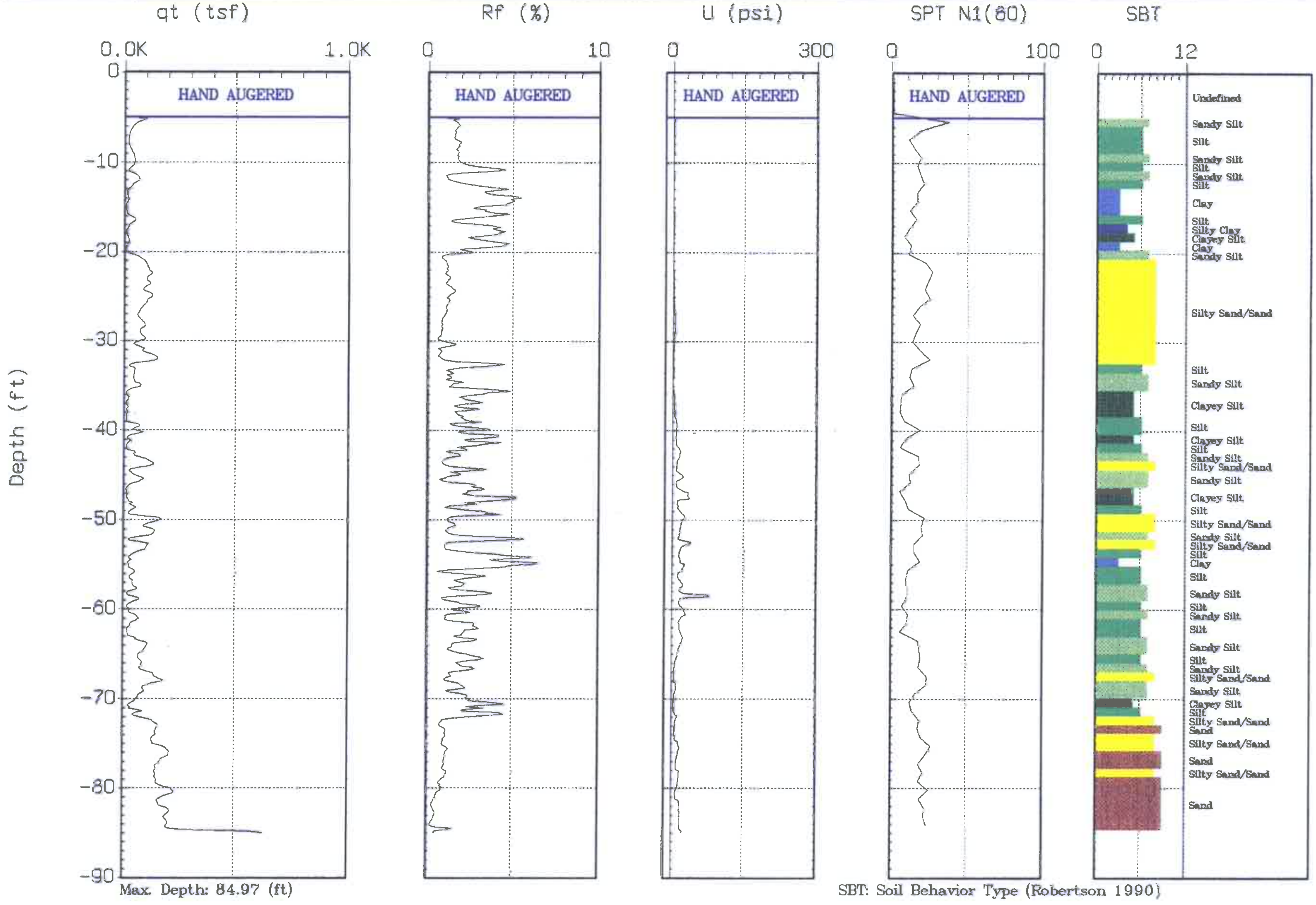
Max. Depth: 104.17 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-25

Geologist : S. BERRYMAN
Date : 09:19:02 11:46



Max. Depth: 84.97 (ft)

Depth Inc.: 0.164 (ft)

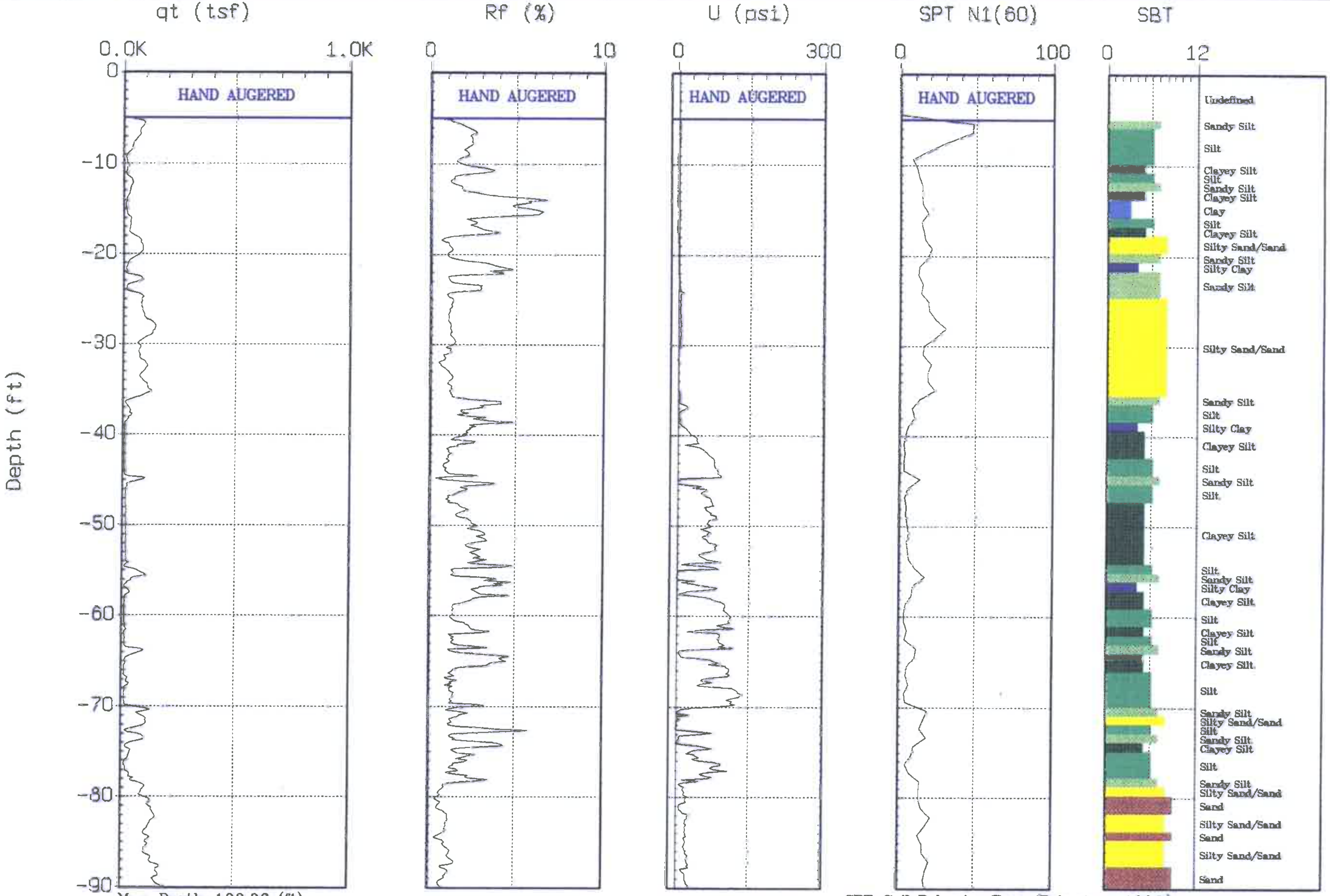
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-26

Geologist : S. BERRYMAN
Date : 09:19:02 13:39



Max. Depth: 100.06 (ft)

Depth Inc.: 0.164 (ft)

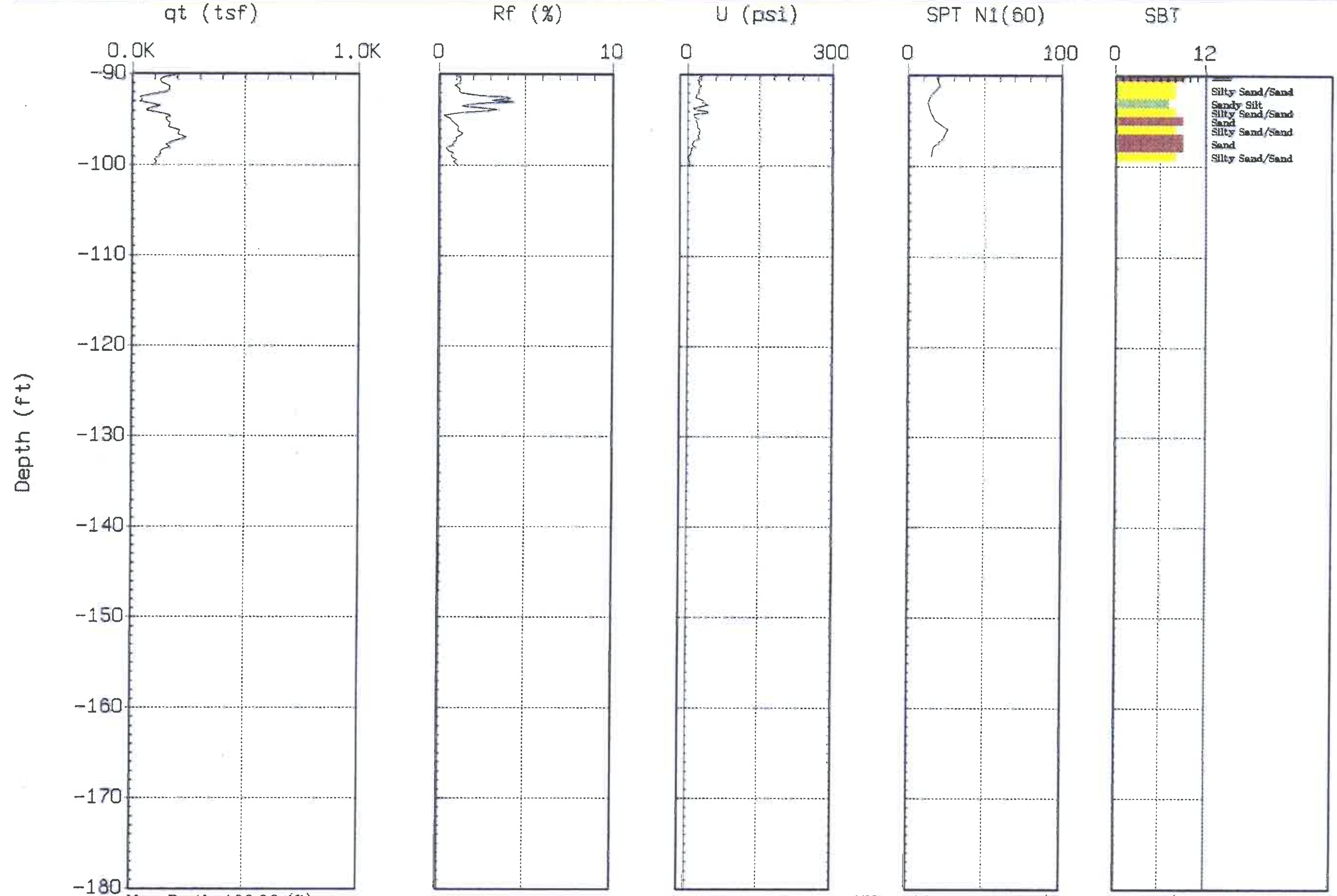
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-26

Geologist : S. BERRYMAN
Date : 09:19:02 13:39



Max. Depth: 100.06 (ft)
Depth Inc.: 0.164 (ft)

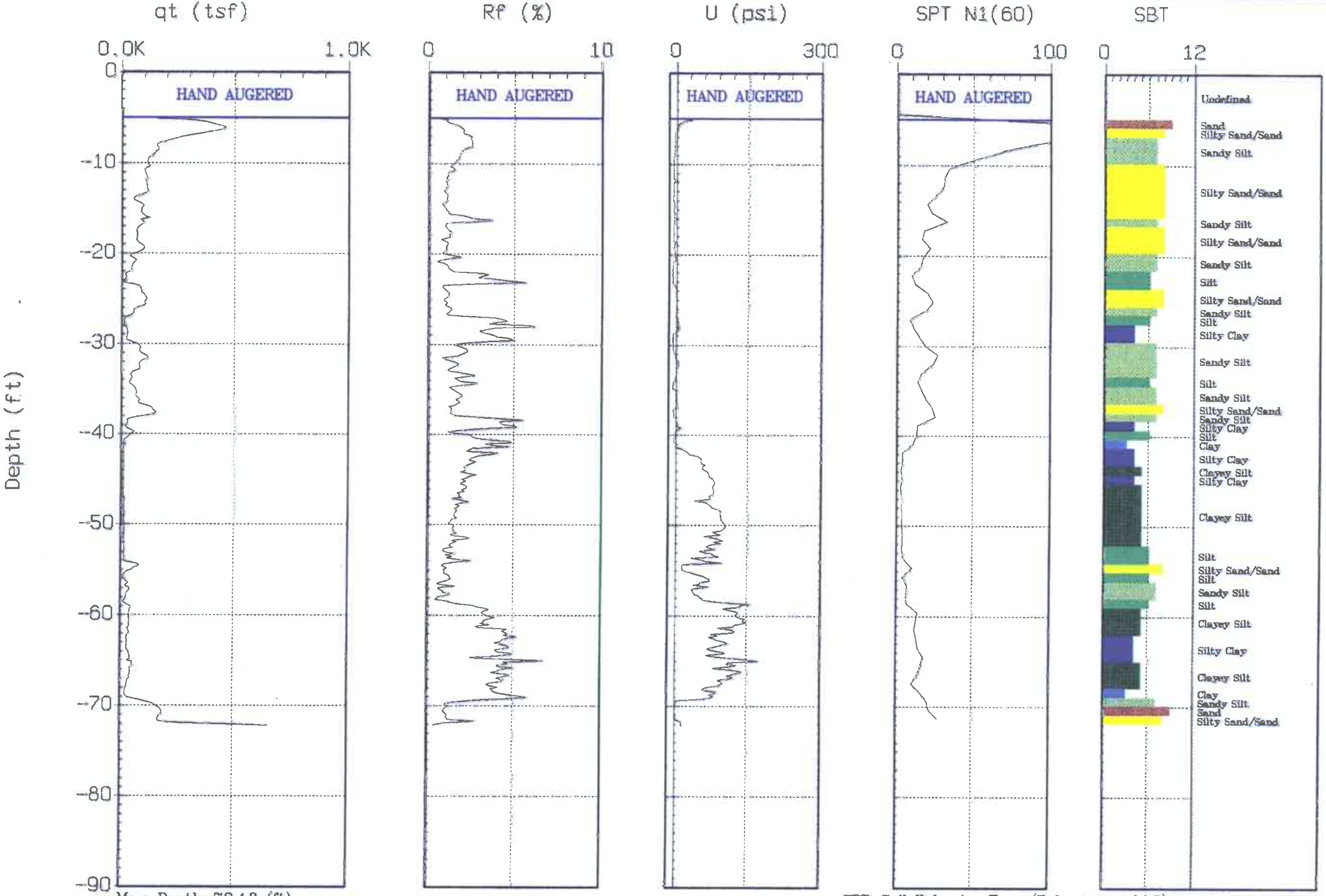
SBT: Soil Behavior Type (Robertson 1990)

GREGG

HARGIS + ASSOCIATES

Site : OMWD S.D.
Location : CPT-27

Geologist : S. BERRYMAN
Date : 09:19:02 15:23



Max. Depth: 72.18 (ft)

Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ELECTRICAL PIEZOCONE

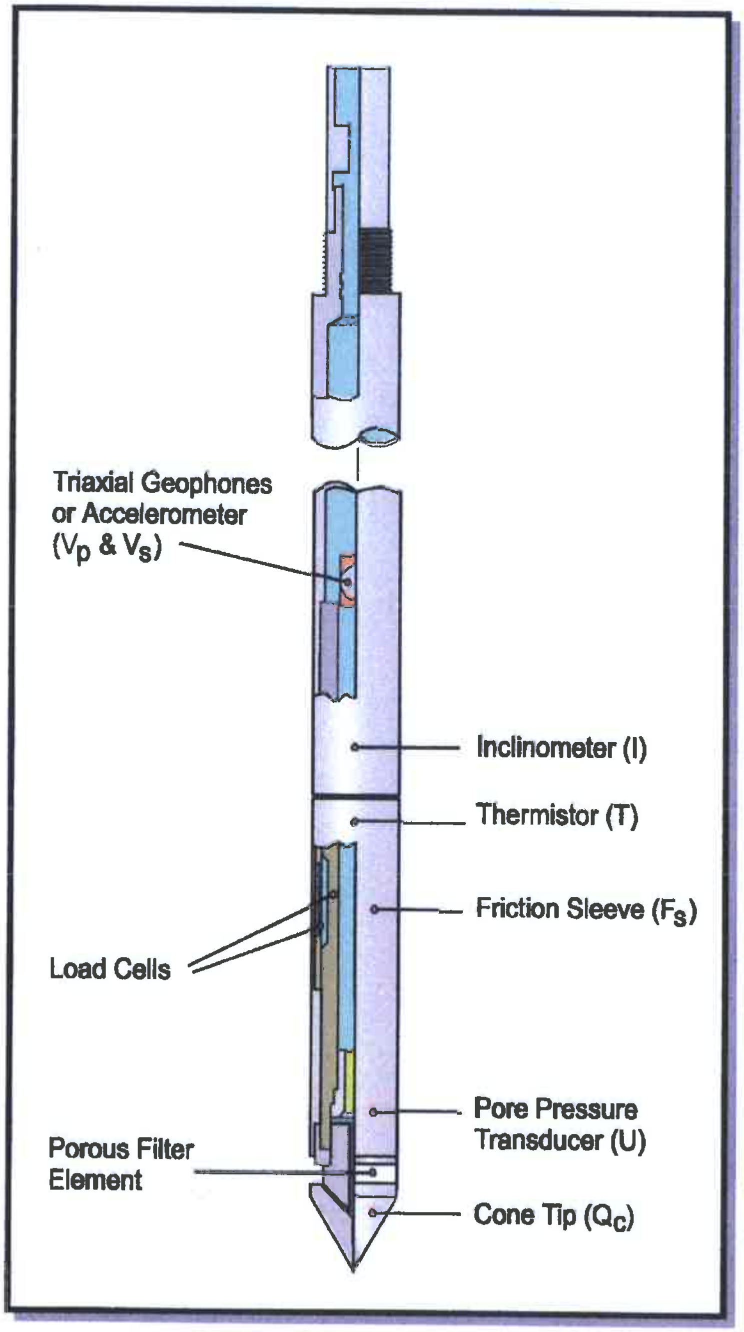
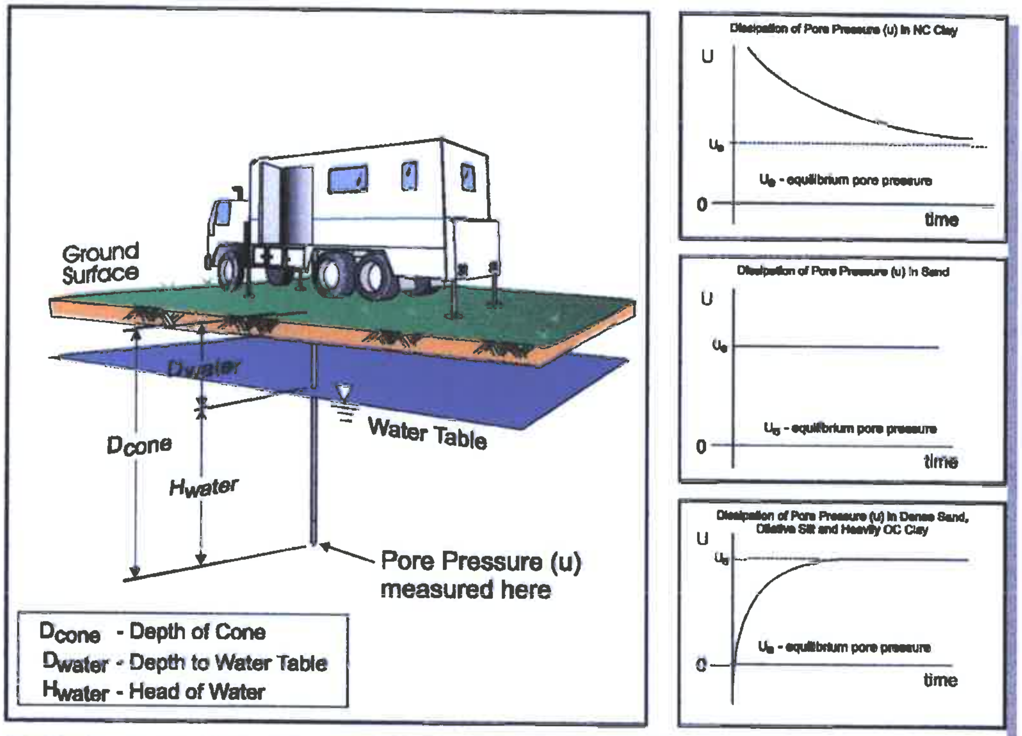


Figure 1

PPDT CORRELATION



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

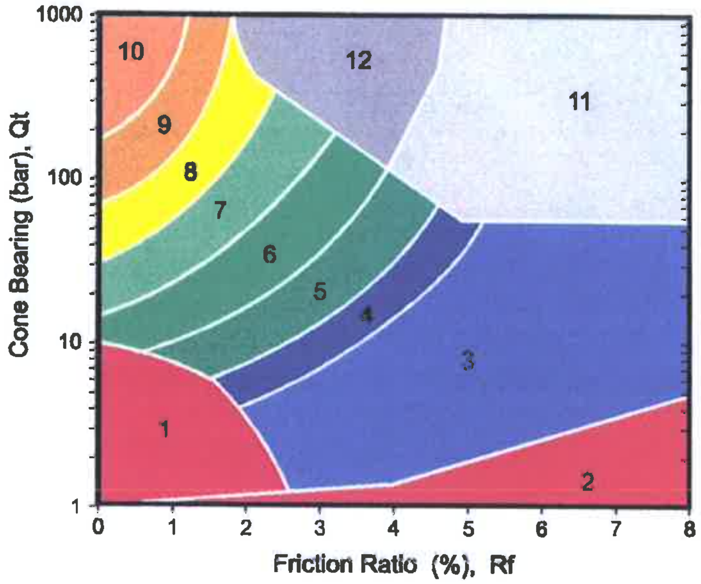
where $H_{water} = U_e$ (depth units)

Useful Conversion Factors:

1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure 2

SOIL CLASSIFICATION CHART



Zone		Q_t / N	Soil Behaviour Type
1	🟥	2	sensitive fine grained
2	🟥	1	organic material
3	🟦	1	clay
4	🟦	1.5	silty clay to clay
5	🟩	2	clayey silt to silty clay
6	🟩	2.5	sandy silt to clayey silt
7	🟩	3	silty sand to sandy silt
8	🟨	4	sand to silty sand
9	🟧	5	sand
10	🟧	6	gravelly sand to sand
11	⬜	1	very stiff fine grained *
12	⬜	2	sand to clayey sand *

* overconsolidated or cemented

After Robertson and Campenella

Figure 3

REFERENCES

Robertson, P.K. and Campanella, R.G. and Wightman, A., 1983 "SPT-CPT Correlations", Journal of the Geotechnical Division, ASCE, Vol. 109, No. GT11, Nov., pp. 1449-1460.

Robertson, P.K. and Wride C.E., 1998 "Evaluating Cyclic Liquefaction Potential Using The Cone Penetration Test", Journal of Geotechnical Division, Mar. 1998, pp. 442-459.

Robertson, P.K. and Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of In Situ 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K. and Campanella, R.G., 1988, "Guidelines for Use, Interpretation and Application of the CPT and CPTU", UBC, Soil Mechanics Series No. 105, Civil Eng. Dept., Vancouver, B.C., V6T 1W5, Canada.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Rice, A., 1986, "Seismic CPT to Measure In Situ Shear Wave Velocity", Journal of Geotechnical Engineering, ASCE, Vol. 112, No. 8, pp. 791-803.

Gregg In Situ
Environmental and Geotechnical Site Investigation Contractors

Gregg In Situ CPT Interpretations as of January 7, 1999 (Release 1.00.19)

Gregg In Situ's interpretation routine should be considered a calculator of current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (typically 0.25m). Note that Qt is the recorded tip value, Qc, corrected for pore pressure effects. Since all Gregg In Situ cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, Fs, are not required.

The tip correction is: $Qt = Qc + (1-a) \bullet Ud$

where: *Qt* is the corrected tip load
Qc is the recorded tip load
Ud is the recorded dynamic pore pressure
a is the Net Area Ratio for the cone (typically 0.85 for Gregg In Situ cones)

Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). The stress calculations use unit weights assigned to the Soil Behavior Type zones or from a user defined unit weight profile.

Details regarding the interpretation methods for all of the interpreted parameters is given in table 1. The appropriate references referred to in table 1 are listed in table 2.

The estimated Soil Behavior Type is based on the charts developed by Robertson and Campanella shown in figure 1.

Table 1 CPT Interpretation Methods

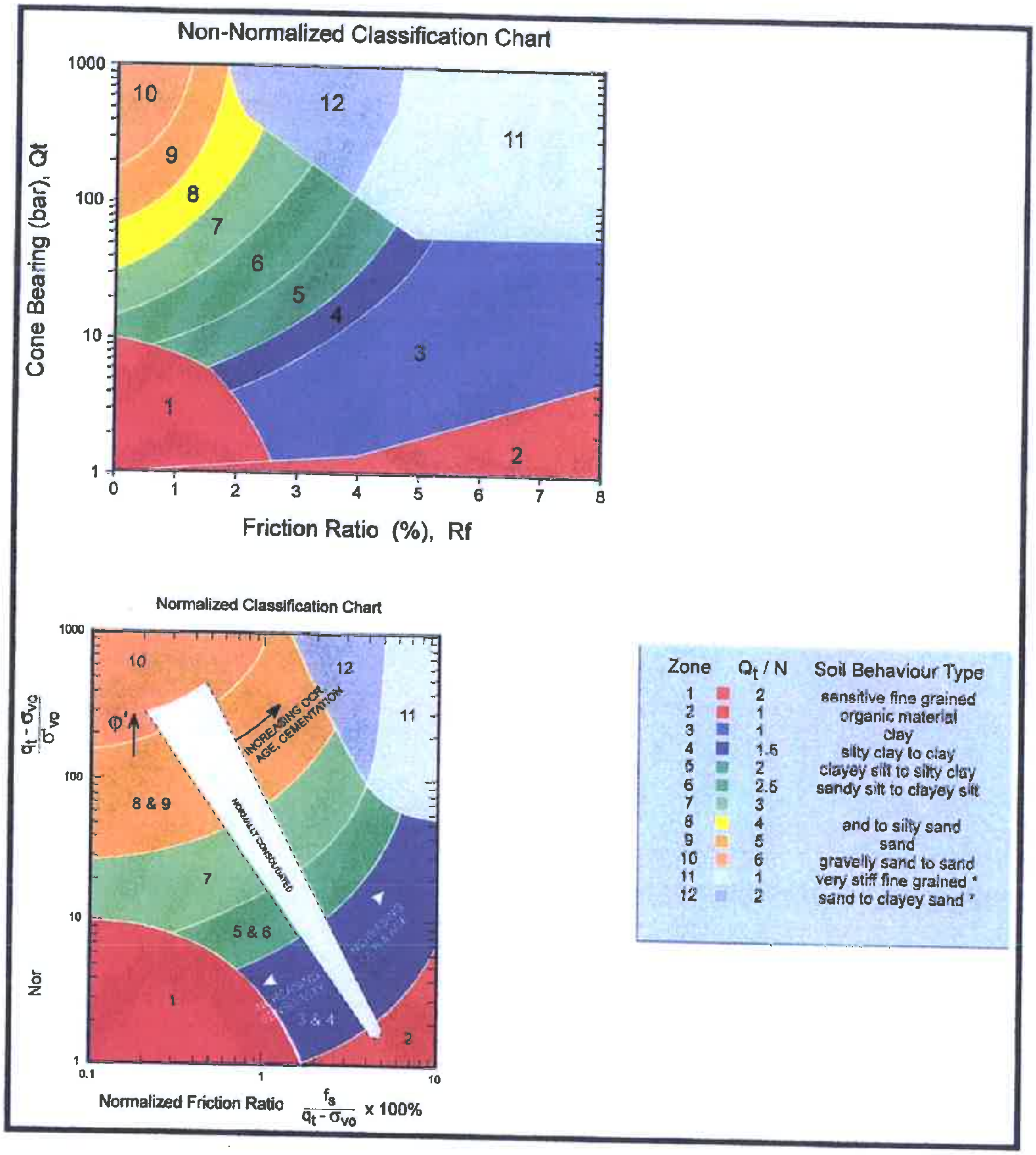
Interpreted Parameter	Description	Equation	Ref
Depth	mid layer depth		
AvgQt	Averaged corrected tip (Qt)	$AvgQt = \frac{1}{n}\sum_{i=1}^{n} Qt_i$	
AvgFs	Averaged sleeve friction (Fs)	$AvgFs = \frac{1}{n}\sum_{i=1}^{n} Fs_i$	
AvgRf	Averaged friction ratio (Rf)	$AvgRf = 100\% \bullet \frac{AvgFs}{AvgQt}$	
AvgUd	Averaged dynamic pore pressure (Ud)	$AvgUd = \frac{1}{n}\sum_{i=1}^{n} Ud_i$	
SBT	Soil Behavior Type as defined by Robertson and Campanella		1

CPT Interpretations

U.Wt.	Unit Weight of soil determined from: 1) uniform value or 2) value assigned to each SBT zone 3) user supplied unit weight profile		
TStress	Total vertical overburden stress at mid layer depth	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	
EStress	Effective vertical overburden stress at mid layer depth	$EStress = TStress - Ueq$	
Ueq	Equilibrium pore pressure determined from: 1) hydrostatic from water table depth 2) user supplied profile		
Cn	SPT N_{60} overburden correction factor	$Cn=(\sigma_v')^{-0.5}$ where σ_v' is in tsf $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from Qt/N ratios assigned to each SBT zone		3
$(N1)_{60}$	SPT N_{60} value corrected for overburden pressure	$N1_{60} = Cn \bullet N_{60}$	3
$\Delta(N1)_{60}$	Equivalent Clean Sand Correction to $(N1)_{60}$	$\Delta(N1)_{60} = \frac{K_{SPT}}{1 - K_{SPT}} \bullet (N1)_{60}$ Where: K_{SPT} is defined as: 0.0 for FC < 5% 0.0167 • (FC - 5) for 5% < FC < 35% 0.5 for FC > 35% FC - Fines Content in %	7
$(N1)_{60cs}$	Equivalent Clean Sand $(N1)_{60}$	$(N1)_{60cs} = (N1)_{60} + \Delta(N1)_{60}$	7
Su	Undrained shear strength - Nkt is use selectable	$Su = \frac{Qt - \sigma_v}{N_{kt}}$	2
k	Coefficient of permeability (assigned to each SBT zone)		6
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{Qt - \sigma_v}$	2
Qtn	Normalized Qt for Soil Behavior Type classification as defined by Robertson, 1990	$Qtn = \frac{Qt - \sigma_v}{\sigma'_v}$	4
Rfn	Normalized Rf for Soil Behavior Type classification as defined by Robertson, 1990	$Rfn = 100\% \bullet \frac{f_s}{Qt - \sigma_v}$	4
SBTn	Normalized Soil Behavior Type (slightly modified from that published by Robertson, 1990. This version includes all the soil zones of the original non-normalized SBT chart - see figure 1)		4
Qc1	Normalized Qt for seismic analysis	$qc1 = qc \bullet (Pa/\sigma_v')^{0.5}$ where: Pa = atm. pressure	5
Qc1N	Dimensionless Normalized Qt1	qc1N = qc1 / Pa where: Pa = atm. pressure	

CPT Interpretations

ΔQc1N1	Equivalent clean sand correction	$\Delta qc1N = \frac{K_{CPT}}{1 - K_{CPT}} \bullet qc1N$ Where: K_{CPT} is defined as: 0.0 for FC < 5% 0.0267 • (FC - 5) for 5% < FC < 35% 0.5 for FC > 35% FC - Fines Content in %	5
Qc1Ncs	Clean Sand equivalent Qc1N	$qc1Ncs = qc1N + \Delta qc1N$	5
Ic	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log Q)^2 + (\log F + 1.22)^2]^{0.5}$	5
FC	Fines content (%)	$FC=1.75(Ic^{3.25}) - 3.7$ $FC=100$ for $Ic > 3.5$ $FC=0$ for $Ic < 1.26$ $FC = 5\%$ if $1.64 < Ic < 2.6$ AND $Rfn<0.5$	8
PHI	Friction Angle	Campanella and Robertson Durunoglu and Mitchel Janbu	1
Dr	Relative Density	Ticino Sand Hokksund Sand Schmertmann 1976 Jamiolkowski - All Sands	1
OCR	Over Consolidation Ratio		1
State Parameter			9
CRR	Cyclic Resistance Ratio		7



Zone		Q_t / N	Soil Behaviour Type
1	🟥	2	sensitive fine grained
2	🟥	1	organic material
3	🟦	1	clay
4	🟦	1.5	silty clay to clay
5	🟩	2	clayey silt to silty clay
6	🟩	2.5	sandy silt to clayey silt
7	🟩	3	
8	🟨	4	and to silty sand
9	🟧	5	sand
10	🟧	6	gravelly sand to sand
11	⬜	1	very stiff fine grained *
12	🟦	2	sand to clayey sand *

Figure 1 Non-Normalized and Normalized Soil Behavior Type Classification Charts

GREGG

Table 2 References

No.	Reference
1	Robertson, P.K. and Campanella, R.G., 1986, "Guidelines for Use, Interpretation and Application of the CPT and CPTU", UBC, Soil Mechanics Series No. 105, Civil Eng. Dept., Vancouver, B.C., Canada
2	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
3	Robertson, P.K. and Campanella, R.G., 1989, "Guidelines for Geotechnical Design Using CPT and CPTU", UBC, Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada
4	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
5	Robertson, P.K. and Fear, C.E., 1995, "Liquefaction of Sands and its Evaluation", Keynote Lecture, First International Conference on Earthquake Geotechnical Engineering, Tokyo, Japan.
6	Gregg In Situ Internal Report
7	Robertson, P.K. and Wride, C.E., 1997, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
8	Wride, C.E. and Robertson, P.K., 1997, "Phase II Data Review Report (Massey and Kidd Sites, Fraser River Delta)", Volume 1 - Data Report (June 1997), University of Alberta.
9	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.

APPENDIX F

PORE PRESSURE DISSIPATION TESTS

APPENDIX F

PORE PRESSURE DISSIPATION TESTS

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TABLES

FIGURES

ATTACHMENTS

APPENDIX F

PORE PRESSURE DISSIPATION TESTS

1.0 SUMMARY OF PORE PRESSURE DISSIPATION TESTS

Pore pressure dissipation tests were conducted at 14 locations during the Cone Penetrometer Testing (CPT) investigations (Table F-1; Figure F-1). A cone with a tip area of 15 cm^2 and a 5.0 millimeter (mm)-thick pore water pressure element located directly behind the cone tip was used for the dissipation tests.

During round I, coarser-grained zones ranging from sandy silt to sand were targeted for pore pressure dissipation tests. Each test was executed until the pore pressure appeared to approach a static level, which generally occurred within ten minutes (Attachment F-1).

During round II, fine-grained zones assumed to represent the aquitard sediments (ranging from silt to silty clay) were targeted for pore pressure dissipation tests. Each test was executed until the pore pressure appeared to approach a static level, with a maximum one-hour duration (Attachment F-2). Several of the tests in very fine-grained zones were terminated prior to the evident approach of a static pore pressure.

The rate at which the pressure dissipates to static gives an indication of the relative soil permeability at the depth and location of the pore pressure dissipation tests. Results of round II pore pressure dissipation tests may be evaluated further to aid in estimating hydraulic conductivity of the aquitard sediments for modeling purposes.

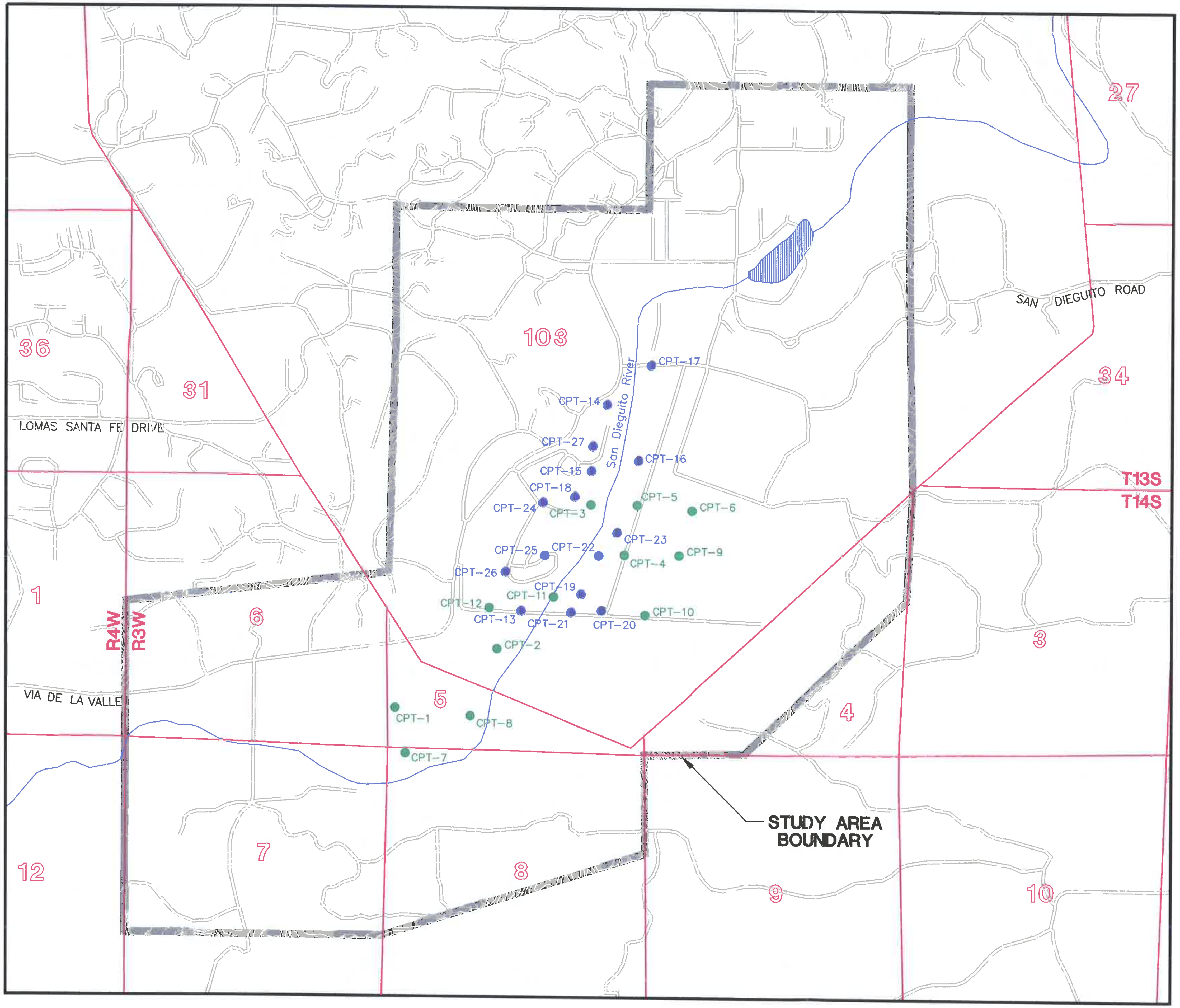
Table F-1

PORE PRESSURE DISSIPATION TEST SUMMARY

	IDENTIFIER	Date Installed	Total Depth (feet bls)	Depth of Pore Pressure Dissipation Test (feet bls)	Soil Type at Pore Pressure Dissipation Test Depth	Duration of Pore Pressure Dissipation Test (min)
Round I	CPT-2	03/11/02	140.09	66.11	silty sand	9.8
	CPT-4	03/11/02	112.37	24.93	silty sand	10
	CPT-5	03/11/02	82.18	81.2	sand	10.4
	CPT-6	03/11/02	102.69	94	sandy silt	10.1
	CPT-7	03/12/02	128.12	56.92	silty sand	9.7
	CPT-11	03/13/02	80.22	18.7	silty sand	17.5
Round II	CPT-16	09/17/02	55.94	42.98	silt	35.4
	CPT-18	09/18/02	145.01	60.37	clayey silt	65.3
	CPT-21	09/18/02	90.39	32.15	clayey silt	61.8
	CPT-23	09/19/02	119.59	52.66	clayey silt	67.6
	CPT-24	09/19/02	104.17	44.29	clayey silt	57.8
	CPT-25	09/19/02	84.97	47.57	clayey silt	74
	CPT-26	09/19/02	100.06	40.85	clayey silt	61.9
	CPT-27	09/19/02	72.18	42.16	silty clay	61.5

FOOTNOTES

bls = Below land surface
min = Minutes
CPT = Cone Penetrometer Test



EXPLANATION

● ROUND I CPT LOCATION

● ROUND II CPT LOCATION

CPT = CONE PENETROMETER TESTING

SAN DIEGUITO GROUNDWATER BASIN

CPT LOCATIONS
ROUNDS I AND II

HARGIS+ASSOCIATES, INC
Hydrogeology/Engineering

10/02

FIGURE F-1

PREP BY SLB	REV BY RAN	RPT NO. 689.20	410-3812	A

ATTACHMENT F-1

ROUND I PORE PRESSURE DISSIPATION PLOTS

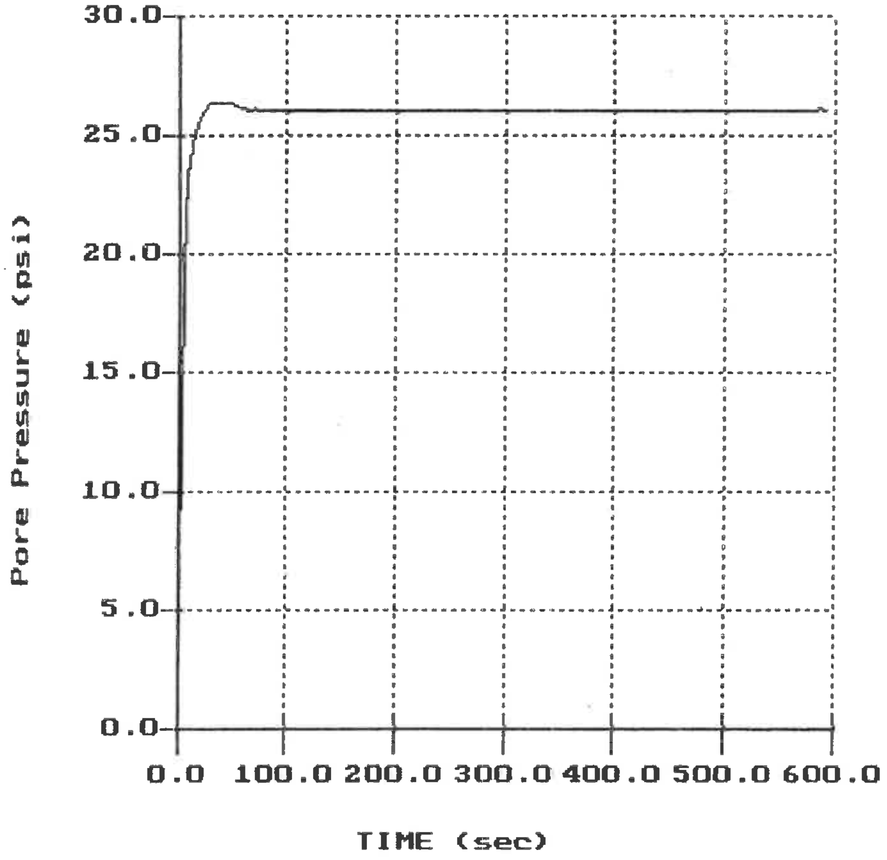
HARGIS + ASSOC.

Site: SAN DIEGUITO
Location: CPT-2

Engineer: S. BERRYMAN
Date: 03:11:02 21:30

File: 050C02.PPC
Depth (m): 20.15
(ft): 66.11
Duration : 590.0s
U-min: 5.82 0.0s
U-max: 26.35 40.0s

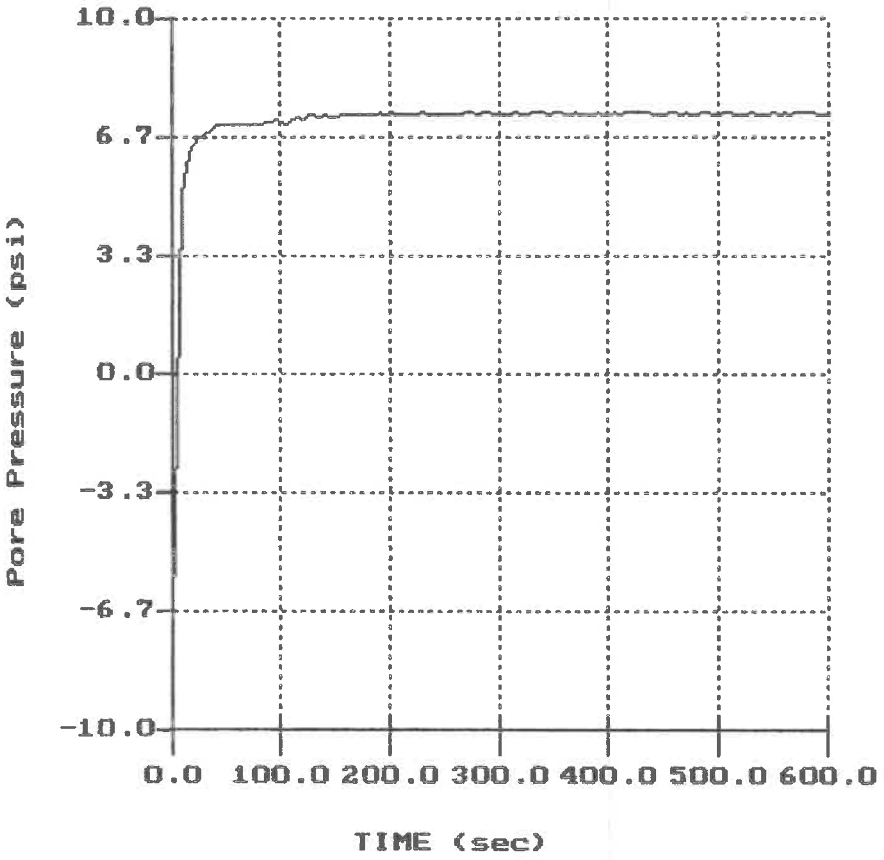
PORE PRESSURE DISSIPATION RECORD



HARGIS + ASSOC.
Site: SAN DIEGUITO
Location: CPT-4
Engineer: S. BERRYMAN
Date: 03:12:02 01:18

File: 050C04.PPC
Depth (m): 7.60
(ft): 24.93
Duration : 600.0s
U-min: -7.30 0.0s
U-max: 7.34 585.0s

PORE PRESSURE DISSIPATION RECORD



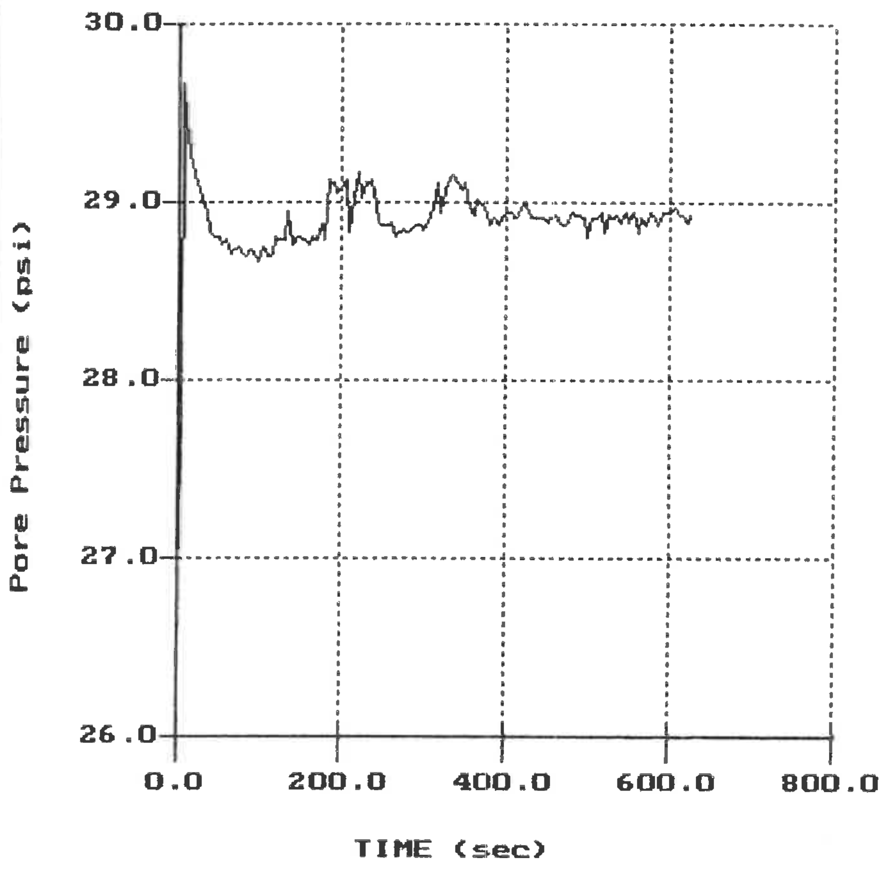
HARGIS + ASSOC.

Site: St AD07402
Location: PT-5

Engineer: S. BERRYMAN
Date:03:12:02 02:15

File: 050C05.PPC
Depth (m): 24.75
(ft): 81.20
Duration : 625.0s
U-min: 26.18 0.0s
U-max: 29.66 5.0s

PORE PRESSURE DISSIPATION RECORD

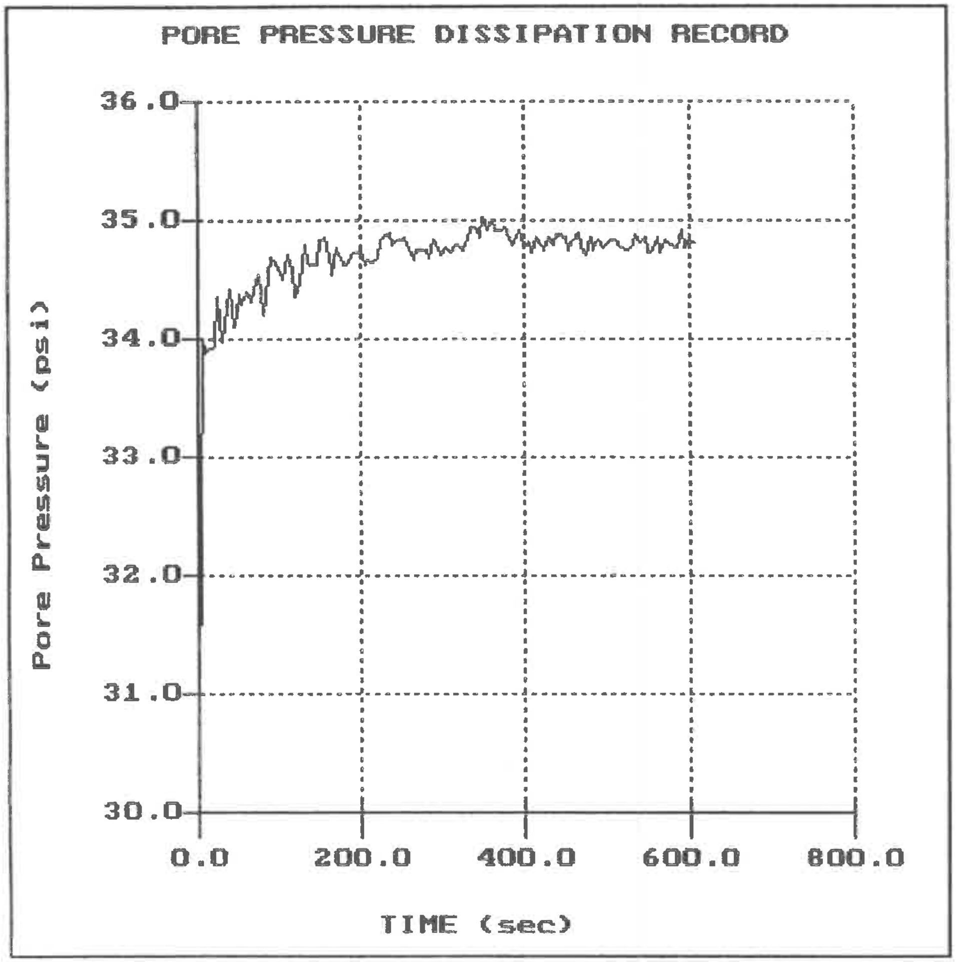


HARGIS + ASSOC.

Site: SAN DIEGUITO
Location: CPT-6

Engineer: S. BERRYMAN
Date: 03:12:02 03:12

File: 050C06.PPC
Depth (m): 28.65
(ft): 94.00
Duration : 605.0s
U-min: 30.76 0.0s
U-max: 35.03 350.0s



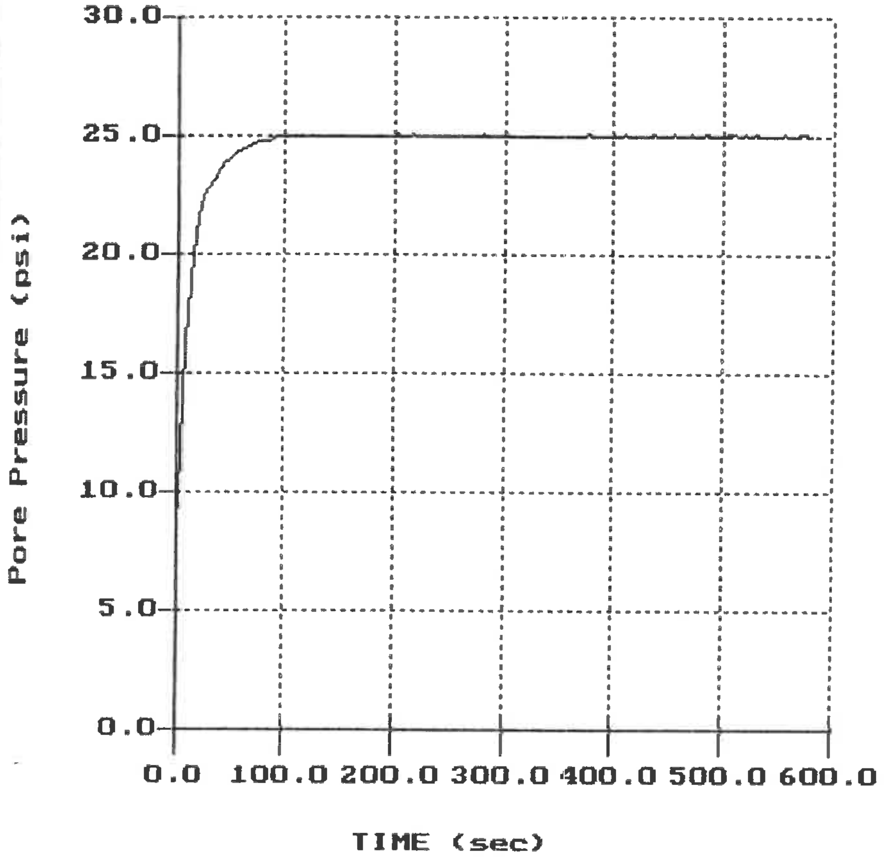
HARGIS + ASSOC.

Site: St AD07407
Location: PT-7

Engineer: S. BERRYMAN
Date:03:12:02 20:26

File: 050C07.PPC
Depth (m): 17.35
(ft): 56.92
Duration : 580.0s
U-min: 8.59 0.0s
U-max: 25.09 575.0s

PORE PRESSURE DISSIPATION RECORD

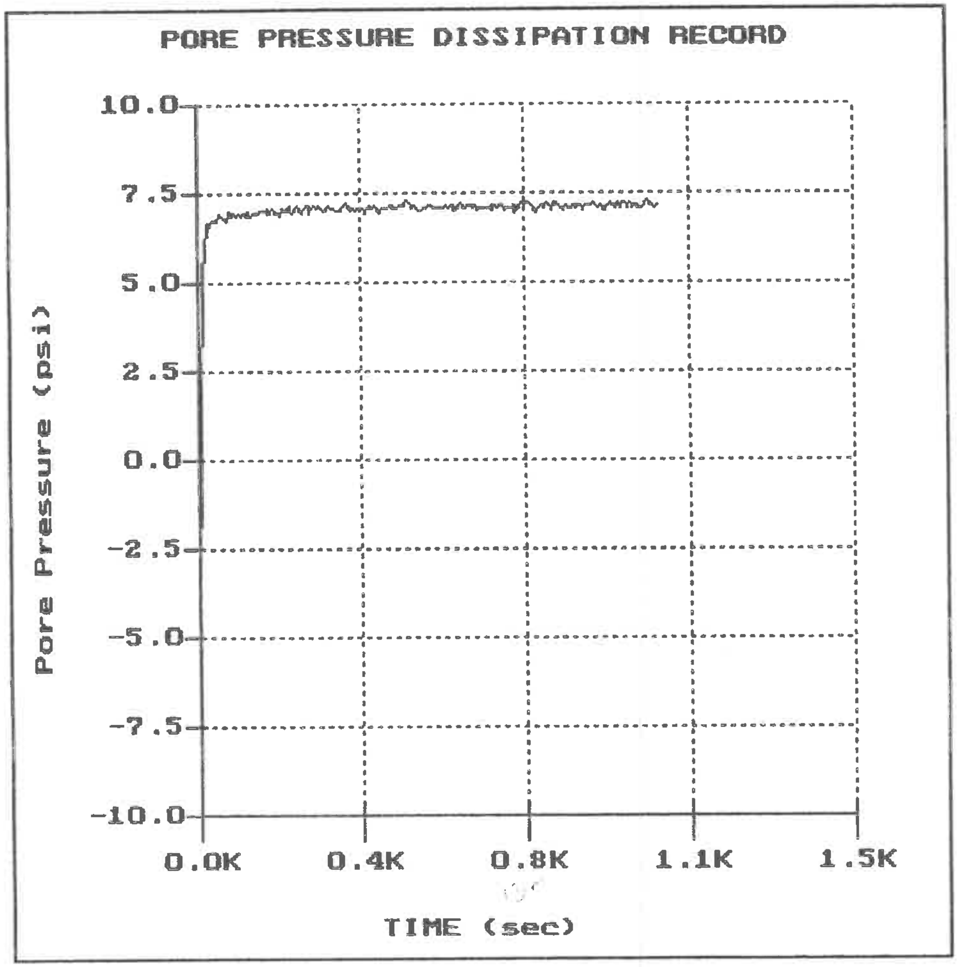


HARGIS + ASSOC.

Site: St AD07411
Location: PT-11

Engineer: S. BERRYMAN
Date:03:13:02 21:06

File: 050C11.PPC
Depth (m): 5.70
(ft): 18.70
Duration : 1050.0s
U-min: -5.33 0.0s
U-max: 7.28 1030.0s



PORE PRESSURE DISSIPATION RECORD

ATTACHMENT F-2

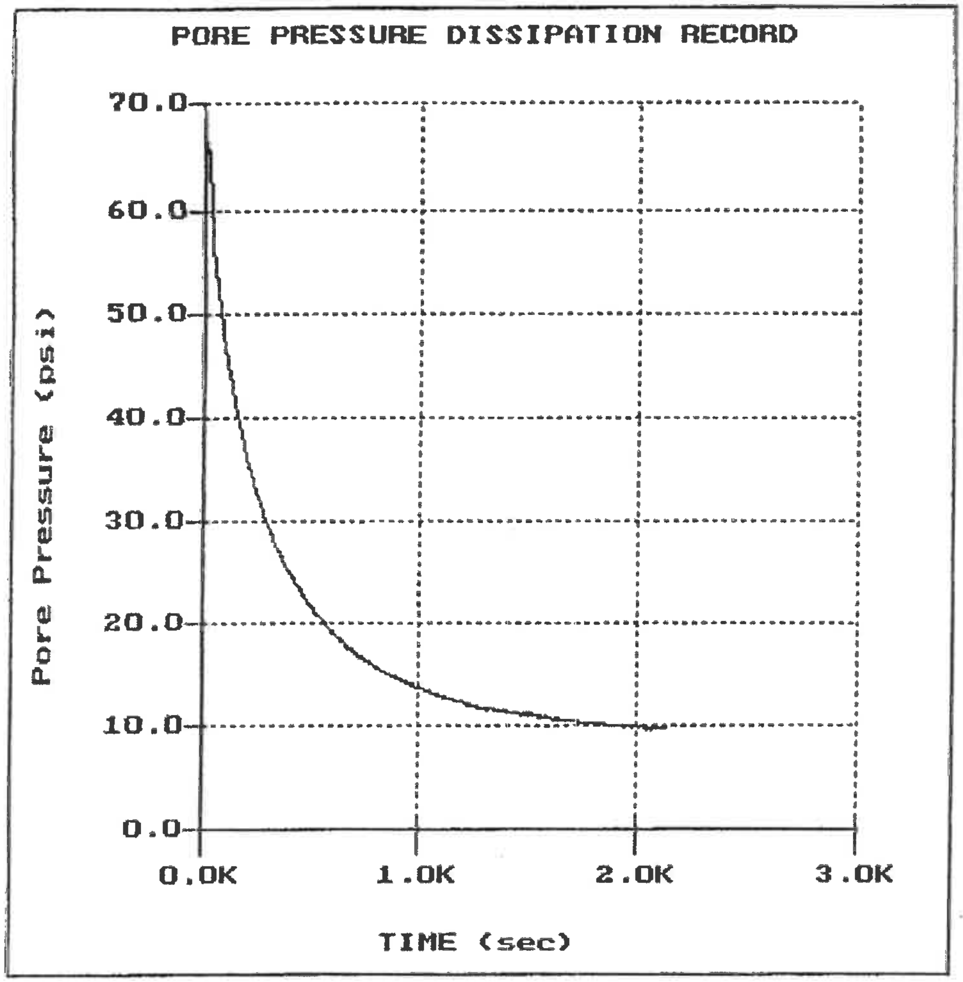
ROUND II PORE PRESSURE DISSIPATION PLOTS

HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-16

Engineer: S. BERRYMAN
Date:09:17:02 15:44

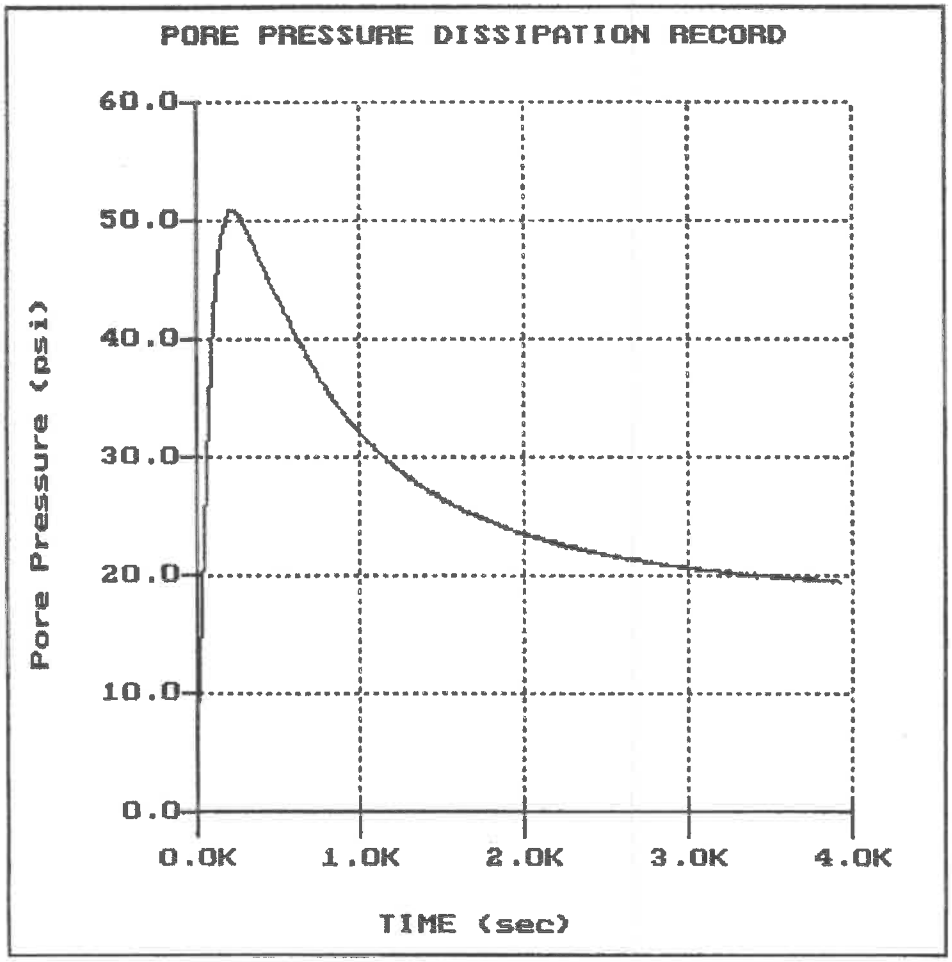
File: 236C16.PPC
Depth (m): 13.10
(ft): 42.98
Duration : 2125.0s
U-min: 9.60 2055.0s
U-max: 66.32 10.0s



HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-18

Engineer: S. BERRYMAN
Date:09:18:02 08:20

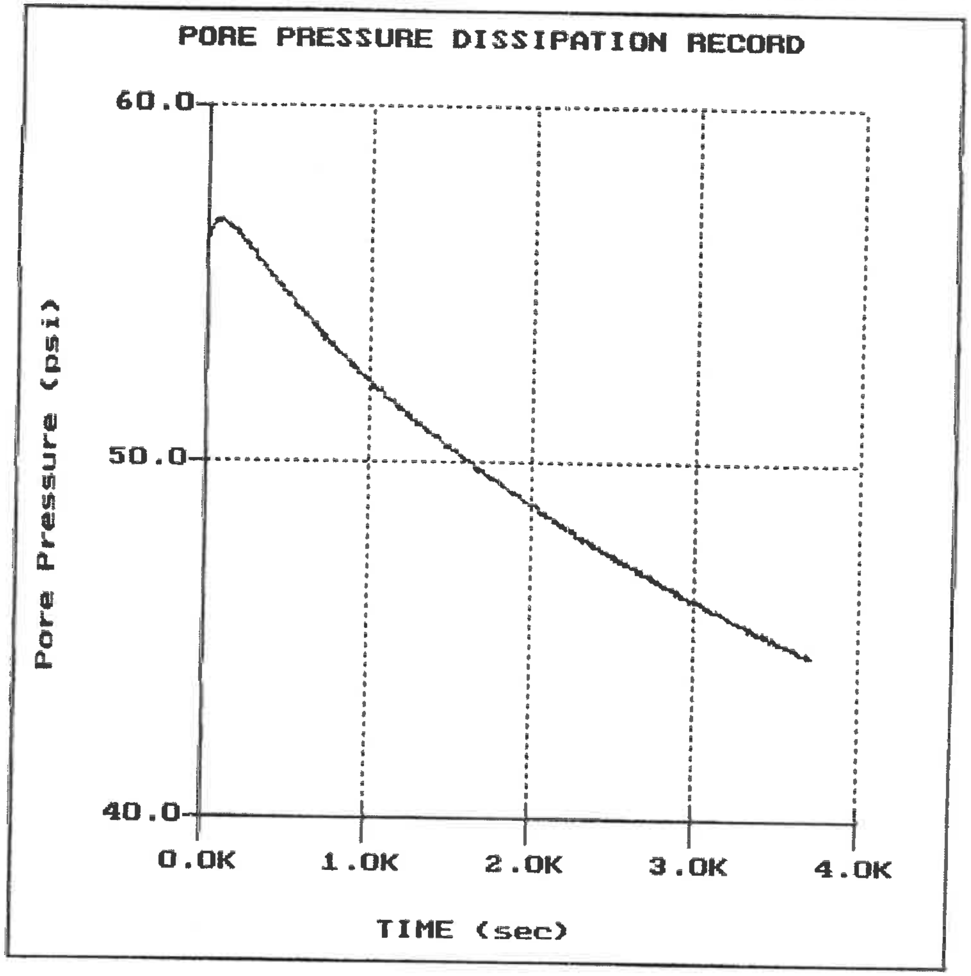


```
File: 236C18.PPC
Depth (m): 18.40
     (ft): 60.37
Duration : 3920.0s
U-min:   6.75    0.0s
U-max:  50.88  210.0s
```

HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-21

Engineer: S. BERRYMAN
Date:09:18:02 13:11


PORE PRESSURE DISSIPATION RECORD

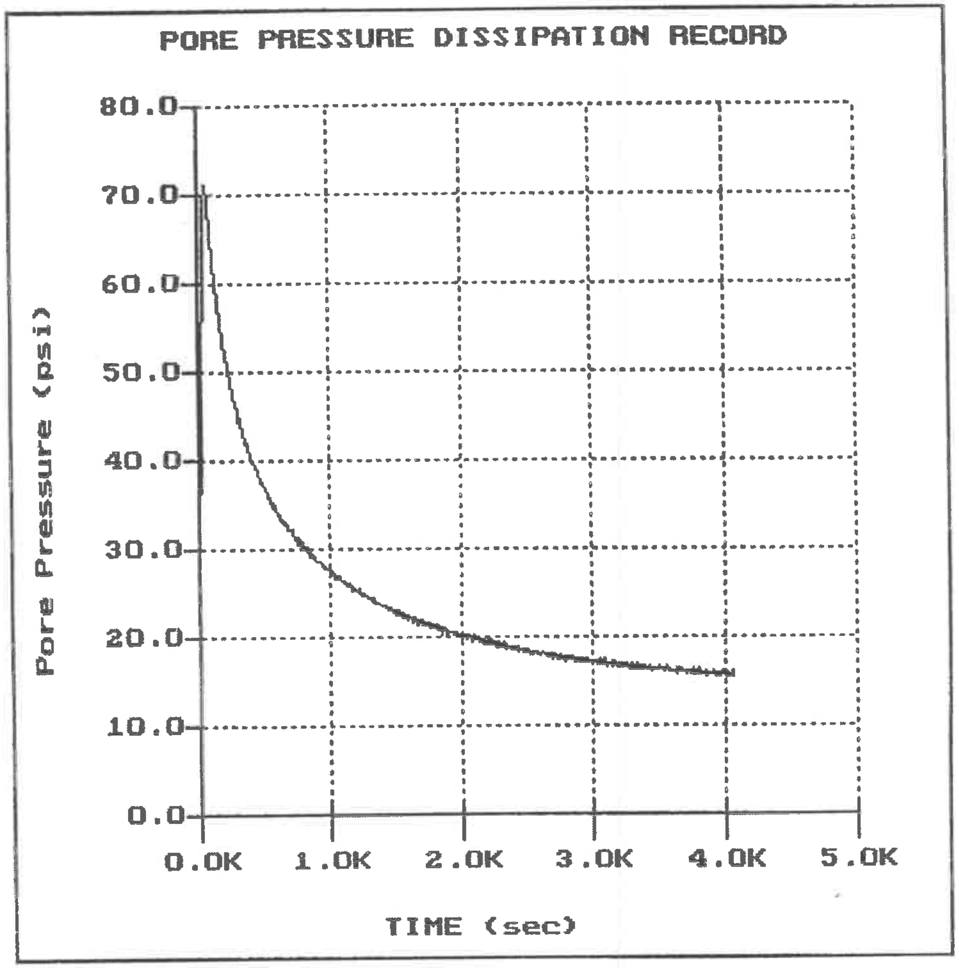
File: 236C21.PPC
Depth (m): 9.80
(ft): 32.15
Duration : 3710.0s
U-min: 44.58 3710.0s
U-max: 59.02 0.0s

HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-23

Engineer: S. BERRYMAN
Date:09:19:02 07:45

File: 236C23.PPC
Depth (m): 16.05
(ft): 52.66
Duration : 4055.0s
U-min: 15.46 4050.0s
U-max: 71.07 55.0s

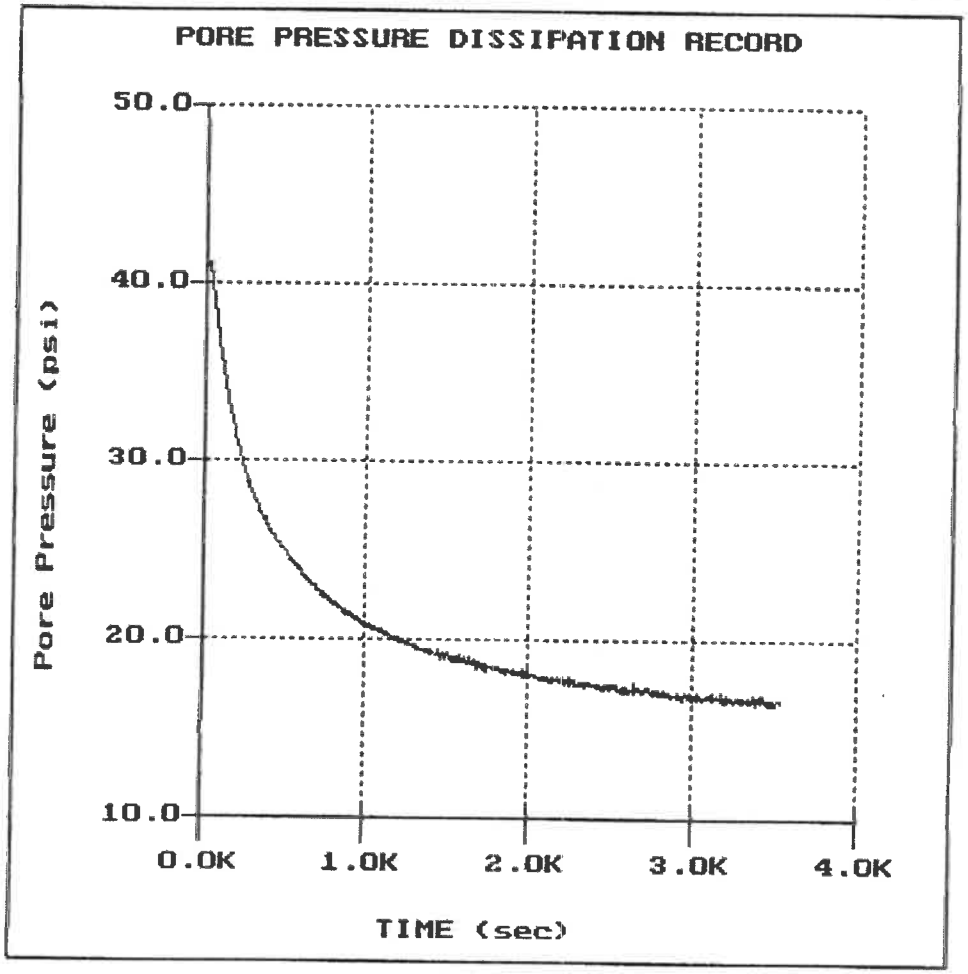


HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-24

Engineer: S. BERRYMAN
Date:09:19:02 09:59

File: 236C24.PPC
Depth (m): 13.50
(ft): 44.29
Duration : 3535.0s
U-min: 16.34 3465.0s
U-max: 43.54 0.0s


PORE PRESSURE DISSIPATION RECORD

HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-25

Engineer: S. BERRYMAN
Date:09:19:02 11:46

File: 236C25.PPC
Depth (m): 14.50
(ft): 47.57
Duration : 4440.0s
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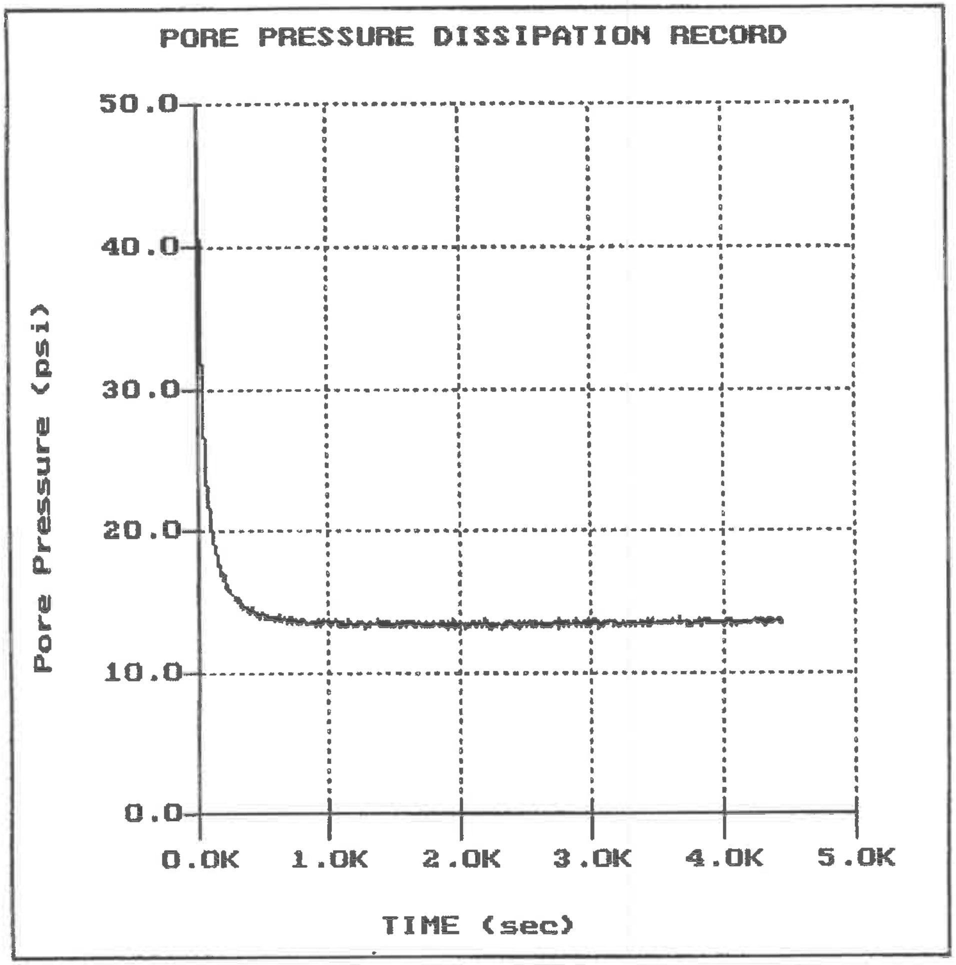
U-max: 40.57 5.0s



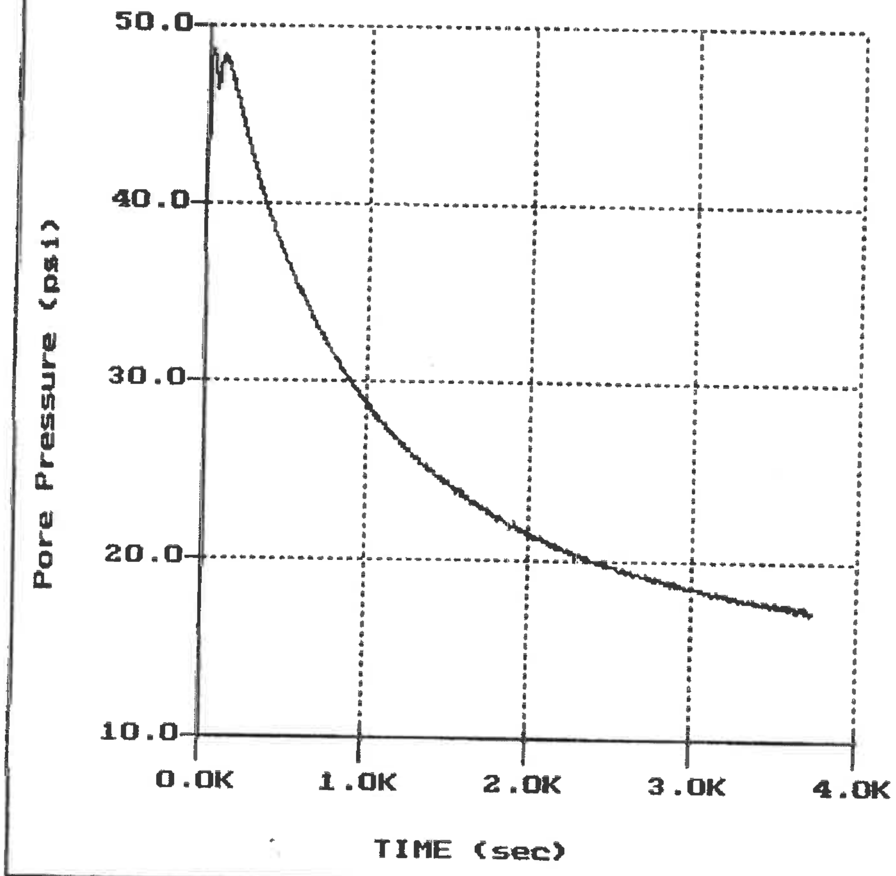
HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-26

Engineer: S. BERRYMAN
Date:09:19:02 13:39

File: 236C26.PPC
Depth (m): 12.45
(ft): 40.85
Duration : 3725.0s
U-min: 17.15 3715.0s
U-max: 48.58 35.0s

PORE PRESSURE DISSIPATION RECORD

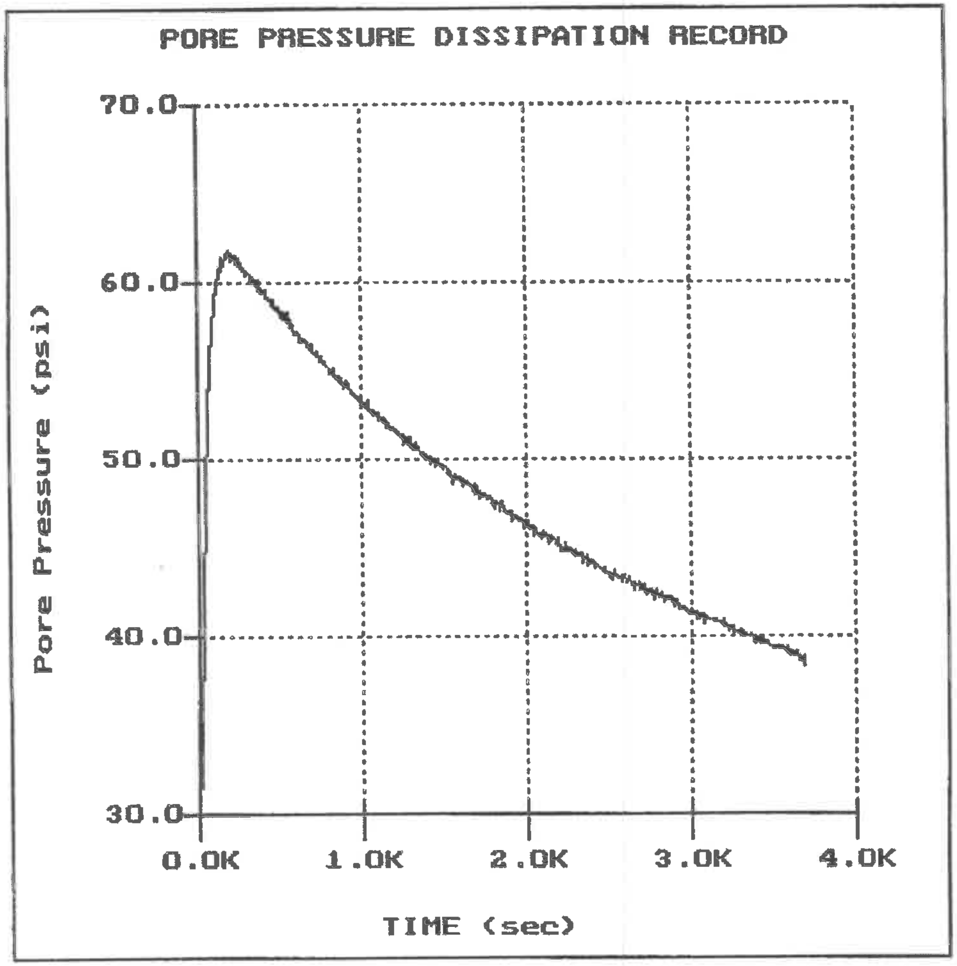


HARGIS + ASSOC.

Site: OMWD S.D.
Location: CPT-27

Engineer: S. BERRYMAN
Date:09:19:02 15:23

File: 236C27.PPC
Depth (m): 12.85
(ft): 42.16
Duration : 3690.0s
U-min: 30.92 5.0s
U-max: 61.81 195.0s


PORE PRESSURE DISSIPATION RECORD

APPENDIX G

WELL INVENTORY

APPENDIX G

WELL INVENTORY

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WELL INVENTORY

1.0 WELL INVENTORY SUMMARY

1.1 OVERVIEW

Previous review of historical documents indicated that over 100 wells may have been installed within the basin since the early 1900's. Information regarding the location, date drilled, depth, and status of wells within the project study area was compiled (Table G-1; Figure G-1). Project well numbers were assigned to each well based on the State Well Number where available. State Well Numbers are comprised of the Township/Range and Section Number followed by a letter that indicates the subarea of the section and a final number that indicates the sequence of wells in the subarea. When assigning project well numbers the Township/Range was dropped. For wells without State Well Numbers the project well number was assigned using a similar approach, based on the section number and subsection letter, however the well sequence was designated with a letter rather than a number. When plotting wells on maps the section numbers have been dropped from the project well number, but can be verified based on the number of the section in which the well is located.

As part of the well inventory, the status of potentially existing and historical wells within 2,000 feet of Morgan Run was updated based on interviews with property owners, local drillers, and pump service companies in the area to improve the reliability of historical well information. Well status information obtained during the well inventory is summarized in Table G-1. Locations of wells in which drillers' logs have been obtained are shown in Figure G-2.

A field reconnaissance was conducted during 2002 to confirm the location and status of wells within 2,000 feet of Morgan Run. Geographic coordinates of potentially abandoned and destroyed wells whose status was unknown were digitized from historical well location maps maintained by the California Department of Water Resources (DWR), the United States Geological Survey, and information in local agency files. Well coordinates were subsequently downloaded into a global positioning system (GPS) unit to facilitate locating these wells during several field reconnaissance trips. If there was no visual evidence of a well at the location indicated on historical maps, an electromagnetic sweep using a metal detector was conducted in a minimum of 30 square feet surrounding the documented location. If a well was found using the above procedure, new GPS coordinates were obtained at the wellhead and photographs were taken to document the well condition. Results of the field reconnaissance are reflected in the well status as presented in Table G-1.

1.2 MORGAN RUN WELL EVALUATION

A review of well location maps obtained from DWR indicated that three wells, which may have been located on what is now the Morgan Run property and the adjacent residential subdivisions along Via de la Valle, were not identified in the field during the well inventory task described above. A more intensive search of agency documents and historical aerial photographs was conducted in December 2003 in order to establish the condition and confirm the location of these wells. The following offices were visited to review records and photographs to determine the status of wells 5B1, 5C1 and 32Q1:

- County of San Diego, Department of Environmental Health (DEH), well records/permits desk;
- County of San Diego, Department of Planning and Land Use;
- County of San Diego, mapping desk; and
- Aerial Fotobank, Sorrento Valley.

Despite a comprehensive search of available records, no clear evidence of these three wells was found. No permits or abandonment records for these wells were on file with DEH for the Morgan Run property. No reference to the three wells was recorded on subdivision maps or subdivision improvement plans. No reference to these wells was found in soils reports or grading plans available for review in December 2003.

A 1953 vertical aerial photograph shows a structure in an agricultural field near the mapped location of 5C1. The structure may have been a shed or small utility building, and its appearance was consistent with a pump house. No other indication of a well was observed in the area, and the only nearby power line was located several hundred feet east of the structure. In addition, well 5C1 was reportedly installed in 1962 for the Whispering Palms Golf and Country Club and is identical to the Drillers Report for well 32R3, an older golf course well installed near the Number 3 Green North Well.

There is no evidence of the above structure or any other possible well-related structures near the mapped locations of the three wells in aerial photographs taken after 1953. The next available photographs, c. 1967 and later, show the areas after rough grading had been completed in preparation for golf course and residential subdivision construction.

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
	28JA	Casa de Vinci	Yes	12/18/1987	55	55	Prob. Existing & Active
13S/3W-28N1	28N1	Rosenblatt old well					Unknown^2
13S/3W-28N2	28N2	Collins	Yes	12/10/1964	161	161	Unknown^2
13S/3W-28N3	28N3	Rosenblatt new well		6/1/1981		97	Unknown^2
13S/3W-28N5	28N5	Y. C. Soda		Pre 1974		80.7	Unknown^2
13S/3W-28P1	28P1	Y. C. Soda				129.9	Unknown^2
13S/3W-28Q1	28Q1						Unknown^2
	28QA	Former Bauce Property					Existing - Active
	28RA	Buie	Yes	7/7/1989	80	80	Existing - Active
	28RB	Int'l Farms Shallow	Yes	4/27/1992	64	64	Existing - Active
	28RC	Int'l Farms Deep	Yes	4/25/1994	770	760	Existing - Inactive
	32GA	Williams	Yes	10/4/1991	167	167	Prob. Existing & Active
13S/3W-32H1	32H1	McElhinney	Yes	1/25/1977	150	143	Unknown^2
	32HA	Friedkin	Yes	2/6/1992	125	121	Existing - Active
13S/3W-32J1	32J1	Old Friedkin Well					Unknown^1
13S/3W-32J2	32J2	Morgan Run, near Gun					Unknown^1
13S/3W-32J3	32J3	Morgan Run, near Gun					Unknown^1
13S/3W-32J4	32J4	Morgan Run, near Gun					Unknown^1
	32JA	Morgan Run Old Gun	Yes	8/15/1983	138	132	Existing - Inactive-Buried
	32JB	Morgan Run Gun	Yes	7/25/1988	110	108	Existing - Inactive, Damaged
	32JC	Skeets-Dunn	Yes	11/30/1990	1205	1205	Existing & Prob. Active
	32JD	Morgan Run GunR (Gun Replacement)		6/1/2001			Existing - Active

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
13S/3W-32Q1	32Q1	John Murdy		Pre 1951			Unknown[1]
13S/3W-32R1	32R1	Whispering Palms No. 2		1971		110	Unknown[1]
13S/3W-32R2	32R2	A. L. Hobson Well 101 (Duplicate of 5G1 and 5K1)[3]	Yes	5/1/1924	104	104	Unknown[1]
13S/3W-32R3	32R3	Morgan Run No. 3 Green (Old 8"); also Whispering Palms No. 1	Yes	5/3/1962	110	110	Existing - Inactive, Filled-In
	32RA	Morgan Run No. 3 Green North (Old 2)	Yes	8/23/1983	140	110	Existing - Inactive, Damaged
	32RB	Morgan Run No. 3 Green North	Yes	2/27/1995	120	NA	Existing - Active
	32RC	Morgan Run No. 3 Green North (Old 1)		Post 1981	NA	113.3	Existing - Inactive, Damaged
13S/3W-33B1	33B1	Gravel Quarry					Unknown[2]
13S/3W-33B2	33B2	Fairbanks #2 Obs Well		April-81			Unknown[2]
13S/3W-33B3	33B3	Fairbanks #3 Obs Well		April-81			Unknown[2]
	33BA	Albert Court	Yes	3/26/1987	86	85	Existing - Active
13S/3W-33C1	33C1			Pre 1953			Unknown[2]
13S/3W-33C2	33C2	Smith East		1967		102	Existing; Inactive
13S/3W-33C3	33C3	Chino Old					Unknown[2]
13S/3W-33C4	33C4	Chino Old					Unknown[2]
13S/3W-33C5	33C5	Chino Old	Yes	8/1/1956	130	130	Unknown[2]
13S/3W-33C6	33C6	Chino Old		Sept. 1976	110	97	Unknown[2]
13S/3W-33C7	33C7	Chino	Yes	9/25/1976	120	97	Existing - Active
	33CA	Rancho Paseana N.	Yes	11/27/1983	101	98	Existing - Active
	33CB	Edwards	Yes	9/6/1988	105	105	Exist - Prob Active
13S/3W-33D1	33D1	Smith West		Pre 1953		105	Existing; Inactive
13S/3W-33D2	33D2	Smith					Unknown[1]
13S/3W-33E1	33E1	MacFarlane Turbine Base (Davis #4)					Destroyed 2002

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
13S/3W-33E2	33E2	MacFarlane South (Davis #2)					Destroyed 2002
13S/3W-33E3	33E3	MacFarlane East (Davis # 3)					Destroyed 2002
13S/3W-33E4	33E4	MacFarlane (Buried # 1)					Destroyed 2002
13S/3W-33E5	33E5	MacFarlane 6" PVC (Davis #5)					Destroyed 2002
	33EA	MacFarlane N.	Yes	5/30/1983	130	127	Existing - Active
13S/3W-33F1	33F1						Unknown^2
13S/3W-33F2	33F2						Unknown^2
13S/3W-33F3	33F3						Unknown^2
13S/3W-33F4	33F4						Unknown^2
13S/3W-33F7	33F7	Chino/Fairbanks Ranch		May-81			Unknown^2
	33FA	Schoenfelder No.1 (North)	Yes	7/20/1983	160	135	Existing - Active
	33FB	Schoenfelder No. 2 (South)	Yes	9/10/1991	150	150	Existing - Active
13S/3W-33G1	33G1						Unknown^2
13S/3W-33G2	33G2	Fairbanks Ranch #5 Obs. Well		Apr-81		21	Unknown^2
13S/3W-33G3	33G3	Fairbanks Ranch #1 Obs. Well	Yes	May-81	110	104	Unknown^2
	33K1						Unknown^2
	33K2						Unknown^2
13S/3W-33K3	33K3	A. L. Hobson Well 102	Yes	6/4/1924	115	115	Unknown^2
13S/3W-33K4	33K4	A. L. Hobson Well 104	Yes	7/10/1924	120	120	Unknown^2
13S/3W-33K5	33K5	A. L. Hobson Dutch Draw Well	Yes	Pre 1919	119	123	Unknown^2
13S/3W-33K6	33K6						Unknown^2
13S/3W-33K7	33K7						Unknown^2
13S/3W-33K8	33K8	H. Woodward Animal Center (North)	Yes	3/13/1979	110	103	Existing - Active
13S/3W-33L1	33L1	Fairbanks Ranch		Pre 1945		~140	Unknown^1
13S/3W-33L2	33L2	Fairbanks Ranch		Pre 1945		~140	Unknown^1
13S/3W-33L3	33L3	Fairbanks Ranch		Pre 1945		~140	Unknown^1
13S/3W-33L4	33L4	Fairbanks Ranch		Pre 1945		~140	Unknown^1

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
13S/3W-33L5	33L5	Nativity Catholic Church old south	Yes	2/24/1953	136	134	Unknown[1]
13S/3W-33L6	33L6	Nativity Catholic Church old north	Yes	11/14/1978	123	123	Destroyed (USGS)
13S/3W-33L7	33L7	FBR Homeowners No. 1 (East)	Yes	5/6/1981	100	100	Existing - Inactive
13S/3W-33L8	33L8	Nativity Catholic Church / Originally Golf Inns.	Yes	4/3/1982	130	130	Existing - Active
	33LA	FBR Homeowners No. 2 (West)		Mid 90's			Existing - Active
	33LC	Harris	Yes	8/2/1991	125	125	Existing - Active
	33LD	Heller	Yes	7/25/1996	90	90	Existing - Active
	33LE	Champion	Yes	9/4/1998	95	95	Existing - Active
13S/3W-33M1	33M1	MacFarlane Buried #2 (South); Griset Bros.		Pre 1954		90.2 in 1954	Destroyed 2002
13S/3W-33M2	33M2	Morgan Run East Pond Well	Yes	9/26/1979	119	118	Destroyed, Stainless steel casing pulled
	33MA	AMWA, Inc. / Farhood	Yes	3/31/1990	1128	200	Unknown[2]
	33MB	Doan / Roundy / Altman	Yes	3/31/1993	160	160	Existing - Active
	33MC	Rogers	Yes	8/26/1993	120	120	Existing - Active
	33MD	Goldberg	Yes	5/18/1998	110	110	Existing - Active
	33ME	Wassermann / DMCC Land					Existing - Active
	33MF	Farhood					Existing - Active
13S/3W-33N1	33N1	A. L. Hobson Well 103	Yes	6/26/1924	132	132	Destroyed (USGS)
13S/3W-33N2	33N2	Rancho Paseana South (West)					Existing - Inactive
	33NA	Morgan Run Old East Well	Yes	8/15/1983	138	132	Existing - Inactive
	33NB	Bergen / Levy / King	Yes	12/1/1983	93	93	Unknown[1]
	33NC	Morgan Run East Well	Yes	11/5/1990	138	130	Existing - Inactive
	33ND	Bosstick	Yes	7/17/1996	127	123	Existing - Active
	33NE	Dadu / Hazel		5/23/1997	80-100	80-100	Existing - Active
	33PA	Rancho Paseana South (East)	Yes	4/2/1984	124	120	Existing - Active
	33PB	Fairbanks Country Day Sch.	yes	6/25/1990	153	133	Existing - Active

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
13S/3W-33Q2	33Q2	L. B. Culver / H. Woodward Animal Center (South)	Yes	11/17/1978	107	107	Unknown^2
14S/3W-4D1	4D1	Rancho Paseana / Griset Bros. Bean Patch 2					Located; Destroyed
14S/3W-4E1	4E1	E. W. Gard Test Well 11	Yes	Pre 1957	110	NA	Unknown^1
14S/3W-4E2	4E2	E. W. Gard Test Well 12	Yes	Pre 1957	123	NA	Unknown^2
14S/3W-4F1	4F1	E. W. Gard Test Well 10	Yes	Pre 1957	126	NA	Unknown^2
14S/3W-4F2	4F2	E. W. Gard Test Well 13	Yes	Pre 1957	105	NA	Unknown^2
14S/3W-4K1	4K1						Unknown^2
14S/3W-4K2	4K2						Destroyed
14S/3W-4L1	4L1	E. W. Gard Test Well 14	Yes	Pre 1957	90	NA	Unknown^2
14S/3W-4N1	4N1						Unknown^2
14S/3W-4P1	4P1						Unknown^2
14S/3W-4P2	4P2						Unknown^2
14S/3W-4P3	4P3						Unknown^2
	5B1						Unknown^1
14S/3W-5C1	5C1	Whispering Palms CC	Yes	5/3/1962	110	110	Same as 32-R3, Probably mis-located
14S/3W-5F1	5F1	RSF Polo Club 5F1				65	Existing - Inactive
14S/3W-5F2	5F2	E. W. Gard Test Well 7 / RSF Polo Club	Yes	Pre 1957	75	NA	Unknown^1
14S/3W-5F3	5F3	E. W. Gard Test Well 8 / RSF Polo Club	Yes	Pre 1957	135	NA	Unknown^1
	5FA	RSF Club Polo No. 1		1985-86	~60 to 80	60	Existing - active
	5FB	RSF Polo Club No. 2		1985-86	105	105	Existing - Inactive, Damaged
	5FC	RSF Polo Club No. 2R (No. 2 Replacement)	Yes	6/1/2001	120	110	Existing - Active

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
14S/3W-5G1	5G1	A. L. Hobson Well 101 (Duplicate of 32R2)[3]	Yes	5/28/1924	104	NA	Unknown[1]
	5GA	RSF Polo Club Test Well				79	Existing - Inactive
14S/3W-5H1	5H1	E. W. Gard Test Well 9 / Rancho Paseana	Yes	Pre 1957	133	NA	Unknown[1]
14S/3W-5H2	5H2	Morgan Run Fairway 2	Yes	10/27/1978	125	125	Existing - Inactive
14S/3W-5H3	5H3	Rancho Paseana Sump			>20	10.5	Existing - Active
14S/3W-5H4	5H4	Morgan Run South Pond Well				21	Unknown[1]
14S/3W-5K1	5K1	Walter Connely (Duplicate of 5G1)					Unknown[1]
14S/3W-5K2	5K2	E.River Bank Turbine Pump Well					Existing - Inactive
14S/3W-5K3	5K3	E. W. Gard Test Well 6	Yes	Pre 1957	118	NA	Unknown[1]
14S/3W-5L1	5L1	E. W. Gard Test Well 15	Yes	Pre 1957	73	NA	Unknown[1]
14S/3W-5L2	5L2	E. W. Gard Test Well 16	Yes	Pre 1957	73	NA	Unknown[1]
14S/3W-5M1	5M1			1962	450	450	Destroyed
14S/3W-5M2	5M2			1934	60		Unknown[2]
14S/3W-5N1	5N1						Unknown[2]
14S/3W-5N2	5N2						Unknown[2]
14S/3W-5P1	5P1	E. W. Gard Test Well 1	Yes	Pre 1957	103	NA	Unknown[2]
14S/3W-5P2	5P2	E. W. Gard Test Well 2	Yes	Pre 1957	123	NA	Unknown[2]
14S/3W-5P3	5P3	E. W. Gard Test Well 3	Yes	Pre 1957	123	NA	Unknown[2]
14S/3W-5P4	5P4	E. W. Gard Test Well 4	Yes	Pre 1957	115	NA	Unknown[2]
14S/3W-5P5	5P5						Unknown[2]
14S/3W-6G1	6G1						Unknown[2]
14S/3W-6K1	6K1						Unknown[2]
14S/3W-6J1	6J1						Destroyed
	6LA	McCoy No. 2	Yes	4/28/1983	180	Not Completed	Destroyed

TABLE G-1
SUMMARY OF WELL INVENTORY

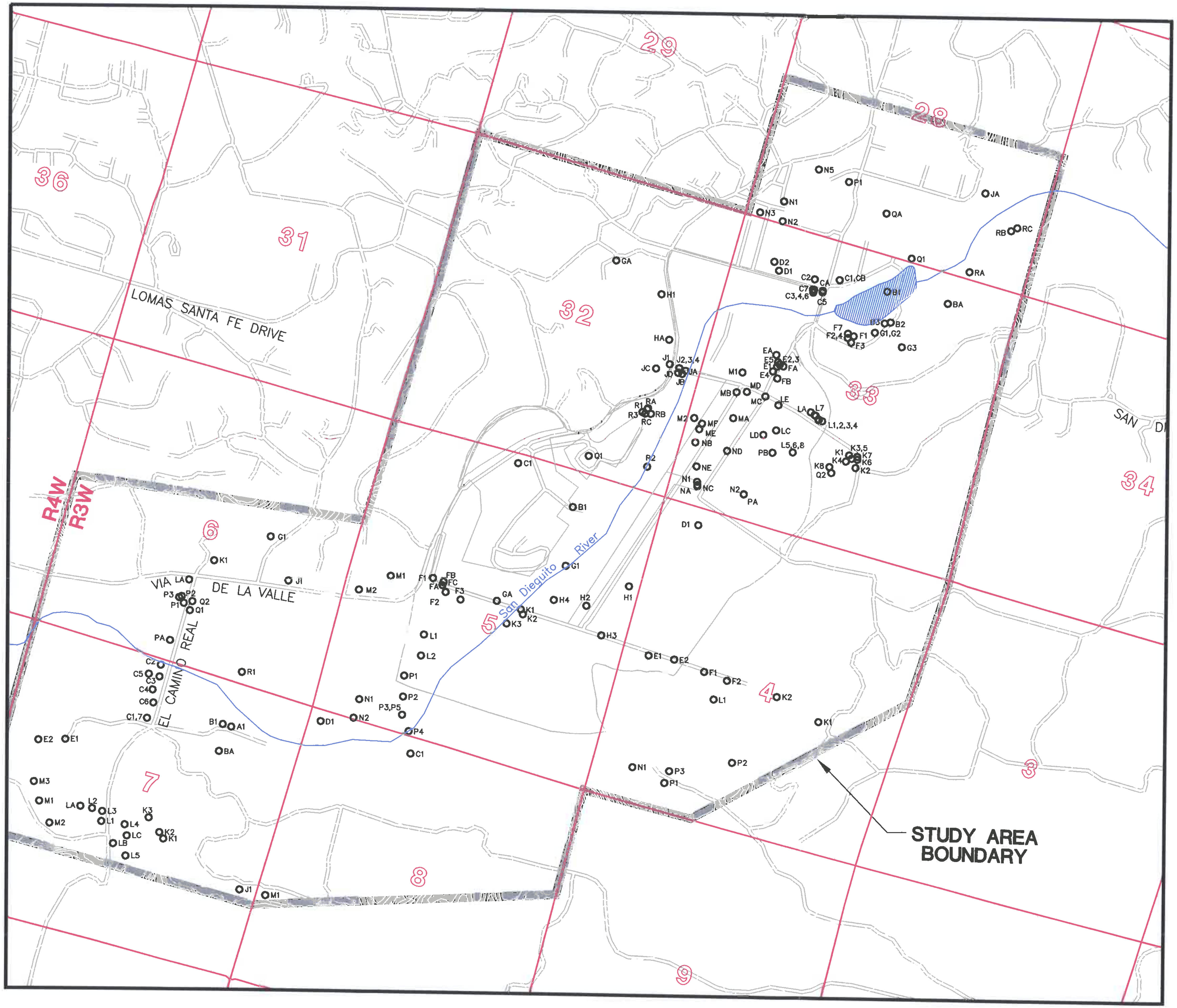
State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
	6PA	McCoy No. 1	Yes	4/27/1983	117	Not Completed	Destroyed
14S/3W-6P1	6P1						Unknown^{1}
14S/3W-6P2	6P2						Unknown^{1}
14S/3W-6P3	6P3						Unknown^{1}
14S/3W-6Q1	6Q1	Old Valley Lane Farms Well					Unknown^{1}
14S/3W-6Q2	6Q2	Valley Lane Farms	Yes	7/27/1968	120	108	Unknown^{1}
14S/3W-6R1	6R1						Unknown^{2}
14S/3W-7A1	7A1						Unknown^{2}
14S/3W-7B1	7B1						Existing; Filled in
	7BA	Rancho Del Mar	Yes	11/14/1985	332	322	Existing - Active
14S/3W-7C1	7C1	W. Connely		Pre 1953	100		Unknown^{1}
14S/3W-7C2	7C2	E. W. Gard # 1 Well	Yes	Pre 1957	140	NA	Unknown^{1}
14S/3W-7C3	7C3	E. W. Gard # 2 Well	Yes	Pre 1957	158	150	Unknown^{1}
14S/3W-7C4	7C4	E. W. Gard # 3 Well	Yes	Pre 1957	186	177	Unknown^{1}
14S/3W-7C5	7C5						Unknown^{1}
14S/3W-7C6	7C6						Unknown^{1}
14S/3W-7C7	7C7						Unknown^{1}
14S/3W-7E1	7E1						Unknown^{2}
14S/3W-7E2	7E2	H. C. Blazzard	Yes	Nov. 1983	72	72	Unknown^{2}
14S/3W-7J1	7J1						Unknown^{2}
14S/3W-7K1	7K1						Unknown^{2}
14S/3W-7K2	7K2						Unknown^{2}
14S/3W-7K3	7K3	Far West Farms	Yes	3/3/1982	112	114	Existing - Active
14S/3W-7L1	7L1						Unknown^{2}
14S/3W-7L2	7L2						Unknown^{2}

TABLE G-1
SUMMARY OF WELL INVENTORY

State Well Number (T/R-Section)	Project Well Number	Owner Name/Well Identifier	Well Log (Yes/No)	Date Drilled	Total Boring Depth (Feet bls)	Well Depth (Feet bls)	Well Status
14S/3W-7L3	7L3						Unknown[2]
14S/3W-7L4	7L4						Unknown[2]
14S/3W-7L5	7L5						Unknown[2]
	7LA	Rancho El Camino	Yes	9/23/1983	120	120	Existing - Active
	7LB	E. Southworth	Yes	3/29/1977	400	400	Unknown[2]
	7LC	E. Southworth	Yes	4/9/1977	365	365	Unknown[2]
14S/3W-7M1	7M1						Unknown[2]
14S/3W-7M2	7M2						Unknown[2]
14S/3W-7M3	7M3						Unknown[2]
14S/3W-8C1	8C1	E. W. Gard # 5 Well	Yes	Pre 1957	153	NA	Unknown[2]
14S/3W-8D1	8D1	E. W. Gard Test Well	Yes	Pre 1957	153	NA	Unknown[2]
14S/3W-8M1	8M1						Unknown[2]

Footnotes:

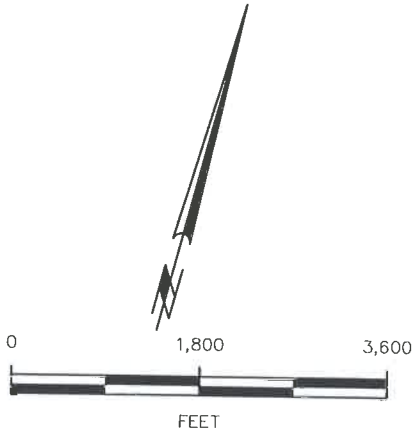
1) Field inspection was conducted, no evidence of well was apparent. Well status unknown.
2) Field inspection was not conducted. Well status unknown.
3) Based on driller's log, wells 32R2 and 5G1 are the same well. It is not known which of the two indicated well locations represents the actual location for this well, therefore, they are not shown on Figure G-2.



EXPLANATION

JA ○ LOCATION OF WELL IN STUDY AREA

NOTE: WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.



SAN DIEGUITO GROUNDWATER BASIN

LOCATION OF WELLS

HARGIS + ASSOCIATES, INC
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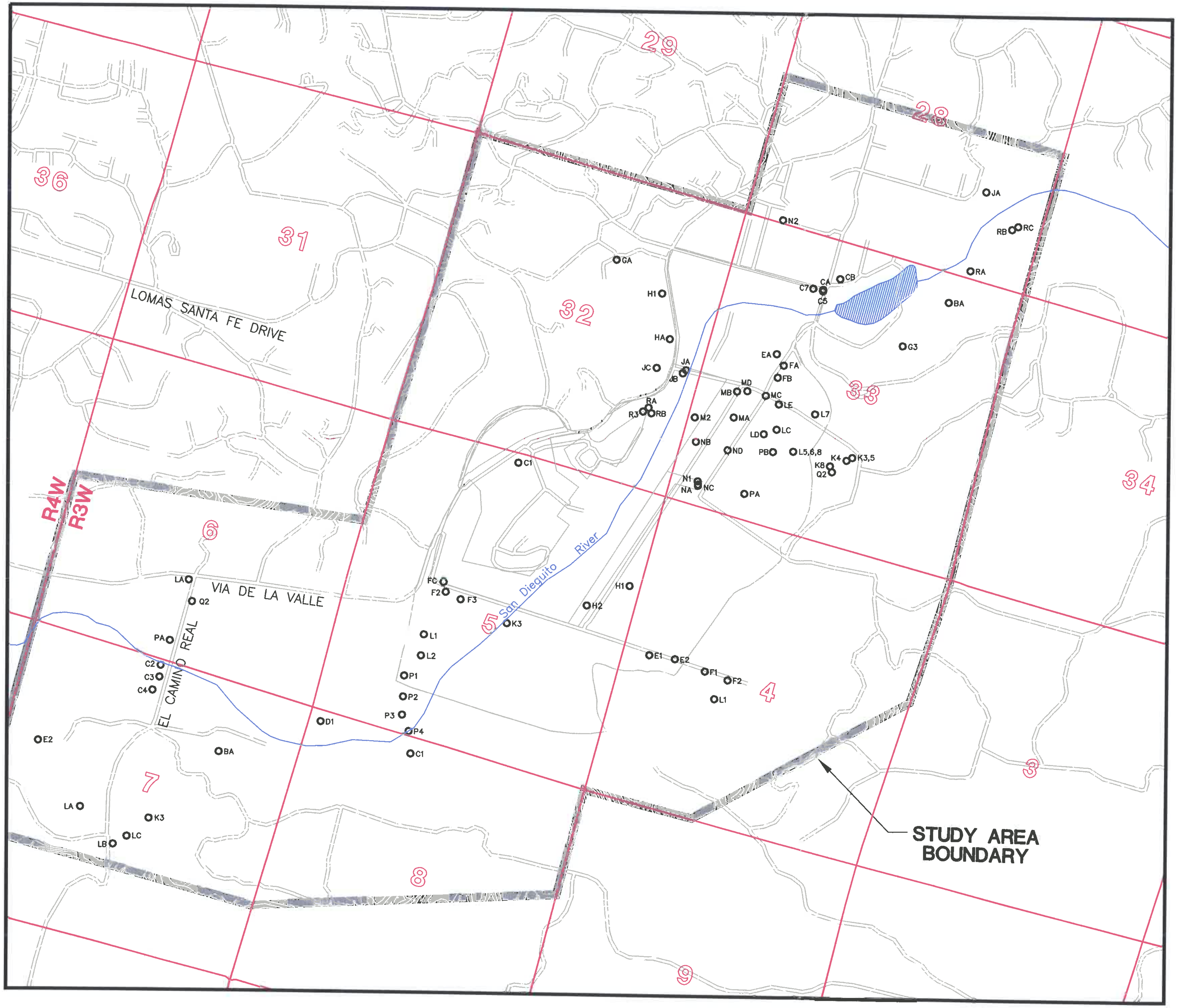
FIGURE G-1

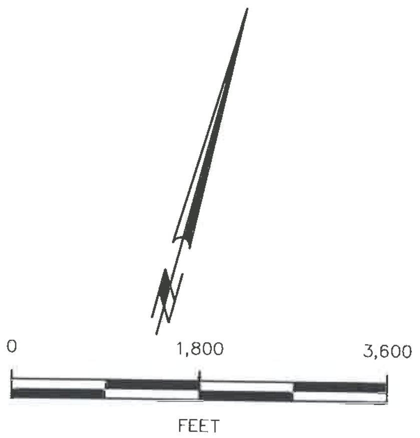
PREP BY RAN REV BY MAP RPT NO. 689.20 410-4878 A



EXPLANATION

P2 ○ LOCATION OF WELL IN STUDY AREA WITH DRILLERS LOG

NOTE: WELL IDENTIFIERS ENDING IN NUMBERS ARE AN ABBREVIATION OF THE STATE WELL NUMBER. WELLS WITH IDENTIFIERS ENDING IN LETTERS HAVE NOT BEEN ASSIGNED A STATE WELL NUMBER, BUT ARE BASED ON A SIMILAR IDENTIFICATION SCHEME.



SAN DIEGUITO GROUNDWATER BASIN

LOCATION OF WELLS WITH DRILLERS LOGS

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09/04

FIGURE G-2

PREP BY RAN REV BY MAP RPT NO. 689.20 410-4877 A

APPENDIX H

NEW WELL INSTALLATION

APPENDIX H

NEW WELL INSTALLATION

TABLE OF CONTENTS

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TABLES

FIGURES

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FIGURES CONTINUED

APPENDIX H

NEW WELL INSTALLATION

1.0 OVERVIEW

A series of borings and wells, including one exploratory boring, eleven shallow and two deep piezometers, and a test well, was installed at the Site between March 2002 and July 2003 (Figure H-1). Shallow piezometers P-1 through P-11A were screened across the water table. Intermediate piezometer P-11B was screened within the fine grained sediments overlying the confined aquifer. Deep piezometers P-4D and P-11D were screened in the deep confined aquifer. Exploratory boring EB-1 was drilled to a total depth of 140 feet below land surface (bls), and provided lithologic data used in the design of the OMWD test well which was installed ten feet south of EB-1. Test well TW-1 was screened within the deep confined aquifer. The test well was used to conduct injection and extraction tests within the confined aquifer at the Site.

2.0 WELL INSTALLATION SUMMARY

The following Sections summarize installation of piezometers, exploratory borings and the test well at the Site.

2.1 PIEZOMETERS

A series of 14 shallow and deep piezometers was installed at the Site between March 2002 and June 2003. Two shallow piezometers, P-1 and P-2, were installed using direct-push techniques. Remaining piezometers were installed using hollow stem auger drilling methods. Lithologic logs and well construction diagrams for piezometers have been provided (Figures H-2 through H-15).

Eleven shallow piezometers, designated P-1 through P-11A, were screened across the water table to total depths of 23 feet bls to 35 feet bls (Table H-1). Lengths of screen varied from 10 feet to 20 feet.

Intermediate piezometer P-11B was screened from 40 feet bls to 45 feet bls, below the water table and above the confined aquifer (Table H-1). Intermediate piezometer P-11B was placed in a well cluster configuration with adjacent shallow and deep piezometers P-11A and P-11D. Measurement of the intermediate piezometer provides water level data above the confined aquifer.

Two deep piezometers were screened in the confined aquifer. Screen intervals of deep piezometers P-4D and P-11D were approximately 75 to 90 feet bls and 84 to 99 feet bls, respectively (Table H-1). Deep piezometers P-4D and P-11D were placed in a well cluster configuration with adjacent shallow piezometers P-4S and P-11A, respectively. Measurement of deep piezometers provides water level data within the confined aquifer.

2.2 EXPLORATORY BORINGS

Exploratory boring EB-1 was drilled at the proposed test well location in June 2003, to provide the lithologic data needed to design the test well. EB-1 was drilled to a depth of 140 feet bls using mud rotary methods (Table H-1). The lithologic log for exploratory boring EB-1 has been provided (Figures H-2 and H-16). Following drilling and lithologic logging, boring EB-1 was backfilled to the surface with neat cement.

2.3 TEST WELL

Test well TW-1 was installed at the Site in July 2003 ten feet south of EB-1. Test well TW-1 was drilled to a total depth of 138 feet bls using mud rotary methods. The well construction diagram for the test well has been provided (Figure H-17).

Test well TW-1 was screened from 87 feet to 137 feet bls, within the confined aquifer (Table H-1). The test well was used to conduct injection and extraction pumping tests in the deep confined aquifer underlying the Site.

TABLE H-1

BORING / PIEZOMETER CONSTRUCTION DATA

WELL IDENTIFIER	DATE INSTALLED	TOTAL DEPTH OF BOREHOLE (feet bls)	BORING DIAMETER (inches)	PERFORATED INTERVAL (feet bls)	SCREEN SLOT SIZE (inches)^a	CASING DIAMETER (inches)^a	FILTER PACK INTERVAL (feet bls)	FILTER PACK SAND SIZE	BENTONITE CHIP SEAL (feet bls)	CEMENT SEAL (feet bls)^b
P-1	3/12/2002	23	2	8 - 23	0.01	1	4 - 23	#2/12	3 - 4	0 - 3
P-2	3/12/2002	23	2	8 - 23	0.01	1	4 - 23	#2/12	3 - 4	0 - 3
P-3	10/24/2002	31	8	10.8 - 30.8	0.02	2	8 - 31	#2/12	3 - 8	0 - 3
P-4S	10/24/2002	26	8	10.5 - 25.5	0.02	2	8 - 26	#2/12	3 - 8	0 - 3
P-4D	10/25/2002	90.5	9	74.5 - 89.5	0.02	2	72 - 89.5	#2/12	69 - 72	0 - 3 3 - 69(c)
P-5	4/14/2003	31	7	10 - 30	0.02	2	8 - 31	#2/12	3 - 8	0 - 3
P-6	4/14/2003	31	7	15 - 30	0.02	2	13 - 31	#2/12	3 - 13	0 - 3
P-7	4/14/2003	36	7	15 - 35	0.02	2	13 - 36	#2/12	3 - 13	0 - 3
P-8	4/15/2003	31	7	15 - 30	0.02	2	13 - 31	#2/12	3 - 13	0 - 3
P-9	4/15/2003	26	7	15 - 25	0.02	2	13 - 26	#2/12	3 - 13	0 - 3
P-10	4/15/2003	26	7	10 - 25	0.02	2	8 - 26	#2/12	3 - 8	0 - 3
P-11A/B	6/4/2003	45	8	17 - 27 40 - 45	0.01 0.01	1 1	16 - 28 38.5-45	#2/12 #2/12	10-16 28-38.5	0 - 10

WELL IDENTIFIER	DATE INSTALLED	TOTAL DEPTH OF BOREHOLE (feet bls)	BORING DIAMETER (inches)	PERFORATED INTERVAL (feet bls)	SCREEN SLOT SIZE (inches)^a	CASING DIAMETER (inches)^a	FILTER PACK INTERVAL (feet bls)	FILTER PACK SAND SIZE	BENTONITE CHIP SEAL (feet bls)	CEMENT SEAL (feet bls)^b
P-11D	6/4/2003	99	8	84 - 99	0.01	2	74 - 99	#2/12	73 - 74	0 - 68
TW-1	7/15/2003	138	22; 13.5(d)	87 - 137	0.04; 0.08(e)	8	22 - 138	#3 Special	20 - 22	0 - 20(c)
BORING IDENTIFIER										
EB-1	6/3/2003	140	5	---	---	---	---	---	---	0 - 140

FOOTNOTES

bls = Below land surface

a = Schedule 40 polyvinyl chloride screen and casing

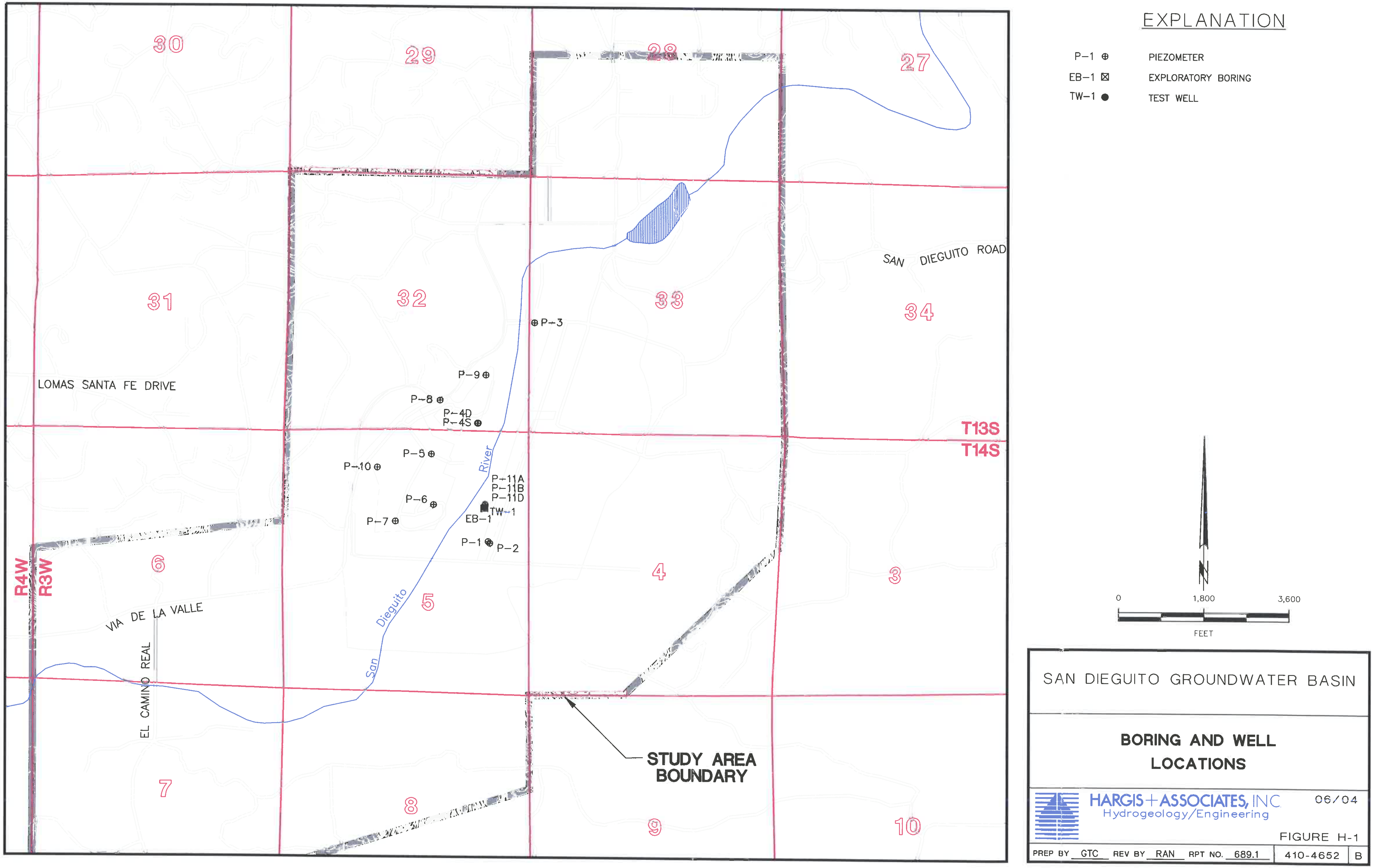
b = Indicates cement-based materials (concrete or neat cement)

c = Bentonite grout seal

d = 22-inch diameter to 70 feet bls; 13.5-inch diameter to 138 feet bls

e = 0.040-inch slots at 87 feet to 117 feet bls; 0.080-inch slots at 117 feet to 137 feet bls

f = #3 sand at 22 feet to 112 feet bls; Lonestar Special Blend at 112 feet to 138 feet bls



SAN DIEGUITO GROUNDWATER BASIN

BORING AND WELL LOCATIONS

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

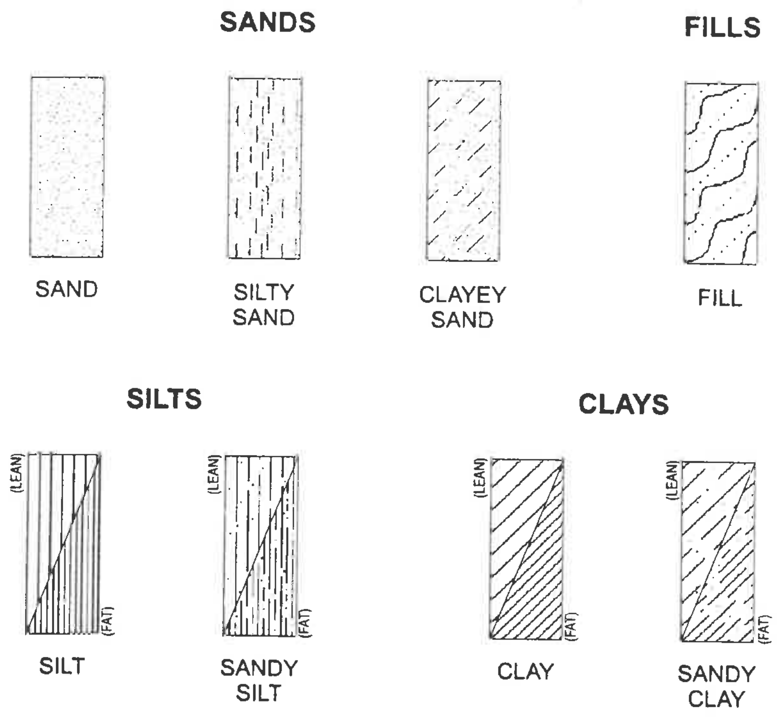
06/04

FIGURE H-1

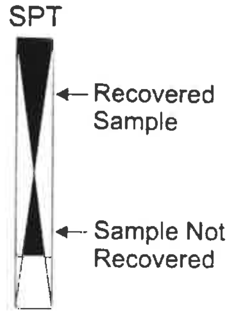
PREP BY GTC REV BY RAN RPT NO. 689.1 410-4652 B

LITHOLOGIC LOG SYMBOLS

GRAPHIC LOG MATERIALS SYMBOLS



SAMPLE TYPE SYMBOLS



6/04 | RPT NO 689 26 | Figure 2 CDR | VER 1

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FIGURE H-2: LOG SYMBOLS

PIEZOMETER P-1

DATE DRILLED: *3/12/02*

SURFACE ELEVATION: *25 feet msl*

BOREHOLE DIA.: *2 inches*

TOTAL DEPTH OF BORING *23 feet bls*

DRILLING COMPANY: *Gregg In-Situ, Inc.*

METHOD: *Direct Push*

DRILLER'S NAME:

DRILL RIG: *Cone Penetrometer*

LOGGED BY: *S. Berryman*

CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*

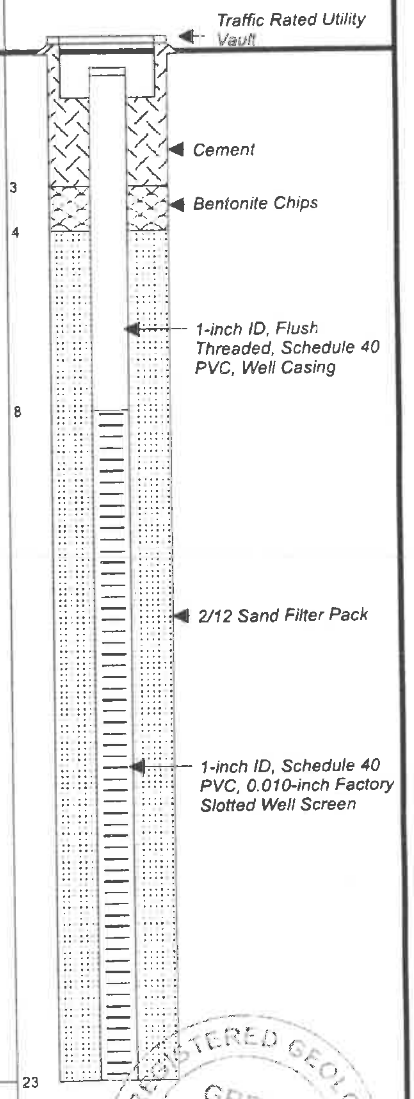
PROJECT NUMBER: *689.06*

LOCATION *Morgan Run Country Club*
Rancho Santa Fe, CA

COMMENTS

DEPTH (feet)	SAMPLE	RECOVERY	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
2 4 6 8 10 12 14 16 18 20 22						Direct Push Borings not logged.
24 26						TOTAL DEPTH OF BORING = 23 FEET BELOW LAND SURFACE

WELL CONSTRUCTION DIAGRAM



REGISTERED GEOLOGIST
GREG T. CRANHAM
No. 5897
Date Signed 9/14/04
STATE OF CALIFORNIA

FIGURE H-3: LITHOLOGIC LOG FOR PIEZOMETER P-1

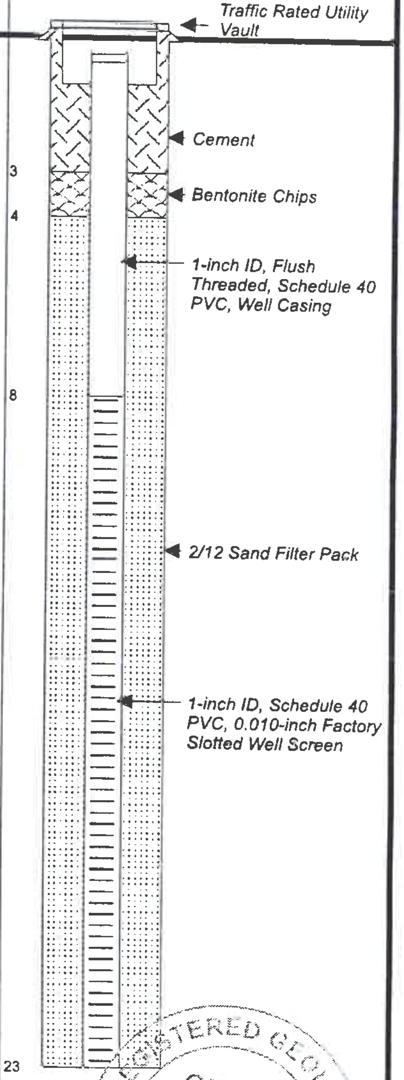
PIEZOMETER P-2

DATE DRILLED: *3/12/02*
SURFACE ELEVATION: *25 feet msl*
BOREHOLE DIA.: *2 inches*
TOTAL DEPTH OF BORING *23 feet bls*
DRILLING COMPANY: *Gregg In-Situ, Inc.*
METHOD: *Direct Push*
DRILLER'S NAME:
DRILL RIG: *Cone Penetrometer*
LOGGED BY: *S. Berryman*
CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.06*
LOCATION *Morgan Run Country Club*
Rancho Santa Fe, CA
COMMENTS

DEPTH (feet)	SAMPLE	RECOVERY	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
						Direct Push Borings not logged.
2						
4						
6						
8						
10						
12						
14						
16						
18						
20						
22						
24						TOTAL DEPTH OF BORING = 23 FEET BELOW LAND SURFACE
26						

WELL CONSTRUCTION DIAGRAM



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No. 5897
Date Signed 9/14/04

FIGURE H-4: LITHOLOGIC LOG FOR PIEZOMETER P-2

PIEZOMETER P-3

DATE DRILLED: *10/24/02*

SURFACE ELEVATION: *27 feet msl*

BOREHOLE DIA.: *8 inches*

TOTAL DEPTH OF BORING *31 feet bls*

DRILLING COMPANY: *West Hazmat*

METHOD: *Hollow Stem Auger*

DRILLER'S NAME: *R. Suffle*

DRILL RIG: *CME 75*

LOGGED BY: *S. Berryman*

CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*

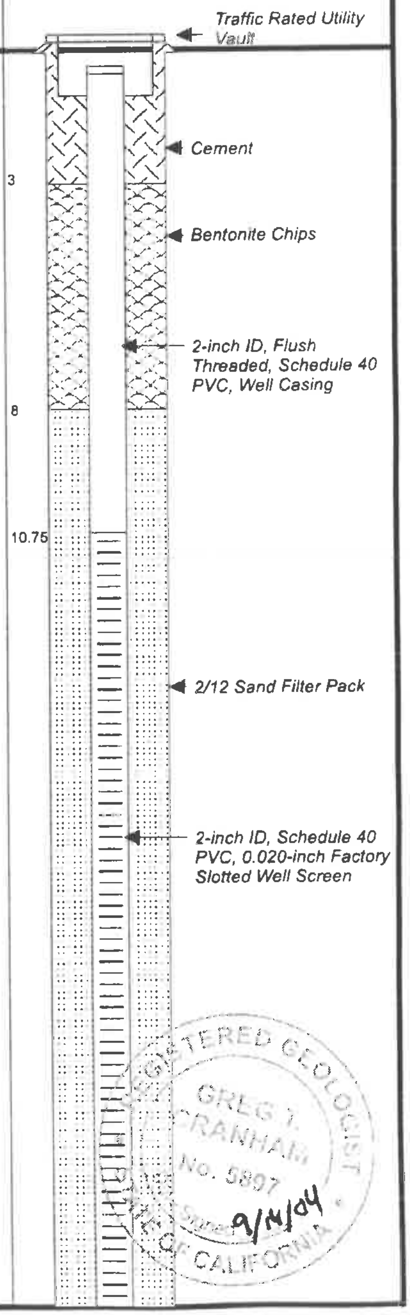
PROJECT NUMBER: *846.16*

LOCATION *Morgan Run Country Club*
Rancho Santa Fe, CA

COMMENTS
Weather: Overcast
Sampler: 1.5" Diameter SPT
Split Barrel Sampler

DEPTH (feet)	SAMPLE	RECOVERY	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
2						
4						
	⧗	▮	20 22 32	SP	▨	SAND (0/95/5) Yellowish brown (10YR 5/6), slightly moist, dense to very dense, fine- to medium-grained, predominantly fine, moderately sorted, angular to subangular; trace silt.
6						
8						
10	⧗	▮	25 40 45	SW	▨	SAND (0/95/5) Yellowish brown (10YR 5/6) to dark yellowish brown (10YR 3/6), slightly moist, very dense, fine- to coarse-grained, poorly sorted, angular to subrounded; trace silt, trace gravel to ¾-inch length.
12						
14						
	⧗	▮	20 25 25	SP-SM	▨	SAND WITH SILT (0/90/10) Olive brown (2.5Y 4/4), moist, dense to very dense, fine-grained, trace medium to coarse, well sorted, angular; slightly micaceous.
16						
18						
20	⧗	▮	10 15 18	SW/ML	▨	SAND (0/95/5) Olive brown (2.5Y 4/4), moist, medium dense to dense, fine-grained, trace medium to coarse, well sorted, angular, trace silt, micaceous; Interbedded with SILT (0/0/100), dark grayish brown (2.5Y 4/2), moist, low plasticity, micaceous, trace fine sand, finely laminated.
22						
24						SILTY SAND (0/85/15) Dark yellowish brown (10YR 3/4) to olive brown (2.5Y 4/4), moist, medium dense to dense, fine- to coarse-grained, predominantly fine, poorly sorted, angular to subrounded; micaceous.
	⧗	▮	10 18 20	SM ML	▨	SILT (0/0/100) Very dark grayish brown (2.5Y 3/2), moist, low plasticity; micaceous, trace fine sand, finely laminated.
26						

WELL CONSTRUCTION DIAGRAM



GREG T. CRANHAM No. 5897 9/4/04

FIGURE H-5: LITHOLOGIC LOG FOR PIEZOMETER P-3

PIEZOMETER P-3

PAGE 2 OF 2

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *846.16*
DATE DRILLED *10/24/02*

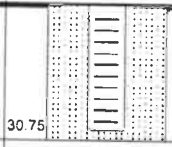
DEPTH (feet)	SAMPLE	RECOVERY	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL	WELL CONSTRUCTION DIAGRAM
30	⧗	▮	10 20 20	SP	▒	SAND (0/95/5) Grayish brown (2.5Y 5/2), moist, fine- to medium-grained, moderately sorted, angular to subangular; slightly micaceous, trace silt.	 30.75
32						TOTAL DEPTH OF BORING = 31 FEET BELOW LAND SURFACE	
34							
36							
38							
40							
42							
44							
46							
48							
50							
52							
54							
56							
58							

FIGURE H-5: LITHOLOGIC LOG FOR PIEZOMETER P-3

PIEZOMETER P-4S

DATE DRILLED: *10/24/02*	SURFACE ELEVATION: *33 feet msl*
BOREHOLE DIA.: *8 inches*	TOTAL DEPTH OF BORING *26 feet bls*
DRILLING COMPANY: *West Hazmat*	METHOD: *Hollow Stem Auger*
DRILLER'S NAME: *R. Suffle*	DRILL RIG: *CME 75*
LOGGED BY: *S. Berryman*	CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*

PROJECT NUMBER: *846.16*

LOCATION *Morgan Run Country Club*
Rancho Santa Fe, CA

COMMENTS
Weather: Overcast
Sampler: 1.5" Diameter SPT
Split Barrel Sampler

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
2					
4 6	⧗	25 25 27	SM	▨	SILTY SAND (0/85/15) Olive brown (2.5Y 4/4), slightly moist, very dense, fine- to medium-grained, predominantly fine, moderately sorted, angular to subrounded; slightly micaceous.
8					
10	⧗	5 5 5	SP	▨	SAND (0/95/5) Yellowish brown (10YR 5/4), slightly moist, medium dense, fine- to medium-grained, poorly sorted, angular to subrounded; slightly micaceous, trace silt.
12					
14 16	⧗	5 6 7	SP	▨	SAND moist, otherwise same as above.
18					
20	⧗	5 8 10	ML	▥	SANDY SILT (0/30/70) Very dark grayish brown (10YR 3/2), moist, low to medium plasticity; sand fine- to medium-grained, predominantly fine, micaceous.
22					
24 26	⧗	5 8 10	ML	▥	SANDY SILT Same as 19.5 to 21 feet.

TOTAL DEPTH OF BORING = 26 FEET BELOW LAND SURFACE

WELL CONSTRUCTION DIAGRAM

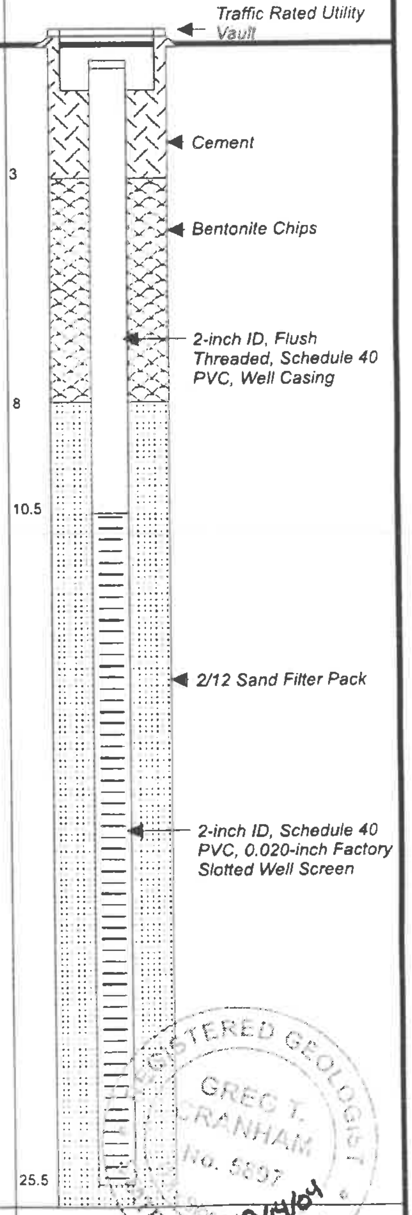


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FIGURE H-6: LITHOLOGIC LOG FOR PIEZOMETER P-4S

PIEZOMETER P-4D

DATE DRILLED: *10/24/02*

SURFACE ELEVATION: *33 feet msl*

BOREHOLE DIA.: *8 inches*

TOTAL DEPTH OF BORING *90.5 feet bls*

DRILLING COMPANY: *West Hazmat*

METHOD: *Hollow Stem Auger*

DRILLER'S NAME: *R. Suffle*

DRILL RIG: *CME 75*

LOGGED BY: *S. Berryman*

CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*

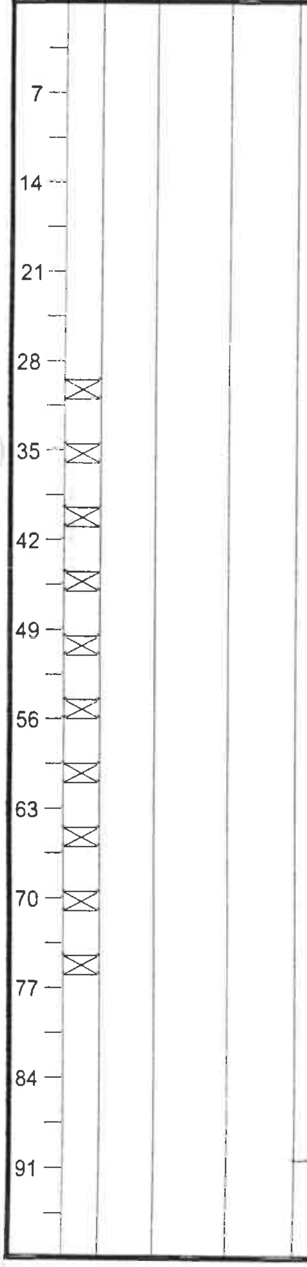
PROJECT NUMBER: *846.16*

LOCATION *Morgan Run Country Club*
Rancho Santa Fe, CA

COMMENTS

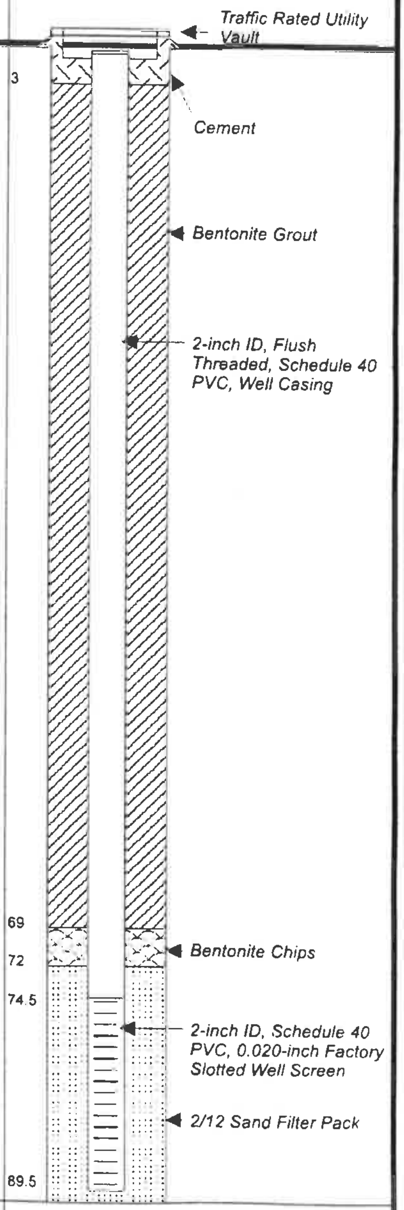
Weather: Overcast
Sampler: 1.5" Diameter SPT
Split Barrel Sampler

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL	WELL CONSTRUCTION DIAGRAM



Surface to 26 feet below land surface:
See Soil Boring P-4S Log (Figure 4).

From 26 feet to 90.5 feet bls, heaving sands prevented recovery of lithologic samples.



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TOTAL DEPTH OF BORING = 90.5 FEET BELOW LAND SURFACE

FIGURE H-7: LITHOLOGIC LOG FOR PIEZOMETER P-4D

PIEZOMETER P-5

DATE DRILLED: *04/14/03*

SURFACE ELEVATION: *29 feet msl*

BOREHOLE DIA.: *7 inches*

TOTAL DEPTH OF BORING *31 feet bls*

DRILLING COMPANY: *West Hazmat*

METHOD: *Hollow Stem Auger*

DRILLER'S NAME: *R. Suffle*

DRILL RIG: *CME 75*

LOGGED BY: *S. Berryman*

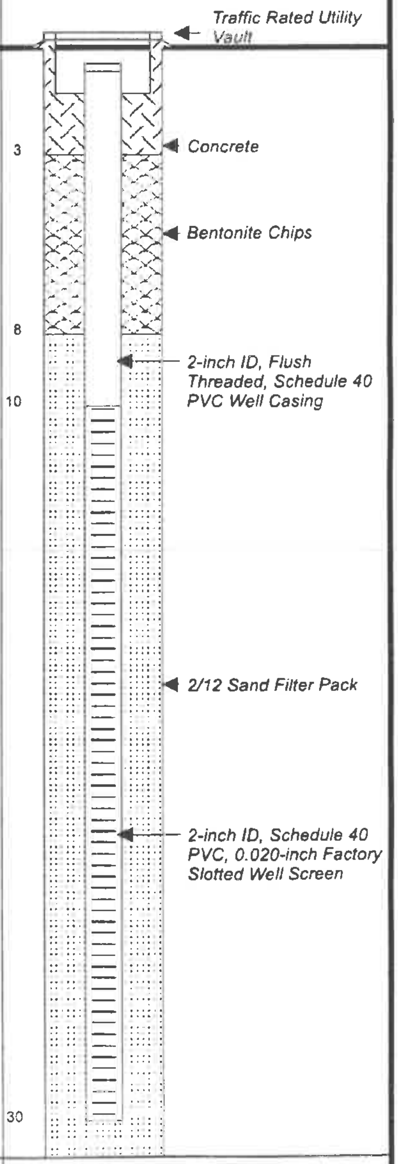
CHECKED BY: *G. Cranham (R.G #5897)*

PROJECT NAME: *OMWD-San Dieguito*

PROJECT NUMBER: *689.26*

LOCATION *Cancha de Golf at Via Osuna*
Rancho Santa Fe, CA

COMMENTS
Weather: Rain

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL	WELL CONSTRUCTION DIAGRAM
5 10 15 20 25 30					Boring not logged. See Cone Penetrometer Log CPT-24 for Lithology.	

TOTAL DEPTH OF BORING = 31 FEET
BELOW LAND SURFACE

GREG T. CRANHAM
No. 5897
9/14/04

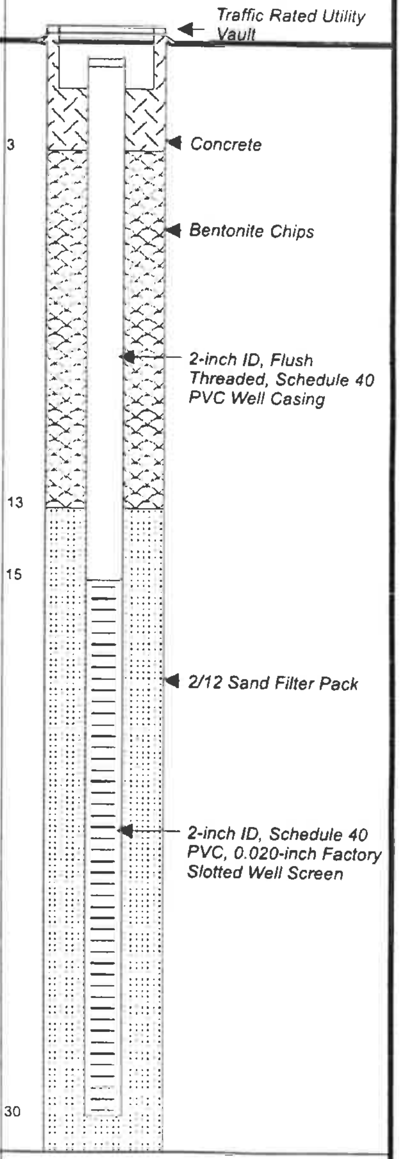
FIGURE H-8: LITHOLOGIC LOG FOR PIEZOMETER P-5

PIEZOMETER P-6

DATE DRILLED: *04/14/03*
SURFACE ELEVATION: *31 feet msl*
BOREHOLE DIA.: *7 inches*
TOTAL DEPTH OF BORING *31 feet bls*
DRILLING COMPANY: *West Hazmat*
METHOD: *Hollow Stem Auger*
DRILLER'S NAME: *R. Suffle*
DRILL RIG: *CME 75*
LOGGED BY: *S. Berryman*
CHECKED BY: *G. Cranham (R.G #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
LOCATION *Via Reposo at Avenida Brisa, Rancho Santa Fe, CA*

COMMENTS
Weather: Rain

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL	WELL CONSTRUCTION DIAGRAM
5 10 15 20 25 30					Boring not logged. See Cone Penetrometer Log CPT-25 for Lithology.	
					TOTAL DEPTH OF BORING = 31 FEET BELOW LAND SURFACE	

REGISTERED GEOLOGIST
GREG T. CRANHAM
No. 5897
9/14/04
STATE OF CALIFORNIA

FIGURE H-9: LITHOLOGIC LOG FOR PIEZOMETER P-6

PIEZOMETER P-7

DATE DRILLED: *04/14/03*

SURFACE ELEVATION: *30 feet msl*

BOREHOLE DIA.: *7 inches*

TOTAL DEPTH OF BORING *36 feet bls*

DRILLING COMPANY: *West Hazmat*

METHOD: *Hollow Stem Auger*

DRILLER'S NAME: *R. Suffle*

DRILL RIG: *CME 75*

LOGGED BY: *S. Berryman*

CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*

PROJECT NUMBER: *689.26*

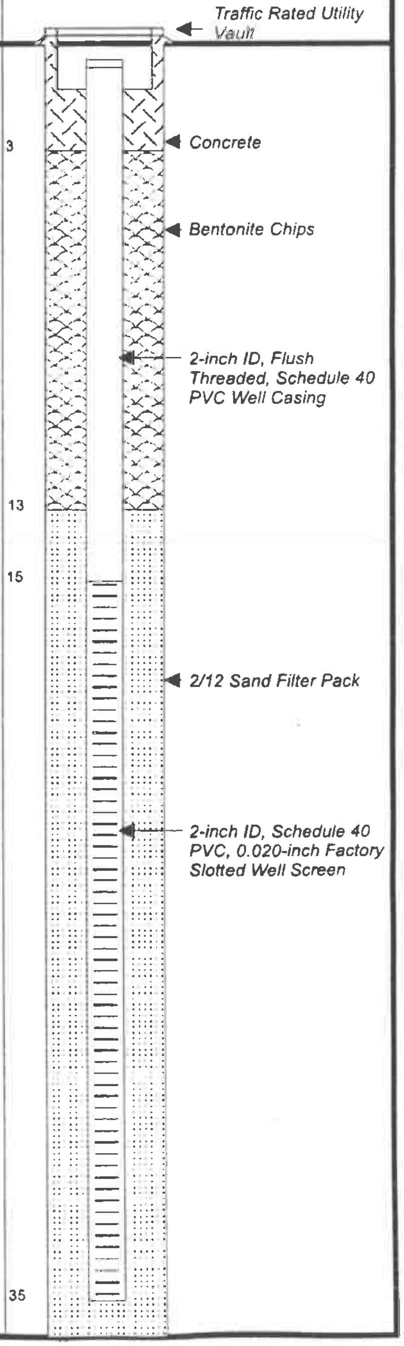
LOCATION *Via de las Palmas at Avenida Feliz, Rancho Santa Fe, CA*

COMMENTS

Weather: Rain

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
					Boring not logged. See Cone Penetrometer Log CPT-26 for Lithology.
5					
10					
15					
20					
25					
30					
35					TOTAL DEPTH OF BORING = 36 FEET BELOW LAND SURFACE

WELL CONSTRUCTION DIAGRAM



GREG T. CRANHAM No. 5897

Date Signed 9/14/04

FIGURE H-10 LITHOLOGIC LOG FOR PIEZOMETER P-7

PIEZOMETER P-8

DATE DRILLED: *04/15/03*
SURFACE ELEVATION: *31 feet msl*
BOREHOLE DIA.: *7 inches*
TOTAL DEPTH OF BORING *31 feet bls*
DRILLING COMPANY: *West Hazmat*
METHOD: *Hollow Stem Auger*
DRILLER'S NAME: *R. Suffle*
DRILL RIG: *CME 75*
LOGGED BY: *S. Berryman*
CHECKED BY: *G. Cranham (R.G #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
LOCATION *Via Valle Verde at Hole 5 Tee Box, Rancho Santa Fe, CA*

COMMENTS
Weather: Rain
Sampler: 1.5" Diameter SPT Split Barrel Sampler

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
5	⧗	10 15 20	ML		SILT (0/10/90) Dark yellowish brown (10YR 3/6), moist, stiff to very stiff, low plasticity; trace sand, fine-grained, micaceous.
10	⧗	10 10 10	ML		SILT WITH SAND (0/20/80) Dark grayish brown (2.5Y 4/2), moist, stiff, medium plasticity; sand fine- to medium-grained, slightly micaceous.
15	⧗	10 15 15	SP		SAND (0/95/5) Pale olive (5Y 6/3), moist, medium dense, fine- to coarse-grained, poorly sorted, subrounded to rounded; trace silt.
20	⧗	10 15 16	SP		SAND Pale olive (5Y 6/4), slightly coarser-grained, otherwise as above.
25	⧗	10 18 20	SP		SAND Same as above.
30	⧗		Td		BEDROCK, Probable Delmar Formation

TOTAL DEPTH OF BORING = 31 FEET
BELOW LAND SURFACE

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9/14/04

WELL CONSTRUCTION DIAGRAM

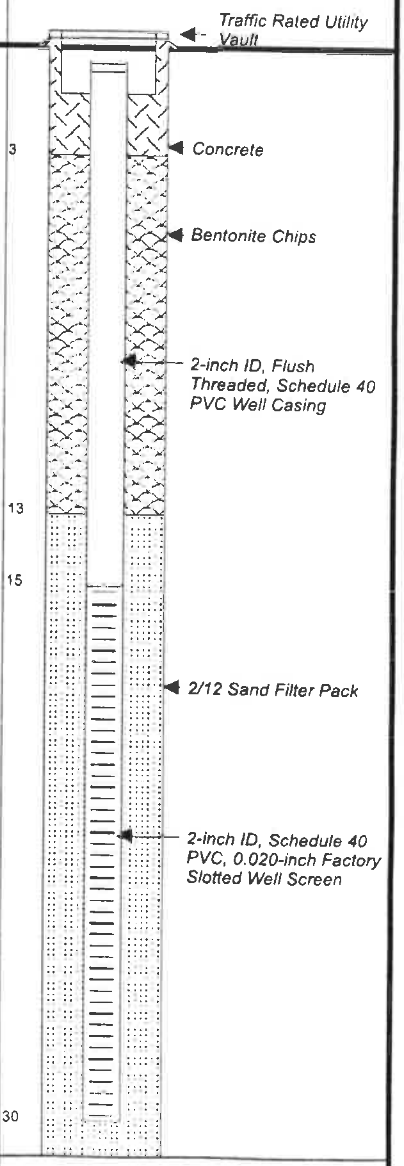


FIGURE H-11: LITHOLOGIC LOG FOR PIEZOMETER P-8

PIEZOMETER P-9

DATE DRILLED: *04/15/03*

SURFACE ELEVATION: *35 feet msl*

BOREHOLE DIA.: *7 inches*

TOTAL DEPTH OF BORING *26 feet bls*

DRILLING COMPANY: *West Hazmat*

METHOD: *Hollow Stem Auger*

DRILLER'S NAME: *R. Suffle*

DRILL RIG: *CME 75*

LOGGED BY: *S. Berryman*

CHECKED BY: *G. Cranham (R.G #5897)*

PROJECT NAME: *OMWD-San Dieguito*

PROJECT NUMBER: *689.26*

LOCATION *Via Valle Verde north end, cul-de-sac, Rancho Santa Fe,CA*

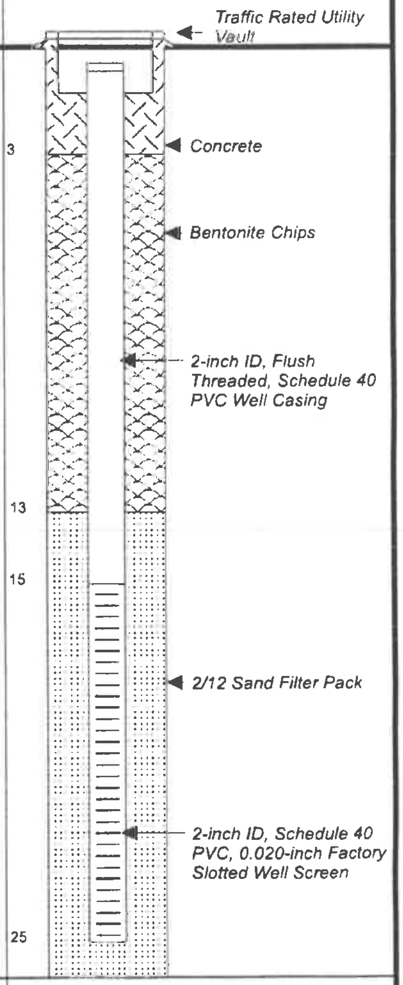
COMMENTS

Weather: Rain
Sampler: 1.5" Diameter SPT
Split Barrel Sampler

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
5	⧗	10 15 15	SP-SM		SAND WITH SILT (0/90/10) Olive brown (2.5Y 4/4), moist, medium dense, fine- to coarse-grained, predominantly fine, moderately sorted, subrounded; micaceous.
10	⧗	10 15 15	SP-SM SP		SAND WITH SILT Same as above. SAND (0/100/0) Dark yellowish brown (10YR 3/6), moist, medium dense, fine- to coarse-grained, moderately sorted, subrounded; slightly micaceous.
15	⧗	10 15 15	SP		SAND (0/95/5) Olive brown (2.5Y 4/4), moist, medium dense, fine- to medium-grained, predominantly fine, moderately to well sorted, subangular to subrounded; trace silt, micaceous.
20	⧗	5 10 15	SP		SAND (0/98/2) Olive brown (2.5Y 4/4), moist, medium dense, fine- to coarse-grained, predominantly medium, moderately sorted, subangular to subrounded; trace silt, micaceous.
25	⧗	5 10 15	SP		SAND Same as above
30					

TOTAL DEPTH OF BORING = 26 FEET
BELOW LAND SURFACE

WELL CONSTRUCTION DIAGRAM



GREG T. CRANHAM
No. 5897
9/14/04

FIGURE H-12: LITHOLOGIC LOG FOR PIEZOMETER P-9

PIEZOMETER P-10

DATE DRILLED: *04/15/03*
SURFACE ELEVATION: *31 feet msl*
BOREHOLE DIA.: *7 inches*
TOTAL DEPTH OF BORING *26 feet bls*
DRILLING COMPANY: *West Hazmat*
METHOD: *Hollow Stem Auger*
DRILLER'S NAME: *R. Suffle*
DRILL RIG: *CME 75*
LOGGED BY: *S. Berryman*
CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
LOCATION *Avenida Calma at 16050,*
Rancho Santa Fe, CA

COMMENTS
Weather: Rain
Sampler: 1.5" Diameter SPT
Split Barrel Sampler

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
5		25 50 25	SP-SM		SAND WITH SILT (0/90/10) Olive brown (2.5Y 4/4), moist, medium dense to dense, fine- to medium-grained, predominantly fine, moderately sorted, subangular; micaceous.
10		5 6 6	SP-SM		SAND WITH SILT Loose, otherwise as above
15		10 10 10	SP		SAND (0/100/0) Olive brown (2.5Y 4/4), moist, medium dense, fine- to coarse-grained, predominantly medium, moderately sorted, subangular to subrounded; micaceous.
20		10 10 15	SP ML		SAND Same as above SANDY SILT (0/30/70) Dark brown (10YR 3/3), moist, stiff, medium plasticity; sand fine-grained, micaceous.
25		10 15 15	SP ML		SAND (0/95/5) Olive brown (2.5Y 4/4), moist, medium dense, fine- to medium-grained, moderately sorted, subangular; trace silt, micaceous. SILT WITH SAND (0/20/80) Dark brown (10YR 3/3), moist, stiff, medium plasticity; sand fine-grained, micaceous.
30					

TOTAL DEPTH OF BORING = 26 FEET
BELOW LAND SURFACE

WELL CONSTRUCTION DIAGRAM

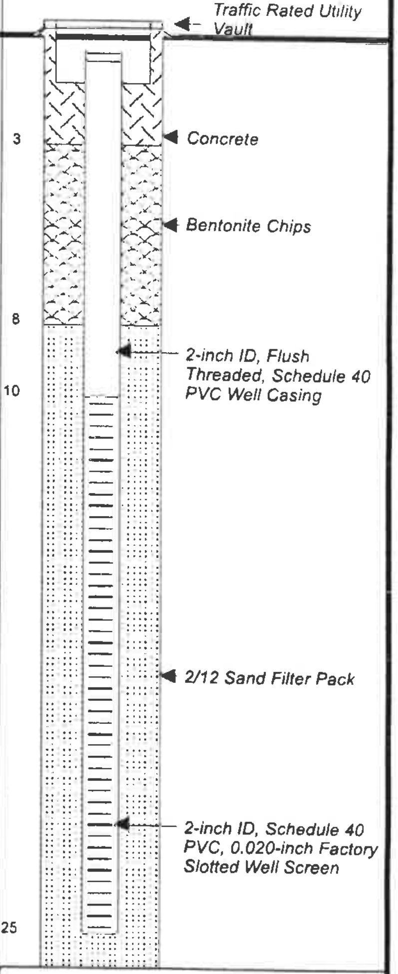


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FIGURE H-13: LITHOLOGIC LOG FOR PIEZOMETER P-10

PIEZOMETER CLUSTER P-11A/B

DATE DRILLED: *06/04/03*
SURFACE ELEVATION: *23 feet msl*
BOREHOLE DIA.: *8 inches*
TOTAL DEPTH OF BORING *45 feet bls*
DRILLING COMPANY: *West Hazmat*
METHOD: *Hollow Stem Auger*
DRILLER'S NAME: *T. Nichols*
DRILL RIG: *CME 85*
LOGGED BY: *C. Perkovac (R.G. #6576)* CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
LOCATION *Morgan Run Golf Resort, Rancho Santa Fe, CA*

COMMENTS
Weather: Overcast

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
					Boring not logged. See Cone Penetrometer Log CPT-22 for Lithology.
					NOTE: Well screened from 17 to 27 feet is designated as "P-11A"; and well screened from 40 to 45 feet is designated as "P-11B".
10					
20					
30					
40					
					TOTAL DEPTH OF BORING = 45 FEET BELOW LAND SURFACE

CHRISTIAN PERKOVAC No. 6576 9/14/04

WELL CONSTRUCTION DIAGRAM

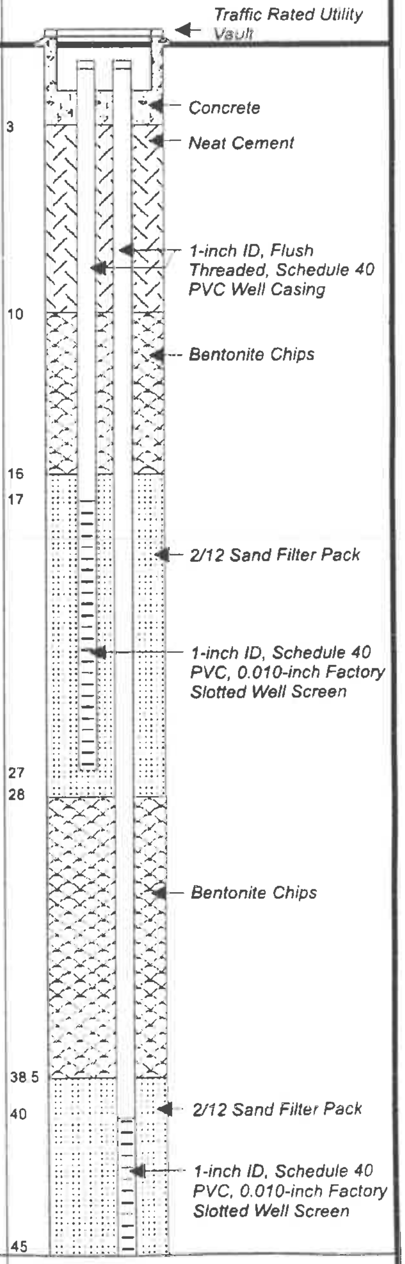


FIGURE H-14: LITHOLOGIC LOG FOR PIEZOMETER CLUSTER P-11A/B

PIEZOMETER P-11D

DATE DRILLED: *06/04/03*
SURFACE ELEVATION: *23 feet msl*
BOREHOLE DIA.: *8 inches*
TOTAL DEPTH OF BORING *99 feet bls*
DRILLING COMPANY: *West Hazmat*
METHOD: *Hollow Stem Auger*
DRILLER'S NAME: *T. Nichols*
DRILL RIG: *CME 85*
LOGGED BY: *C. Perkovac (R.G #6576)* CHECKED BY: *G. Cranham (R.G #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
LOCATION *Morgan Run Golf Resort, Rancho Santa Fe, CA*

COMMENTS
Weather: Overcast

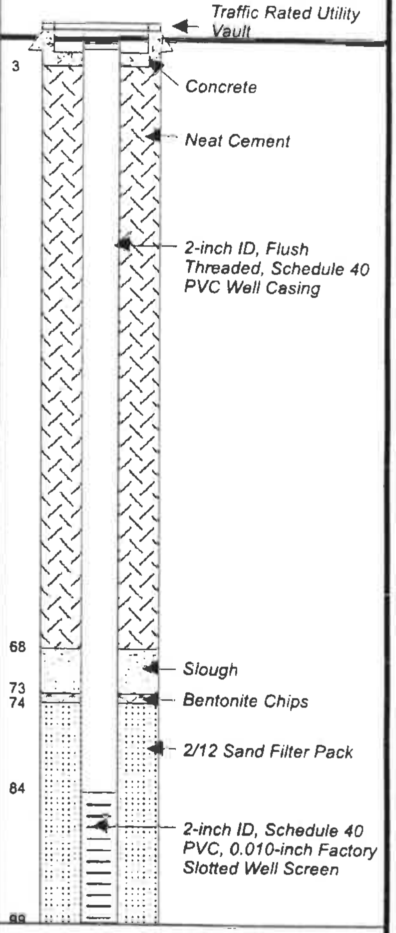
DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL	WELL CONSTRUCTION DIAGRAM
20 40 60 80					Boring not logged. See Cone Penetrometer Log CPT-22 for Lithology.	
100 120					TOTAL DEPTH OF BORING = 99 FEET BELOW LAND SURFACE	

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FIGURE H-15: LITHOLOGIC LOG FOR PIEZOMETER P-11D

BORING EB-1

DATE DRILLED: *06/02/03 to 06/03/03*
SURFACE ELEVATION: *23 feet msl*
BOREHOLE DIA.: *5 inches*
TOTAL DEPTH OF BORING *140 feet bls*
DRILLING COMPANY: *West Hazmat*
METHOD: *Mud Rotary*
DRILLER'S NAME: *T. Nichols*
DRILL RIG: *CME 85*
LOGGED BY: *C. Perkovac (R.G. #6576)* CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
LOCATION *Morgan Run Golf Resort, Rancho Santa Fe, CA*

COMMENTS
Sampler: Continuous coring and modified California sampler.

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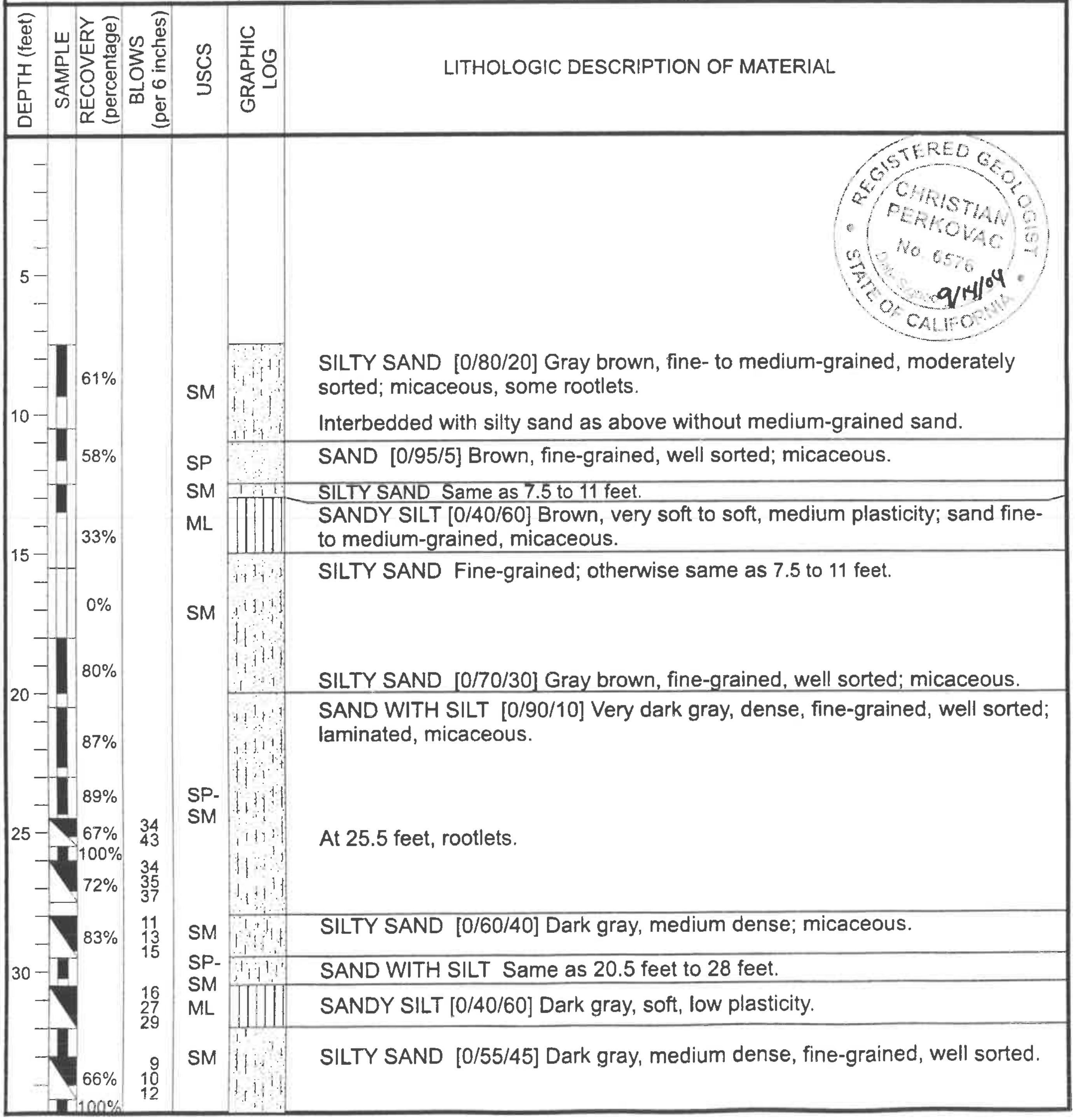

DEPTH (feet)	SAMPLE	RECOVERY (percentage)	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
5						
10		61%		SM		SILTY SAND [0/80/20] Gray brown, fine- to medium-grained, moderately sorted; micaceous, some rootlets. Interbedded with silty sand as above without medium-grained sand.
		58%		SP		SAND [0/95/5] Brown, fine-grained, well sorted; micaceous.
				SM		SILTY SAND Same as 7.5 to 11 feet.
				ML		SANDY SILT [0/40/60] Brown, very soft to soft, medium plasticity; sand fine- to medium-grained, micaceous.
15		33%				
		0%		SM		SILTY SAND Fine-grained; otherwise same as 7.5 to 11 feet.
20		80%				SILTY SAND [0/70/30] Gray brown, fine-grained, well sorted; micaceous.
		87%		SP-SM		SAND WITH SILT [0/90/10] Very dark gray, dense, fine-grained, well sorted; laminated, micaceous.
		89%				
25		67%	34 43			At 25.5 feet, rootlets.
		100%				
		72%	34 35 37			
		83%	11 13 15	SM		SILTY SAND [0/60/40] Dark gray, medium dense; micaceous.
30				SP-SM		SAND WITH SILT Same as 20.5 feet to 28 feet.
			16 27 29	ML		SANDY SILT [0/40/60] Dark gray, soft, low plasticity.
		66%	9 10 12	SM		SILTY SAND [0/55/45] Dark gray, medium dense, fine-grained, well sorted.
		100%				

FIGURE H-16: LITHOLOGIC LOG FOR BORING EB-1

BORING EB-1

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
DATE DRILLED *06/02/03 to 06/03/03*

DEPTH (feet)	SAMPLE	RECOVERY (percentage)	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
		100%	7 12 16	SC		CLAYEY SAND [0/70/30] Dark gray, loose to medium dense, fine-grained, well sorted; micaceous, with pink shell fragments up to 1/4 inch in length.
		75%				
		87%		SM		SILTY SAND [0/70/30] Dark gray, fine-grained, well sorted; micaceous.
40						
		100%		SC		CLAYEY SAND [0/60/40] Dark gray, fine-grained; with shell fragments.
				SM		SILTY SAND [0/70/30] Dark gray, fine-grained, well sorted.
				ML		SANDY SILT [0/40/60] Dark gray, soft, medium plasticity.
		50%				
45						
		100%	17 24 31	SM		SILTY SAND [0/60/40] Dark gray, medium dense to dense, fine-grained, well sorted; micaceous.
				ML		SANDY SILT [0/40/60] Dark gray, soft, low plasticity; micaceous, sand fine-grained.
		77%		SM		SILTY SAND [0/70/30] Dark gray, fine-grained; abundant shell fragments.
				ML		SANDY SILT [0/40/60] Dark gray, soft, medium plasticity; sand fine-grained.
50		100%	12 16 21			
		100%				SILTY SAND [0/60/40] Dark gray, fine-grained, well sorted; micaceous, with shell fragments.
		80%		SM		At 54 to 55 feet; slightly coarser sand.
55						
60				SM /ML		SILTY SAND TO SANDY SILT [0/50/50] Dark gray, fine-grained, soft, medium plasticity.
			17 24 27			SILTY SAND Same as 51.5 feet to 59.5 feet.
		83%		SM		
65						
		83%				SAND [0/96/4] Dark gray, fine- to medium-grained, predominantly fine, moderately sorted; locally laminated, slightly micaceous.
70				SP		
		73%				At 73.5 feet to 74.5 feet; medium sand fraction decreases.

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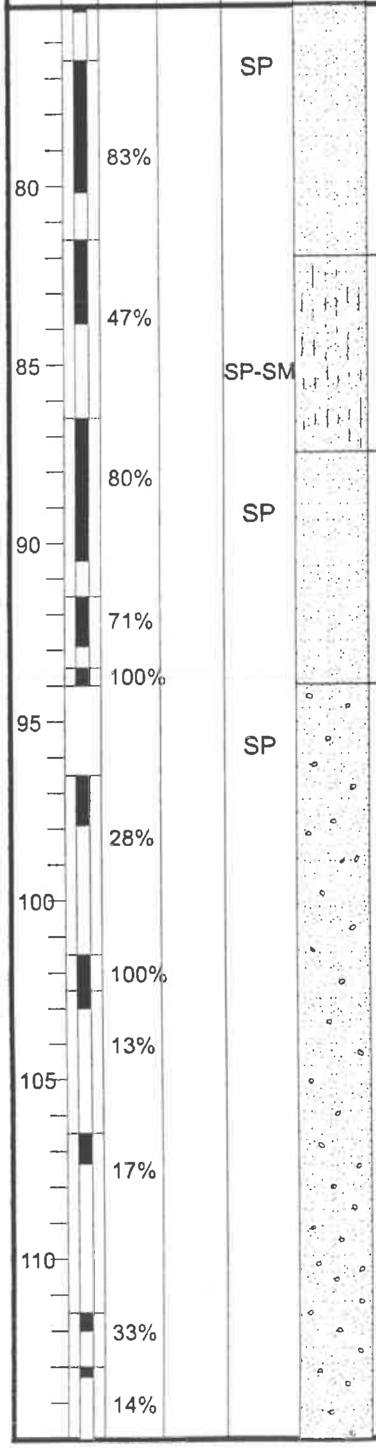
FIGURE H-16: LITHOLOGIC LOG FOR BORING EB-1

BORING EB-1

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
DATE DRILLED *06/02/03 to 06/03/03*

DEPTH (feet)	SAMPLE	RECOVERY (percentage)	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL



SAND as above.

SAND WITH SILT [0/90/10] Dark gray, fine-grained, well sorted; laminated, micaceous.

At 85 feet; harder drilling, per driller.

SAND [0/97/3] Gray, fine- to medium-grained, moderately sorted; micaceous.

At 88 feet to 93 feet; cemented soil or gravel, per driller.

At approximately 94 feet; gravel observed in shoe.

At 93; feet harder drilling, per driller, with rig chatter.

SAND [10/90/0] Gray, fine- to coarse-grained, well sorted; trace gravel, angular, micaceous.

~15% fluid loss from ~93 feet to 112.5 feet. Required thickening of mud.

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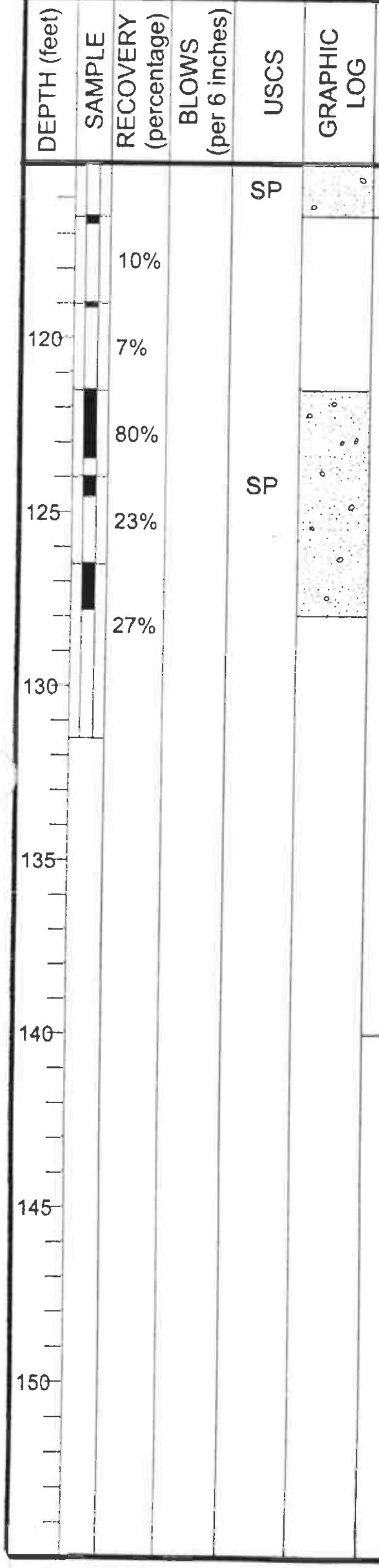
At approximately 112.5 feet; local thin layer of fine- to medium-grained sand.

FIGURE H-16: LITHOLOGIC LOG FOR BORING EB-1

BORING EB-1

PROJECT NAME: *OMWD-San Dieguito*
PROJECT NUMBER: *689.26*
DATE DRILLED *06/02/03 to 06/03/03*



LITHOLOGIC DESCRIPTION OF MATERIAL

SAND as above.

At 117 feet; rig chatter.

SAND [5/95/0] Gray, medium- to coarse-grained, moderately sorted; trace gravel.
At 122 feet; rig chatter.

From 125.5 feet to 128 feet; sand, per driller.

From 128 feet to 129.5 feet; gravelly, per driller.
At 129.5 feet; sand, per driller.

From 132 feet to 134.5 feet; cobbly, per driller; no recovery.

From 134.5 to 140 feet; drilled with tri-cone bit.
From 135 to 135.5 feet; sand, per driller.

From 136 to 137 feet; sand, per driller.
From 137 to 138 feet; gravel, per driller.

At 140 feet; gravel, per driller.

TOTAL DEPTH OF BORING = 140 FEET
BELOW LAND SURFACE

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FIGURE H-16: LITHOLOGIC LOG FOR BORING EB-1

TEST WELL TW-01

DATE DRILLED: *7/11 - 7/15/03* SURFACE ELEVATION: *33 feet msl*

BOREHOLE DIA.: *14 & 22 inches* TOTAL DEPTH OF BORING *138 feet bls*

DRILLING COMPANY: *Fain Drilling* METHOD: *Mud Rotary*

DRILLER'S NAME: *J. Edwards* DRILL RIG: *Speed Star 30K*

LOGGED BY: *C. Perkovac (R.G. #6576)* CHECKED BY: *G. Cranham (R.G. #5897)*

PROJECT NAME: *OMWD-San Dieguito*

PROJECT NUMBER: *846.16*

LOCATION *Morgan Run Country Club*
Rancho Santa Fe, CA

COMMENTS

DEPTH (feet)	SAMPLE	BLOWS (per 6 inches)	USCS	GRAPHIC LOG	LITHOLOGIC DESCRIPTION OF MATERIAL
					Boring not logged. See Exploratory Boring Log EB-1 for Lithology.
10					
20					
30					
40					
50					
60					
70					
80					
90					
100					
110					
120					
130					TOTAL DEPTH OF BORING = 138 FEET BELOW LAND SURFACE

WELL CONSTRUCTION DIAGRAM

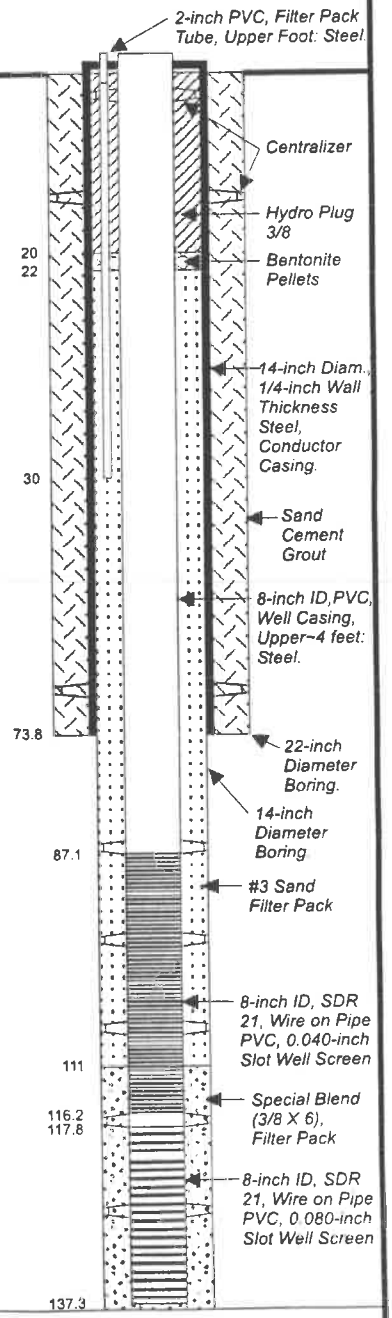

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FIGURE H-17: LITHOLOGIC LOG FOR TEST WELL TW-01

APPENDIX I
PILOT TESTING

APPENDIX I

PILOT TESTING

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TABLES

FIGURES

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FIGURES CONTINUED

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FIGURES CONTINUED

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

als	above land surface
ASR	aquifer storage and recovery project
bls	below land surface
DO	dissolved oxygen
EC	electrical conductivity
gpm	gallons per minute
gpm/ft	gallons per minute per foot of buildup
Morgan Run	Morgan Run Resort and Club
OMWD	Olivenhain Municipal Water District
ORP	oxidation-reduction potential
TDS	total dissolved solids
umhos/cm	micromhos per centimeter

APPENDIX I

PILOT TESTING

1.0 INTRODUCTION

Two pilot injection and recovery tests were conducted at the OMWD test well located near the southeast corner of the Morgan Run Resort and Club (Morgan Run) to evaluate the feasibility of an aquifer storage and recovery (ASR) project in this area. The injection tests involved the injection of water at a rate of 400 gallons per minute (gpm) for periods of between eight and ten days. Injection tests 1 and 2 were conducted utilizing potable water obtained from a fire hydrant and brought to the test well via a temporary 6-inch pipeline. Following Injection Tests 1 and 2 the water was allowed to remain in the aquifer for periods of between one and two months. Following this storage period, the injected water was recovered by pumping the test well for a period of time approximately equal to the duration of the preceding injection period.

The principal objectives of the pilot-testing program were to:

- Evaluate the test well injection capacity and potential for plugging;
- Evaluate the potential water level build-up in the deep confined aquifer during injection;
- Evaluate the impact on the water table from injection;
- Evaluate the test well extraction capacity;
- Evaluate the drawdown in the deep aquifer during extraction; and
- Evaluate water quality of the injected and recovered water.

Details regarding each of the injection and recovery test cycles are provided in Table I-1.

2.0 PILOT TEST PROCEDURES

The first injection and recovery test was conducted during October and November 2003. At the beginning of the first injection test the static water level in the confined aquifer was at about 16.5 feet below land surface (bls) near the test well. This starting depth to water was greater than what typically occurs during the winter months due to drawdown from the seasonal irrigation pumping within the basin.

A second injection and recovery test was conducted during March and May-June 2004, respectively. An additional objective of the second injection test was to assess the water level impacts from injection during a period when groundwater levels were at a seasonal high. Given that the proposed project injection is more likely to occur during winter months, when demand for reclaimed water is at a minimum and groundwater extraction is minimal, these conditions are more likely to be representative of the project conditions. The depth to water was approximately 7.5 feet bls in the confined aquifer near the test well at the start of Injection Test 2.

An additional objective of the second recovery test was to assess whether the quality of the recovered water would improve compared to the first recovery test. Such improvement is typical for ASR projects due to the buffer zone of better water quality that typically forms around an injection well over repeated cycles of injection and extraction.

During each injection test, the injection rate was maintained within about 1% of the target rate of 400 gpm using a diaphragm-operated pressure regulating valve. The water level in the injection well casing was monitored using a pressure transducer to assess changes in the well capacity over time. The water level in the injection well was also periodically measured using a water level sounder until the water level rose above the top of the casing. Once this level was reached all openings on top of the well casing were then shut and the pressure buildup within the well casing was monitored with a pressure gauge.

During each test, water levels were measured in selected piezometers and wells completed in the deep aquifer as well as shallow water table piezometers installed in the vicinity of Morgan

Run and the residential area to the west to assess the impact of injection on local groundwater conditions (Figure I-1). The number of wells and piezometers monitored during each test varied depending on the test objectives and the data collected during prior tests. During the two injection tests the water level in the San Dieguito River was also monitored at the Morgan Run Middle Bridge, which is located near the Test Well (Figure I-1).

During the injection testing, bypass filter tests were conducted on the potable water to evaluate the amount of suspended solids in the source water and to assess to what extent suspended solids might contribute to plugging of the injection well. A slipstream of the source water used for injection was run through a small filter assembly, fitted with a 5-micron filter. The differential pressure across the filter was monitored throughout the test to provide an indication of the plugging potential of the source water. The results of the filter testing indicated that there was sufficient suspended sediment in the water to cause filter plugging during the timeframe of the injection tests. This indicates that suspended sediment was the likely cause of the loss in capacity observed in the injection well. In light of these results, a third injection test is being conducted to evaluate whether the well capacity can be sustained using conventional full scale filtering technology.

Following the injection tests, the injected water was allowed to remain in the formation for a period of four and seven weeks, for Recovery Tests 1 and 2, respectively. Following each injection test and immediately prior to conducting the recovery phase of the testing, the test well was redeveloped using a dual swab airlifting setup to remove suspended solids and restore the lost well capacity.

During Recovery Tests 1 and 2, the test well was pumped at a rate of approximately 400 gpm. The recovered water was piped to the south Morgan Pun pond, which is used to store water for golf course irrigation.

During Recovery Test 1 the water level drawdown was monitored in the test well, as well as in nearby deep piezometers and active and inactive water supply wells screened in the deep aquifer. Nearby shallow piezometers were also monitored to evaluate any drawdown effect on the water table.

The quality of the injected water and recovered water was monitored during the pilot testing program. Samples of the native groundwater, injected water, and recovered water were collected and submitted to a certified laboratory for analysis of various inorganic compounds and constituents. During each recovery test, water quality parameters were monitored periodically using field meters in combination with a flow through cell. Field parameters that were monitored included electrical conductivity (EC), pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), temperature, and chlorine residual.

3.0 PILOT TEST RESULTS

Results from Injection and Recovery Tests 1 and 2 are summarized in the following sections. Details regarding each of the injection and recovery test cycles are summarized in Table I-1.

3.1 INJECTION TESTS

3.1.1 Test Well Injection Capacity

A brief step injection test was conducted at the beginning of Injection Test 1 to establish the baseline injection well performance. The first two steps were conducted at injection rates of 120 and 240 gpm respectively periods for of 80 to 85 minutes (Table I-1). After the two initial steps the injection rate was increased to 400 gpm and was maintained at this rate for a period of ten days. During this test the injection specific capacity declined from 19.3 gallons per minute per foot of buildup (gpm/ft) after one day of injection, to approximately 10.6 gpm/ft at the end of the injection test. The injection test was terminated after the pressure buildup in the well casing reached a level equivalent to approximately 37 feet of water above the initial static level (Figure I-2).

During Injection Test 2, potable water was injected at a rate of 400 gpm for a period of eight days (Table I-1). During this test the injection specific capacity declined from 20.1 gpm/ft of buildup after 14 hours of injection, to 5.2 gpm/ft at the end of the test. The injection test was terminated after the pressure buildup in the well casing reached a level equivalent to approximately 77 feet of water above the initial static level (Figure I-3).

In theory, the water level buildup in an injection well is expected to increase with time, but will typically begin to stabilize under ideal conditions. The trend of the water level buildup curves for both injection tests indicated that the rate of water level buildup was continuing to increase toward the end of the test rather than decreasing, suggesting that the test well was becoming increasingly plugged over time (Figures I-2 and I-3). The bypass filter tests showed a similar increase in differential pressure across the 5-micron filter, suggesting that trace levels of suspended solids were the source of the plugging (Figure I-4). The injection system was maintained under positive pressure during the injection tests and the well casing was sealed to prevent air entry, therefore entrained air was not a likely contributor to the observed plugging. The potable water used for injection also contained a chlorine residual of approximately 2.5 parts per million (ppm), therefore, biological fouling was not the likely cause of the plugging observed during the injection tests.

3.1.2 Deep Aquifer Build-up During Injection

The pressure buildup in the deep aquifer was monitored during both Injection Tests 1 and 2 based on the water levels in deep piezometers and wells in the vicinity of the Morgan Run Golf Course (Figure I-1).

The piezometer nearest the test well is piezometer cluster P-11, which is located 60 feet north of the test well. This cluster consists of three piezometers, one screened in the deep aquifer (P-11D), one screened at the water table (P-11A), and one screened in an intermediate zone between the deep aquifer and the water table (P-11B) (Appendix H). The water level data obtained from this piezometer cluster indicate the extent of the water level buildup occurring in the immediate vicinity of the Test Well where the response to injection and extraction are expected to be greatest.

Figures I-5 and I-6 indicate the amount of water level change in the deep aquifer in the vicinity of the test well prior to, during and following Injection Tests 1 and 2 based on data from P-11D. The water levels for the shallow and intermediate piezometers are also shown on these figures for comparison and are discussed in the following section. The water level in P-11D rose from a static level of 16.5 feet bls to about 3.5 ft bls during the first injection test (Figure I-5). During the second injection test the water level in P-11D rose from a static level of 7.5 feet bls to about five feet above land surface (als) (Figure I-6). The difference between the buildup in the deep aquifer shown on the two graphs appears to be related to the additive effects of small regional water level changes related to local groundwater pumping by existing users. There appears to have been some additional regional water level rise during Injection Test 1 and a small amount of regional water level rise followed by a decline during Injection Test 2. The water level buildup at P-11D, specifically related to the injection tests, appears to be about 11 feet.

Figures I-7 and I-8 indicate the amount of water level change in a piezometer cluster (P-4) located approximately 1,800 feet north of the test well prior to, during, and following Injection Tests 1 and 2. The water level in the deep aquifer piezometer (P-4D) rose from a static level of 23.5 feet bls to about 19 ft bls during the first injection test (Figure I-7). The water level in P-4D rose from a static level of 17.5 feet bls to about 13.5 ft bls during the second injection test (Figure I-8). As noted above, the apparent difference between the buildup shown on the two graphs appears to be related to the additive effects of small water level changes related to changes in local groundwater pumping by existing users. Based on the static water level at the end of the water level recovery period, there appears to have been some additional regional water level rise during Injection Test 1 and a small amount of regional water level rise and decline during Injection Test 2. If the regional water level trend is taken into account, the water level buildup at P-4D specifically related to the injection tests, appears to be about 2.5 feet.

Figures I-9 and I-10 indicate the amount of water level change in inactive deep production well 5-H2, also referred to as the Fairway 2 well, and a nearby shallow piezometer designated P-1. This well cluster is located approximately 700 feet south of the test well. Water levels are shown for these two wells prior to, during and following Injection Tests 1 and 2. The water level in the Fairway 2 well rose about 8.5 feet during the first injection test and about seven feet during the second injection test. As noted above, the difference between the buildup in the deep aquifer, shown on the two graphs, appears to be related to the additive effects of small water level changes related to changes in local groundwater pumping by existing users. There appears to have been some additional regional water level rise during Injection Test 1 and a small amount of regional water level rise and decline during Injection Test 2. The water level buildup at the Fairway 2 well specifically related to the injection tests appears to be about seven feet.

Figures I-11 through I-13 show the change in the water level observed in nearby deep regional wells 5FC, 33NC, and 33N2, prior to, during, and following Injection Test 2. As noted above, the water levels monitored during this test were influenced somewhat by changes in pumping from existing users in the basin. This influence appears to be greatest in areas to the north where most of the groundwater extraction is occurring. The water level rise in these wells due specifically to the test injection appears to range from about 4 to 5.5 feet (Figures I-11 through I-13).

3.1.3 Water Table During Injection

In the project vicinity, the deep aquifer is confined by fine-grained sediments that restrict the vertical movement of water between the deep aquifer and the water table. Water level monitoring data from shallow piezometers, which are indicative of the water table, generally showed little change during the injection testing.

Figure I-5 and I-6 indicate the water levels observed in the shallow and intermediate piezometers located nearest the test well (P-11A and P-11-B) where the buildup in the underlying deep aquifer was the greatest. Figure I-5 indicates the depth to the water table (P-11-A), an intermediate zone (P-11B) during Injection Test 1. Even though there was about 11 feet of injection-related water level rise in the deep aquifer during Injection Test 1, there was no discernable rise in the water table at piezometer P-11A and a substantially dampened rise of about three feet in intermediate piezometer P-11B.

Figure I-6 indicates the depths to water in the three P-11 piezometers during Injection Test 2. Although the water level in the deep aquifer (P-11D) rose about 12 feet, a level equal to five feet als during Injection Test 2, there was no discernable rise in the water table at piezometer P-11A and a substantially reduced rise of about 2.7 feet in the intermediate piezometer P-11B.

Figures I-7 and I-8 indicate the amount of water level change in shallow piezometer P-4S prior to, during, and following Injection Tests 1 and 2. Although the water level in the deep aquifer (P-4D) rose about 4 feet during Injection Tests 1 and 2, the data from P-4S do not indicate any apparent water table response related to the injection tests.

Figures I-9 and I-10 indicate the amount of water table change in shallow piezometer P-1 prior to, during, and following Injection Tests 1 and 2. Although the injection-related water level rise in the deep Fairway 2 well was about seven feet during Injection Tests 1 and 2, the data from shallow piezometer P-1 do not indicate any apparent injection-related water table response during the injection tests.

Shallow piezometers P-5 through P-10 were installed during 2003 to evaluate the water table response beneath the residential neighborhood adjacent to the Morgan Run Resort and Club (Figure I-1). The residential piezometer P-6 which is located closest to the test well was continuously monitored using a pressure transducer during Injection and Recovery Tests 1 and 2. Figures I-14 and I-15 indicate the depth to the water table prior to, during, and following the injection tests. The data from P-6 do not indicate any apparent water table response during the injection tests. Manual water level data collected during Injection Test 2 from the residential piezometers located further from the test well are provided on Figures I-16 through I-20. Although some of these wells exhibited some minor fluctuations over time, there was no discernable water table buildup associated with the injection test.

3.1.4 River Level During Injection

Figures I-21 and I-22 show the level of the surface water in the San Dieguito River near the test well during Injection Tests 1 and 2, respectively. Water levels are based on the depth to water measured from the Morgan Run Middle Bridge, which is located approximately 300 feet northwest of the test well. Although there were some small fluctuations in the river level during the injection tests, there was no discernable rise in the river level related to injection into the deep aquifer.

3.2 RECOVERY TESTS

Following each injection test, the injected water was recovered by pumping the test well at 400 gpm, the same rate used during injection. The injected water was allowed to remain in the formation for a period of about four and seven weeks prior to pumping for Recovery Tests 1 and 2, respectively.

3.2.1 Test Well Pumping Capacity

During Recovery Test 1, potable water was pumped continuously at a rate of 400 gpm for a period of ten days (Table I-1). During this test, the pumping specific capacity declined from 28.9 gpm/ft after 21 hours of pumping, to 25.9 gpm/ft at the end of the test. At the end of Recovery Test 1, the pumping water level in the test well had declined to 29.6 feet below the measuring point, representing a drawdown of approximately 15 feet (Figure I-23). The trend of the water level drawdown and specific capacity during the first recovery test was consistent with the theoretical well response with the specific capacity stabilizing with time.

During Recovery Test 2, potable water was intermittently pumped at a rate of 400 gpm over a period of about one month (Table I-1). Intermittent pumping was required because the storage capacity in the Morgan Run south pond was limited due to a lower irrigation demand caused by the cooler weather. On days when there was significant irrigation demand, the test well was typically pumped during the night for periods ranging from about 13 to 16 hours. The cumulative duration of the pumping intervals was approximately eight days. During the recovery extraction periods the pumping specific capacity ranged from approximately 40 gpm/ft, to 29 gpm/ft. At the end of Recovery Test 2 the pumping water level in the test well was 32 feet below the measuring point representing a drawdown of about 12 feet (Figure I-24).

3.2.2 Water Levels During Extraction

Figure I-25 indicates the water level change that occurred in the vicinity of the test well prior to, during and following Recovery Test 1 based on data from piezometer cluster P-11. The water level in P-11D declined from an initial static level of about 13 feet bls to a maximum of about 22 feet bls during Recovery Test 1 (Figure I-25). Based on the higher static water level at the end of the water level recovery period, there appears to have been a regional water level rise during the test that reduced the amount of drawdown that otherwise would have occurred during the extraction period (Figure I-25). The regional rise appears to be related to changes in local groundwater pumping by existing users and may have reduced the drawdown by about two feet. Accounting for the regional trend, it appears that the drawdown in the deep aquifer related to the pumping of the test well during Recovery Test 1 would have been about ten feet at piezometer P-11D.

Although there was about ten feet of extraction-related drawdown in the deep aquifer during Recovery Test 1, there was no discernable drawdown in the water table at piezometer P-11A and a substantially dampened drawdown of about 1.6 feet in intermediate piezometer P-11B (Figure I-25).

Figure I-26 indicates the water level change that occurred prior to, during and following Recovery Test 1 based on data from piezometer cluster P-4. The water level drawdown in the deep aquifer (P-4D) was less than what would be expected due to a rising regional water level trend during the recovery test. If the regional water trend is taken into account, the water level drawdown at P-4D specifically related to the recovery test appears to be no more than about two feet. The data from shallow piezometer P-4S do not indicate any apparent water table response due to the recovery test.

Figure I-27 indicates the water level change that occurred prior to, during and following Recovery Test 1 based on data from shallow piezometer P-1 and the deep Fairway 2 well. The water level drawdown in the deep Fairway 2 well was also less than what would be expected due to the rising regional water level trend during the recovery test. If the regional water trend is taken into account, the water level drawdown at the Fairway 2 well specifically related to the recovery test appears to be about seven feet. The manual water level data from P-1 do not indicate any apparent water table drawdown due to the recovery test.

Figure I-28 indicates the depth to the water table prior to, during and following Recovery Test 1 based on data from piezometer P-6. The data from P-6 do not indicate any apparent water table response during the Recovery Test 2.

3.2.3 Water Quality During Injection and Recovery

A groundwater sample was collected from the test well shortly after the well was constructed to characterize the native groundwater quality (Table I-2). Samples were also collected from the potable water source to characterize the quality of the water used for injection, and from the test well during Recovery Test 1 and 2 to characterize the quality of the water extracted during recovery (Table I-2). Field water quality parameters were also measured periodically during recovery operations to track the change in the quality of the recovered water.

Based on the groundwater sample collected from the test well following well construction and development, the native groundwater quality in the vicinity of the test well is poor (Table I-2). The total dissolved solids (TDS) of the groundwater at the vicinity of the test well is 4,400 mg/l. The native groundwater in this area is predominantly a sodium-chloride type water (Table I-2).

Based on the water sample collected from the potable water source used during Injection Tests 1 and 2, the TDS of the injected potable water was 490 mg/l (Table I-2). The injected water was a predominantly sodium-calcium-sulfate type water.

Water samples were collected on the first and last day of Recovery Test 1 to assess the overall change in water quality (Table I-2). The initial sample was similar in quality to the potable source water. The recovery test was stopped when the volume of water recovered equaled the volume of water injected, representing 100 percent recovery by volume. The groundwater sample collected at the end of Recovery Test 2 had a TDS of 3,100, indicating that the recovered water represented a mix of native and injected water.

Field EC measurements also provide an indication of the water quality transition from the injected water quality toward the native groundwater quality as the injected water is recovered. The rate of this transition depends in part on the degree of mixing that occurs in the aquifer as well as the direction and velocity of groundwater movement within the aquifer, which can cause the injected water to migrate away from the injection site.

A graph indicating the change in estimated TDS versus percentage of injected water that was recovered is presented in Figure I-29. TDS was calculated from EC using the following formulas:

TDS (mg/l) = EC (umhos/cm) * 0.65

Note: umhos/cm = micromhos per centimeter

Figure I-29 indicates that there was continual mixing of native groundwater and injected water throughout both recovery phases. By the end of the both recovery phases the estimated TDS had increased to about 2,700 to 2,900 mg/l. As mentioned above, ASR projects typically show an improvement in water quality during subsequent injection and recovery cycles due to the creation of a water quality buffer zone in the aquifer around the injection well. This was not the case for the second injection-recovery test cycle on this project. The TDS increased at a slightly faster rate during the initial portion of the second recovery cycle (Figure I-29).

Several factors may have contributed to the more rapid increase in TDS during the second recovery test. During the first recovery test groundwater pumping within the basin was apparently decreasing due to the oncoming winter season. Because of this, the velocity of groundwater flow toward the pumping center to the north was probably decreasing. During the second injection recovery cycle groundwater pumping within the basin was apparently increasing due to the oncoming warm weather, therefore the velocity of groundwater toward the pumping center to the north was probably increasing, potentially resulting in greater lateral displacement of the injected water. The storage time between injection and extraction was also somewhat longer during the second cycle, which may have allowed more time for the injected water to migrate away from the test well.

TABLE I-1

SUMMARY OF PILOT TESTING

	TEST PERIOD		ELAPSED TIME (minutes)	TARGET INJECTION/ EXTRACTION RATE (gpm)
	From	To		
INJECTION TEST NUMBER 1				
Step 1	9/30/2003 13:00	9/30/2003 14:20	80	120
Step 2	9/30/2003 14:20	9/30/2003 15:45	85	240
Step 3	9/30/2003 15:45	10/10/2003 13:59	14,294	400
RECOVERY TEST NUMBER 1				
Step 1	11/4/2003 11:55	11/14/2003 13:15	14,480	400
INJECTION TEST NUMBER 2				
Step 1	3/24/2004 17:00	4/1/2004 13:43	11,323	400
RECOVERY TEST NUMBER 2				
Step 1	5/21/2004 19:50	5/22/2004 9:30	820	400
Stopped	5/22/2004 9:30	5/24/2004 18:45	3,435	0
Step 2	5/24/2004 18:45	5/25/2004 10:00	915	400
Stopped	5/25/2004 10:00	5/25/2004 19:05	545	0
Step 3	5/25/2004 19:05	5/26/2004 10:45	940	400
Stopped	5/26/2004 10:45	5/26/2004 19:25	520	0
Step 4	5/26/2004 19:25	5/27/2004 9:50	865	400
Stopped	5/27/2004 9:50	5/31/2004 21:30	6,460	0
Step 5	5/31/2004 21:30	6/1/2004 10:02	752	400
Stopped	6/1/2004 10:02	6/1/2004 18:45	523	0
Step 6	6/1/2004 18:45	6/2/2004 12:15	1,050	400
Stopped	6/2/2004 12:15	6/2/2004 20:00	465	0
Step 7	6/2/2004 20:00	6/3/2004 10:00	840	400
Stopped	6/3/2004 10:00	6/3/2004 19:55	595	0
Step 8	6/3/2004 19:55	6/4/2004 9:45	830	400
Stopped	6/4/2004 9:45	6/7/2004 19:50	4,925	0
Step 9	6/7/2004 19:50	6/8/2004 9:15	805	400
Stopped	6/8/2004 9:15	6/14/2004 19:15	9,240	0
Step 10*	6/14/2004 19:15	6/15/2004 9:20	845	400
Stopped	6/15/2004 9:20	6/16/2004 19:30	2,050	0
Step 11	6/16/2004 19:30	6/17/2004 9:20	830	400
Stopped	6/17/2004 9:20	6/20/2004 20:00	4,960	0
Step 12	6/20/2004 20:00	6/21/2004 8:21	741	400

TABLE I-2

PILOT TESTING
GENERAL MINERAL AND PHYSICAL ANALYSIS RESULTS

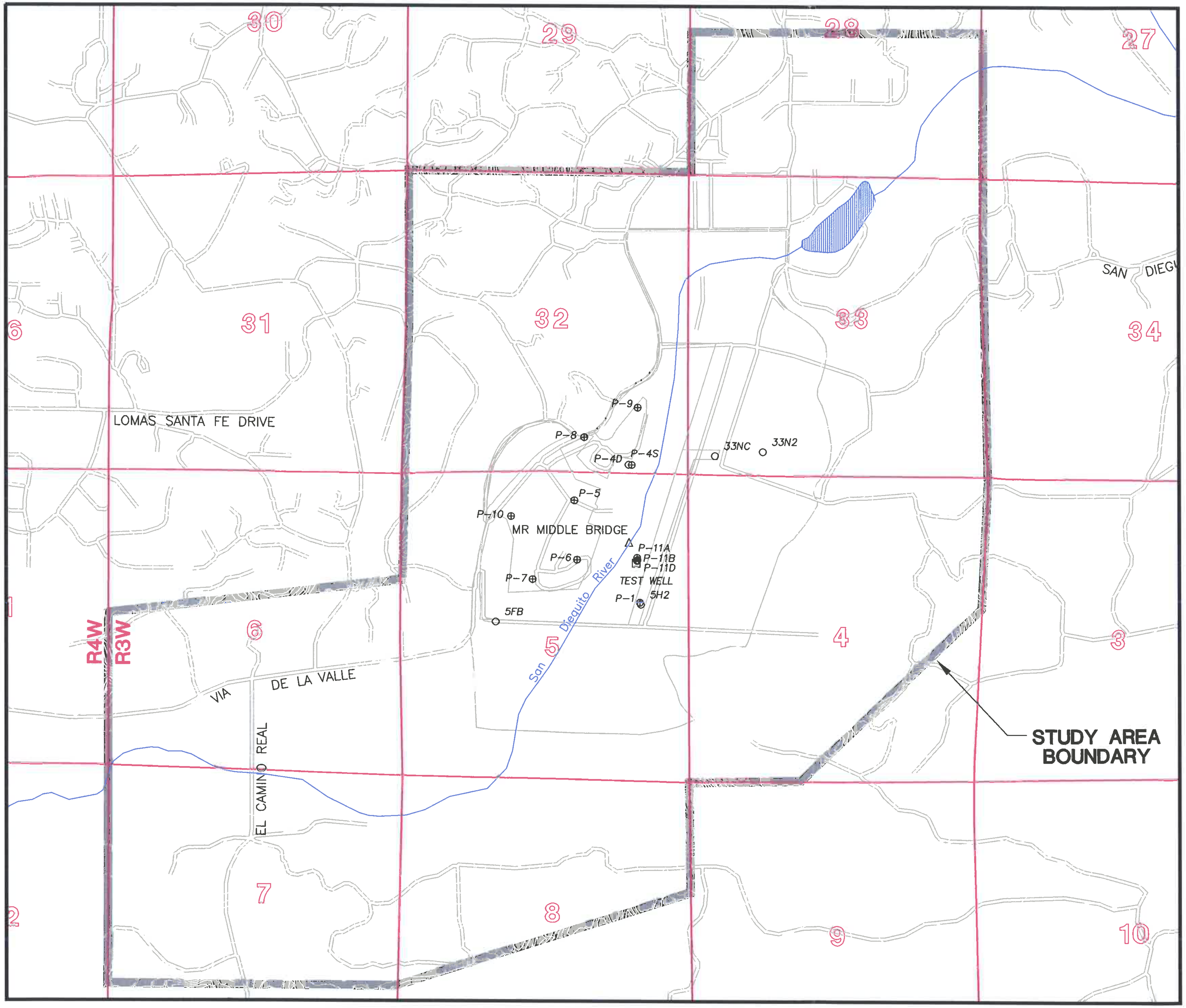
	DATE	07/23/03	10/10/03	11/04/03	11/14/03	6/21/04
FIELD SAMPLE ID		INJ-1	Injected Potable	TWREC-1	Test Well Rec-1-2	TW-R2
SAMPLE DESCRIPTION		Native Groundwater	Potable Source Water	Recovery No.1 Water (Initial)	Recovery No.1 Water (Final)	Recovery No.2 Water (Final)
COMPOUND	UNITS					
Aluminum	mg/l	<0.050	<0.050	<0.050	<0.050	NA
Boron	mg/l	**0.57**	**0.11**	**0.15**	**0.41**	NA
Cadmium	mg/l	<0.0050	<0.0050	<0.0050	<0.0050	NA
Calcium	mg/l	**320**	**49**	**53**	**200**	**210**
Copper	mg/l	<0.010	<0.010	<0.010	<0.010	NA
Iron	mg/l	**0.280**	<0.010	<0.010	**0.011**	<0.010
Iron (Ferrous Iron)	mg/l	**0.34**	NA	<0.040	<0.040	NA
Magnesium	mg/l	**190**	**20**	**23**	**110**	**110**
Manganese	mg/l	**1.5**	<0.020	<0.020	**0.69**	**0.61**
Potassium	mg/l	**52**	**4.3**	**4.3**	**22**	**28**
Selenium	mg/l	**0.0085**	<0.0020	<0.0020	**0.0056**	NA
Sodium	mg/l	**930**	**78**	**83**	**520**	**600**
Zinc	mg/l	**0.056**	<0.020	<0.020	<0.020	<0.020
Chloride	mg/l	**1,600**	**66**	**83**	**1,100**	**1,100**
Residual Chlorine	mg/l	NA	**2.5**	<0.10	<0.10	NA
Fluoride	mg/l	<2.5	<0.50	<0.50	<2.5	NA
Carbon Dioxide	mg/l	**64**	NA	**3.5**	**32**	NA
Ammonia-N	mg/l	**1.6**	<0.50	<0.50	**1.4**	**1.2**
Nitrate-N	mg/l	<0.55	**0.19**	<0.11	<0.22	<0.22
Nitrite-N	mg/l	<0.75	NA	<0.15	<0.75	<0.30
Phosphate (PO4)	mg/l	<2.5	NA	<0.50	<1.0	NA
Sulfate	mg/l	**610**	**150**	**180**	**430**	**460**
Sulfide	mg/l	<0.10	NA	NA	NA	NA
Sulfide as H2S	mg/l	<0.10	NA	<0.10	<0.10	NA
Dissolved Sulfide	mg/l	<0.10	NA	<0.10	<0.10	<0.10
Total Chloramines	mg/l	NA	**2.5**	<0.10	<0.10	NA
TDS	mg/l	**4,400**	**490**	**470**	**5,500***	**3,100**
Total Organic Carbon	mg/l	**5.1**	**2.5**	**3.9**	**5.8**	**4.5**
Total Suspended Solids	mg/l	NA	<10	<10	<10	NA
Specific Conductance	µmhos/cm	**6,700**	**790**	**860**	**4,700**	**4,700**
pH	pH units	**7.37**	**8.38**	**7.80**	**7.41**	NA
Odor	T.O.N.	<1.0	NA	<1.0	<1.0	NA
Turbidity	NTU		<1.0	<1.0	<1.0	NA
Silicon	mg/l as Silica	**33**	**8.6**	**11**	**24**	NA
Biochemical Oxygen Demand	mg/l	<2.0	NA	<2.0	<2.0	<2.0
Chemical Oxygen Demand	mg/l	**21**	<20	<20	**34**	<20
Alkalinity as CaCO3	mg/l	**380**	**110**	**160**	**160**	**380**
Bicarbonate Alkalinity as CaCO3	mg/l	**380**	**110**	**160**	**160**	**380**
Carbonate Alkalinity as CaCO3		<2.0	<2.0	<2.0	<2.0	NA
Hardness (as CaCO3)	mg/l	**1,600**	**210**	**230**	**960**	NA
Methane	mg/l	<0.50	NA	<0.050	<0.050	NA
Ethylene	mg/l	<0.010	NA	<0.010	<0.010	NA
Ethane	mg/l	<0.10	NA	<0.050	<0.050	NA

TABLE I-2

PILOT TESTING
GENERAL MINERAL AND PHYSICAL ANALYSIS RESULTS

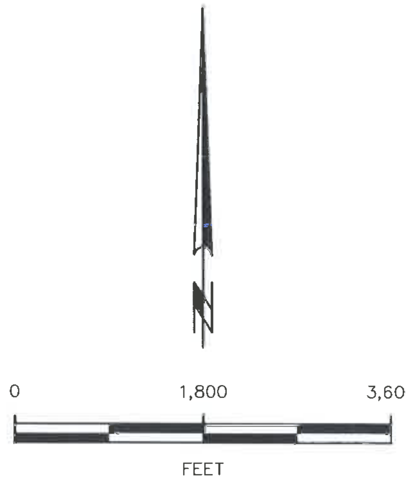
FOOTNOTES

mg/l = Micrograms per liter
NA = Not analyzed
(<) = Less than
TDS = Total dissolved solids
DO = Dissolved oxygen
μmhos/cm = Micromhos per centimeter
T.O.N. = Threshold Odor Number
NTU = Nephalometric turbidity units
NA = Not analyzed
(--) = Not applicable
* = Lab reported concentration is suspect based on individual ion concentrations and E.C. and should not be used for any purpose



EXPLANATION

P-1	⊕	WATER TABLE MONITORING LOCATION
P-11B	⊗	INTERMEDIATE ZONE MONITORING LOCATION
5FB	○	DEEP AQUIFER MONITORING LOCATION
	△	SAN DIEGUITO RIVER MONITORING LOCATION
	☐	TEST WELL



SAN DIEGUITO GROUNDWATER BASIN

PILOT TEST
MONITORING LOCATIONS

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

09/04

FIGURE I-1

PREP BY SLB REV BY MAP RPT NO. 689.20 410-4879 A

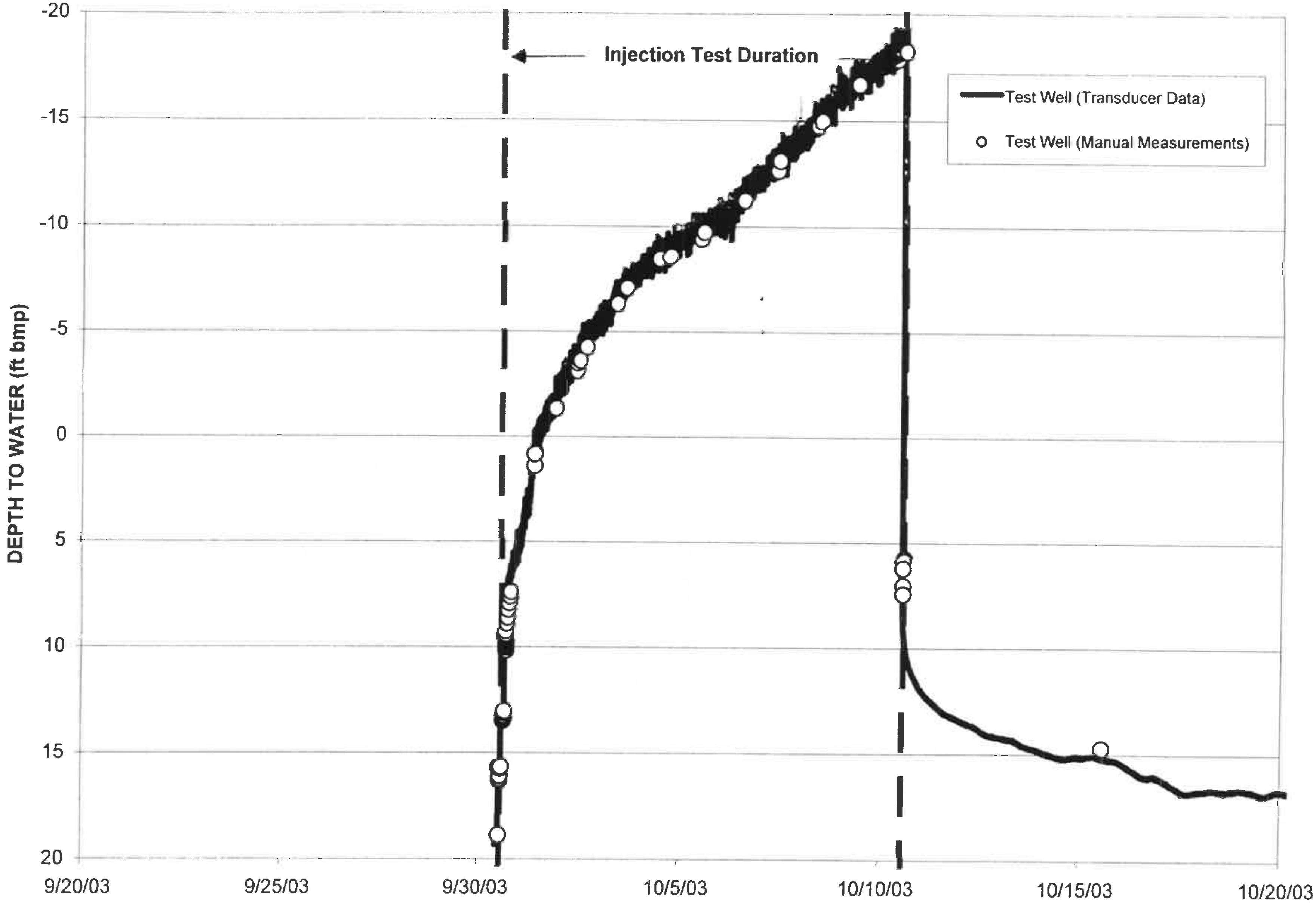


FIGURE I-2: INJECTION TEST NO. 1 WATER LEVELS, TEST WELL

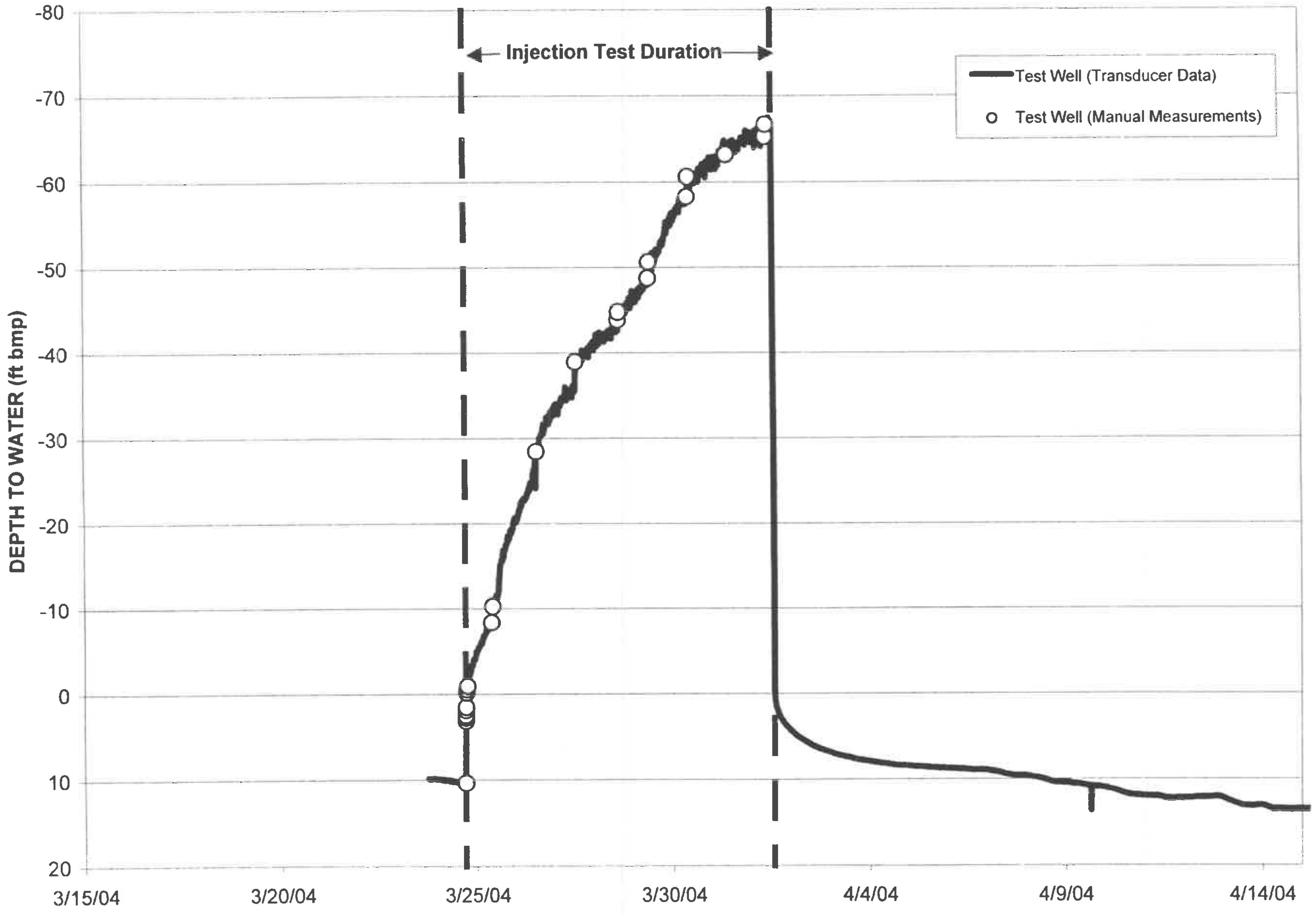


FIGURE I-3: INJECTION TEST NO. 2 WATER LEVELS, TEST WELL

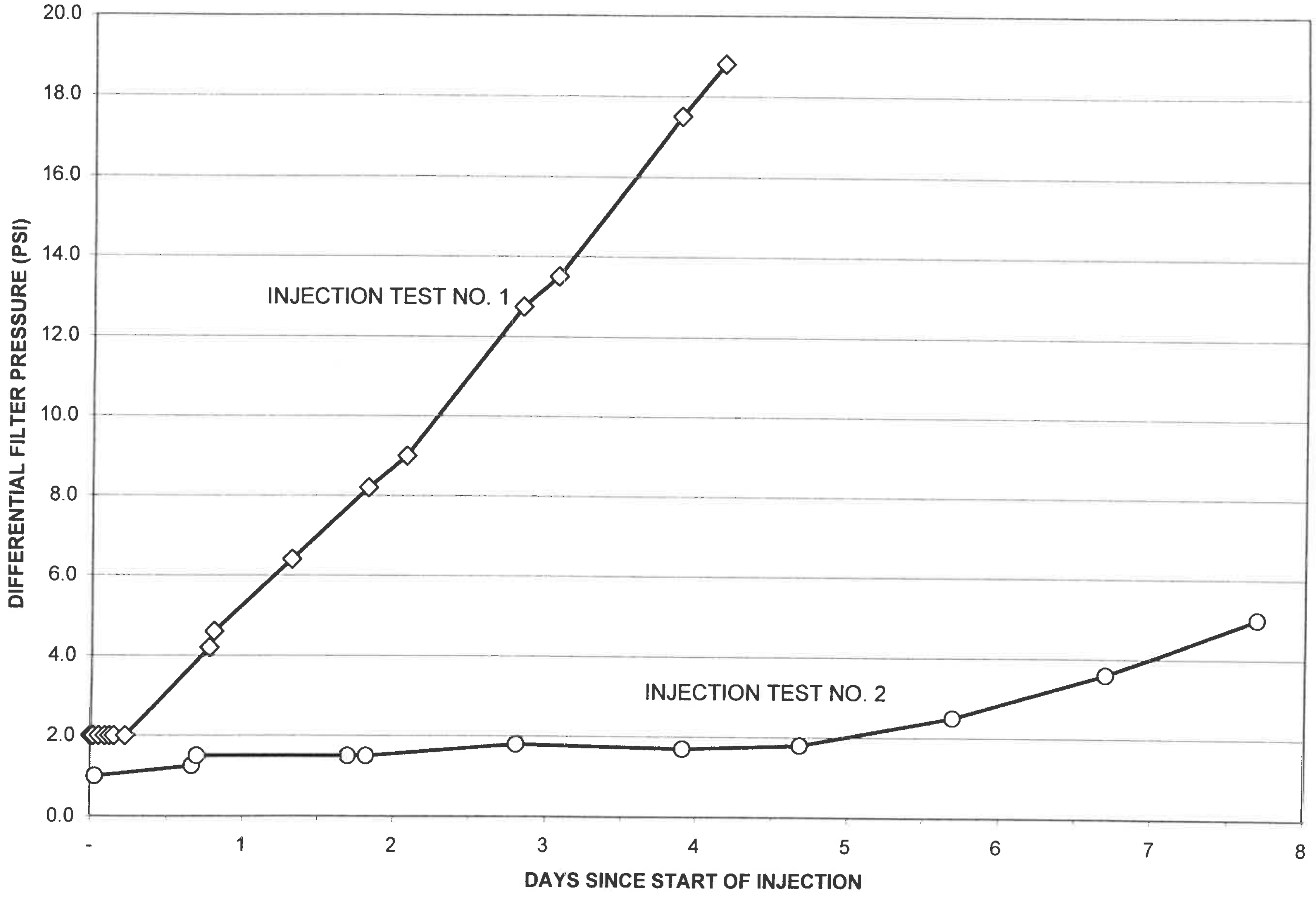


FIGURE I-4: INJECTION TEST NO. 1 AND NO. 2,
BYPASS FILTER RESULTS

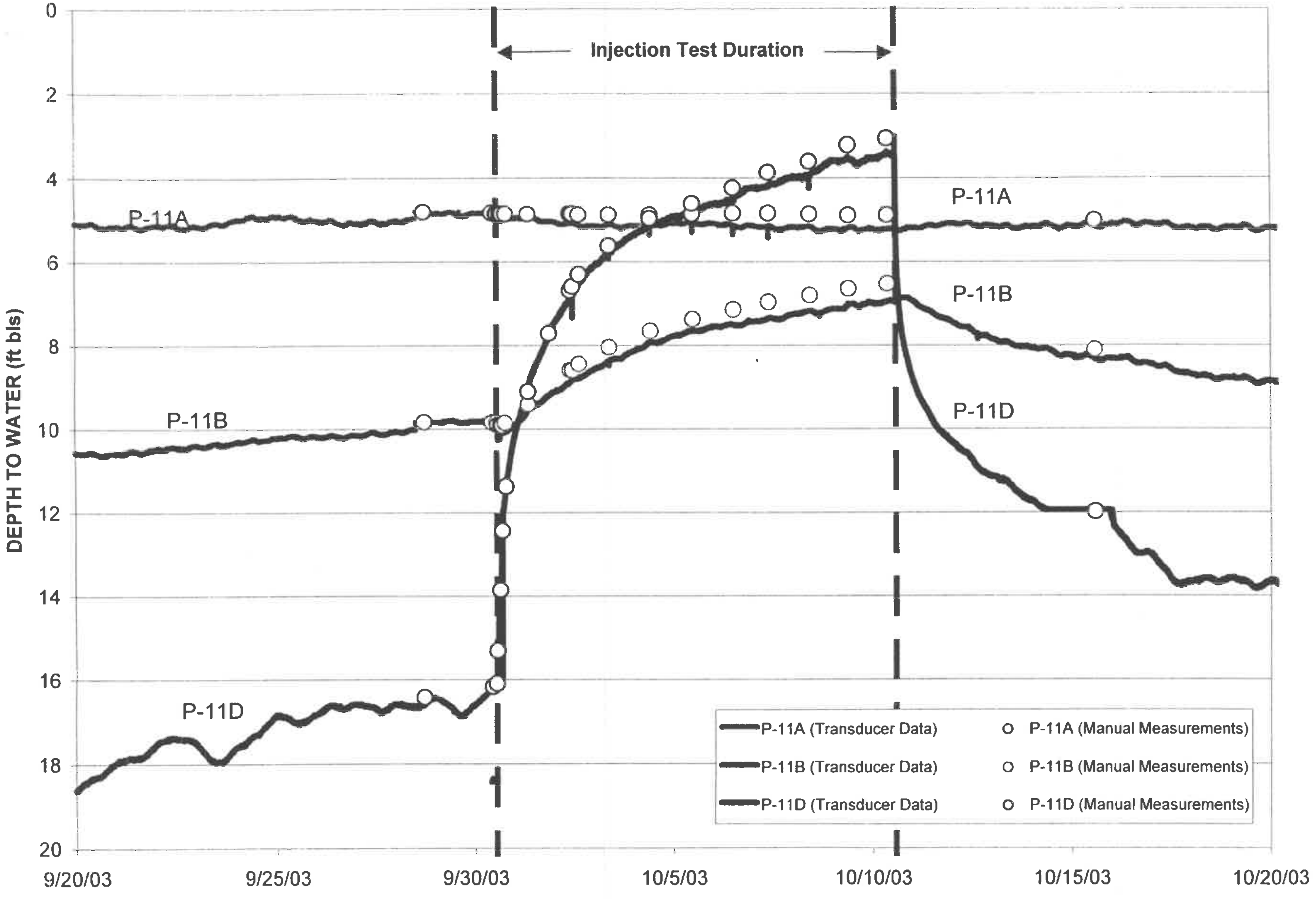


FIGURE I-5: INJECTION TEST NO. 1 WATER LEVELS, PIEZOMETER CLUSTER P-11

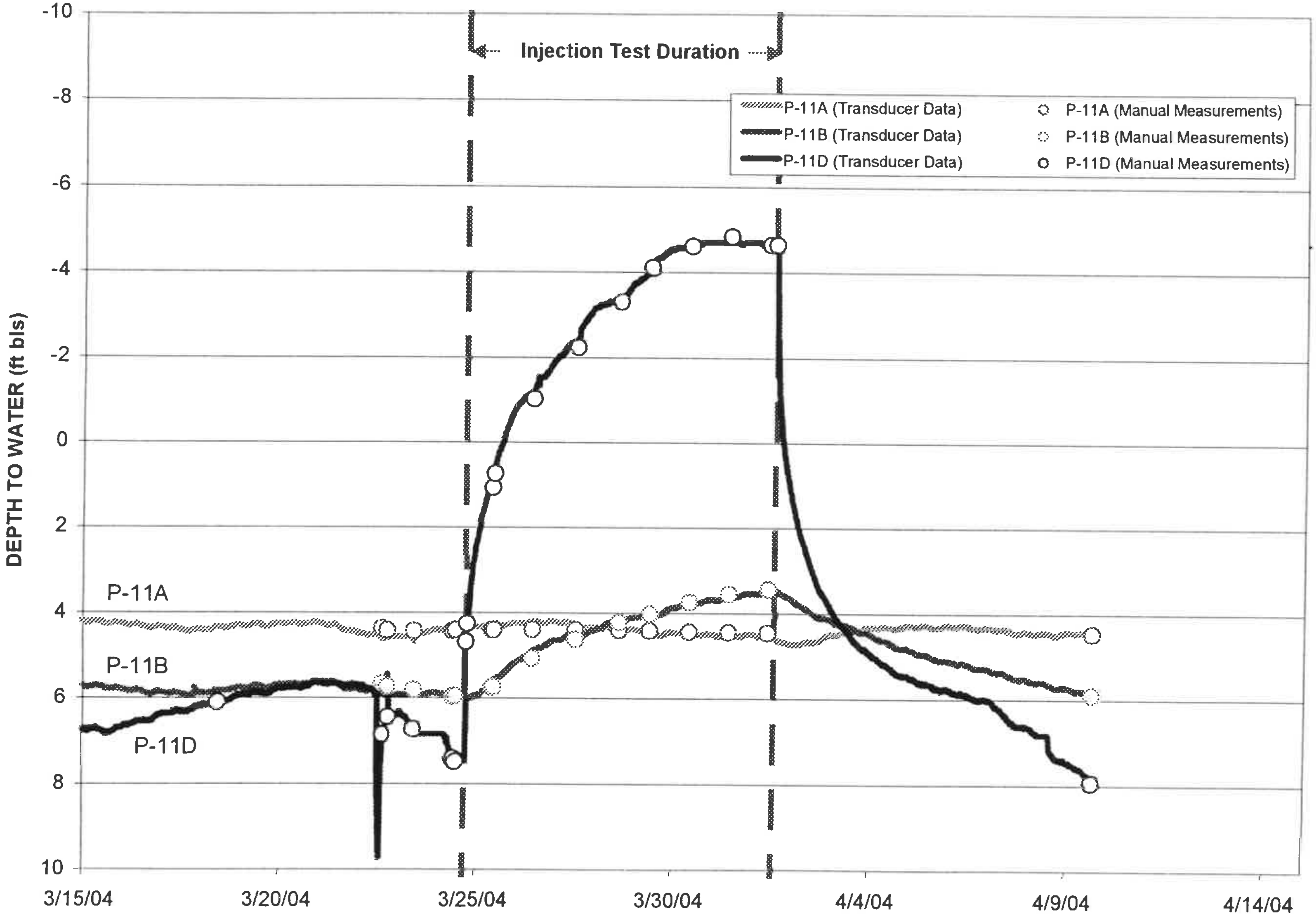


FIGURE I-6: INJECTION TEST NO. 2 WATER LEVELS,
PIEZOMETER CLUSTER P-11

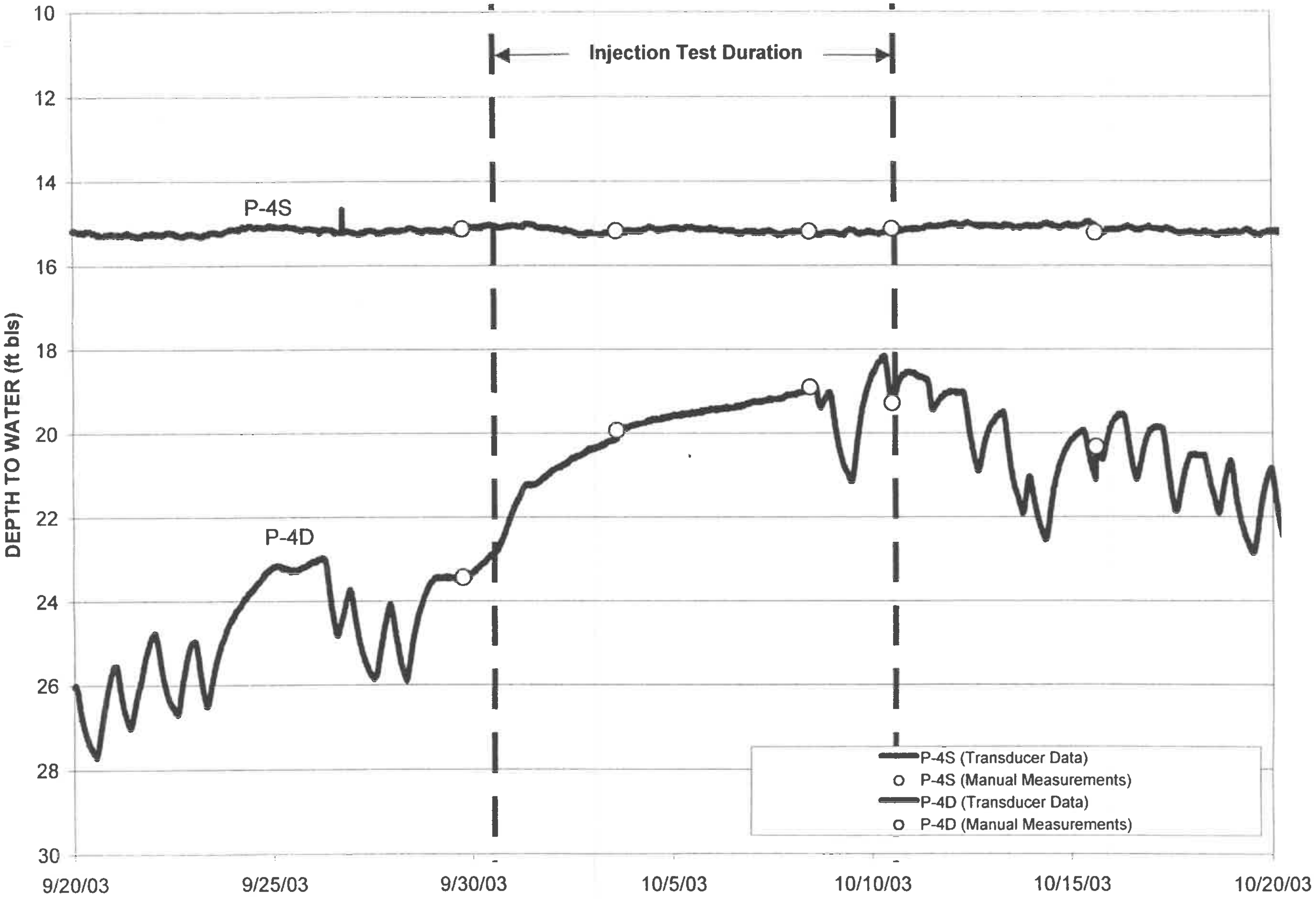


FIGURE I-7: INJECTION TEST NO. 1 WATER LEVELS, PIEZOMETER CLUSTER P-4

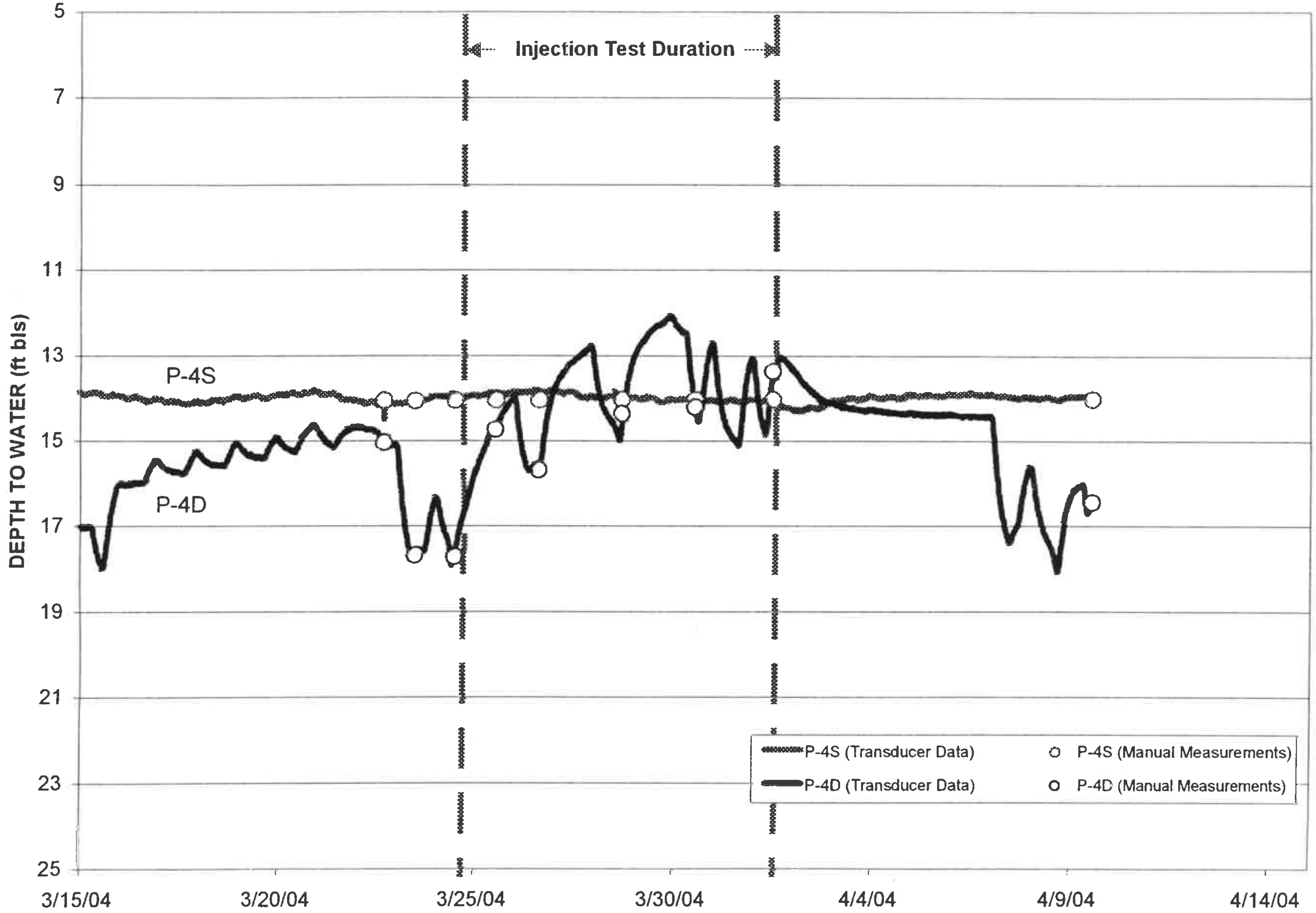


FIGURE I-8: INJECTION TEST NO. 2 WATER LEVELS,
PIEZOMETER CLUSTER P-4

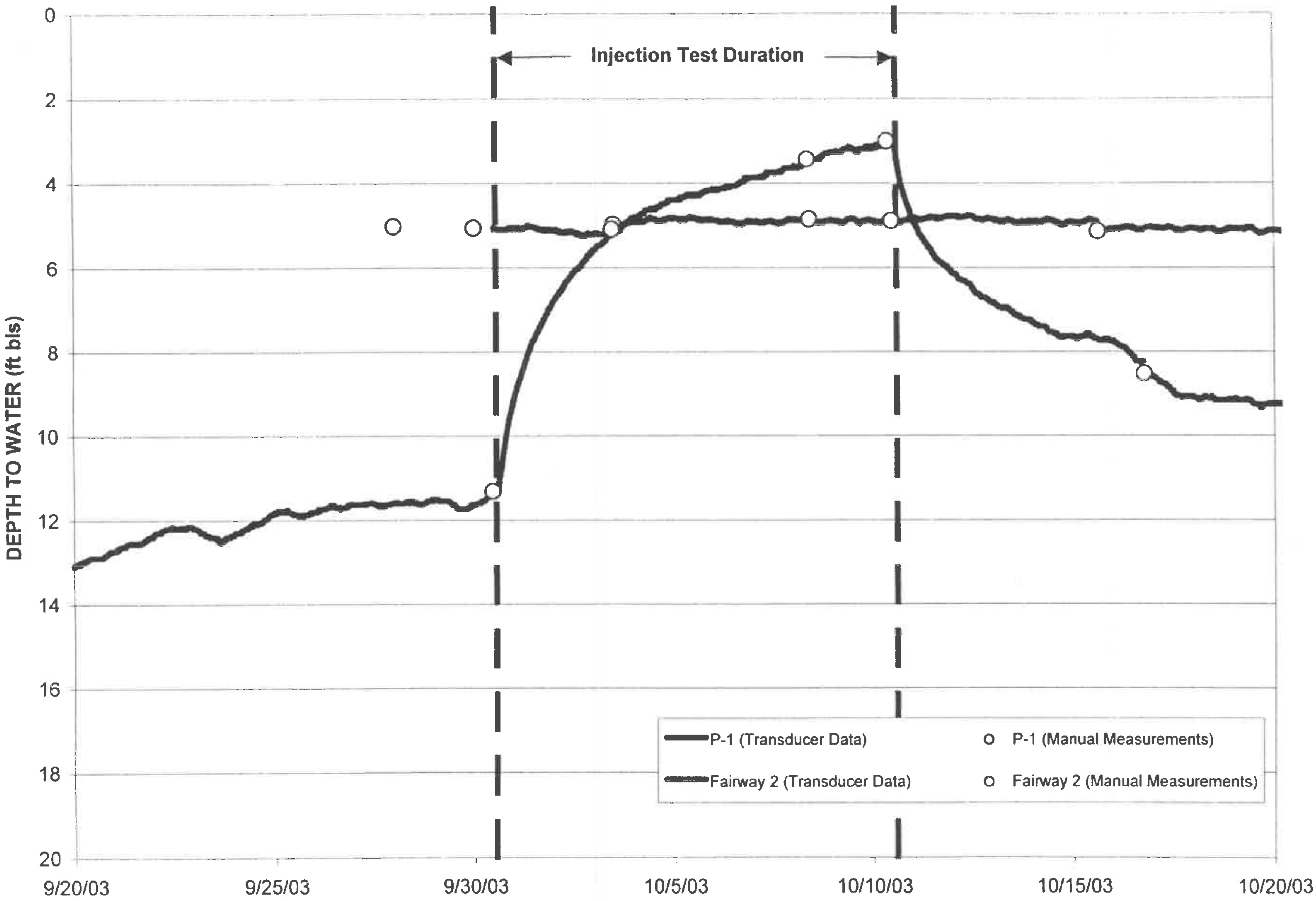


FIGURE I-9: INJECTION TEST NO. 1 WATER LEVELS,
P-1 AND WELL 5H2 (FAIRWAY 2)

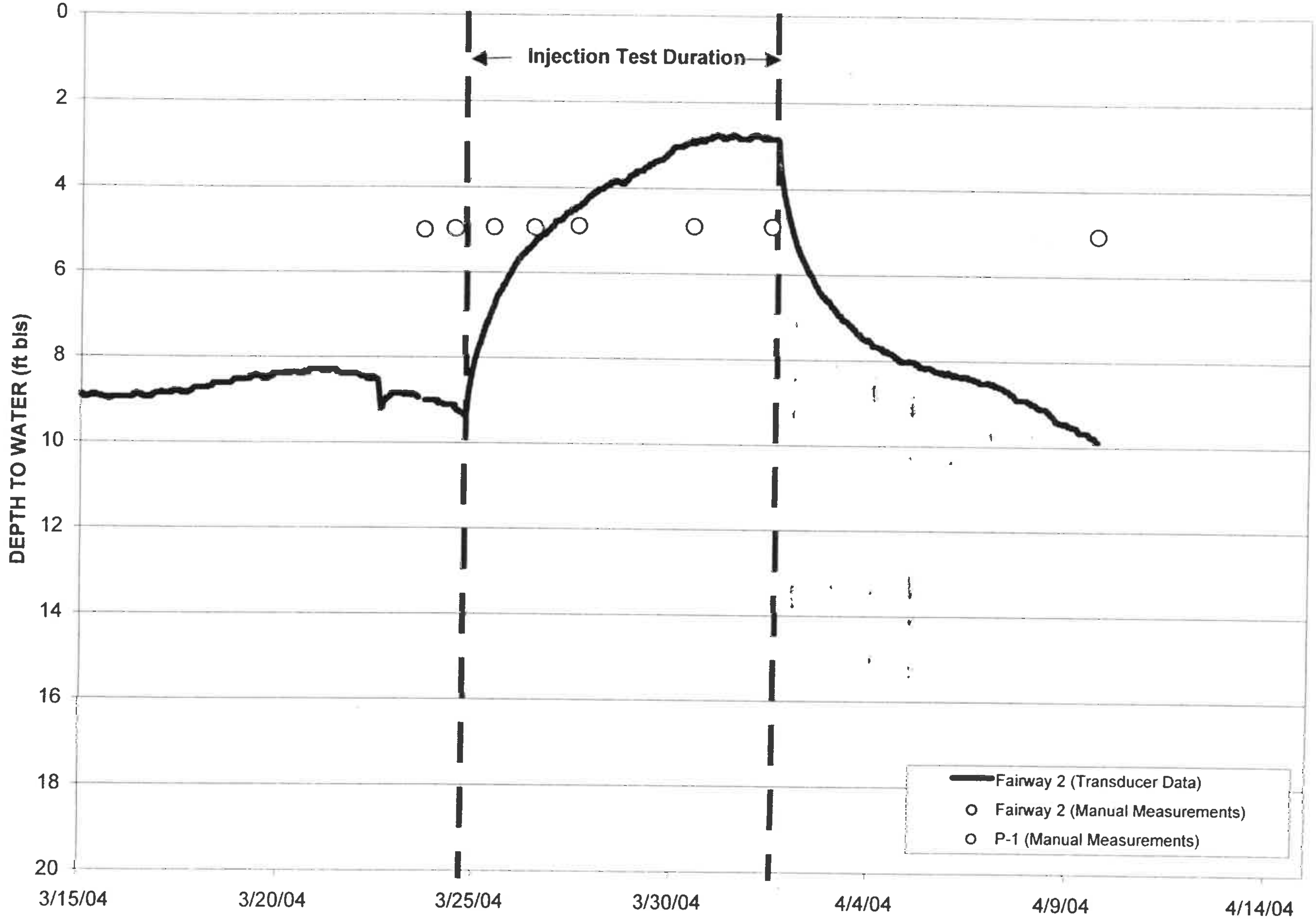


FIGURE I-10: INJECTION TEST NO. 2 WATER LEVELS, P-1 AND WELL 5H2 (FAIRWAY 2)

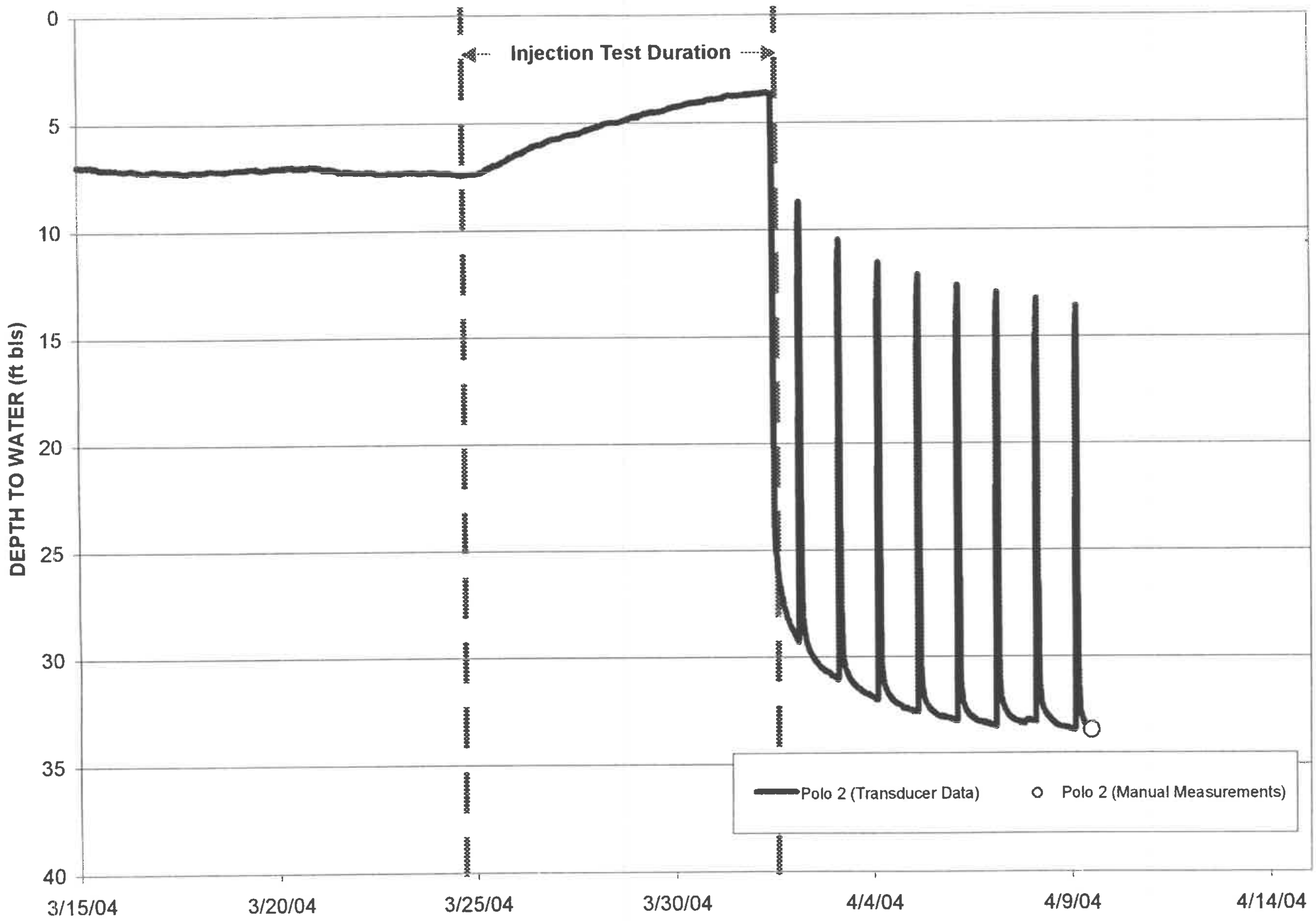


FIGURE I-11: INJECTION TEST NO. 2 WATER LEVELS, WELL 5FB (RSF POLO 2)

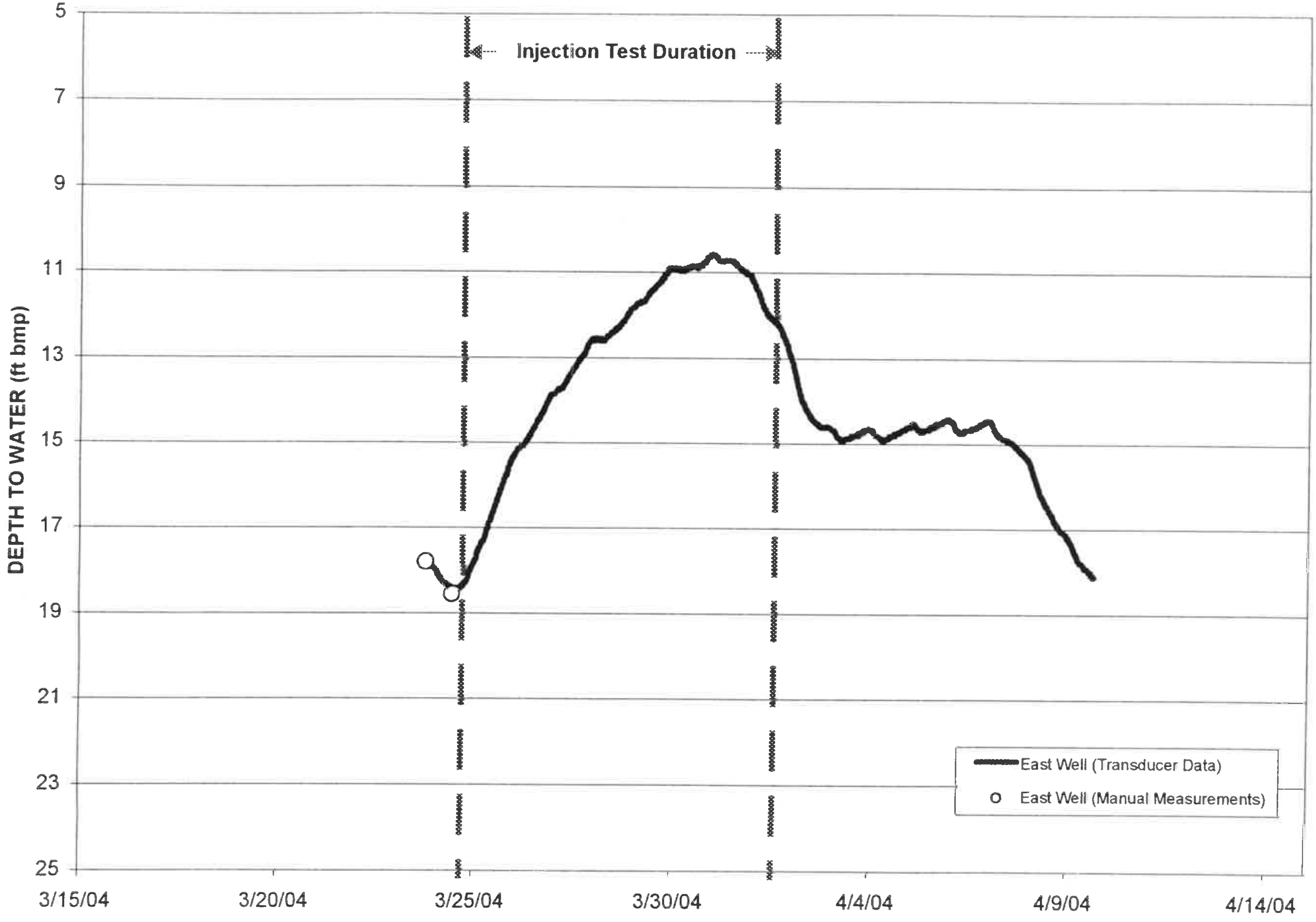


FIGURE I-12: INJECTION TEST NO. 2 WATER LEVELS,
WELL 33NC (EAST WELL)

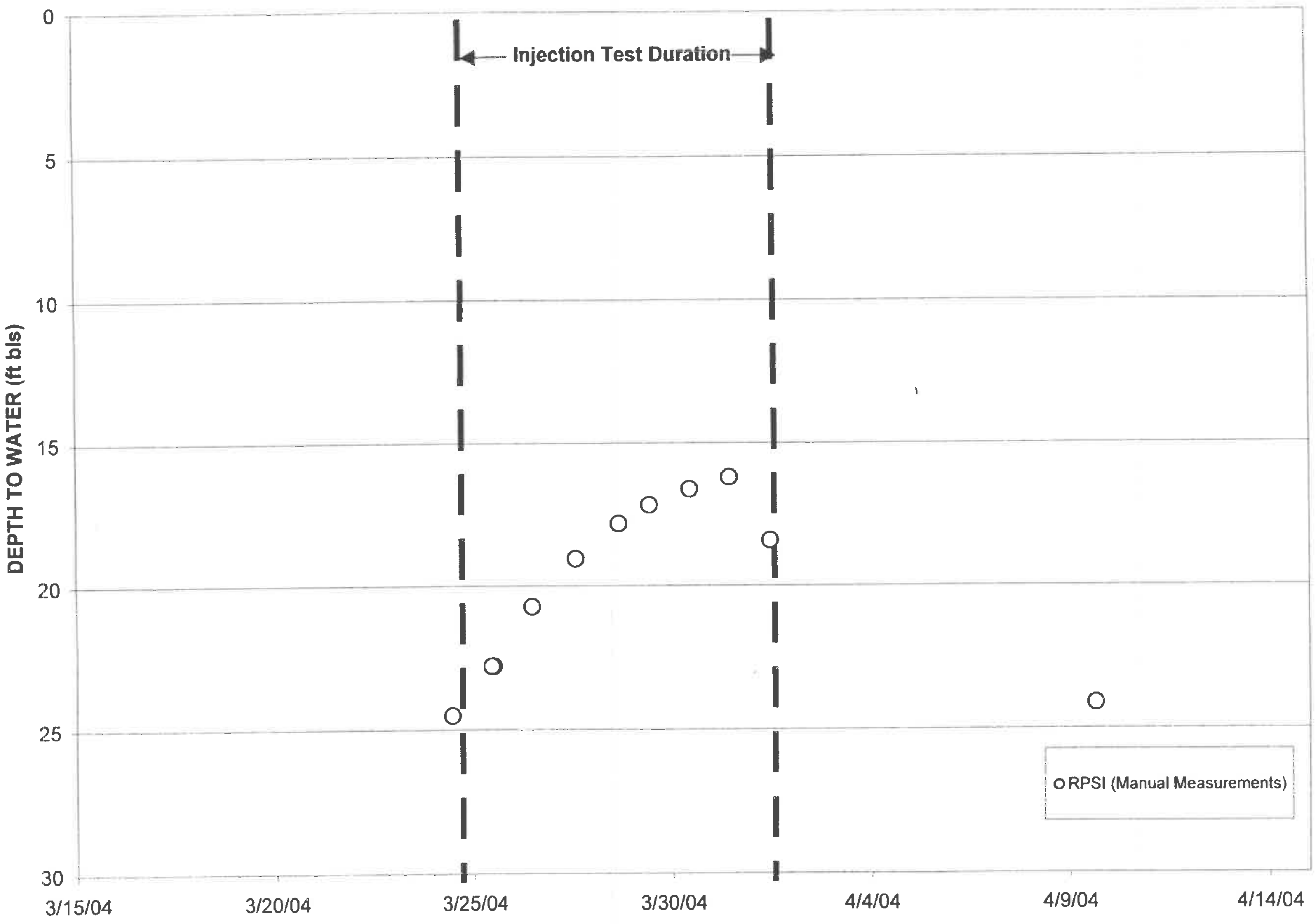


FIGURE I-13: INJECTION TEST NO. 2 WATER LEVELS,
WELL 33 N2 (RPSI)

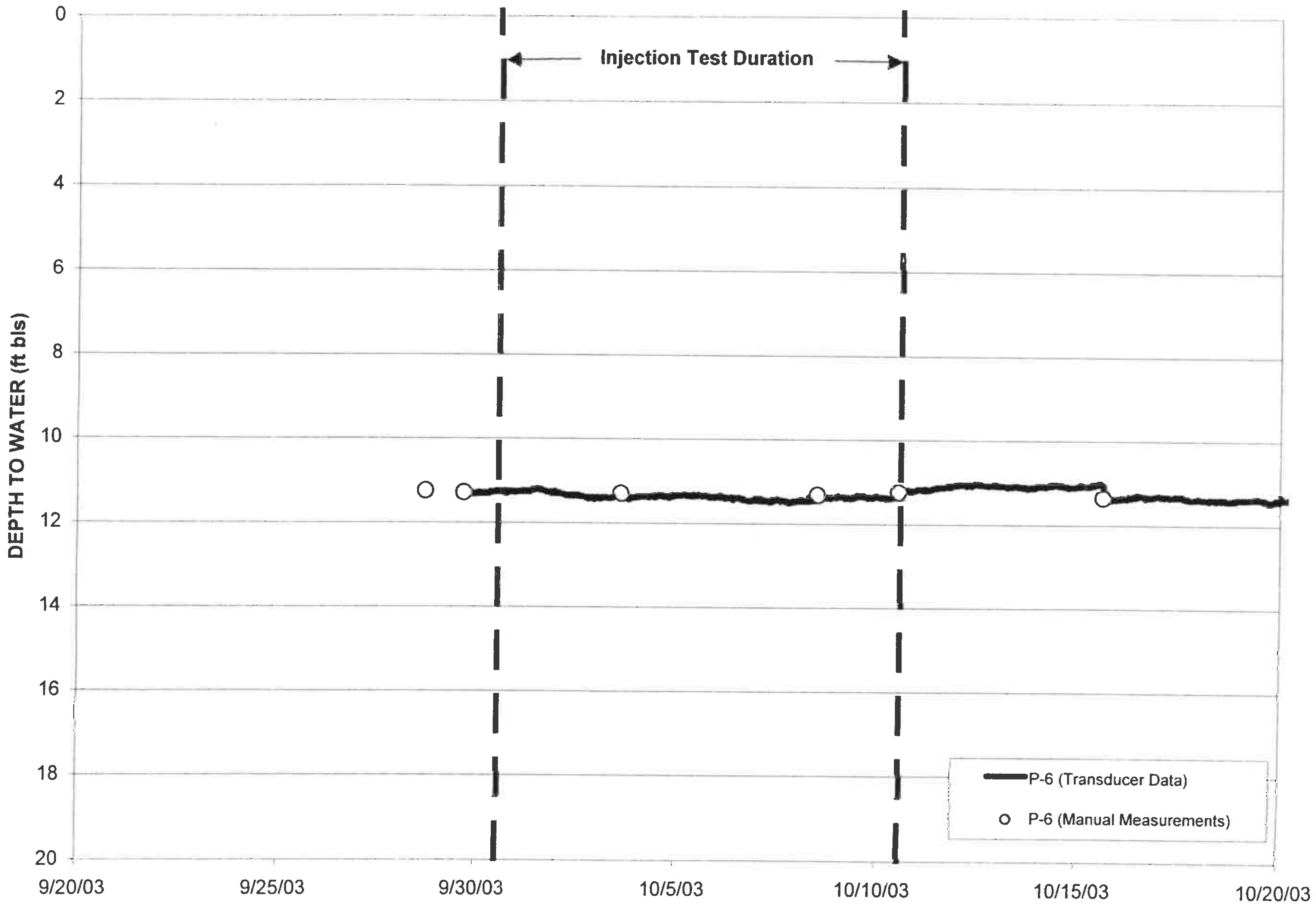


FIGURE I-14: INJECTION TEST NO. 1 WATER LEVELS, P-6

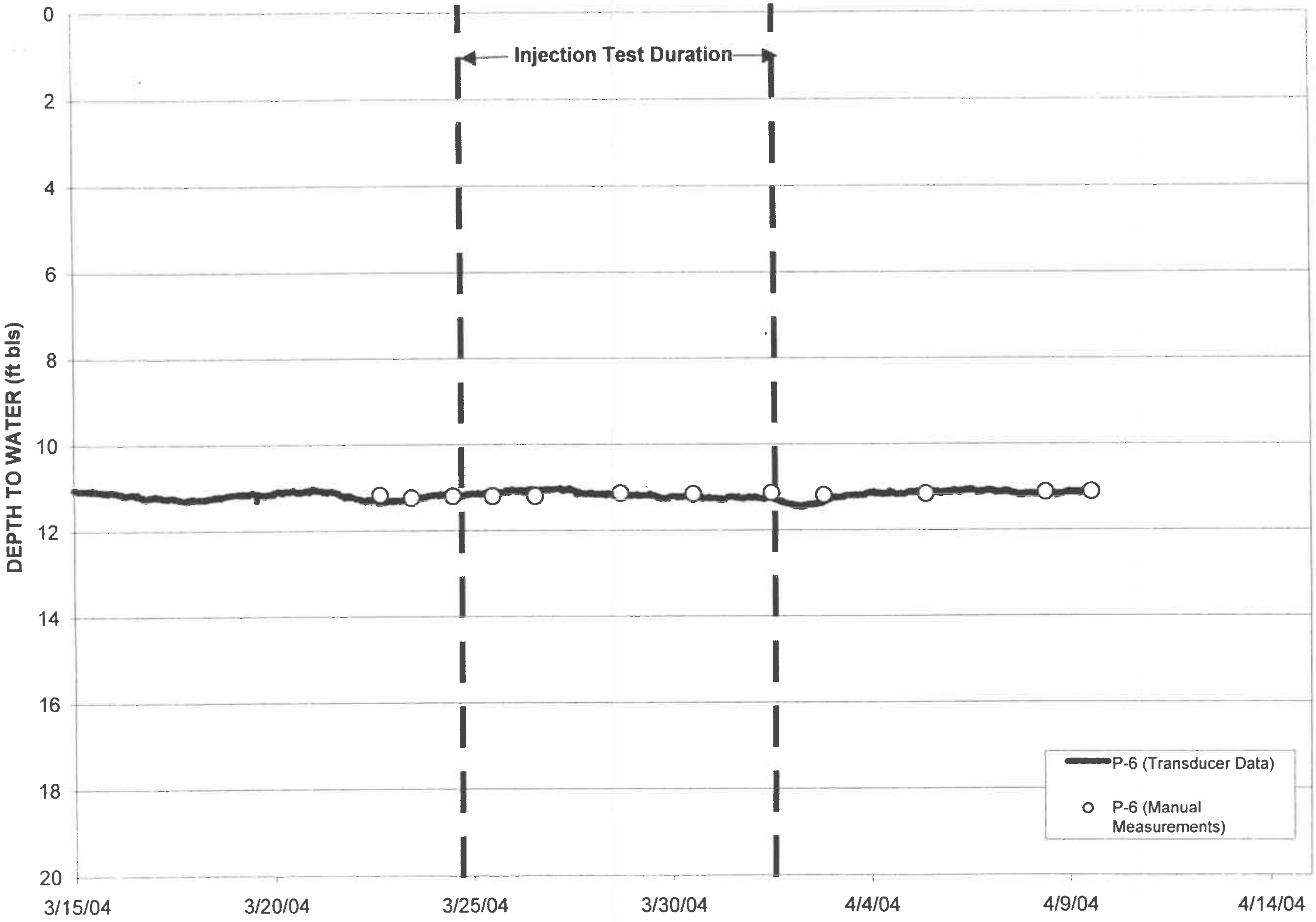


FIGURE I-15: INJECTION TEST NO. 2 WATER LEVELS, P-6

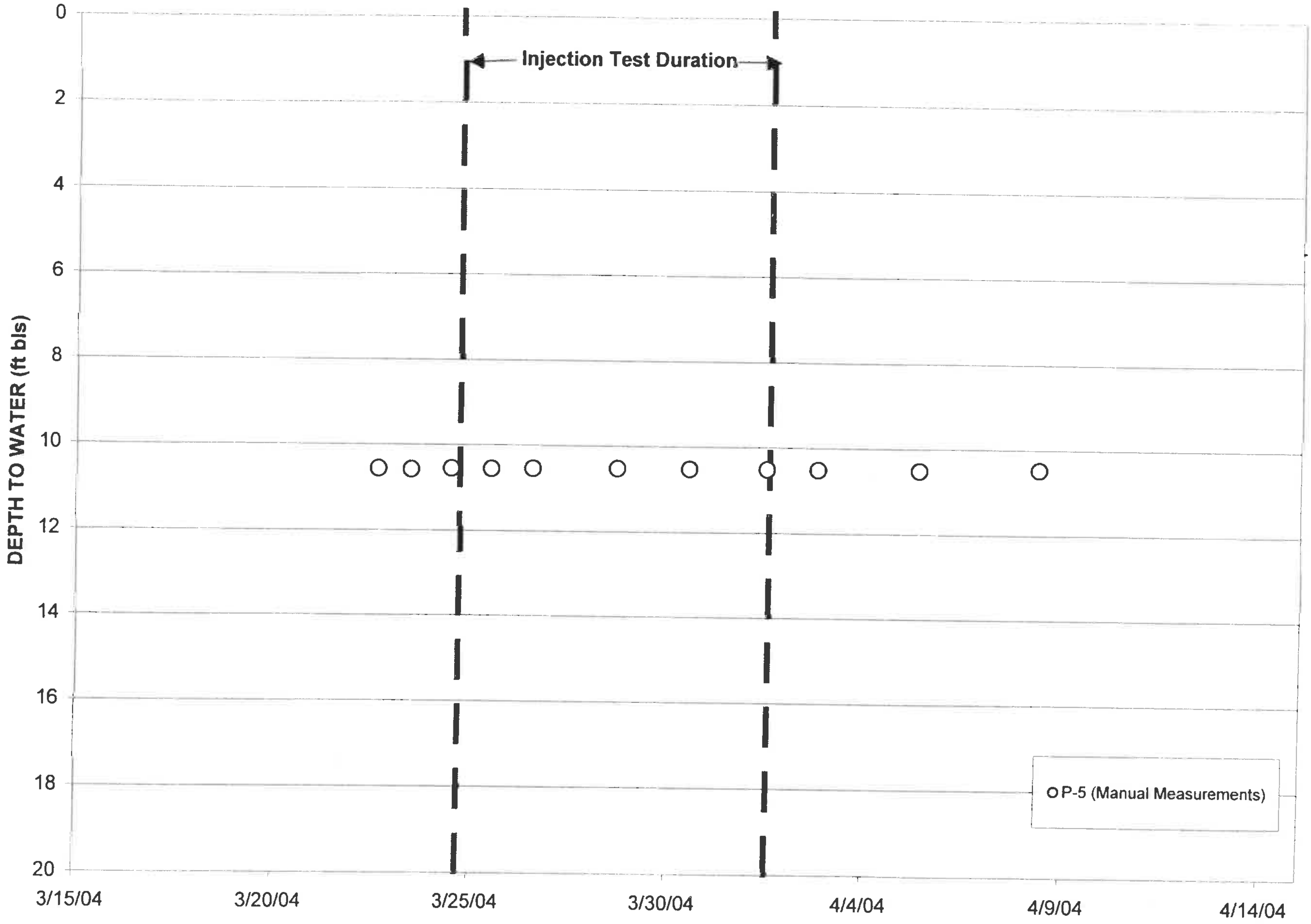


FIGURE I-16: INJECTION TEST NO. 2 WATER LEVELS, P-5

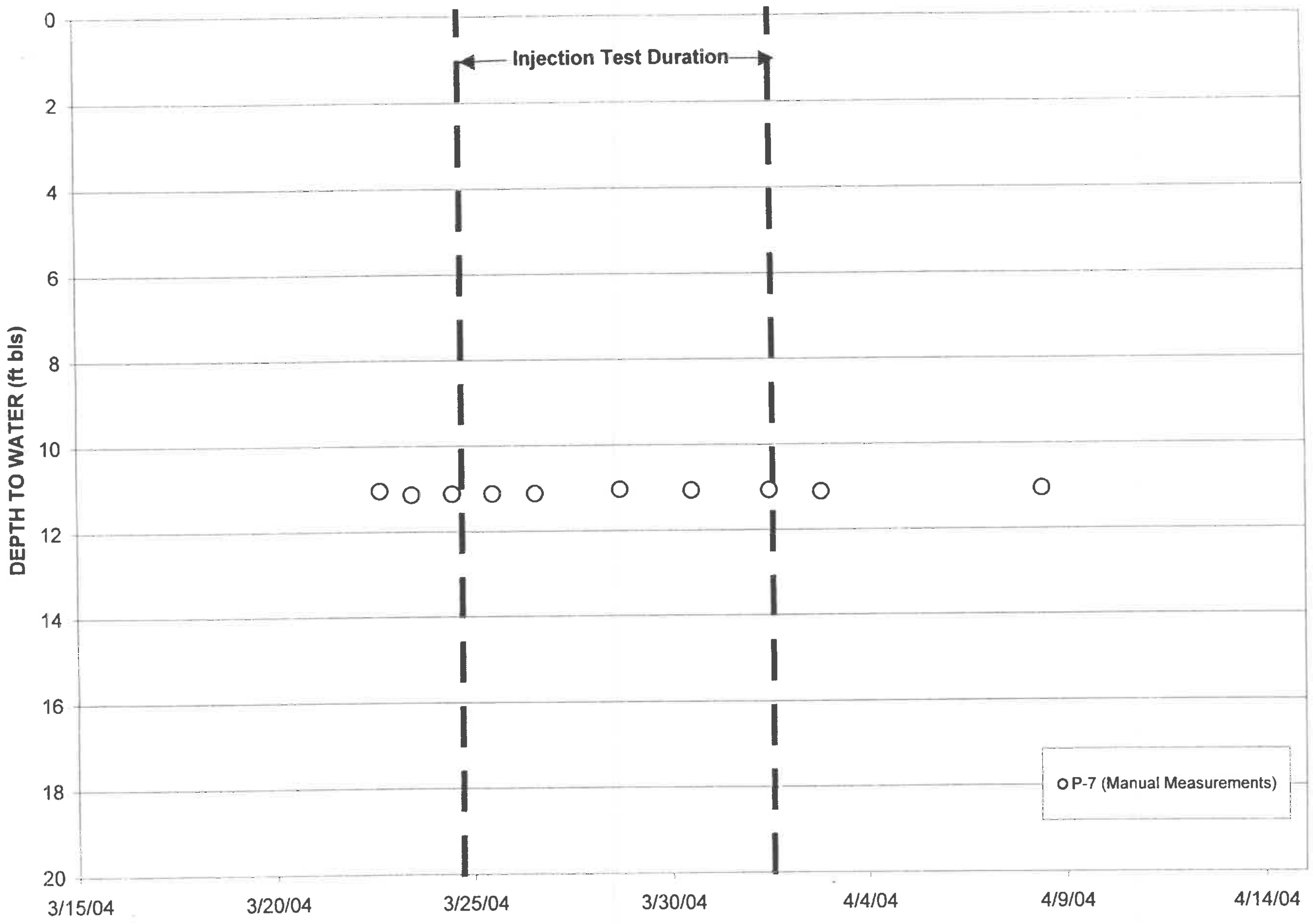


FIGURE I-17: INJECTION TEST NO. 2 WATER LEVELS, P-7

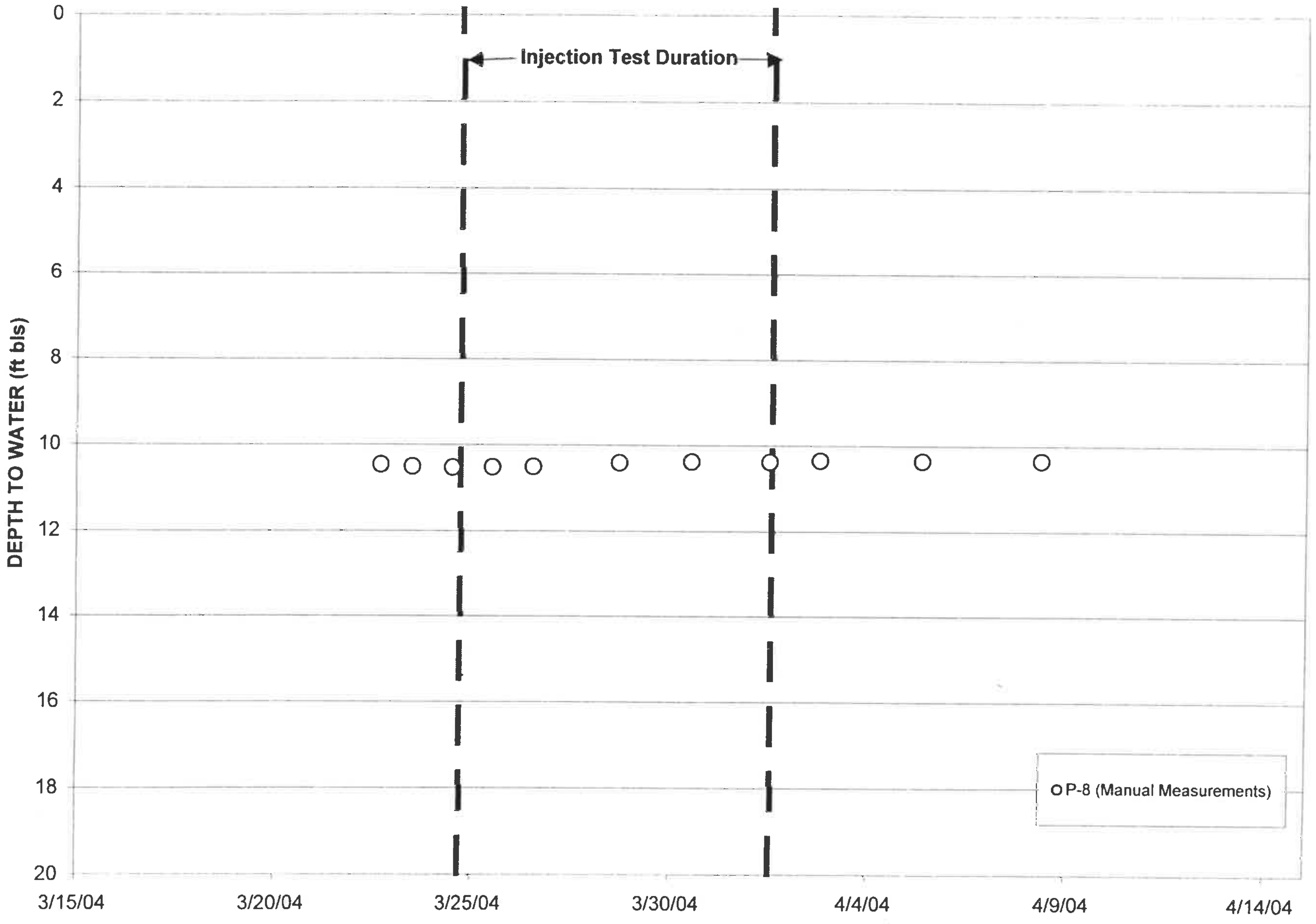


FIGURE I-18: INJECTION TEST NO. 2 WATER LEVELS, P-8

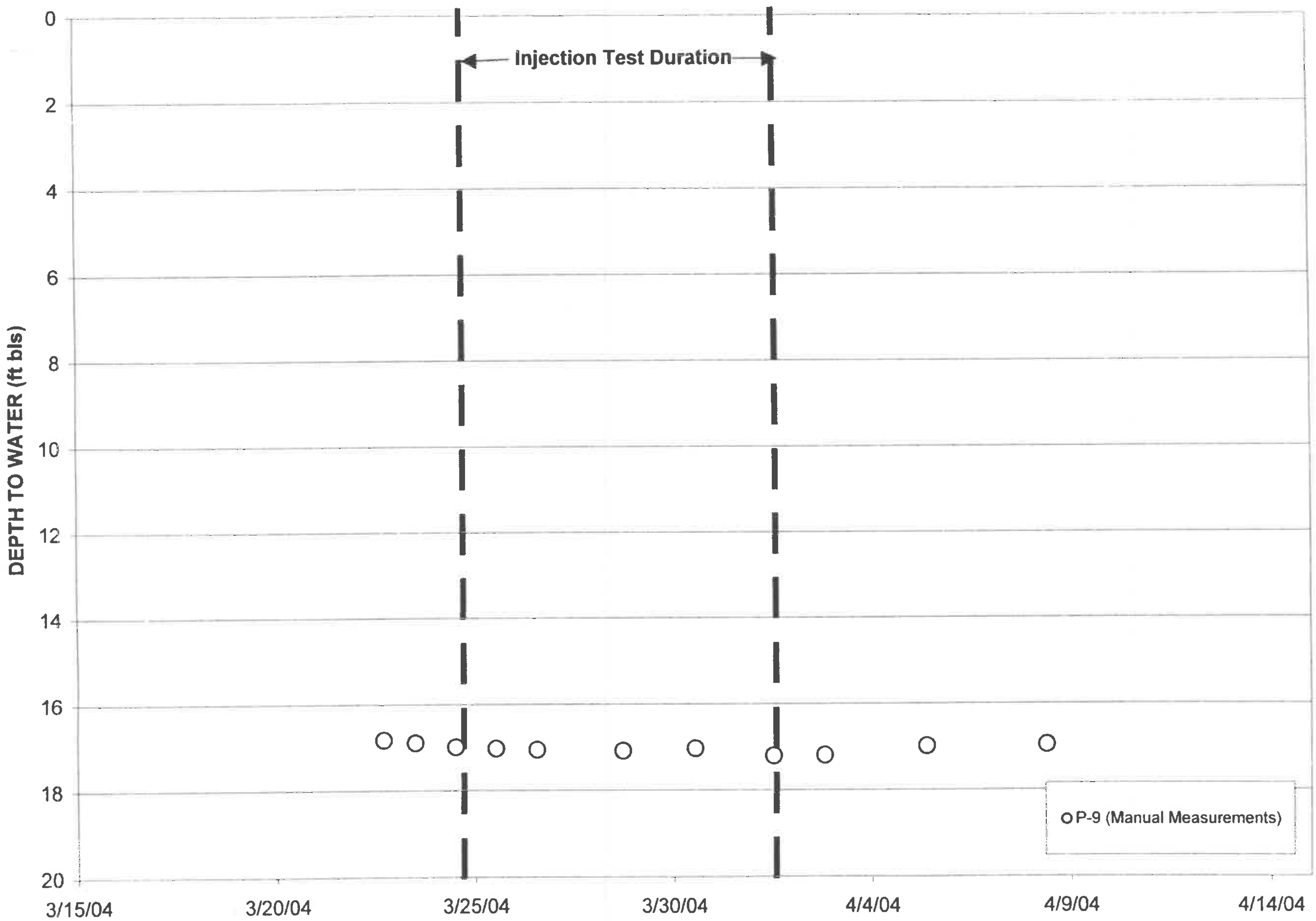


FIGURE I-19: INJECTION TEST NO. 2 WATER LEVELS, P-9

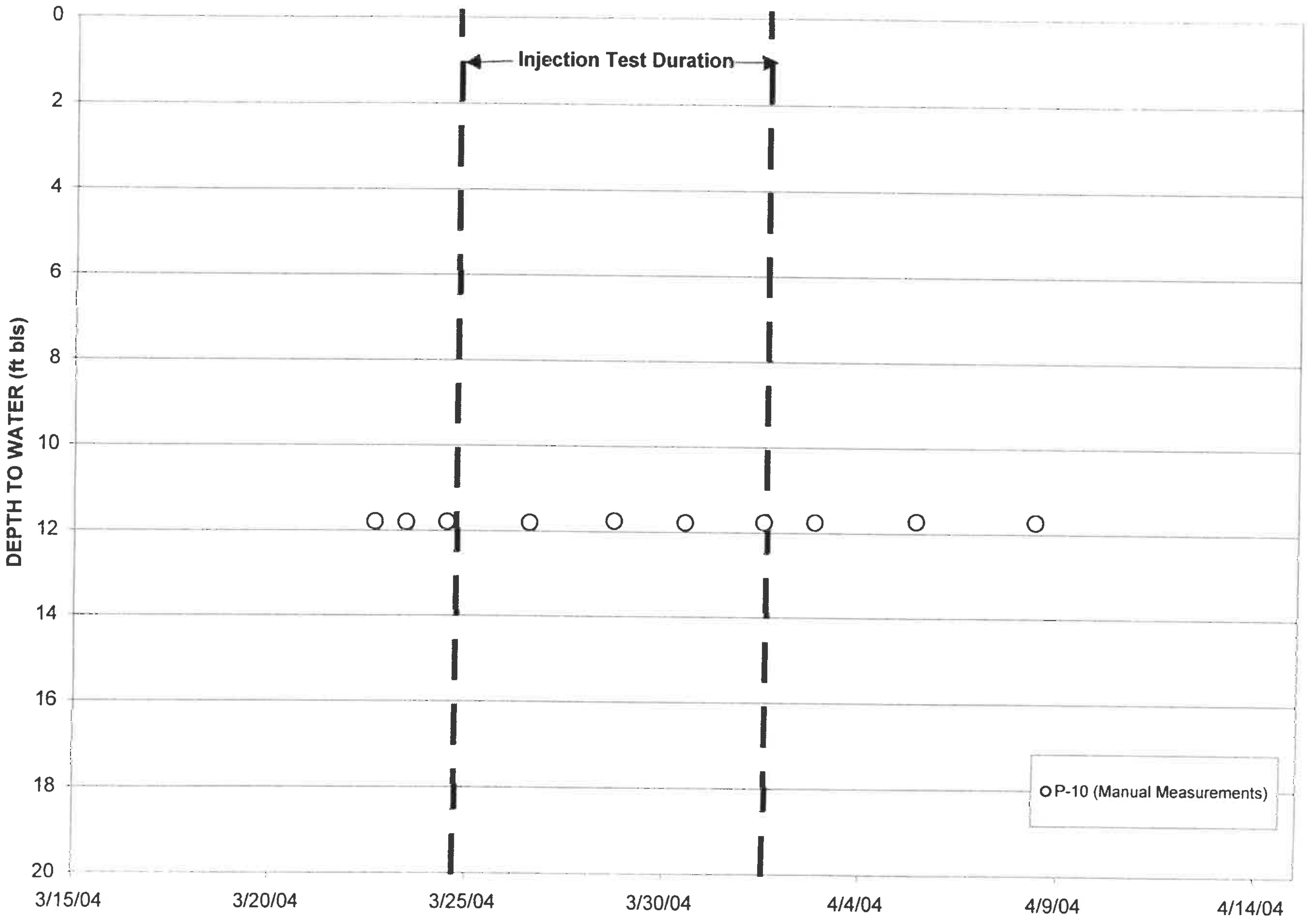


FIGURE I-20: INJECTION TEST NO. 2 WATER LEVELS, P-10

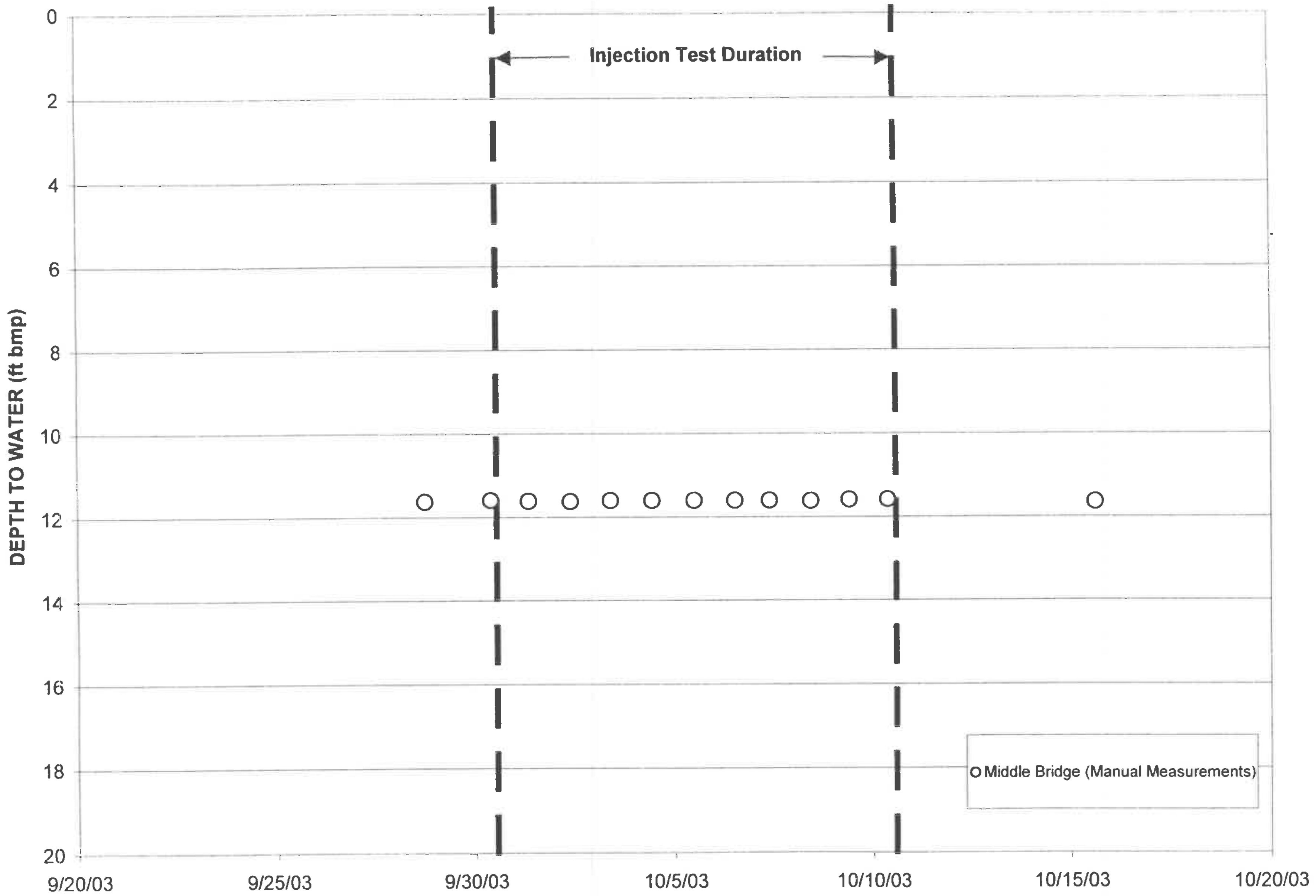


FIGURE I-21: INJECTION TEST NO. 1 WATER LEVELS, MIDDLE BRIDGE

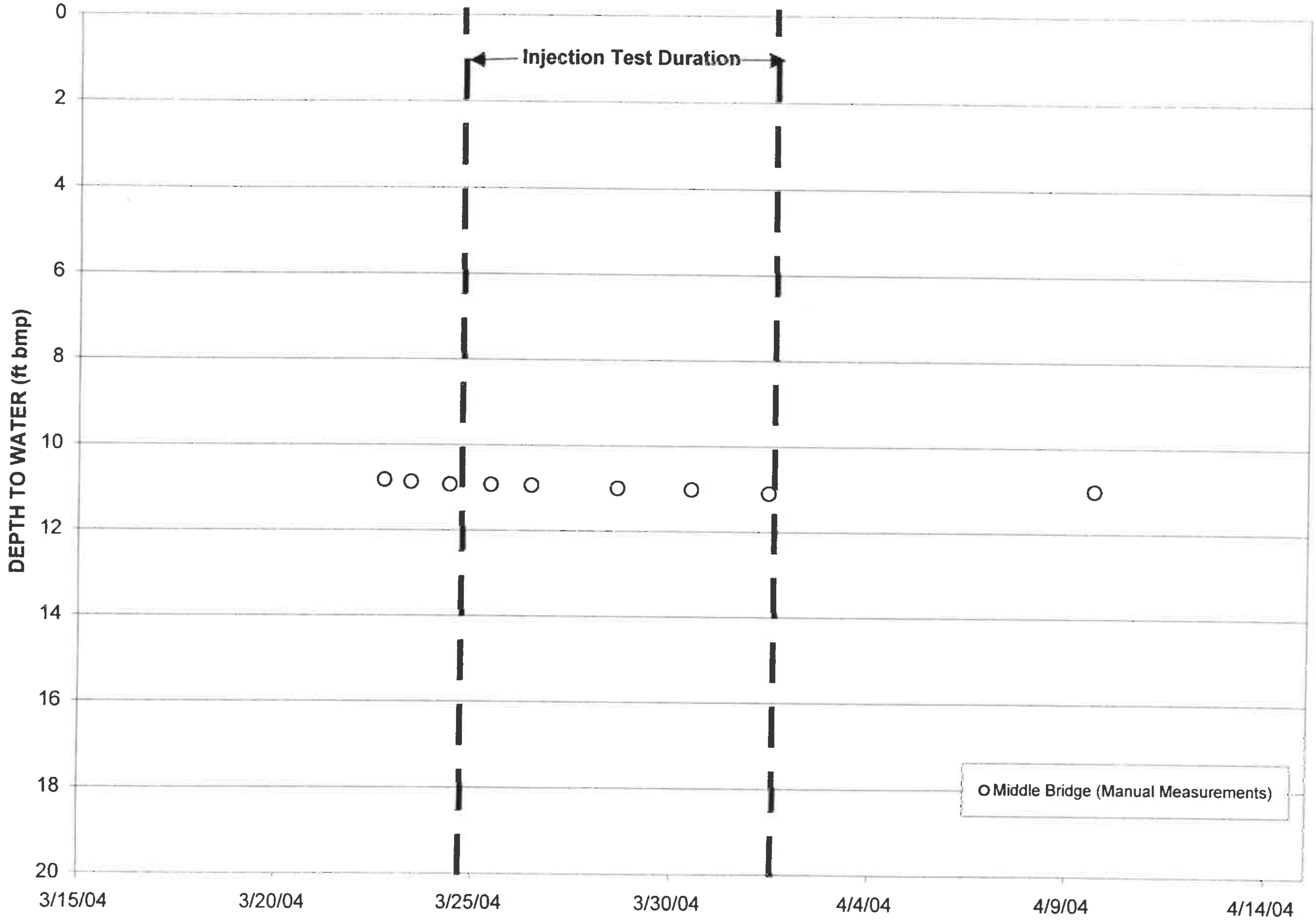


FIGURE I-22: INJECTION TEST NO. 2 WATER LEVELS, MIDDLE BRIDGE

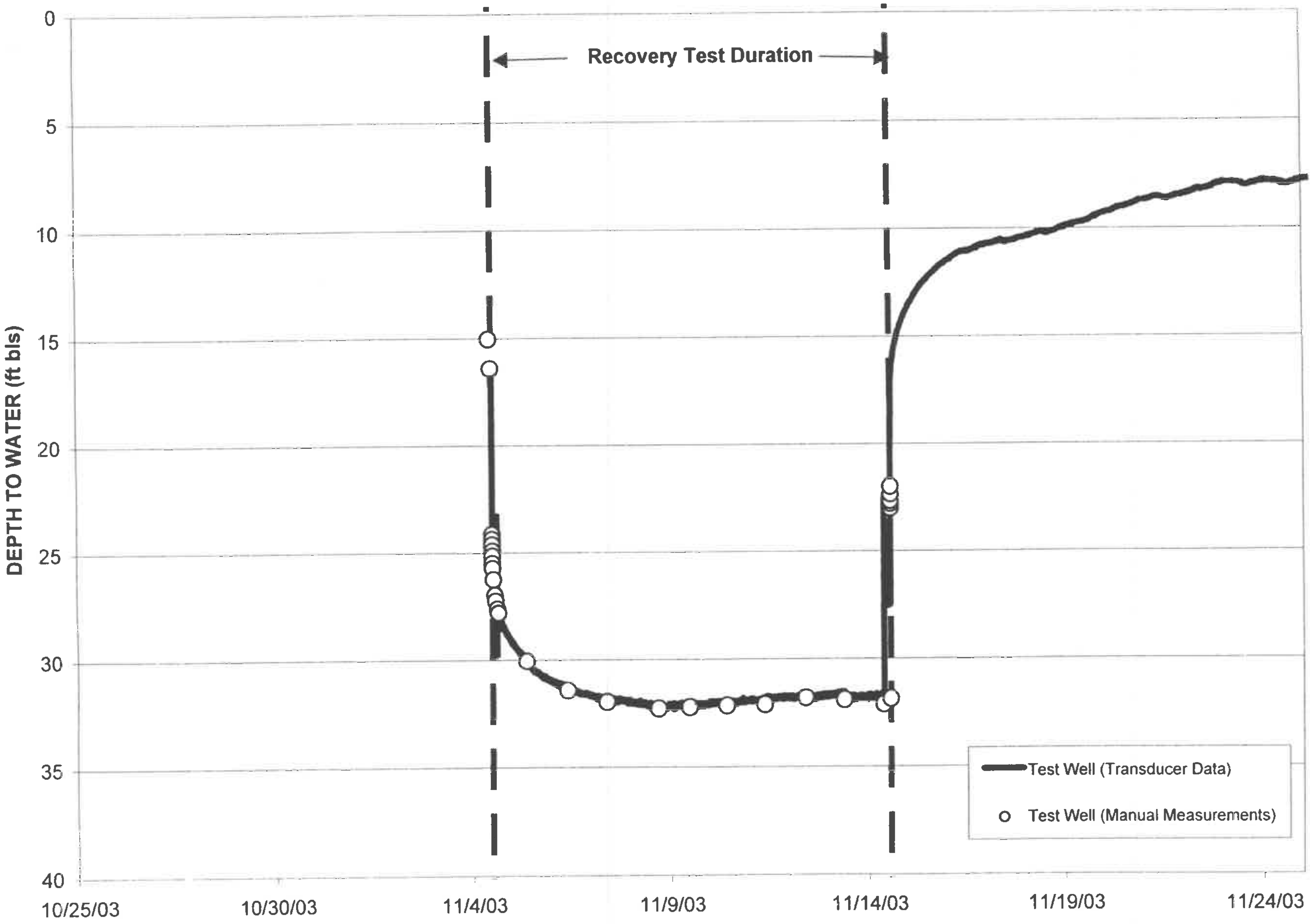


FIGURE I-23: RECOVERY TEST NO. 1 WATER LEVELS, TEST WELL

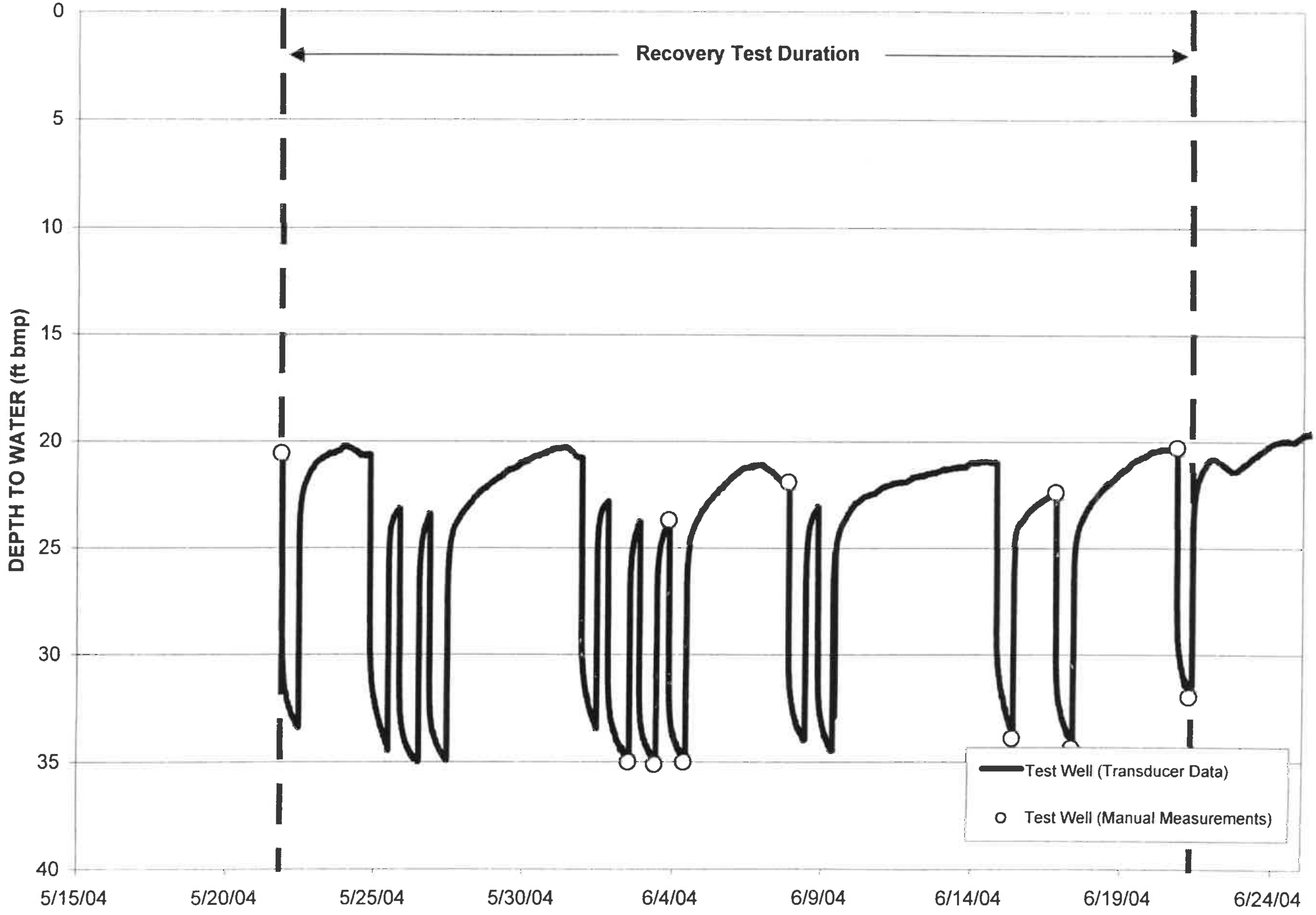


FIGURE I-24: RECOVERY TEST NO. 2 WATER LEVELS,
TEST WELL

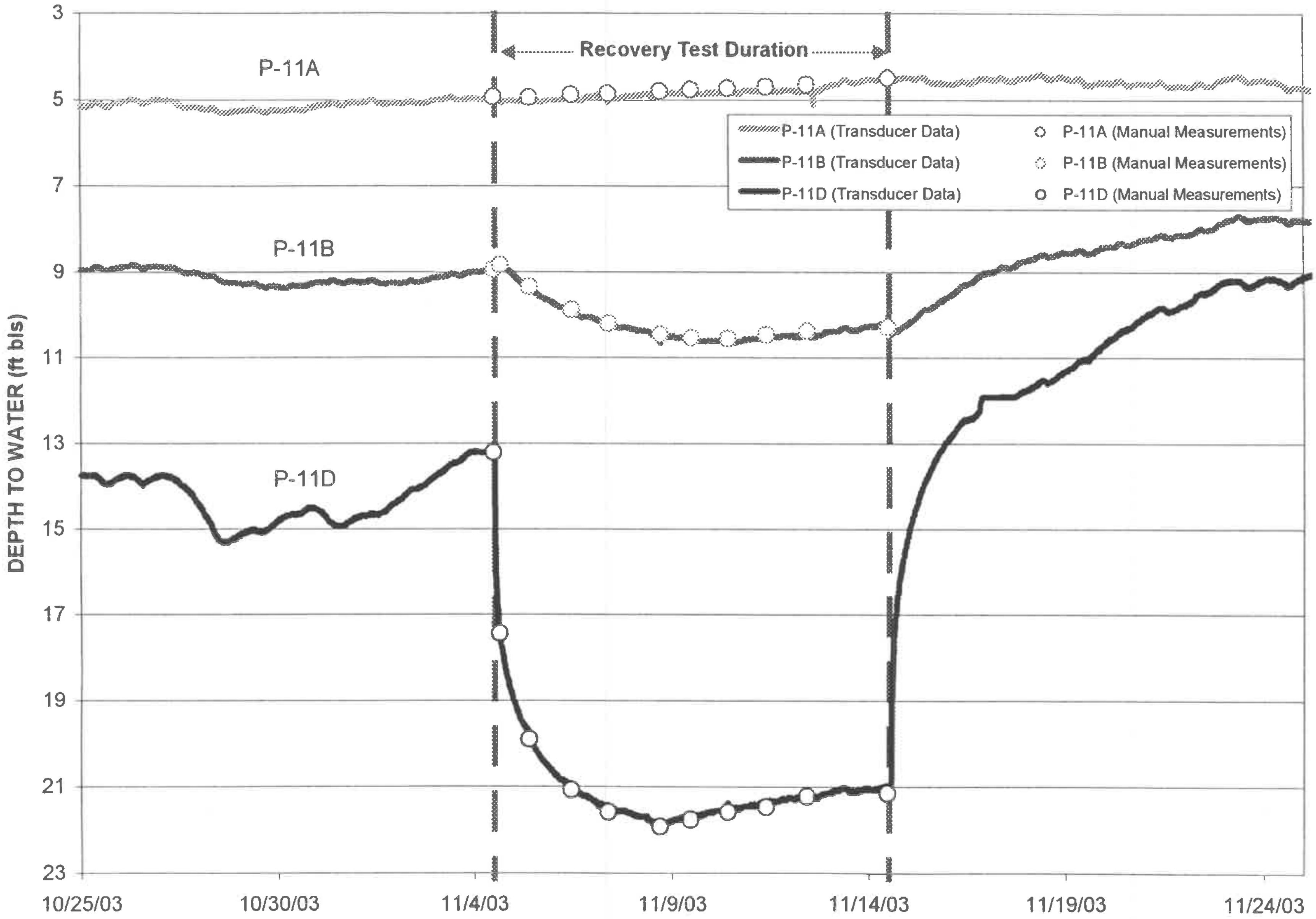


FIGURE I-25: RECOVERY TEST NO. 1 WATER LEVELS,
P-11A, P-11B AND P-11D

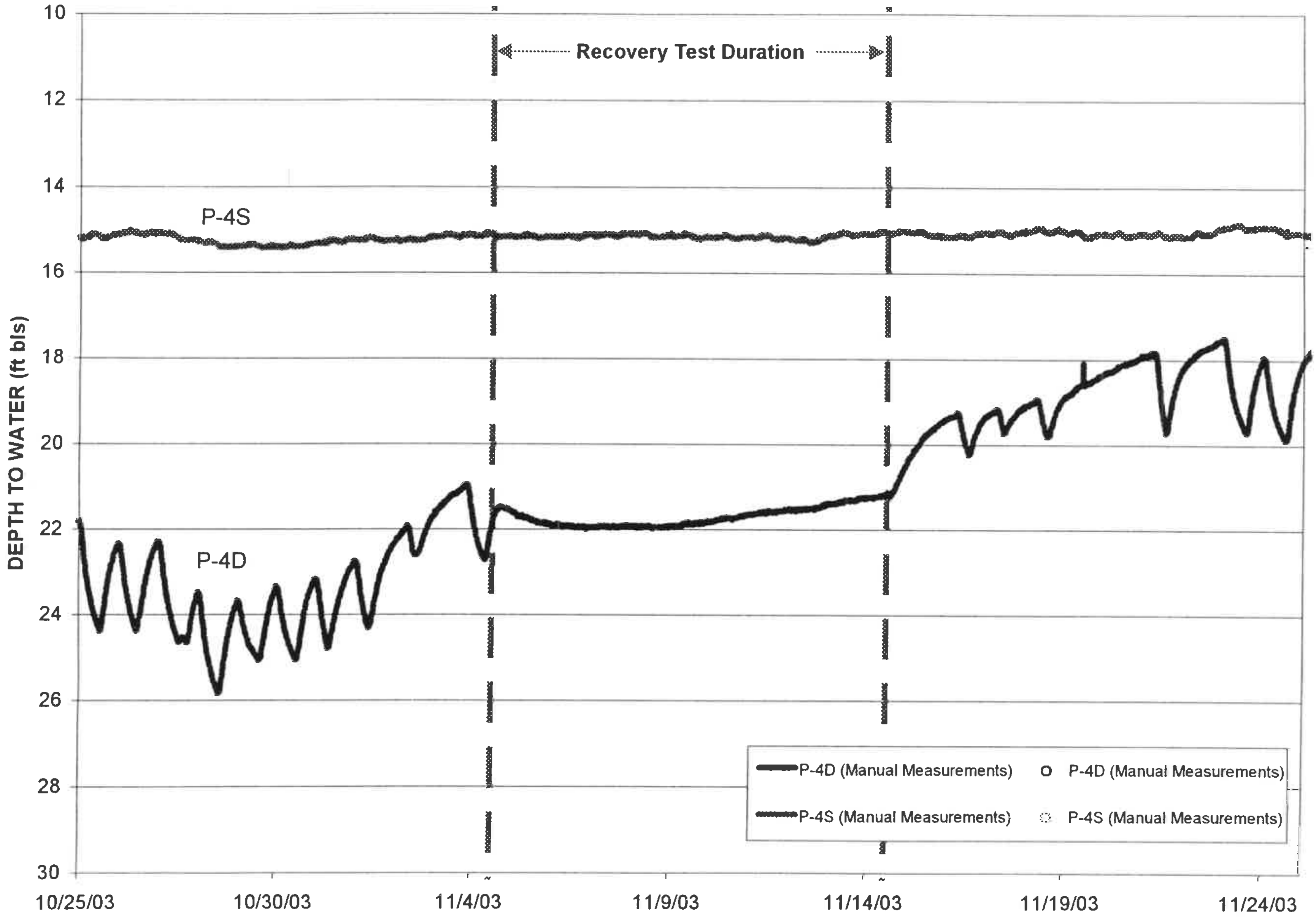


FIGURE I-26: RECOVERY TEST NO. 1 WATER LEVELS, P-4S AND P-4D

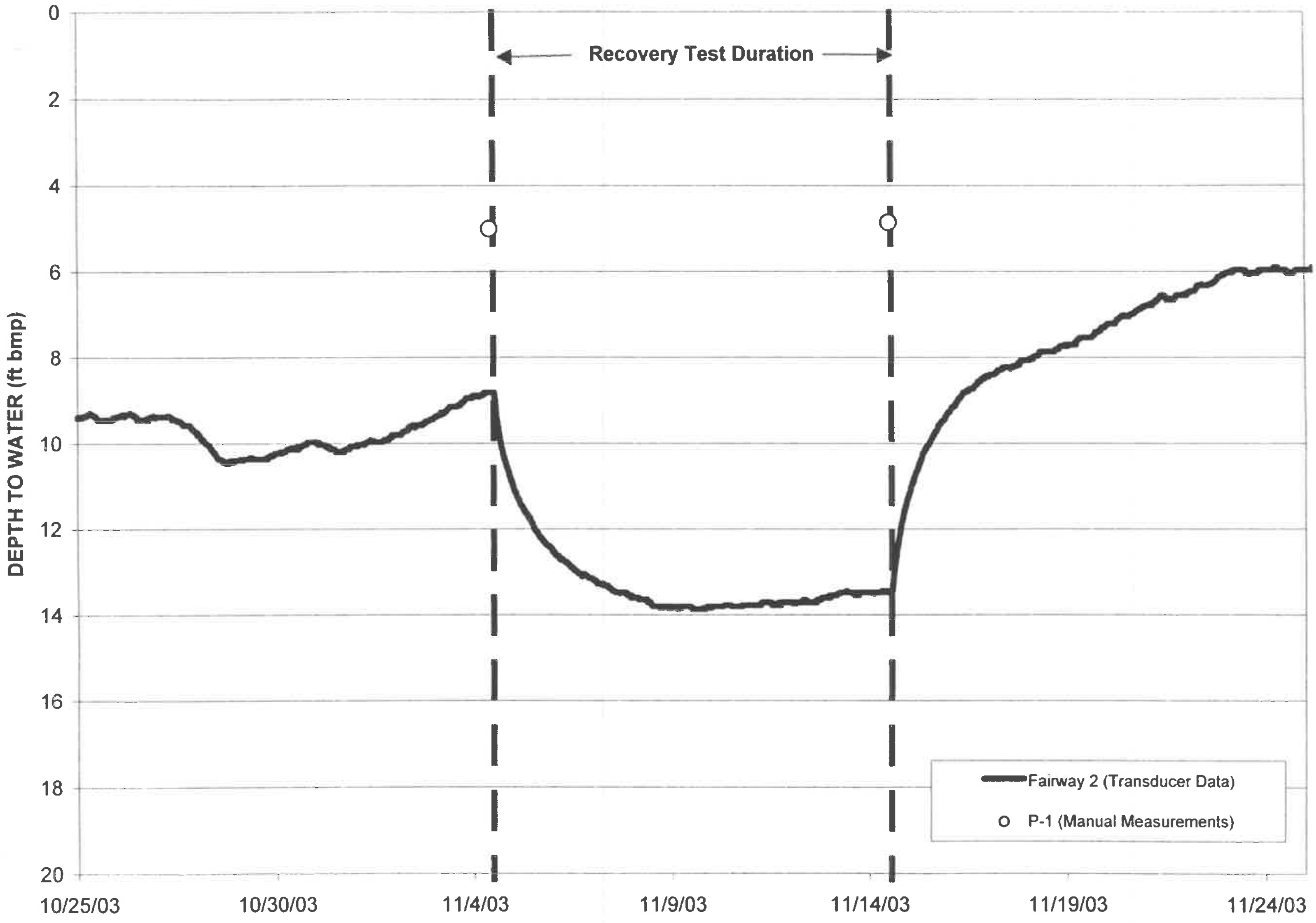


FIGURE I-27: RECOVERY TEST NO. 1 WATER LEVELS,
P-1 AND WELL 5H2 (FAIRWAY 2)

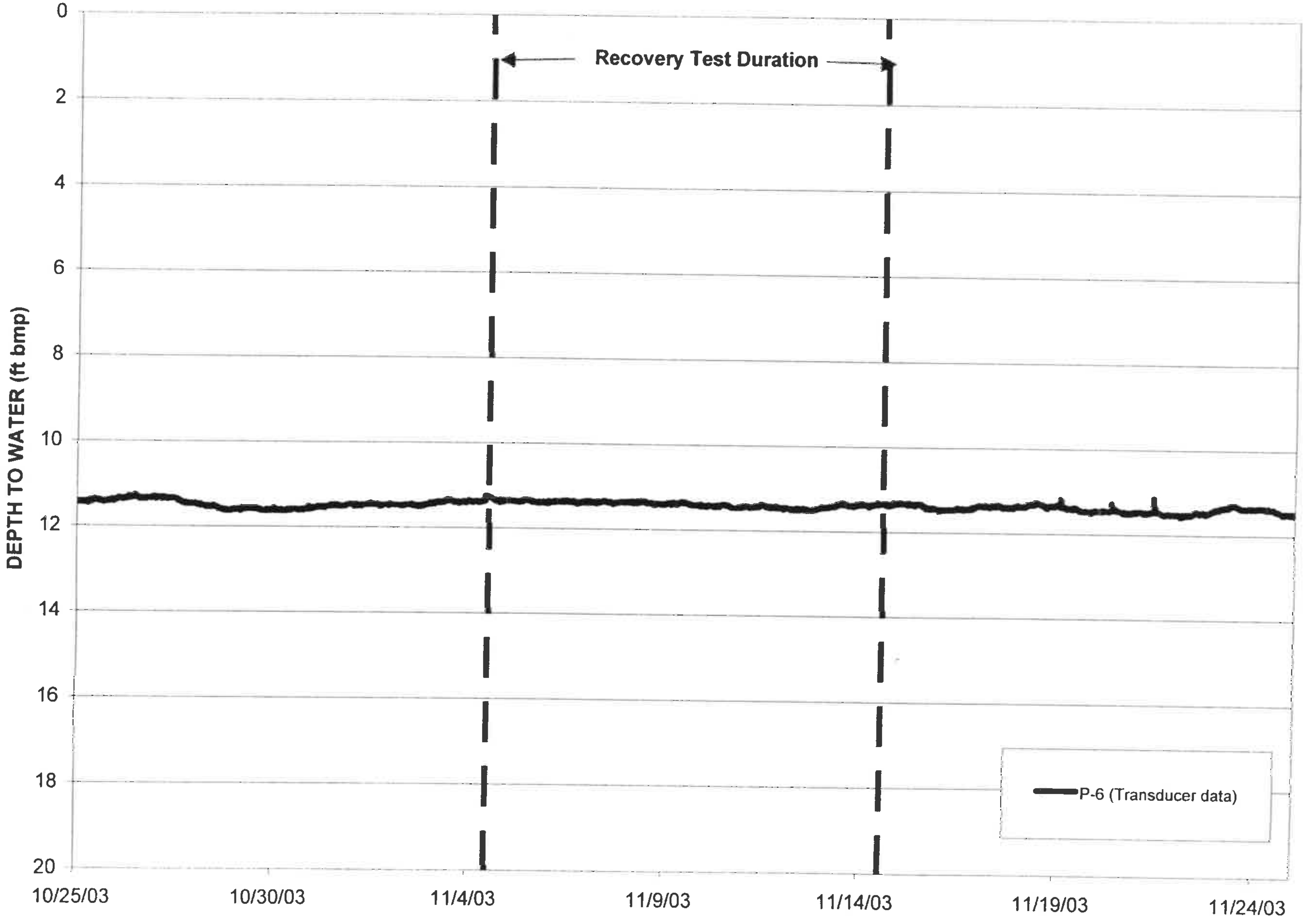
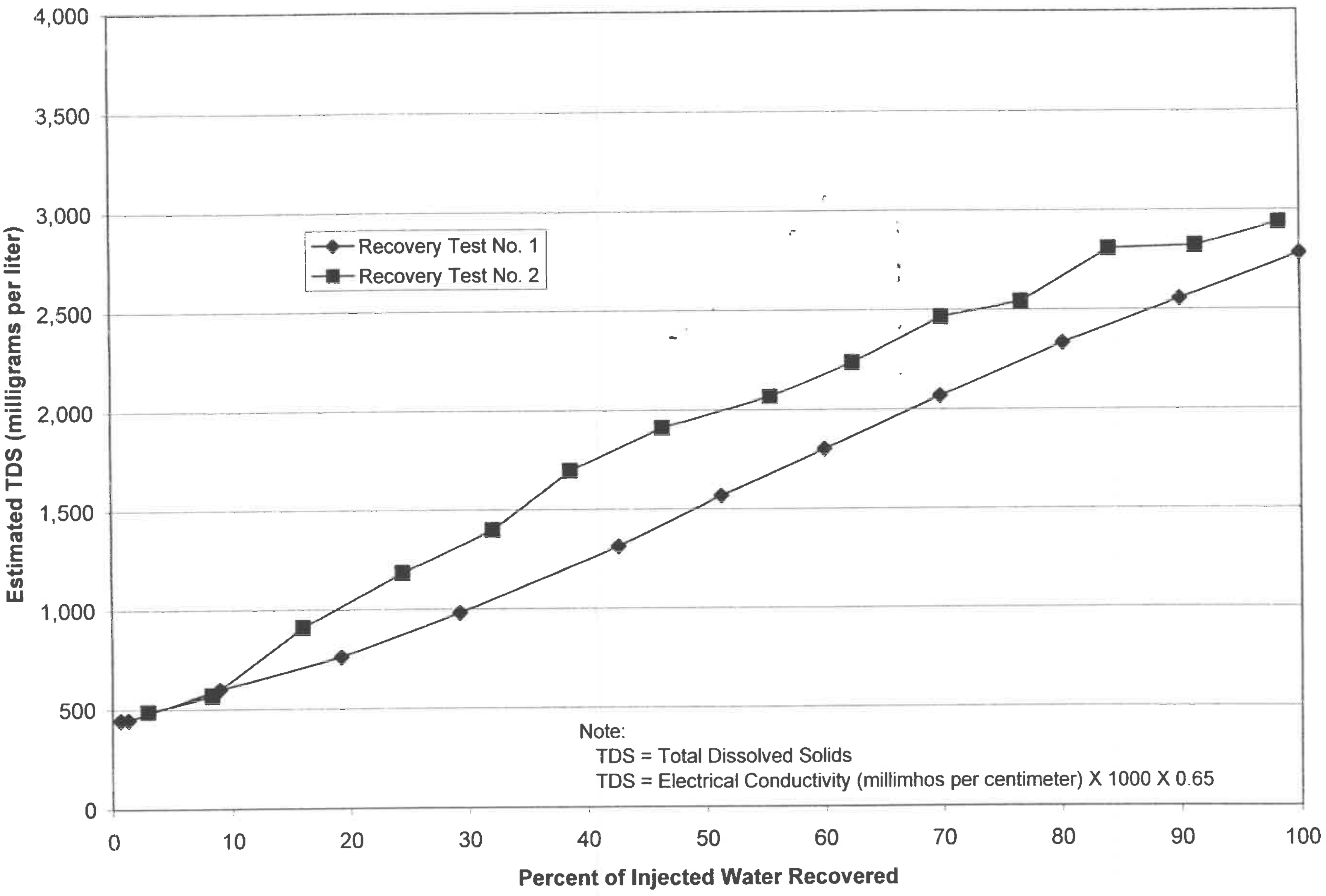


FIGURE I-28: RECOVERY TEST NO. 1 WATER LEVELS, P-6



Note:
TDS = Total Dissolved Solids
TDS = Electrical Conductivity (millimhos per centimeter) X 1000 X 0.65

FIGURE I-29: ESTIMATED TDS OF RECOVERED WATER

ATTACHMENT I-1

LABORATORY DATA

(CD-ROM; REFER TO APPENDIX B)

APPENDIX J

GROUNDWATER FLOW MODEL

APPENDIX J

GROUNDWATER FLOW MODEL

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ACRONYMS AND ABBREVIATIONS

AF	acre feet
ASR	aquifer storage and recovery
CPT	cone penetrometer test
EIR	Environmental Impact Report
EVS	Environmental Visualization System
ft/day	feet/day
gpm	gallons per minute
H+A	Hargis + Associates, Inc.
mg/l	milligrams per liter
TDS	total dissolved solids
USGS	United States Geological Survey

APPENDIX J

GROUNDWATER FLOW MODEL

1.0 INTRODUCTION

This appendix provides an overview of work performed on the construction of a numerical model for simulation of groundwater flow and total dissolved solids (TDS) solute transport in the San Dieguito groundwater basin. The model is based on a previous three-dimensional, finite-element, density-dependent, groundwater flow and transport model of the basin (CH2M Hill, 1995; HYA, 1997) with modifications based on subsequent data. Refer to the main report text for a discussion of the modeling results.

2.0 OBJECTIVE

The overall objective of the groundwater flow and TDS solute transport modeling was to allow improved assessment of potential groundwater impacts associated with the project scenario being considered for the aquifer storage and recovery (ASR) program in the San Dieguito Groundwater Basin. Specifically, the results of the groundwater modeling will be used to aid in the impact assessment presented in the Environmental Impact Report (EIR).

3.0 GROUNDWATER FLOW MODEL

A transient three-dimensional groundwater flow model was developed using the U.S. Geological Survey (USGS) finite difference code MODFLOW (McDonald and Harbaugh, 1988). The flow model simulates groundwater flow and recharge to groundwater within the model domain. Development of the flow model required definition of the boundary between the basin alluvium and surrounding bedrock; the geometry of hydrostratigraphic units within the basin alluvium; hydraulic parameters that control groundwater flow; rates and locations of recharge; water level conditions at the river and at the alluvium/ocean boundary; and rates and locations of regional groundwater extraction wells. The flow model was calibrated to observed water level and flow conditions in the study area by varying the above parameters within reasonable ranges supported by measured data.

3.1 FLOW MODEL CONSTRUCTION

Information compiled for model construction consisted of parameters exported from the previous model which were modified based on groundwater assessment data collected in the basin through November 2003, in addition to published literature regarding hydrogeology and regional well logs in the vicinity.

3.1.1 Model Domain

The model domain comprises an area about the alluvial basin that is approximately 34 square miles (Figure J-1). A finite difference grid was constructed using 132 rows and 163 columns, with a variable grid block size ranging from 125 feet by 125 feet at the central portion of the model in the vicinity of Morgan Run Resort and Club, to 250 feet by 250 feet at the edges of the model domain (Figure J-2).

The model consists of five layers numbered sequentially from the shallowest to the deepest layers, consistent with the convention used in the previous model. The upper most layer represents ground surface down to the top of the aquitard. Layer 2, represents the aquitard between the shallow water table aquifer and the deeper aquifer (Layer 3). Layer 4, represents a deeper fine-grained zone that locally separates the Layer 3 aquifer from the underlying bedrock (Layer 5). Areas that lie outside the alluvial basin in Layers 1 through 4 represent the surrounding bedrock. The model layers are numbered as follows:

- Layer 1 – Upper predominantly coarse grained zone representing the water table aquifer; and the surrounding bedrock outside the alluvial basin boundary.
- Layer 2 – Fine grained zone representing the aquitard between the water table aquifer and the lower aquifer; and the surrounding bedrock outside the alluvial basin boundary. In the northern most portion of the alluvial basin, Layer 2 is coarse grained (the aquitard is absent).
- Layer 3 – Coarse grained zone representing the lower aquifer that is the main production zone in the alluvial basin; and the surrounding bedrock outside the alluvial basin boundary.
- Layer 4 – Fine grained zone at the base of the alluvium; and the surrounding bedrock outside the alluvial basin boundary. Alluvial material represented by Layer 4 is not laterally continuous over the whole alluvial basin.
- Layer 5 – Bedrock.

Geometry of the model layers was modified from the layering used in the previous model based on a three-dimensional krigging of layer elevations that were identified from an evaluation of all currently available lithologic and cone penetrometer logs of well and exploratory borings in the basin as well as the total thickness of the alluvium presented in the USGS Water-Resources Investigation Report 83-4044 (Izbicki, 1983). In addition, the ground surface elevation was defined based on a USGS Digital Elevation Model as well as more accurate survey data in the vicinity of Morgan Run. To allow for realistic horizontal flow of groundwater between the alluvial sediments within the basin and bedrock surrounding the basin, all layers are continuous across the model domain and parameters of the bedrock are assigned to areas in each layer outside the alluvial basin boundary. The thickness of each layer within the bedrock outside the alluvial basin boundary was assigned the average thickness of the layer within the alluvium.

Elevation picks for all model layers were kriged in three dimensions using Ctech Development Corporation's Environmental Visualization System (EVS) software program. The resulting layer geometry was used in the groundwater flow and TDS solute transport model. The elevation of the bottom of Layers 1, 2, 3, and 4 is shown in Figures J-3 to J-6. The bottom elevation of Layer 5 was set at an arbitrary elevation (180 feet below sea level) across the model domain resulting in a minimum Layer 5 thickness of 20 feet.

3.1.2 Hydraulics

Groundwater flow models require assignment of hydraulic properties to each cell in the model. However, rather than assigning a unique value to every cell in the model with an infinite spectrum in the range of property values, regions within the model were defined as zones with similar hydraulic properties, and a single representative property value was assigned to each zone. The distribution of hydraulic conductivity within the model domain was zoned in this manner as described below (Table J-1; Figures J-7 to J-10).

The distribution of hydraulic conductivity within model Layers 1 and 4 were based on the same general convention used in the previous model, such that hydraulic conductivity values were assigned based on lithology types identified from well lithologic logs and Cone Penetrometer Test (CPT) logs, where available, and extrapolated to the edge of the alluvial basin. Areas comprised of predominantly fine-grained material (silts and clays), mixed materials (mixed silts/sands) predominantly sand materials, and predominantly gravels were initially assigned hydraulic conductivity values of 0.1 feet/day (ft/day), 50 ft/day, 150 ft/day, and 500 ft/day, respectively. These values agree with published values of hydraulic conductivity for similar soil types (Bouwer, 1978). The distribution of hydraulic conductivity within model Layer 3 was based on the results of hydraulic tests conducted in 2002 and 2003, where available (Hargis + Associates, Inc. [H+A], 2002). In areas where hydraulic test data is not available in Layer 3, hydraulic conductivity was based on lithology as in Layers 1 and 4, and extrapolated to the edge of the alluvial basin. The distribution of hydraulic conductivity within model Layer 2 was based on the results of pore pressure dissipation tests conducted on the aquitard materials during CPT installation. In the northern portion of the alluvial basin in Layer 2 where fine-grained aquitard materials are absent, the hydraulic conductivity distribution from Layer 3 was duplicated.

The vertical hydraulic conductivity zone values in all layers were related to the horizontal hydraulic conductivities (Table J-1). The values assigned to horizontal and vertical hydraulic conductivity zones were allowed to vary within reasonable ranges during model calibration. Specific yield zones were assigned based on hydraulic conductivity such that hydraulic conductivity zones less than 0.1 ft/day, 0.1 to 10 ft/day, 10 to 150 ft/day, and greater than 150 ft/day were assigned specific yield values of 0.01, 0.05, 0.1, and 0.2 respectively.

3.1.3 Groundwater Recharge

Recharge to the water table within the model domain is derived from precipitation infiltration, seepage from wastewater treatment plant ponds, irrigation return flow, and seepage from the San Dieguito River. Distribution of recharge across the alluvial basin was based on identified land use from aerial photographs. Recharge zones were selected representing the following identified types of land use: open land, infiltration ponds at three waste water treatment plants, Morgan Run golf course, Whispering Palms golf course, Rancho Paseana equestrian area, unnamed equestrian area, Rancho Santa Fe Polo Club (split in two zones), and the residential area east of Morgan Run (Figure J-11). Recharge rates were derived from reclaimed water infiltration pond application rates, estimated irrigation rates, and precipitation (Table J-2). Recharge from the San Dieguito River was handled using the river boundary condition package in MODFLOW, as discussed in the following section.

Estimates of average annual groundwater recharge from precipitation as calculated for the previous model using a soil moisture budget were used (CH2Mhill, 1995). For dry weather simulations, the calculated average recharge based on data from 1945 to 1982 (drier than average years) of 0.53 inches/year was used. For wet weather simulations, the average recharge based on data from 1920 to 1982 of 0.78 inches/year was used. These rates were applied to the recharge zone for open land, and were also added to the rate of recharge calculated from other sources of water to the other recharge zones.

The groundwater recharge rates for infiltration ponds located at the Fairbanks Ranch and Rancho Santa Fe waste water treatment plants were estimated to be equal to the average annual flow rates into the ponds as documented in treatment plant records for 2002. The recharge rate applied to the infiltration ponds at the Whispering Palms treatment plant was estimated to be equal to the average annual flow rate into the ponds minus the reclaimed water delivered to Rancho Paseana for irrigation purposes, as documented in treatment plant records for 2003.

Estimated irrigation rates for the golf courses, equestrian areas, and residential area east of Morgan Run were based on groundwater extraction records for wells that supply the irrigation water. It was assumed that all groundwater extracted was used for irrigation, and that no other source of water, other than precipitation, was used for irrigation for all areas except Rancho Paseana. The reclaimed water obtained from the Whispering Palms wastewater treatment plant for irrigation purposes at Rancho Paseana was added to the amount of groundwater extracted for irrigation purposes, to obtain the total rate of irrigation water applied at Rancho Paseana. The groundwater recharge rate in each area was assumed to be a percentage (1% to 10%) of the total water applied as irrigation. The percentage was based on the general surface soil types, and information from property owners regarding general percolation qualities.

3.1.4 Boundary Conditions

Boundary conditions used in the model include no-flow, constant head, river, and drain boundaries. Areas of the model domain outside the drainage basin boundary were assigned no-flow boundary conditions in all model layers. Constant heads were set at the upper end of the San Dieguito alluvial channel and at the coast (head = sea level) (Figure J-2). The constant head at the upper end of the alluvium was included to simulate subsurface flow entering into the alluvial basin from outside the model domain.

River boundary conditions were placed along the location of the current river. The heads in the river were set based on measured water level elevations at several locations along the river, and interpolated in between. During wet weather simulations, water flows through all reaches of the river. The heads in the river are based on measured water level elevations during a fairly wet period in which there was substantial flow in all reaches of the river in 1998, and interpolated between measurements. During dry weather simulations, the river in the vicinity of Morgan Run golf course and to the north is dry, so the river nodes in the northern part of the alluvial basin are absent, and the river in the vicinity of Morgan Run is simulated using drain boundary conditions (such that if water levels rise above the base of the river, the water is removed from the simulation). The heads in the portion of the river that flows during dry conditions are based on measured water level elevations during a fairly dry period in 2002, and interpolated between measurements.

3.1.5 Seasonal Groundwater Extraction at Current Regional Wells

Groundwater extraction from regional wells in the basin was incorporated into the model. The groundwater users in the basin were identified (Figure J-12), and extraction rates were estimated based on the reported extraction by each user, where available (H+A, 2002, Appendix G). For wells in which extraction data is not available (i.e. flow meter data or estimates of extraction obtained during interviews with well owners), the amount of groundwater extraction was estimated based on approximate acreage of the property that uses the extracted water for irrigation. The extraction rates at each well were roughly translated to quarterly extraction rates that represent the four seasons a year such that 20% of the annual extraction is in fall (October to December), 5% is in winter (January to March), 30% is in spring (April to June), and 45% is in summer (July to September). The general schedule of seasonal extraction was based on wells with available extraction data. The seasonal groundwater extraction rate at regional wells is summarized in Table J-3.

3.2 FLOW MODEL CALIBRATION

Flow model calibration was performed to benchmark the model against measured groundwater conditions in the study area. Two phases of calibration were conducted: 1) Steady-state calibration (seasonal extraction from regional wells not included), and 2) Transient calibration (seasonal extraction from regional wells included). The objective of the flow calibration was to obtain an acceptable agreement between measured and projected groundwater elevations, flow directions and vertical gradients. The majority of observed water level data available for calibration was collected during generally dry weather conditions, so the model was initially calibrated using the dry weather recharge and river boundary conditions.

3.2.1 Steady-State Model Calibration

The model-projected steady-state water levels in Layer 3 were compared to water levels in the alluvial basin in 1982 at the onset of dry weather conditions, when the basin was essentially full of groundwater due to the preceding years of wet weather conditions (Izbicki, 1983). Although the 1982 water levels do not truly represent "steady-state" conditions, where no groundwater is being extracted from the alluvial basin, they are sufficient for the purposes of the steady-state model calibration. The steady-state model was relatively insensitive to changes in hydraulic parameters due to the boundary conditions set in the model. Therefore, the steady-state model was primarily used to calibrate the constant head value set at the upper end of the San Dieguito river channel.

Calibrated steady-state model projected heads are shown in Figure J-13. Calibrated model projected heads compared with the 1982 observed water level measurements at select locations are summarized in Table J-4 and Figure J-14. The final calibrated steady-state groundwater model provided reasonable matches to water level elevations and direction of groundwater flow with a residual mean of –0.6 feet. The heads predicted by the steady-model were used as the initial, water level conditions for the transient model, which simulated the effects of seasonal groundwater extraction from regional wells.

3.2.2 Transient Model Calibration

The model projected transient water levels in Layers 1 and 3, were compared to observed water levels at select monitor wells in 2001 to 2003. Specifically, the seasonal high and low water level elevations and degree of seasonal fluctuation were evaluated. Horizontal and vertical hydraulic conductivities and specific yield in Model Layers 1 to 5 were varied within reasonable ranges based on available data during the transient model calibration.

Calibrated transient model projected heads compared with observed water level data at select monitor wells (Figure J-15) are summarized in Table J-5 and Figures J-16 and J-17. The final calibrated transient groundwater model provided reasonable matches to water level elevations, direction of groundwater flow, and seasonal fluctuations in groundwater levels with a residual mean of –0.09 feet. Calibrated transient model projected water levels for a period of 10 years in Layers 1 and 3 at select wells are shown in Figures J-18 to J-25.

3.2.3 Calibration of Wet Weather Simulations

Subsequent to calibration of the steady-state and transient models with dry weather conditions, the calibrated steady-state and transient models were simulated with the wet weather recharge and river conditions. Isolated water level measurements were collected at some of the project monitor wells during 1998, which was a moderately wet weather year (H+A, 2000). The 1998 data suggest that water levels in the basin may rise several feet during moderately wet weather conditions. Limited evaluation of projected water levels from the wet weather simulations suggests the calibrated parameter values from the dry weather simulations are reasonable, however, extensive observed water level data during truly wet weather conditions is not available for comparison. Model-projected steady-state water levels in the basin during wet weather conditions are shown in Figure J-26. Transient model projected water levels in Layer 3 during wet weather conditions are shown in Figures J-18 to J-25.

4.0 AQUIFER STORAGE AND RECOVERY PROJECT FLOW MODEL INJECTION/EXTRACTION SCENARIOS

Groundwater flow modeling consisting of the project scenario was conducted to simulate the effects of a proposed ASR (Table J-6). The aquifer storage and recovery project was simulated using the model for a period of 13 years. In order to evaluate the project performance during extremes in possible weather conditions, the simulation was conducted assuming seven years of project injection/extraction under dry conditions followed by six years of project injection/extraction under wet conditions. During each year of the simulation 150 acre feet (AF) of reclaimed water was injected into two project wells (Figure J-27) for three months each winter at a combined rate of 372 gallons per minute (gpm). The injected water was recovered over a period of six months during the spring and summer using the same two project wells pumping at a combined rate of 186 gpm. Water level hydrographs were prepared comparing the model projected baseline seasonal water level fluctuations with no project, to the water level fluctuations that are projected to occur with project injection and extraction at select monitoring wells, nearby existing extraction wells, and several areas of interest within the model domain in Layer 1, which currently do have monitor wells (Figure J-27; Figures J-28 to J-39). Refer to the main text of the report for a discussion of results of project flow modeling.

5.0 TOTAL DISSOLVED SOLIDS TRANSPORT MODEL

Solute transport modeling of TDS mixing was conducted for the ASR project scenario using the United States Department of Defense code MT3DMS in conjunction with the USGS code MODFLOW (Zheng et al., 1999). MT3DMS is a modular three-dimensional multispecies transport model for simulation of advection, dispersion, and chemical reactions of solutes in groundwater. The objective of the solute transport modeling was to estimate the TDS of the water removed from the alluvial aquifer during the extraction phase of the proposed ASR project. The projected TDS of water removed from the two project wells is shown in Figure J-40 and J-41.

Development of the TDS transport model required definition of the current distribution of TDS concentrations in groundwater, TDS of water entering the groundwater system from recharge sources including the TDS distribution in the river during wet and dry weather conditions, and solute transport parameters. The following discussion addresses the construction of the TDS solute transport model. Refer to the main text of the report for a discussion of results of the TDS transport modeling.

5.1 CURRENT TOTAL DISSOLVED SOLIDS DISTRIBUTION IN GROUNDWATER

The current distribution of TDS used in the model is based on laboratory derived data from water samples collected at monitoring wells in 2001 to 2003, and estimates of TDS based on specific conductance measured at monitoring wells in 2003, where available. Where recent TDS data is not available, the TDS distribution used in the previous model (based on comprehensive data set compiled by the USGS in 1982) was incorporated (Izbicki, 1983; CH2Mhill, 1995; HYA, 1997). The TDS of groundwater in bedrock was estimated to be 5000 milligrams per liter (mg/l) based on typical values of TDS for the bedrock reported by the

USGS (Izbicki, 1983). The current distribution of TDS in the alluvium used in the model in Layers 1 and 3 are shown in Figures J-42 and J-43.

Based on the current distribution of TDS in groundwater, the TDS of groundwater entering the model from the constant head boundary at the upper end of the alluvial basin was estimated to be 1700 mg/l.

5.2 TOTAL DISSOLVED SOLIDS CONCENTRATION OF RECHARGE WATER

TDS concentration was estimated for recharge water from precipitation, waste water treatment plant infiltration ponds, and return flow from irrigation. The TDS concentration used for each recharge zone is summarized in Table J-2.

The average TDS of recharge water from precipitation in areas of bedrock was estimated to be 5000 mg/l. This value is based on reported typical values of TDS for the type of bedrock in the area (Izbicki, 1983).

Estimated TDS concentrations of recharge water from the infiltration ponds located at the Whispering Palms, Fairbanks Ranch, and Rancho Santa Fe waste water treatment plants were based on TDS values reported by the treatment plants in 2003.

Estimated TDS concentrations of irrigation return flow for the golf courses, equestrian areas, and residential area east of Morgan Run were based on the TDS of groundwater at the wells that supply the irrigation water. The TDS of irrigation return flow at Rancho Paseana was estimated to be the weighted average of the TDS of reclaimed water supplied by the Whispering Palms waste water treatment plant and groundwater extracted for irrigation purposes.

The river TDS distribution during dry weather conditions was estimated based on specific conductance measurements from various points along the river in 2003, and interpolated in between. TDS in the river during dry weather conditions ranges from 20,000 mg/l at the coast, to 2500 mg/l at the uppermost wet reach of the river. During wet weather simulations, the river TDS was estimated to be 1000 mg/l in all reaches of the river based on the range of observed TDS in the river in 1981 and 1982 (wet weather conditions) reported by the USGS (Izbicki, 1983).

5.3 SOLUTE TRANSPORT PARAMETERS

Estimates of the solute transport parameters effective porosity and dispersivity were required for the TDS transport model. Effective porosity was estimated to be 20% across the model domain based on the types of sediments within the alluvial basin. Longitudinal, transverse, and vertical dispersivity was estimated to be 100 feet, 10 feet, and 1 foot based on published field-measured values of longitudinal dispersivity (Gelhar, 1986).

6.0 SENSITIVITY ANALYSIS

Sensitivity analysis consisting of five model runs was conducted to evaluate the sensitivity of the groundwater model to uncertainties in select hydraulic properties (Table J-7). The analysis was conducted on the ASR project scenario so the potential effects of parameter uncertainty on the project could be evaluated. Sensitivity of the flow model to Layer 2 aquitard hydraulic conductivity, bedrock hydraulic conductivity, and Layer 3 hydraulic conductivity was evaluated.

6.1 LAYER 2 AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

Hydraulic conductivity of the aquitard in Model Layer 2 was increased by a factor of 100 during sensitivity analysis. In Layer 3 monitor wells, an increase in aquitard hydraulic conductivity by a factor of 100 causes a decrease in maximum projected water levels of up to approximately six feet during the project injection, and a decrease in the maximum drawdown of up to eight feet during the project extraction (Figures J-44 to J-48).

Projected water levels in the Layer 1 monitor wells are generally not affected by an increase in aquitard hydraulic conductivity by a factor of 100 (Figures J-49 to J-51). There is a slight decrease (up to 0.5 feet) in projected water levels at the Layer 1 piezometer P-11a (Figure J-49).

6.2 BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

Hydraulic conductivity of the bedrock was increased and decreased by a factor of ten during sensitivity analysis. In Layer 3 monitor wells, an increase in bedrock hydraulic conductivity by a factor of ten causes an increase of maximum projected water levels of up to approximately four feet during project injection, and a decrease in the maximum projected drawdown of up to approximately 13 feet during the project extraction (Figures J-52 to J-56). Decrease of bedrock hydraulic conductivity by a factor of ten causes a decrease in the maximum projected water levels of up to approximately ten feet during project injection, and an increase in the maximum drawdown of up to approximately 11 feet during project extraction.

Projected water levels in the Layer 1 monitor wells are generally not greatly affected by an increase or decrease of bedrock hydraulic conductivity by a factor of ten (Figures J-57 to J-59). An increase of bedrock hydraulic conductivity by a factor of ten causes projected water levels in Layer 1 to increase by several feet (up to 2.5 feet) in some areas; and a decrease of bedrock hydraulic conductivity by a factor of ten causes projected water levels to decrease by several feet (up to four feet) in some areas.

6.3 LAYER 3 HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

Hydraulic conductivity of all Layer 3 zones was increased and decreased by a factor of two during sensitivity analysis. In Layer 3 monitor wells, an increase by a factor of two causes a decrease of maximum projected water levels of up to approximately eight feet during project injection, and a decrease in the maximum projected drawdown of up to approximately 13 feet during the project extraction (Figures J-60 to J-64). A decrease of Layer 3 hydraulic conductivity by a factor of two causes an increase in the maximum projected water levels of up to approximately ten feet during project injection, and an increase in the maximum projected drawdown of up to approximately 20 feet during project extraction.

Projected water levels in the Layer 1 monitor wells are generally not affected by an increase of Layer 3 hydraulic conductivity by a factor of two (Figures J-65 to J-67). Decrease in Layer 3 hydraulic conductivity by a factor of two causes an increase in the maximum projected drawdown during project extraction up to two feet in some areas.

7.0 REFERENCES

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TABLE J-1

MODEL HYDRAULIC CONDUCTIVITY ZONE SUMMARY

Zone Number	Layers Zone Occurs	Horizontal Hydraulic Conductivity (ft/d)	Vertical Hydraulic Conductivity (ft/day)
1	2	4.7E-04	4.7E-05
4	4	0.10	0.01
5	1 to 5	0.1	0.0001
8	2	0.3	0.03
9	3	5	0.5
12	2, 3	50	5
13	2, 3	100	10
14	3	150	15
15	3	200	20
16	1	250	25
17	2, 3	300	30
20	3	450	45
21	1, 2, 3	500	50
22	1	900	90
23	5	0.1	0.0001
24	5	0.1	0.0001
25	2	0.00047	0.000047
26	1	5	0.5
27	1, 2	50	5
28	1	150	1.5
30	3	5	0.5
31	3	300	30
33	2	1	0.1

TABLE J-2

MODEL RECHARGE ZONE SUMMARY

Zone Number	Recharge (feet/day)	Total Dissolved Solids Concentration (mg/l)
3	7.97E-02	1000
4	2.31E-01	700
5	4.93E-01	1000
6	1.06E-03	2500
7	5.33E-04	2100
8	4.28E-04	1900
9	2.20E-04	4600
10	4.36E-04	2500
11	4.31E-04	4600
12	4.42E-04	1400
13	1.78E-04	5000

TABLE J-3

REGIONAL WELL SEASONAL GROUNDWATER EXTRACTION RATES

	Extraction Rates (gallons per minute)			
Regional Extraction Well Project ID	Fall (October to December)	Winter (January to March)	Spring (April to June)	Summer (July to September)
28-QA	16	4	24	36
28-RA	11	3	17	25
28-RB	44	11	66	98
32-HA	8	2	12	18
32-JD	112	28	169	253
32-RB	169	42	254	380
33-BA	52	13	78	116
33-FB	99	25	149	224
33-FA	22	6	34	50
33-K8	5	1	8	11
33-LC	6	1	8	13
33-LA	7	2	11	17
33-MB	6	1	8	13
33-ME	5	1	8	12
33-ND	11	3	17	25
33-NE	3	1	5	8
33-CA	45	11	67	101
33-PA	90	22	134	201
33-PB	10	3	15	23
33C7	30	7	45	67
5-FC	62	16	93	140
7-BA	2	1	4	6
7-K3	2	1	4	6
7-LA	2	1	4	6
33-LB	7	2	11	17
33-LD	6	1	8	13
33-LE	3	1	4	6
33-MC	2	1	3	5
33-MD	2	1	3	5
33-MF	6	1	8	13
28-JA	3	1	5	8
32-JC	4	1	7	10
32-GA	4	1	6	9
33-CB	9	2	13	20

TABLE J-4
STEADY-STATE MODEL CALIBRATION SUMMARY

Project Well Number	Layer	Observed 1982 Water Level Elevation[1] (ft msl)	Model Projected Steady-State Water Level Elevation (ft msl)	Residual
33B3	3	30.4	29.4	1.0
5H4	3	19.2	21.2	-2.0
4N1	3	28.2	25.3	2.9
33N2	3	20.9	21.8	-0.9
33E3	3	21.3	22.8	-1.5
33K8	3	23.5	22.3	1.2
5F1	3	17.5	20.8	-3.3
6Q2	3	15.1	17.1	-2.0

[1] From Izbicki, 1983

TABLE J-5
TRANSIENT MODEL CALIBRATION SUMMARY

Well Identifier	Project Well Number	Model Layer	Seasonal High Water Level Elevation (feet msl)			Seasonal Low Water Level Elevation (feet msl)			Seasonal Water Level Fluctuation (feet)	
			Observed	Model Projected	Residual	Observed	Model Projected	Residual	Observed	Model Projected
Morgan Run GunR	32JD	3	17	19.1	-2.1	2	6.6	-4.6	15	12.5
Morgan Run No. 3 Green North Old 2	32RA	3	18	18.1	-0.1	1.5	-0.3	1.8	16.5	18.4
Mc Farlane North	33EA	3	17	19.8	-2.8	0	4.9	-4.9	17	14.9
Morgan Run East	33NC	3	16.5	17.9	-1.4	-4.5	-2.0	-2.5	21	19.9
Rancho Paseana, South (East)	33PA	3	16.5	17.6	-1.1	-6.5	-5.5	-1.0	23	23.1
RSF Polo Club No. 2 Replacement (2R)	5FC	3	15.5	15.6	-0.1	0	-7.9	7.9	15.5	23.5
Morgan Run Fairway 2	5H2	3	18	17.5	0.5	3.5	0.3	3.2	14.5	17.2
Morgan Run Piezometer P-4D	MRP4D	3	17	17.9	-0.9	4	0.2	3.8	13	17.7
Morgan Run Piezometer P-3	MRP3	1	18	19.5	-1.5	6.5	12.0	-5.5	11.5	7.5
Morgan Run Piezometer P-4S	MRP4S	1	18	15.9	2.1	15	15.5	-0.5	3	0.4
Morgan Run Piezometer P-6	MRP6	1	17.5	13.0	4.5	17.5	13.0	4.5	0	0.0
Morgan Run Piezometer P-9	MRP9	1	16	17.1	-1.1	13	15.3	-2.3	3	1.8
Morgan Run Piezometer P-11A	MRP11A	1	17	13.8	3.2	17	13.8	3.2	0	0.0

TABLE J-6

AQUIFER STORAGE AND RECOVERY PROGRAM PROJECT SCENARIO

Project 1: Reclaimed Water Project Only (150 AF each year)								
	Years 1 through 7 (Dry Period)				Years 8 through 13 (Wet Period)			
	Jan-March	April-June	July-Sept	Oct-Dec	Jan-March	April-June	July-Sept	Oct-Dec
Injection	150 AF (372 gpm)				150 AF (372 gpm)			
Extraction		75 AF (186 gpm)	75 AF (186 gpm)			75 AF (186 gpm)	75 AF (186 gpm)	

TABLE J-7

SENSITIVITY ANALYSIS SUMMARY

Sensitivity Parameter	Sensitivity Run	Model	Sensitivity Value
Layer 2 Aquitard Hydraulic Conductivity (Kxy, Kz)	1	Flow	100X
Bedrock Hydraulic Conductivity (Kxy, Kz)	2	Flow	10X
	3	Flow	0.1X
Layer 3 Hydraulic Conductivity - all Zones (Kxy, Kz)	4	Flow	2X
	5	Flow	1/2 X

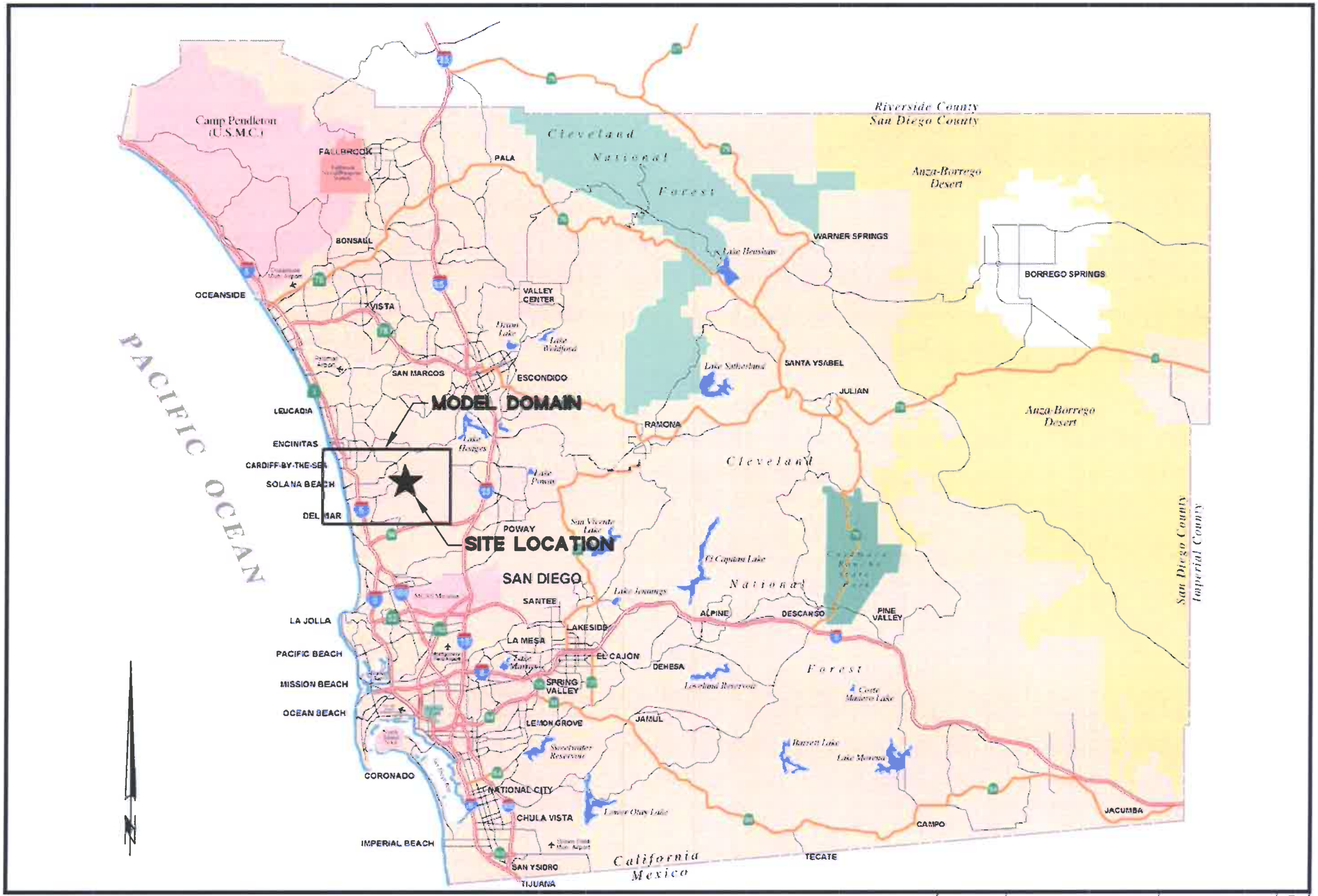

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FIGURE J–1. MODEL DOMAIN

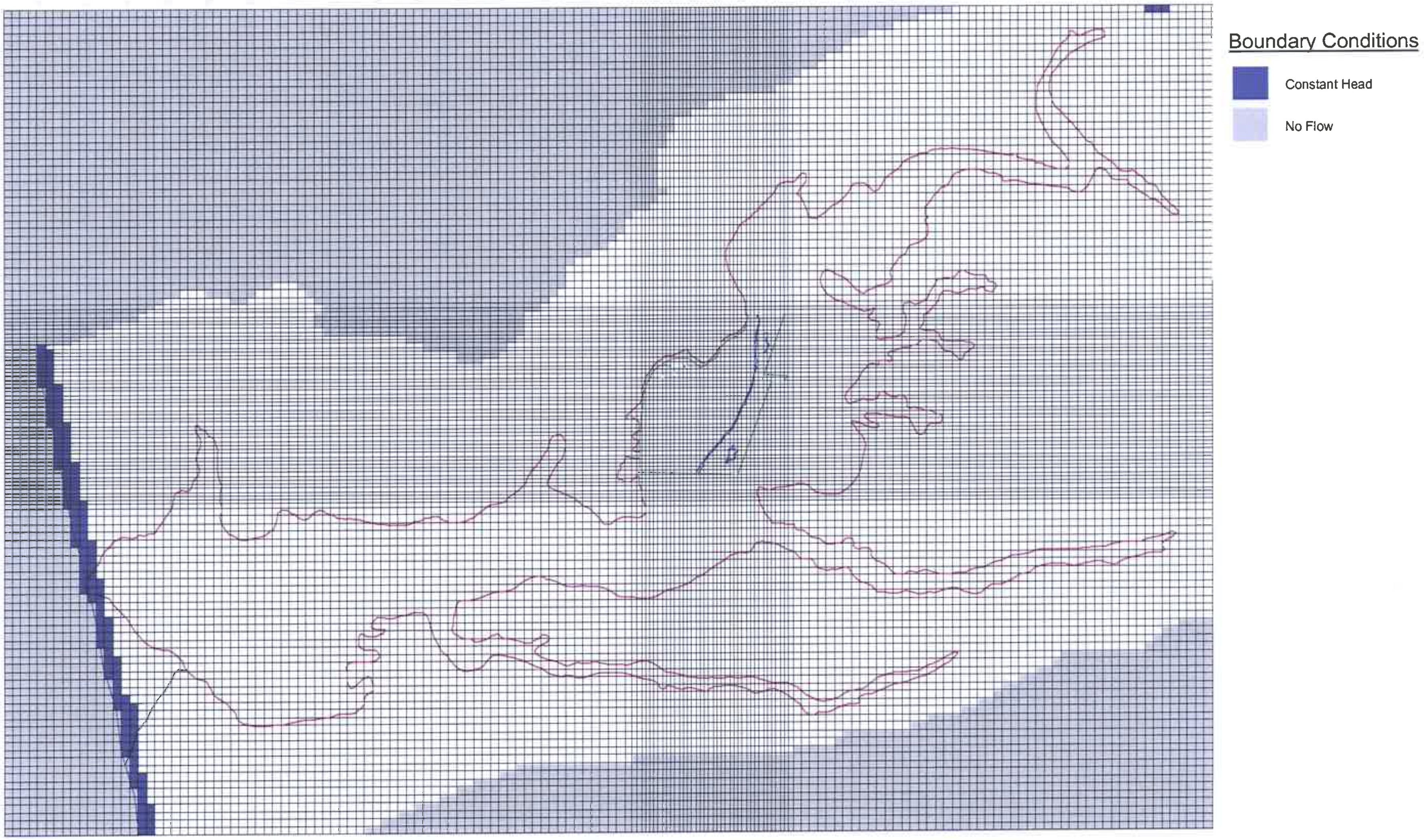

FIGURE J-2. FINITE DIFFERENCE GRID AND BOUNDARY CONDITIONS

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FIGURE J-3. MODEL LAYER 1 - BOTTOM ELEVATION

FIGURE J-4. MODEL LAYER 2 - BOTTOM ELEVATION

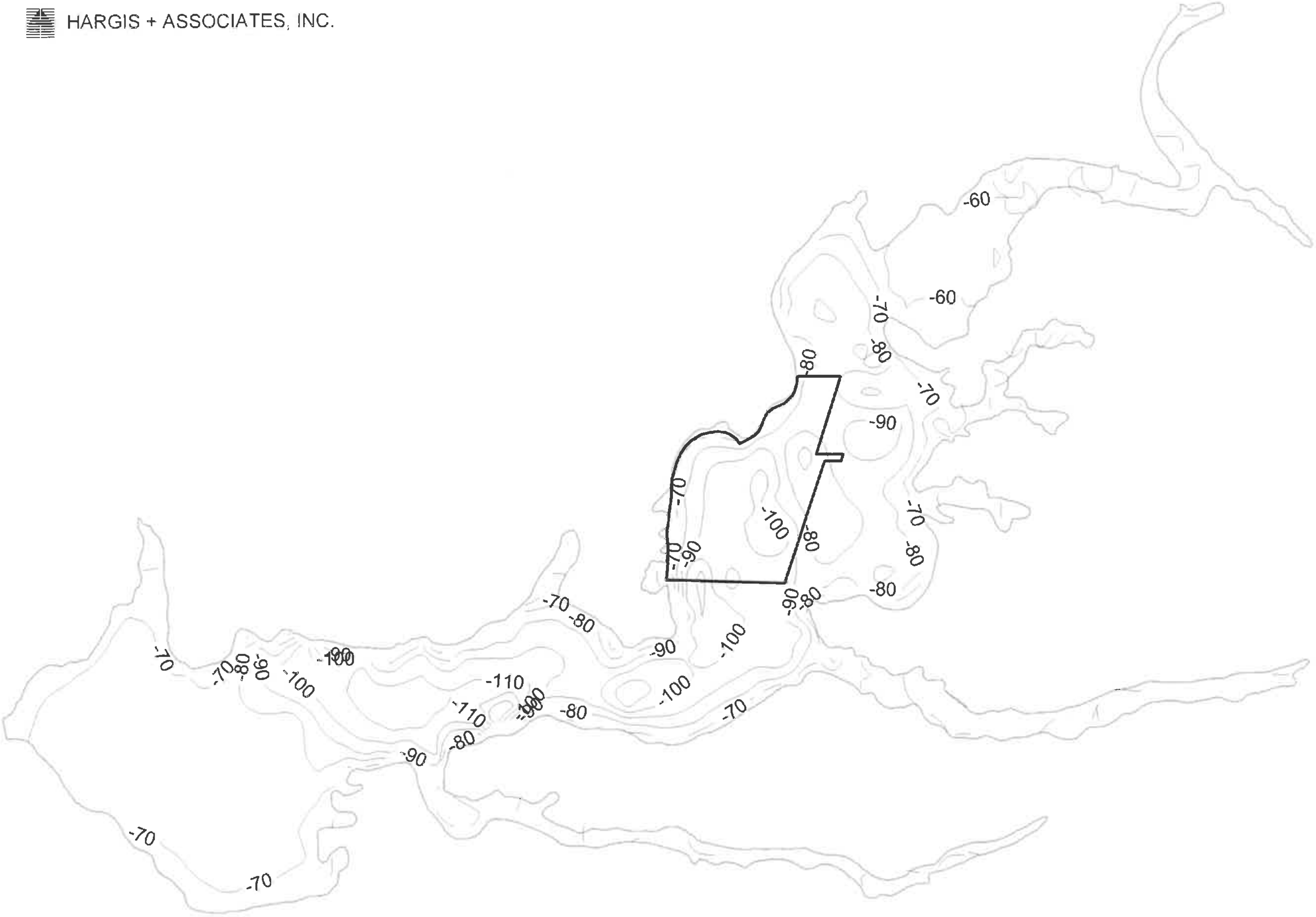

FIGURE J-5. MODEL LAYER 3 - BOTTOM ELEVATION

FIGURE J-6. MODEL LAYER 4 - BOTTOM ELEVATION

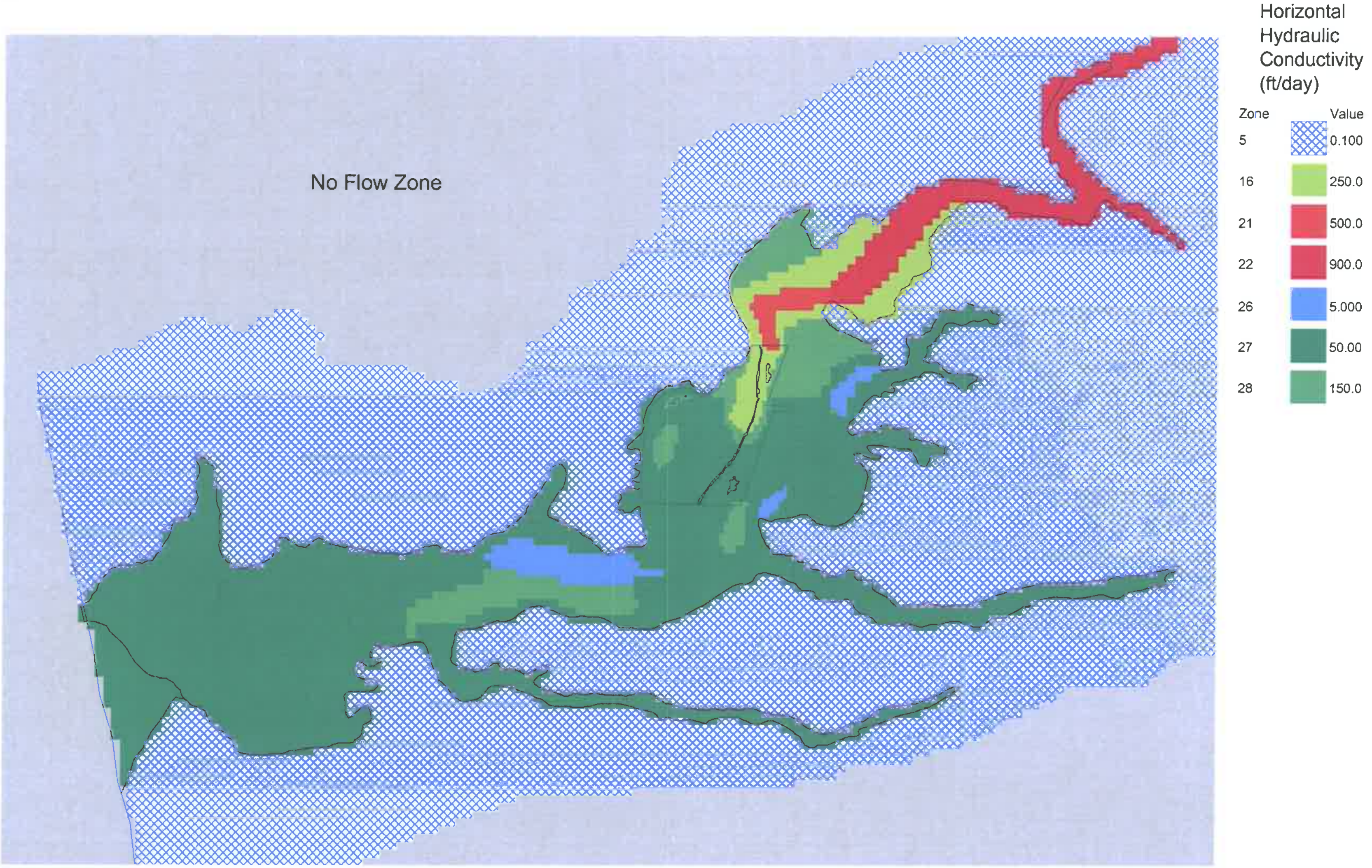

FIGURE J-7. HYDRAULIC CONDUCTIVITY ZONES - MODEL LAYER 1

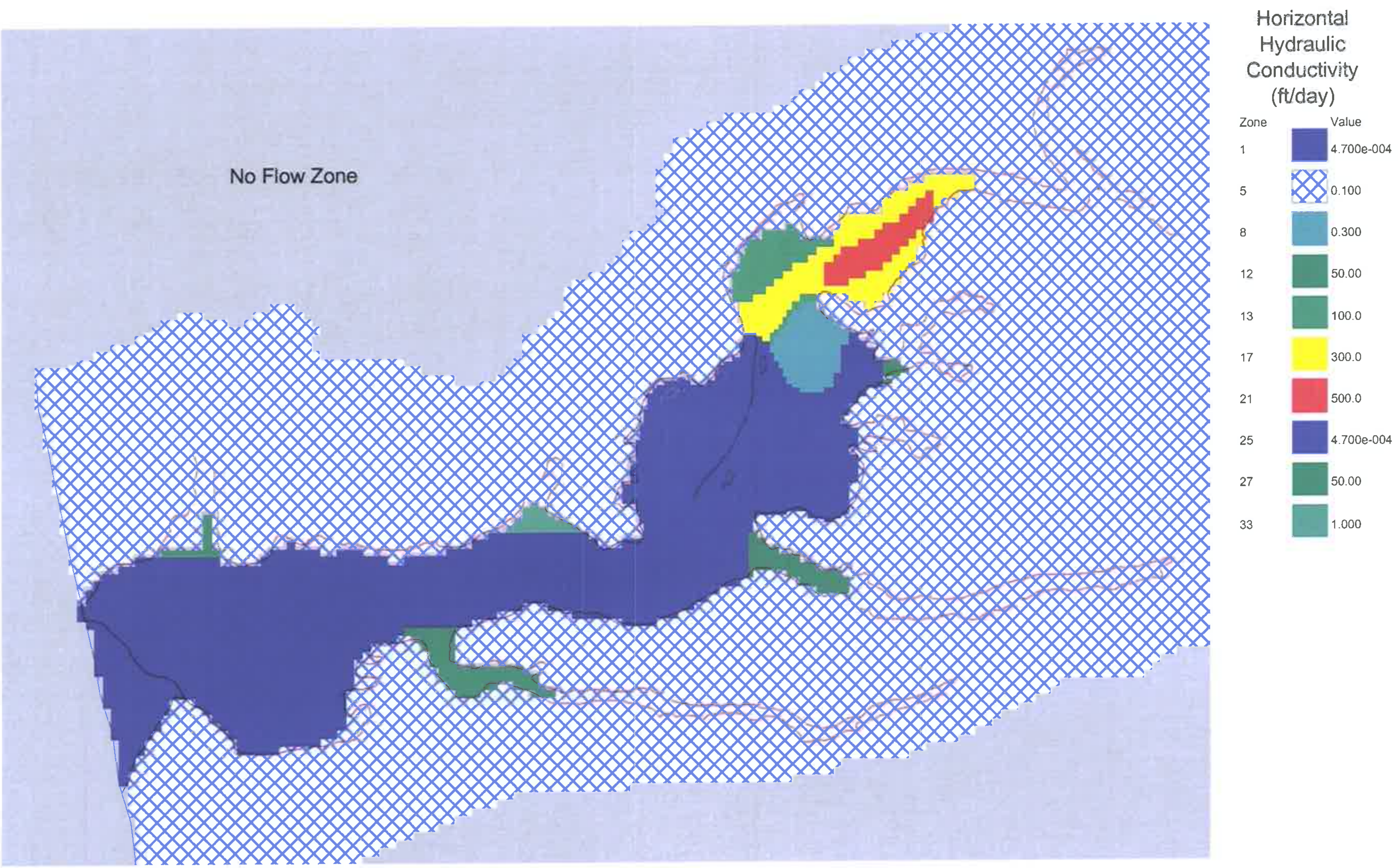

FIGURE J-8. HYDRAULIC CONDUCTIVITY ZONES - MODEL LAYER 2

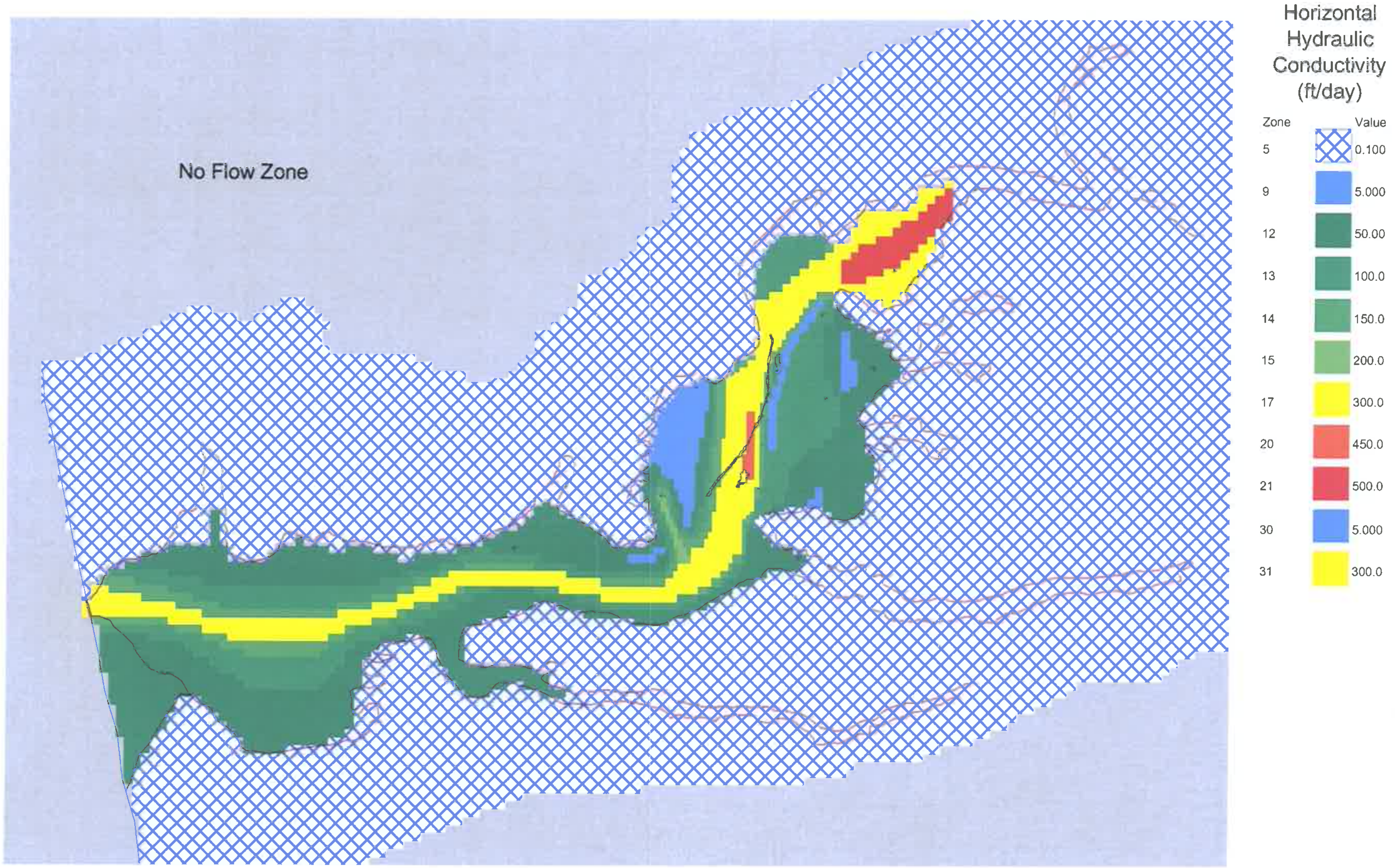

FIGURE J-9. HYDRAULIC CONDUCTIVITY ZONES - MODEL LAYER 3

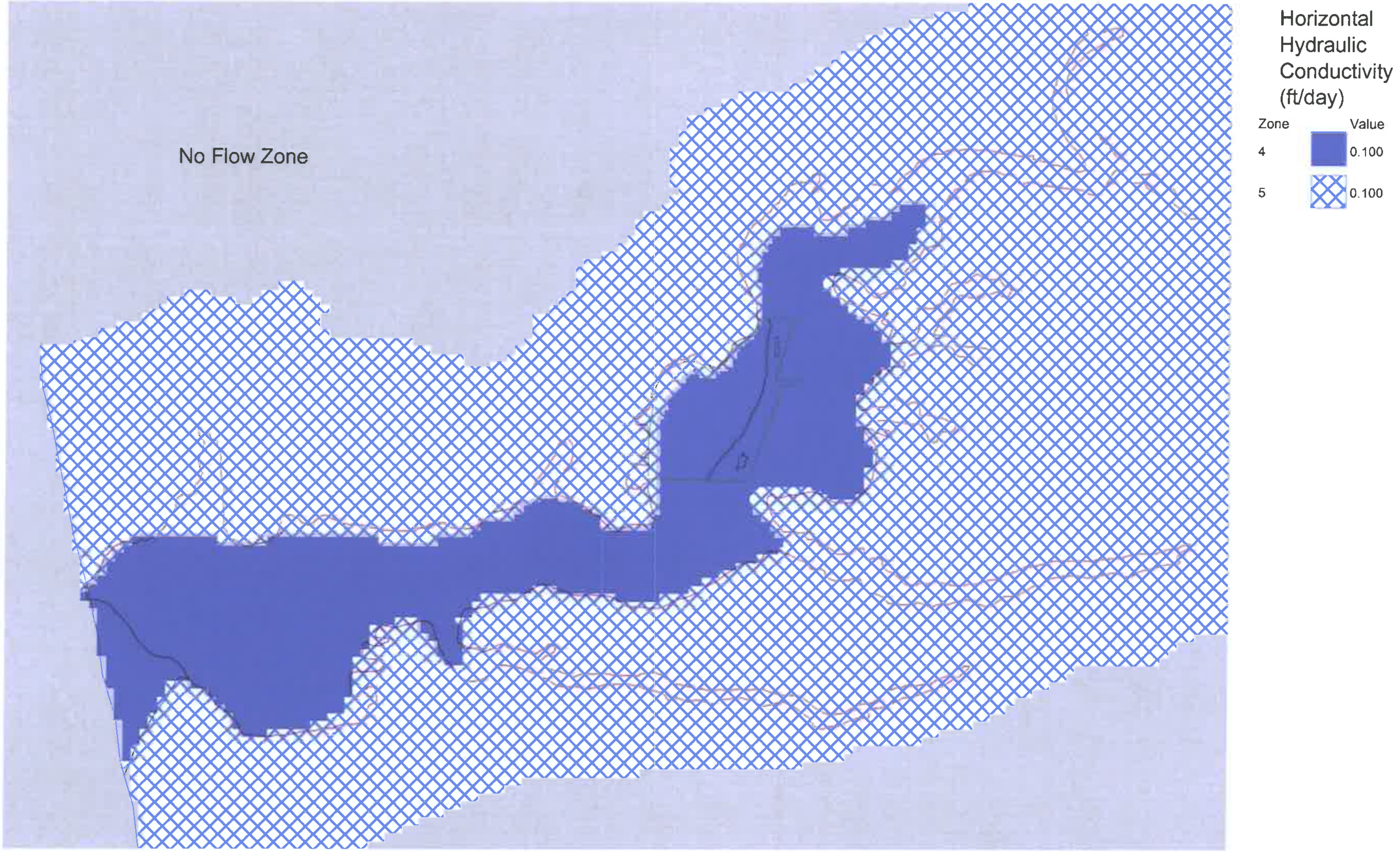

FIGURE J-10. HYDRAULIC CONDUCTIVITY ZONES - MODEL LAYER 4

FIGURE J-11. MODEL RECHARGE ZONES

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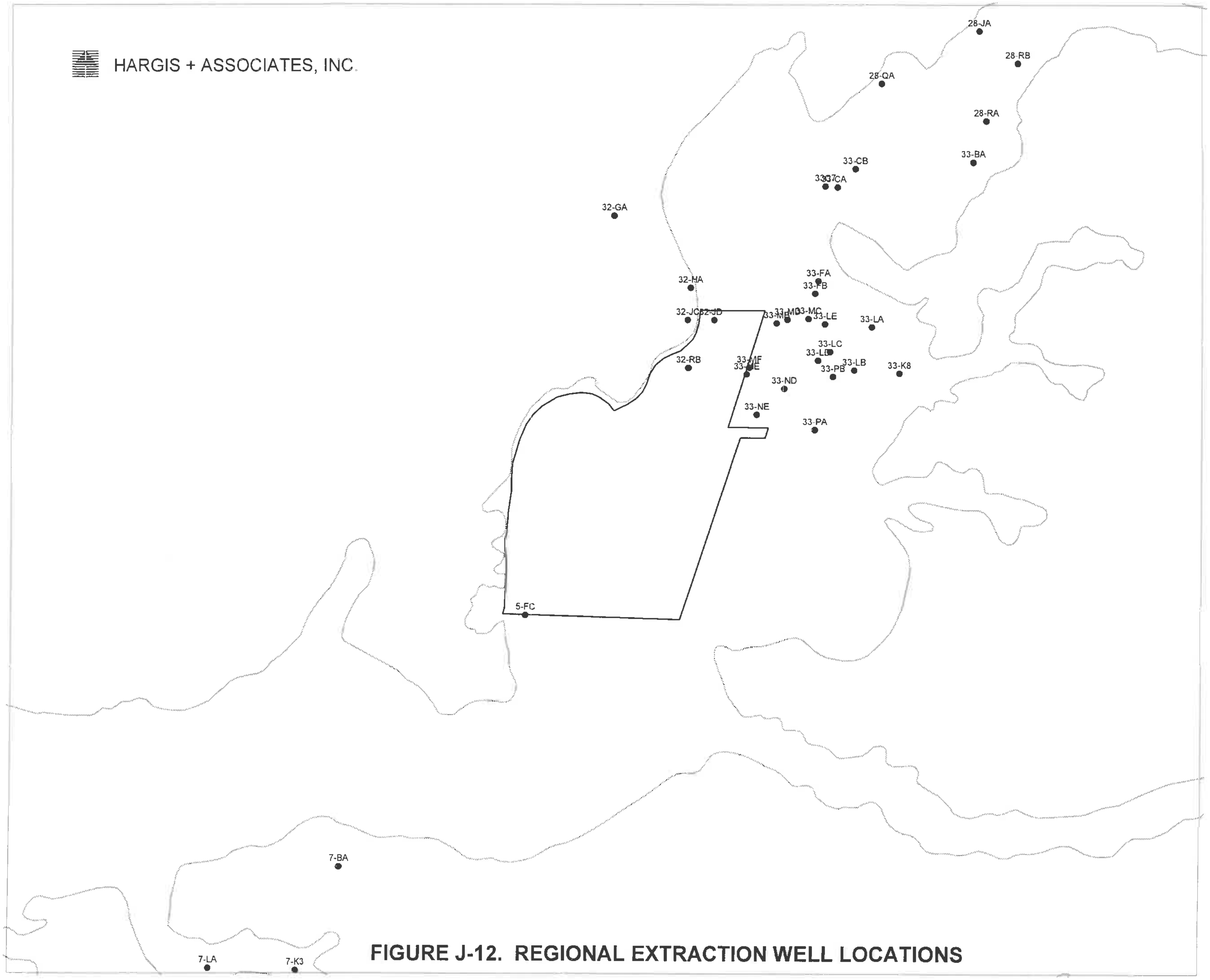

FIGURE J-12. REGIONAL EXTRACTION WELL LOCATIONS

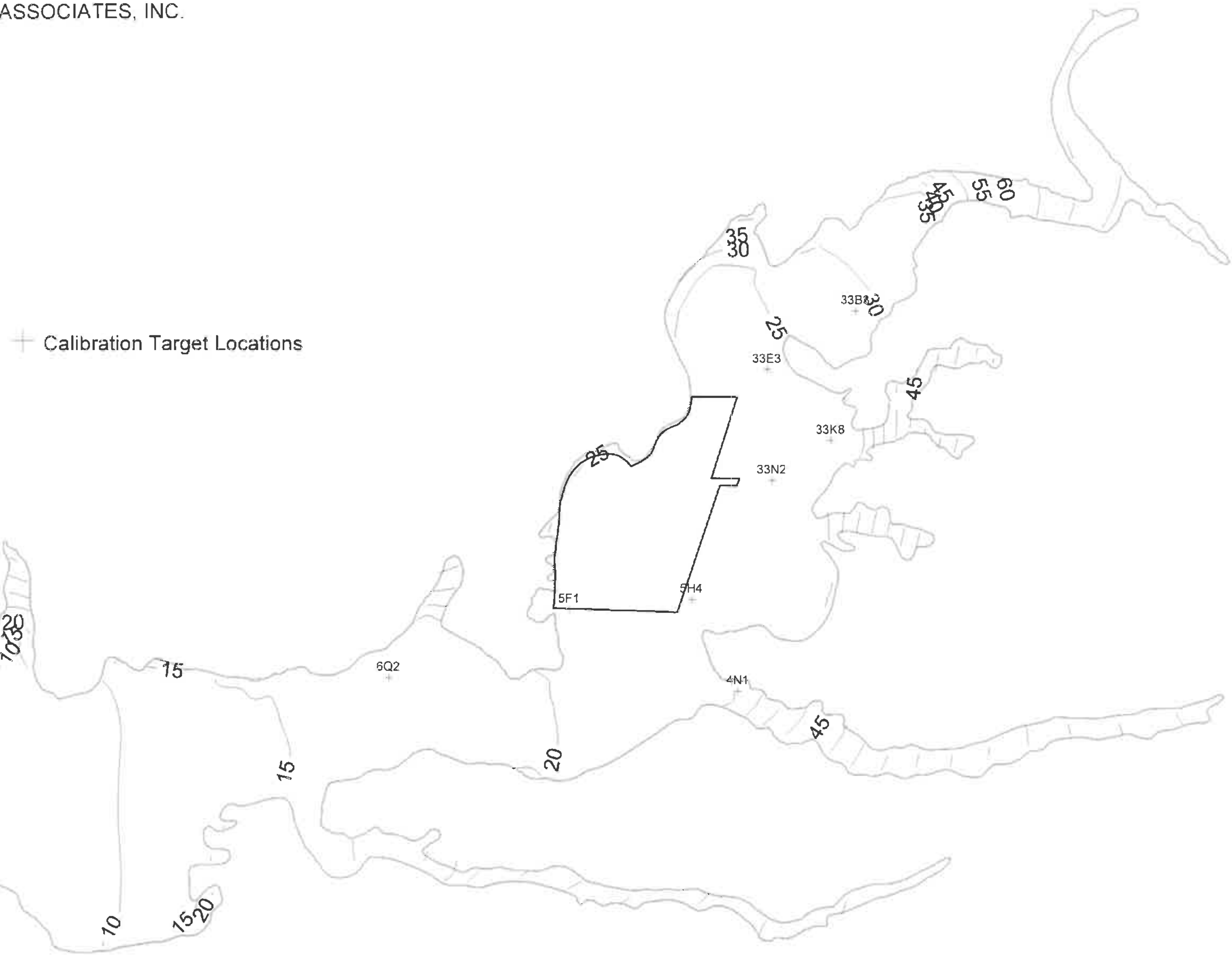

FIGURE J-13. STEADY-STATE MODEL PROJECTED HEADS - DRY WEATHER CONDITIONS

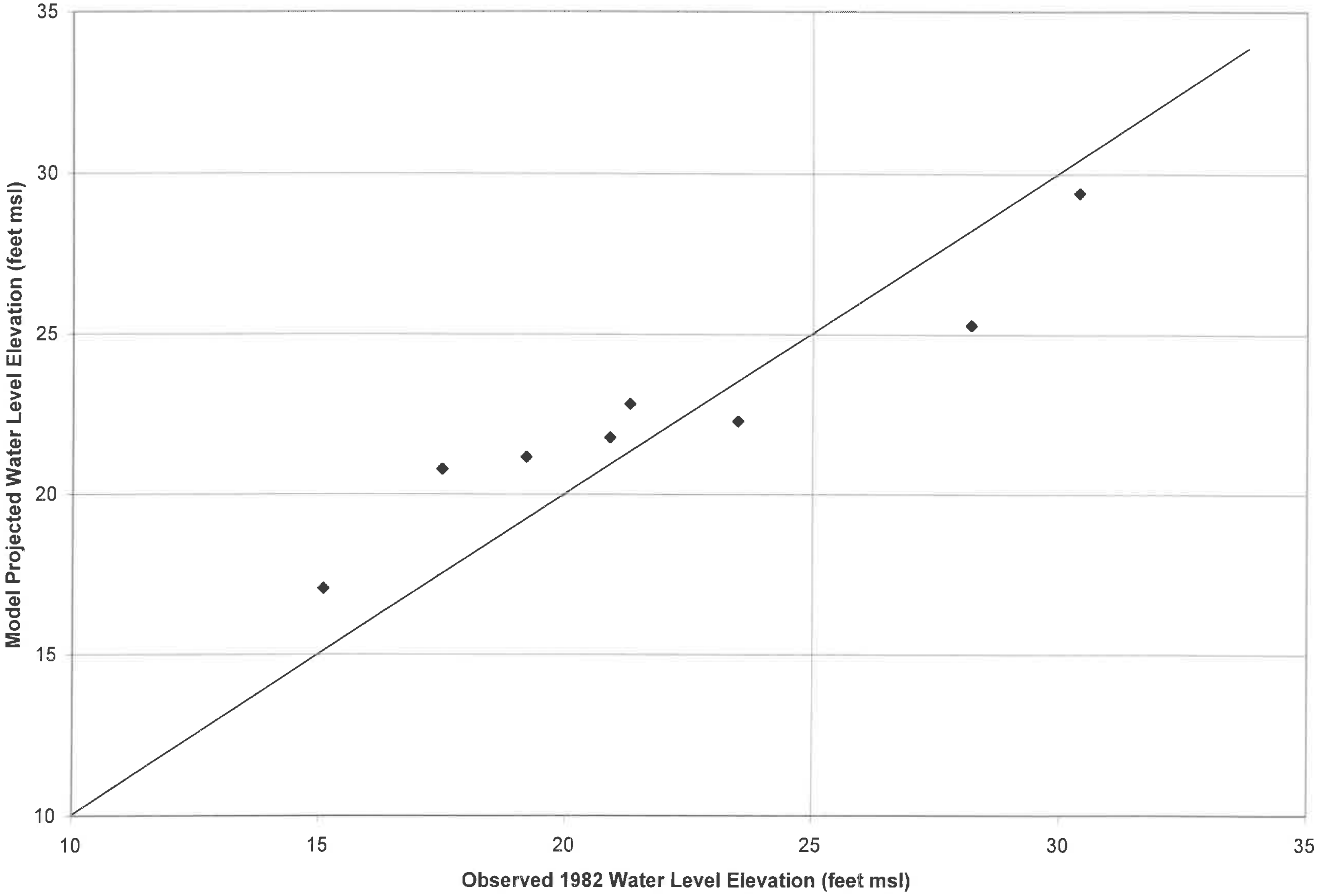

FIGURE J-14. MODEL PROJECTED STEADY-STATE AND OBSERVED 1982 WATER LEVEL ELEVATIONS

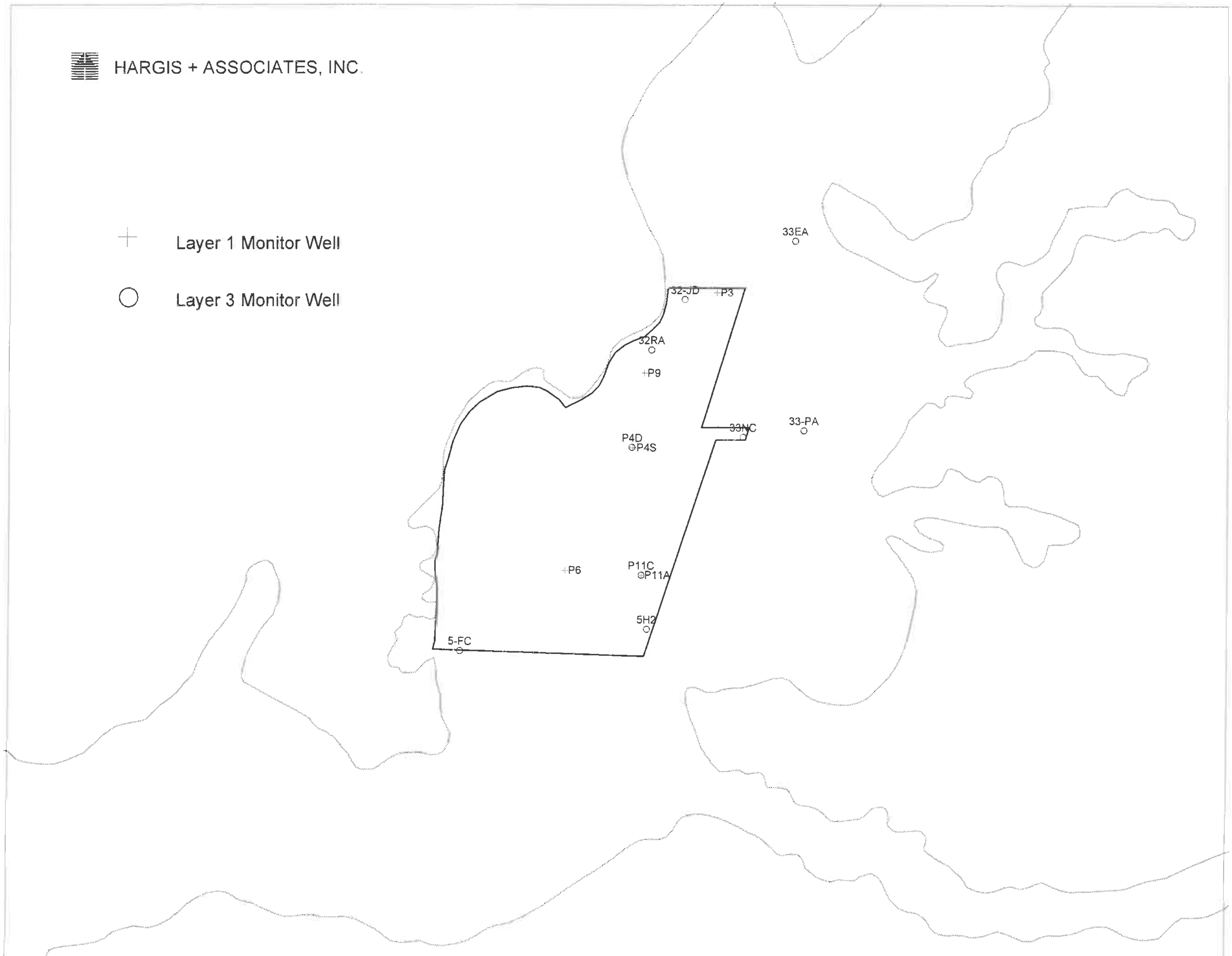

FIGURE J-15. TRANSIENT MODEL CALIBRATION TARGET LOCATIONS

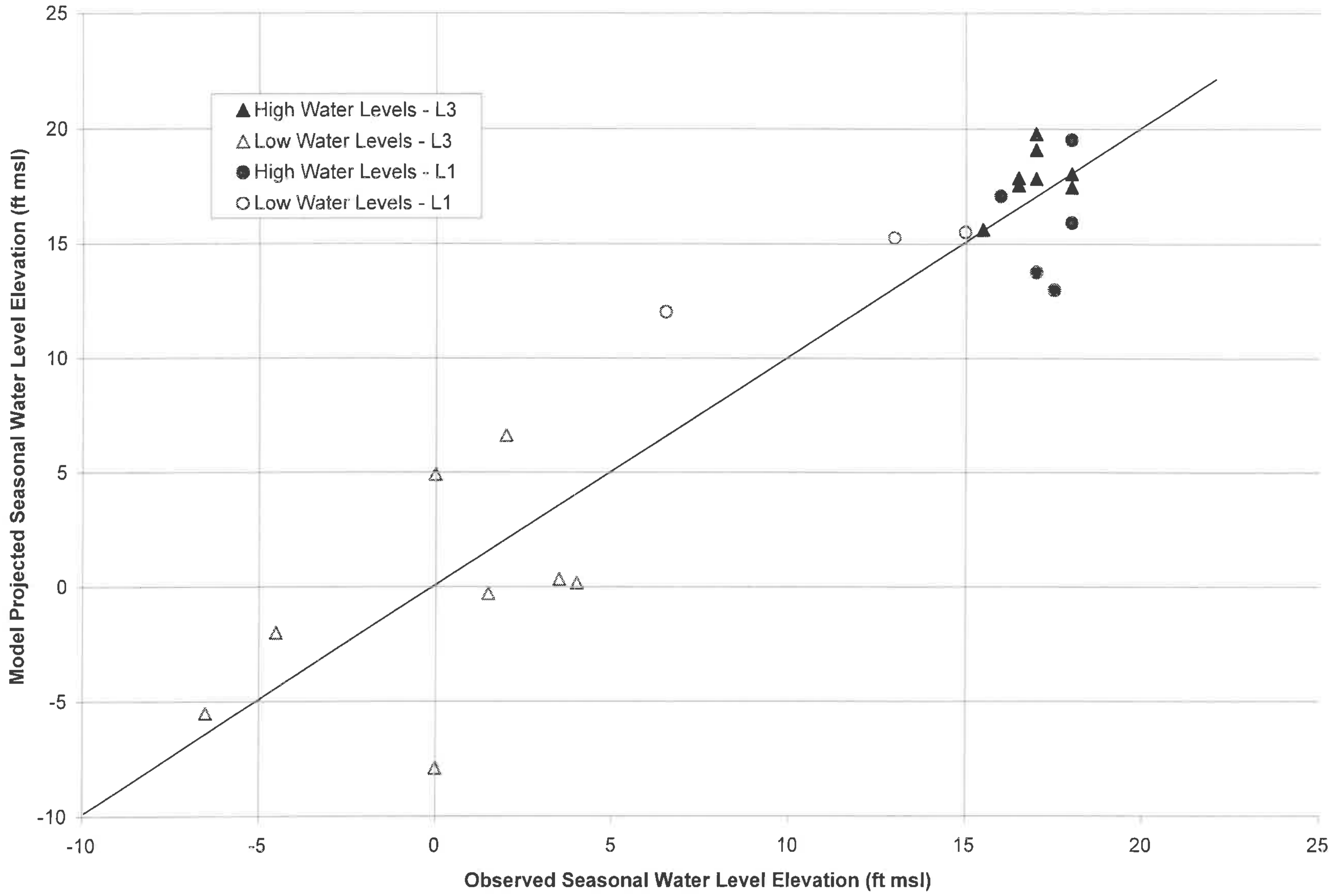

FIGURE J-16. OBSERVED AND MODEL PROJECTED SEASONAL LOW AND HIGH WATER LEVEL ELEVATIONS

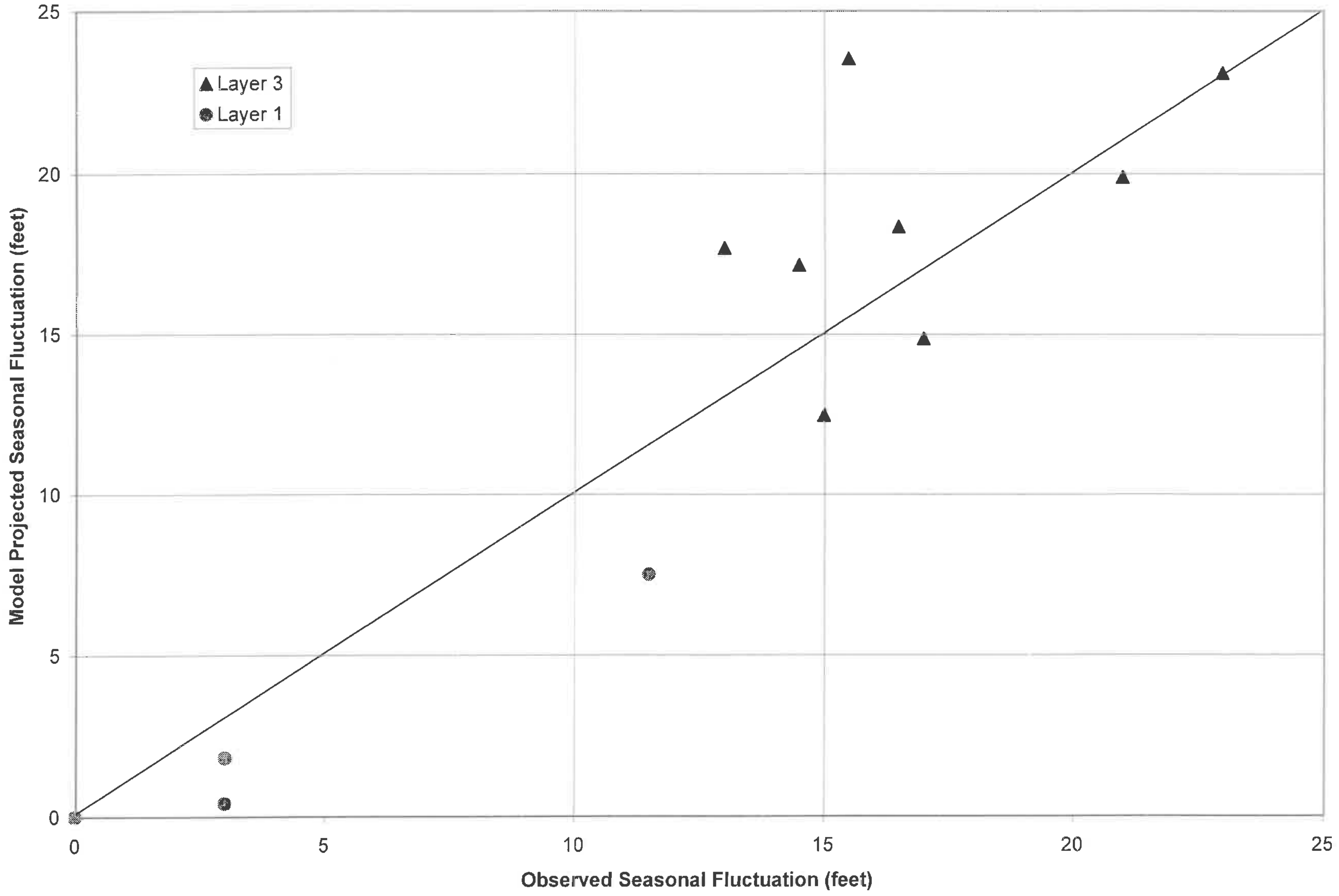

FIGURE J-17. OBSERVED AND MODEL PROJECTED SEASONAL WATER LEVEL FLUCTUATION

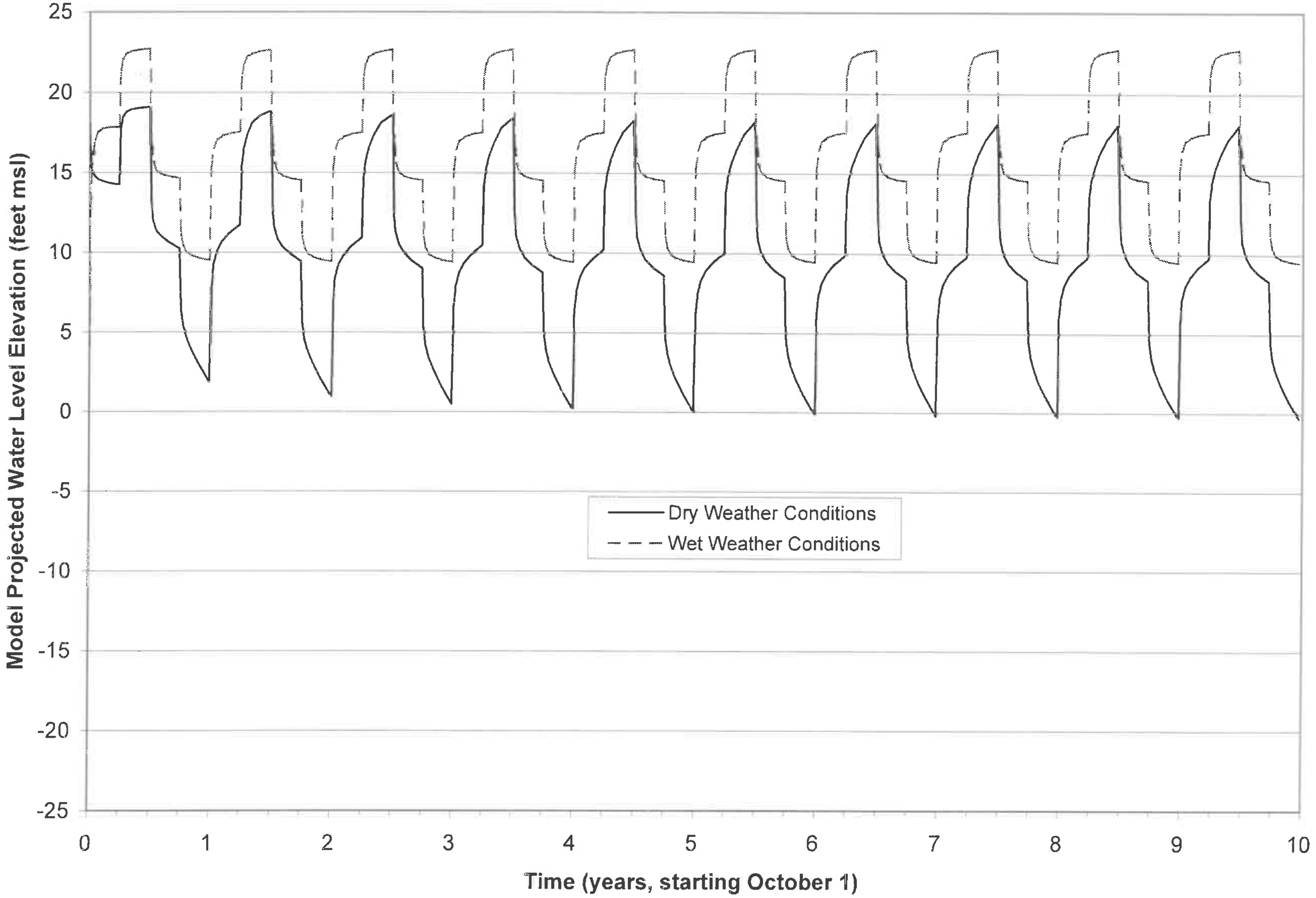

FIGURE J-18. LAYER 3 WELL 32RA TRANSIENT MODEL
PROJECTED WATER LEVEL ELEVATION

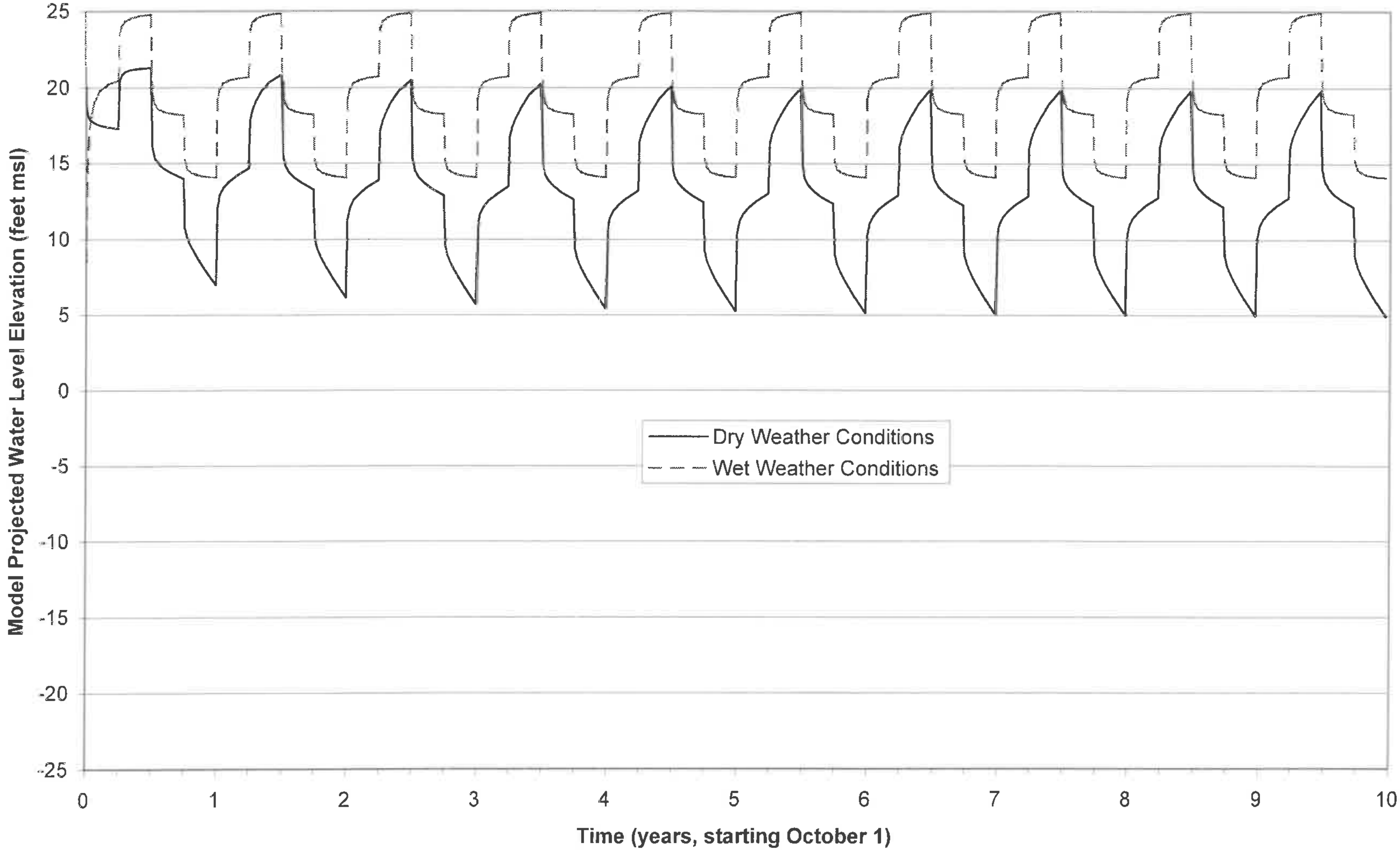

FIGURE J-19. LAYER 3 WELL 33EA TRANSIENT MODEL
PROJECTED WATER LEVEL ELEVATION

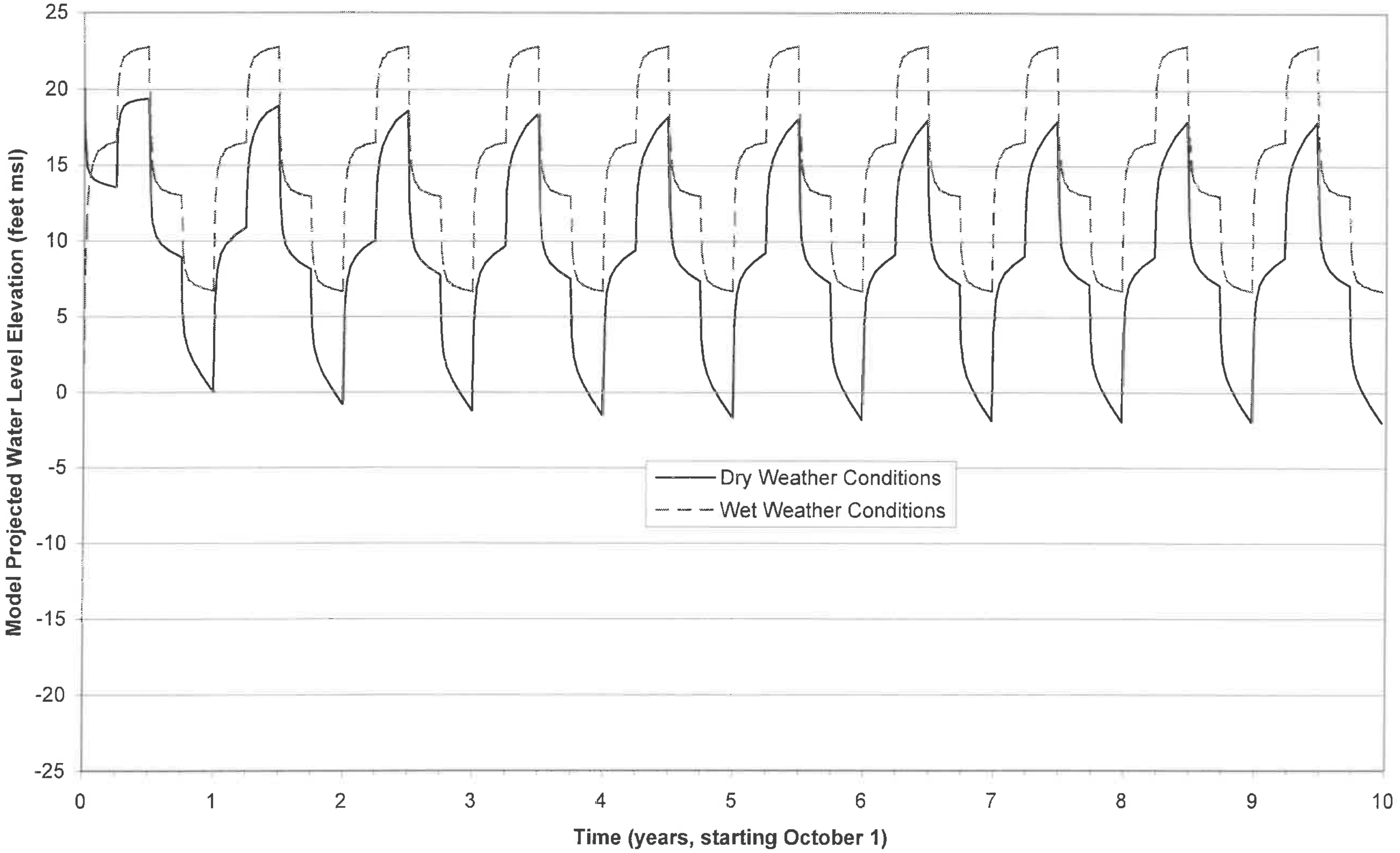

FIGURE J-20. LAYER 3 WELL 33NC TRANSIENT MODEL PROJECTED WATER LEVEL ELEVATION

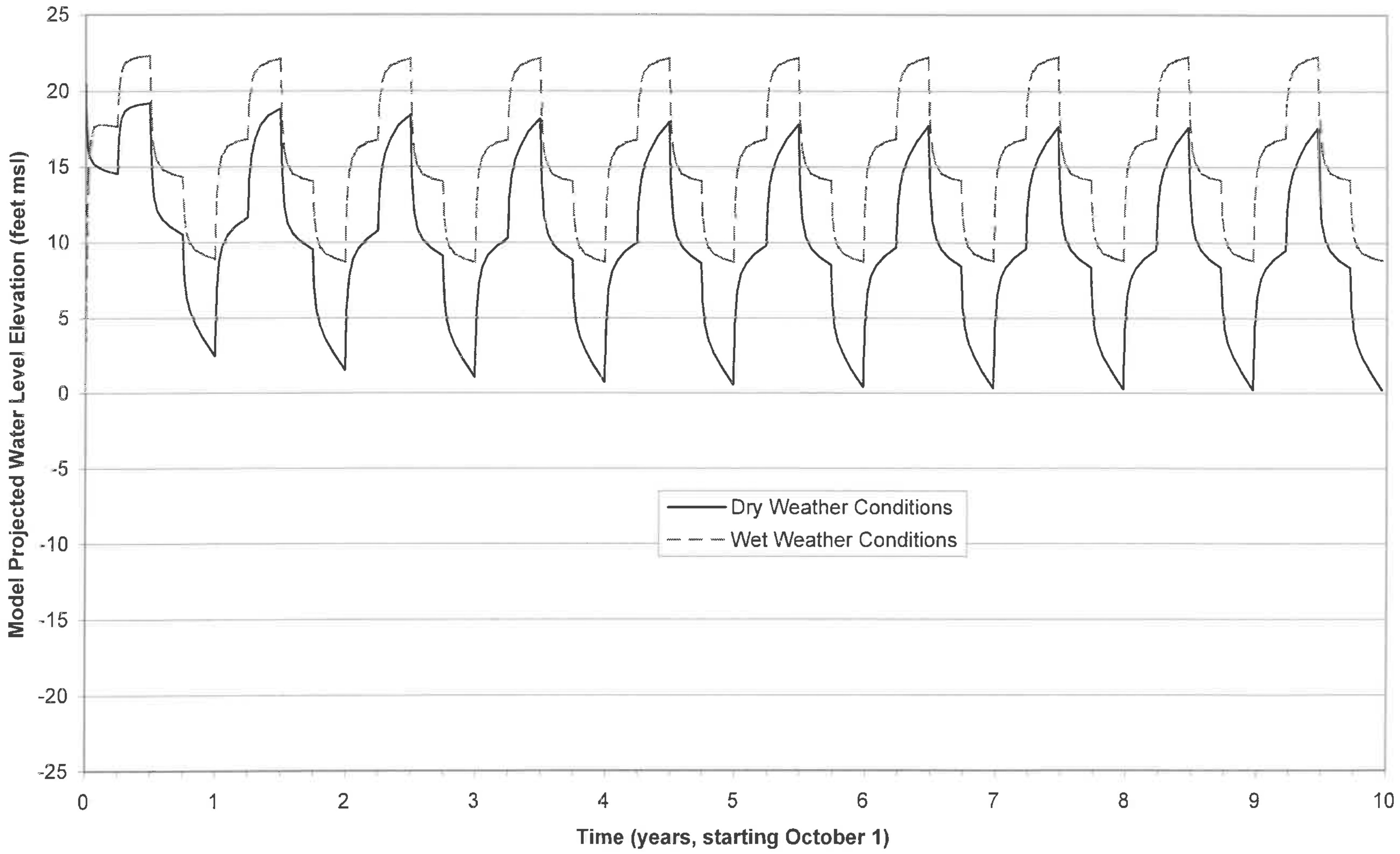

FIGURE J-21. LAYER 3 PIEZOMETER P-11C TRANSIENT MODEL PROJECTED WATER LEVEL ELEVATION

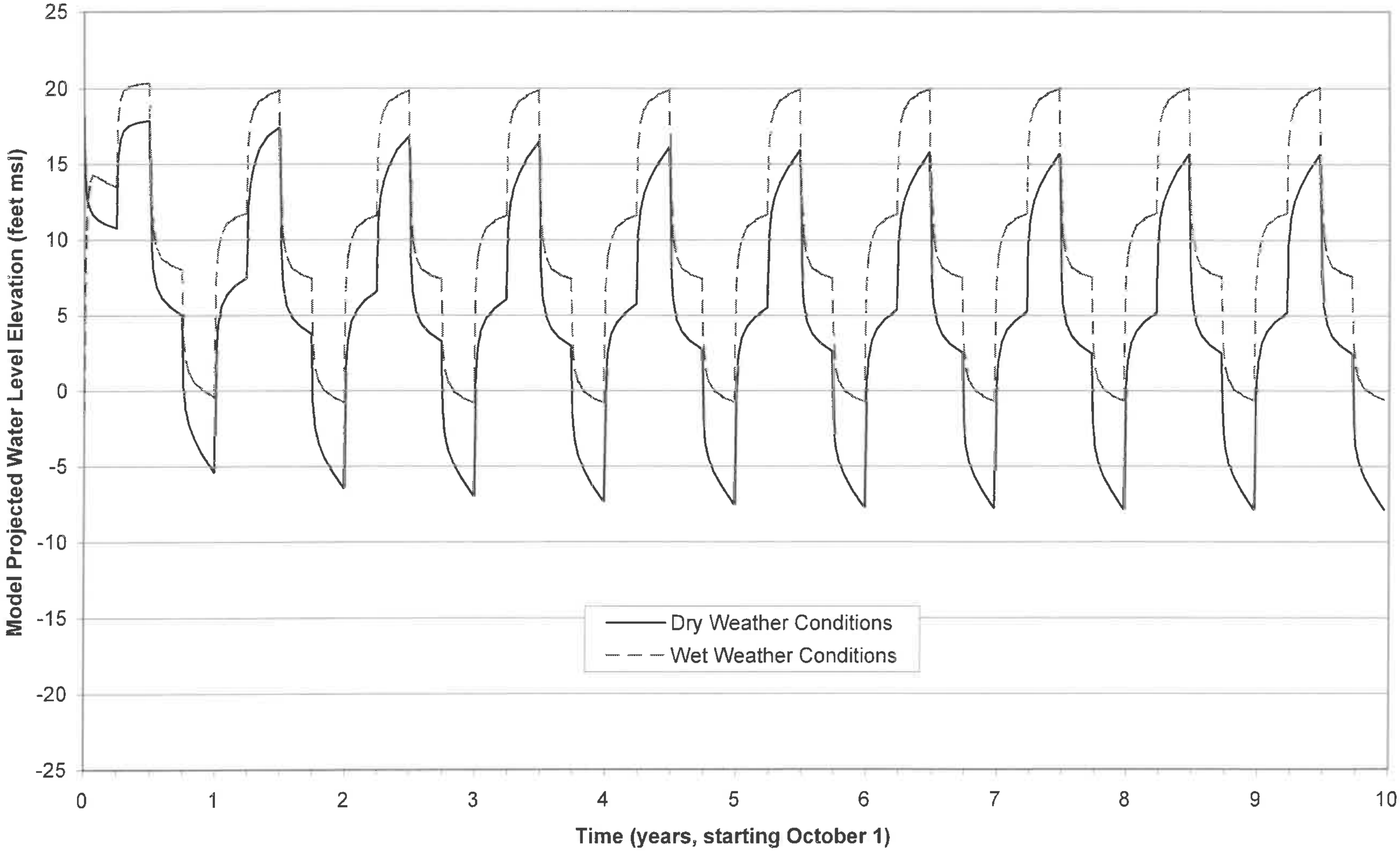

FIGURE J-22. LAYER 3 WELL 5FC TRANSIENT MODEL PROJECTED WATER LEVEL ELEVATION

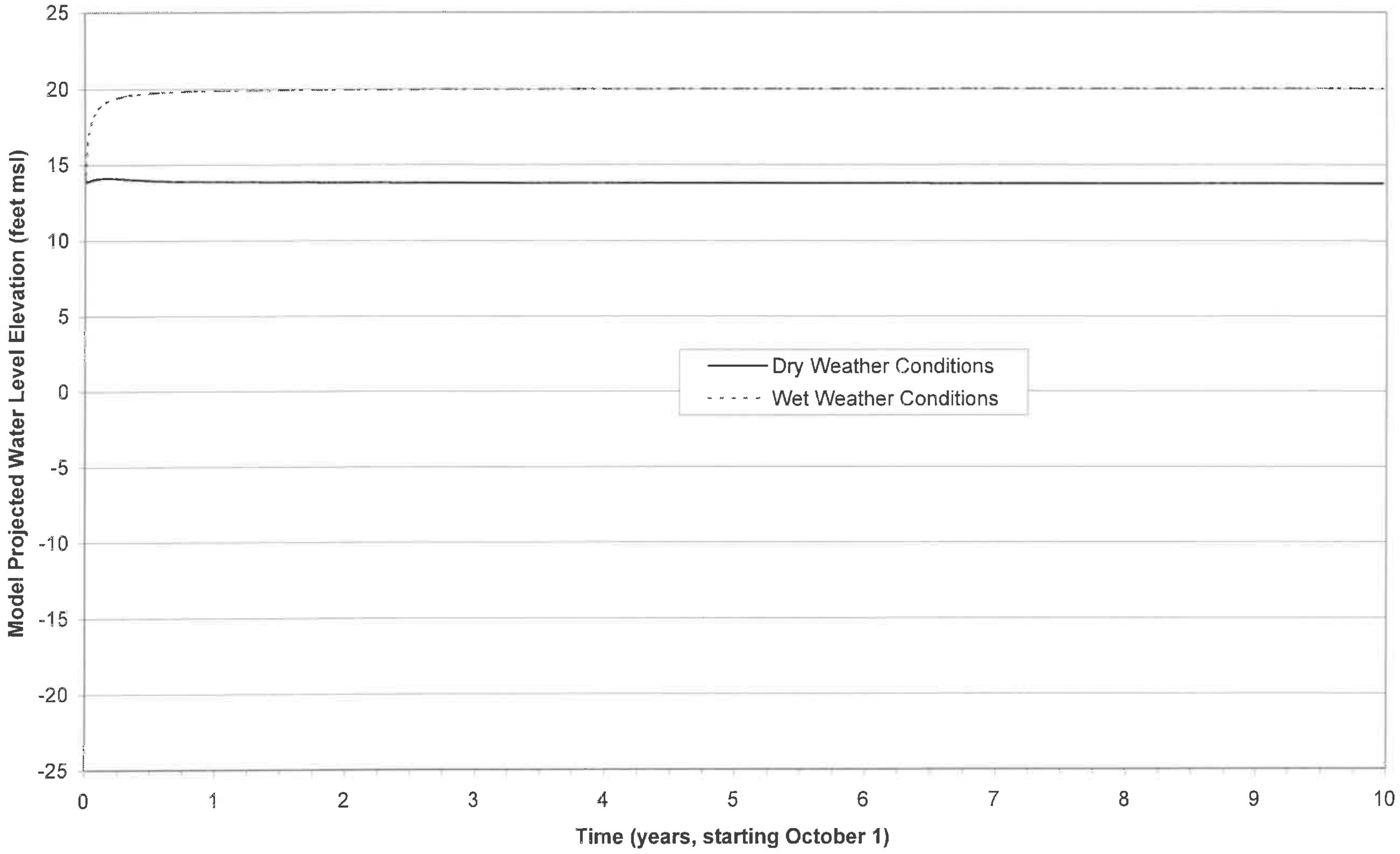

FIGURE J-23. LAYER 1 PIEZOMETER P-11A TRANSIENT MODEL PROJECTED WATER LEVEL ELEVATION

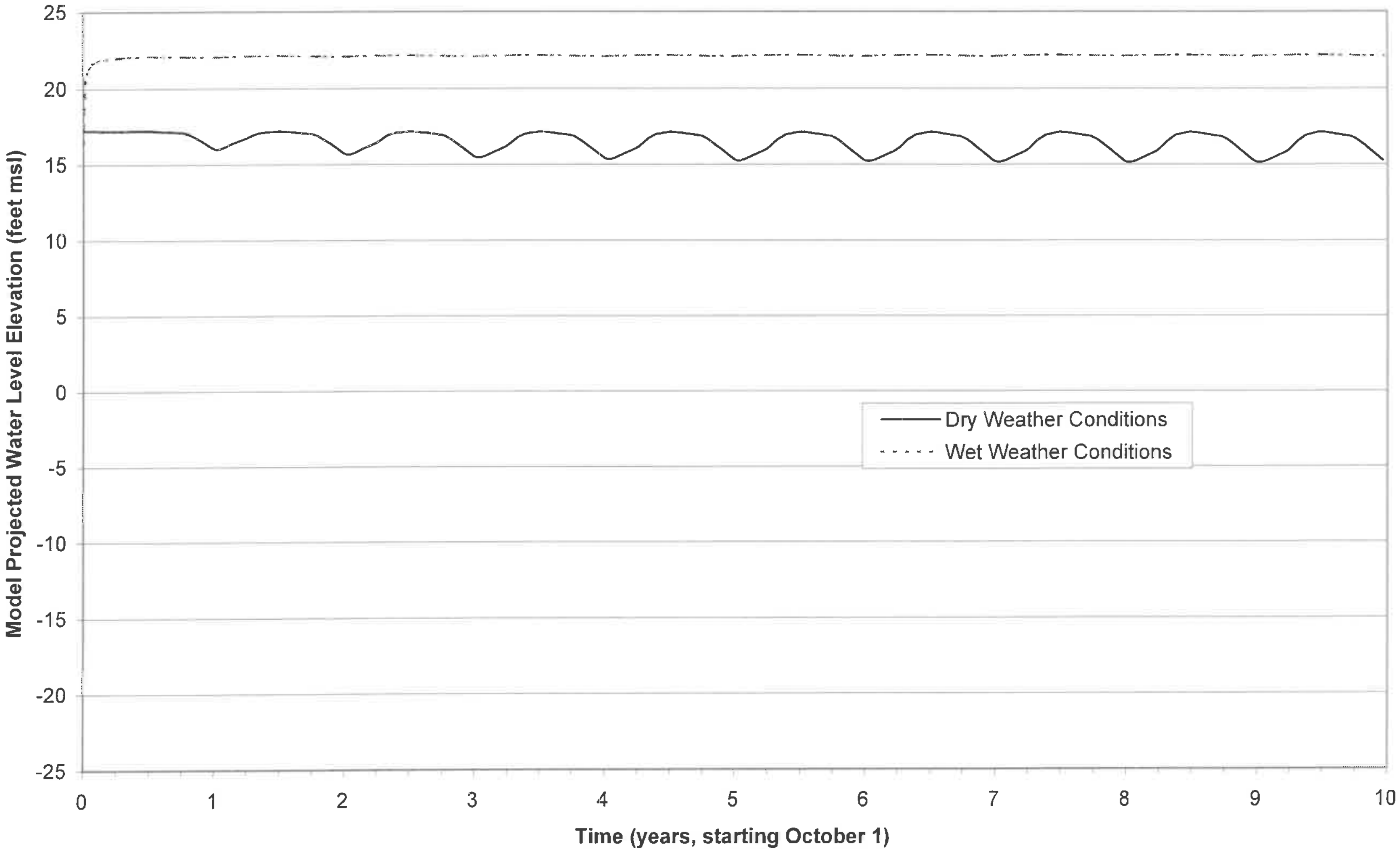

FIGURE J-24. LAYER 1 PIEZOMETER P-9 TRANSIENT MODEL PROJECTED WATER LEVEL ELEVATION

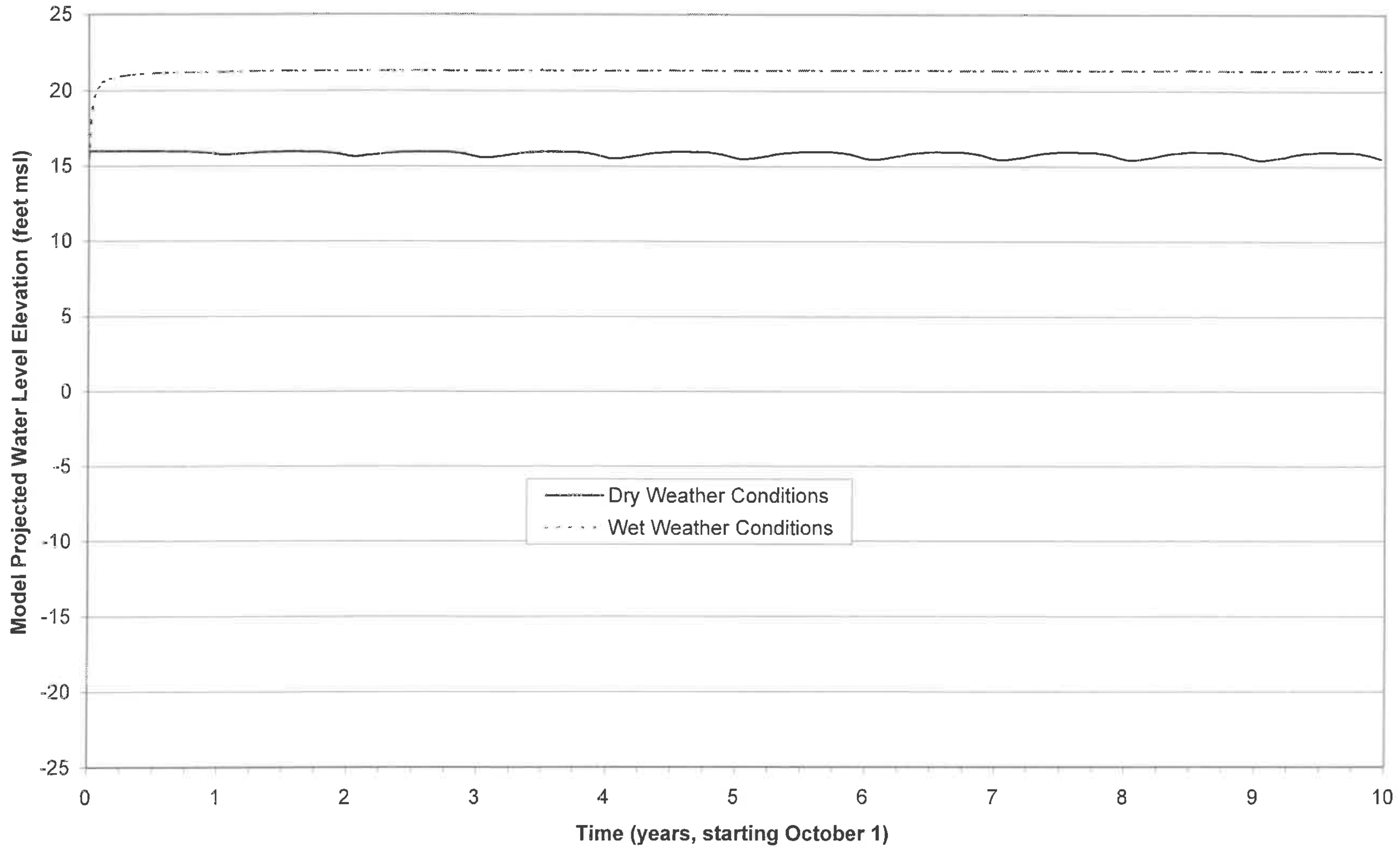

FIGURE J-25. LAYER 1 PIEZOMETER P-4S TRANSIENT MODEL PROJECTED WATER LEVEL ELEVATION

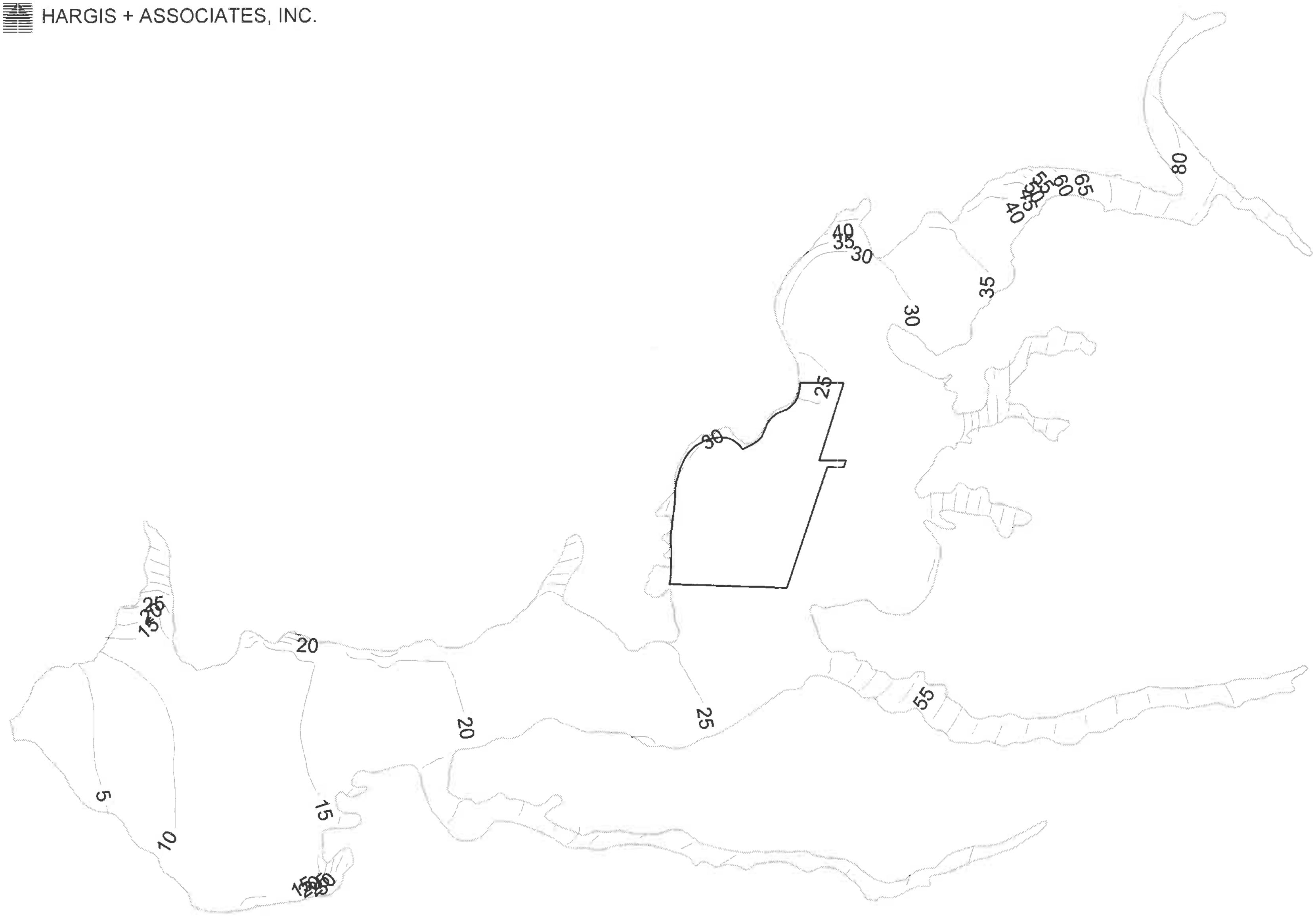

FIGURE J-26. STEADY-STATE MODEL PROJECTED HEADS - WET WEATHER CONDITIONS

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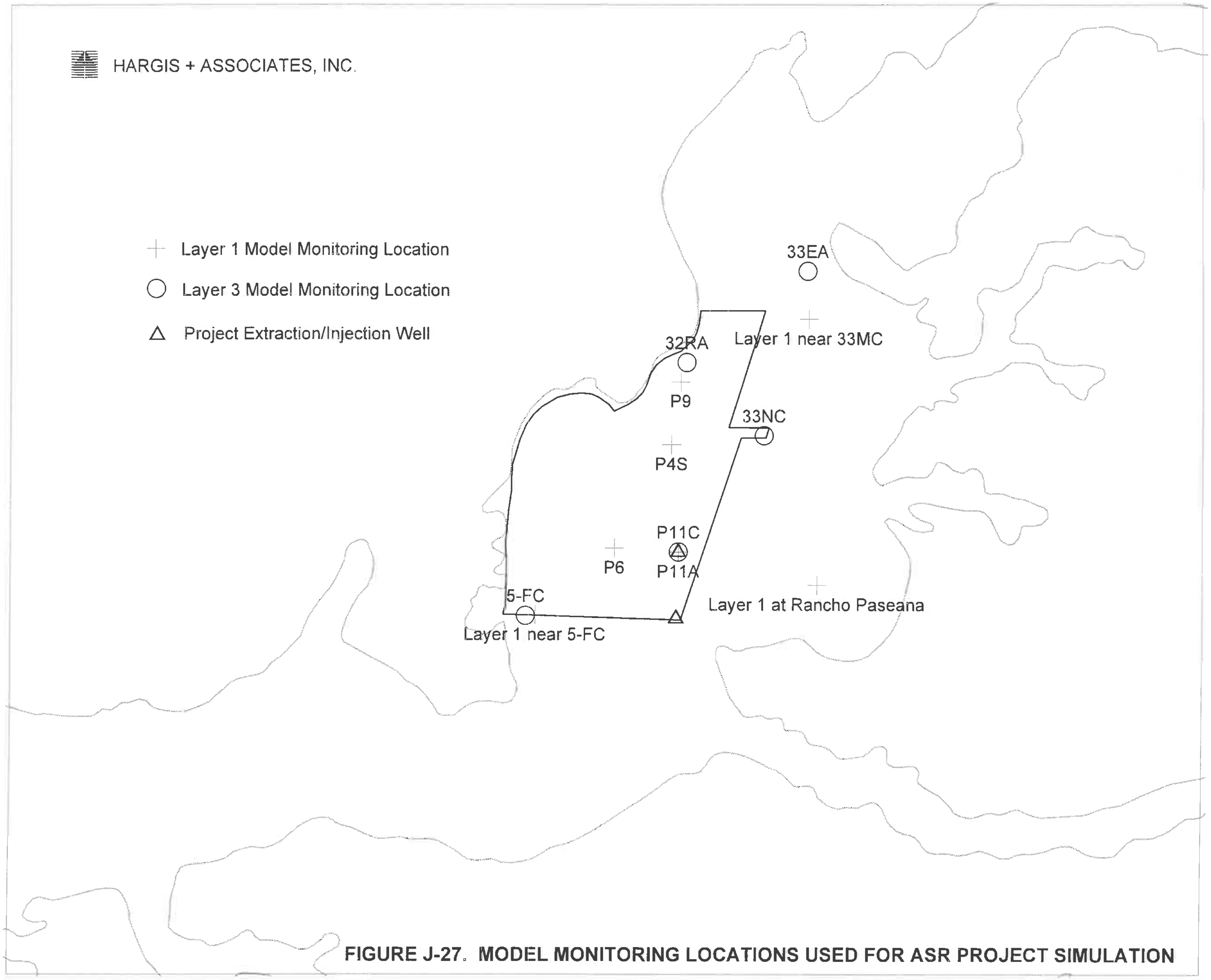

FIGURE J-27. MODEL MONITORING LOCATIONS USED FOR ASR PROJECT SIMULATION

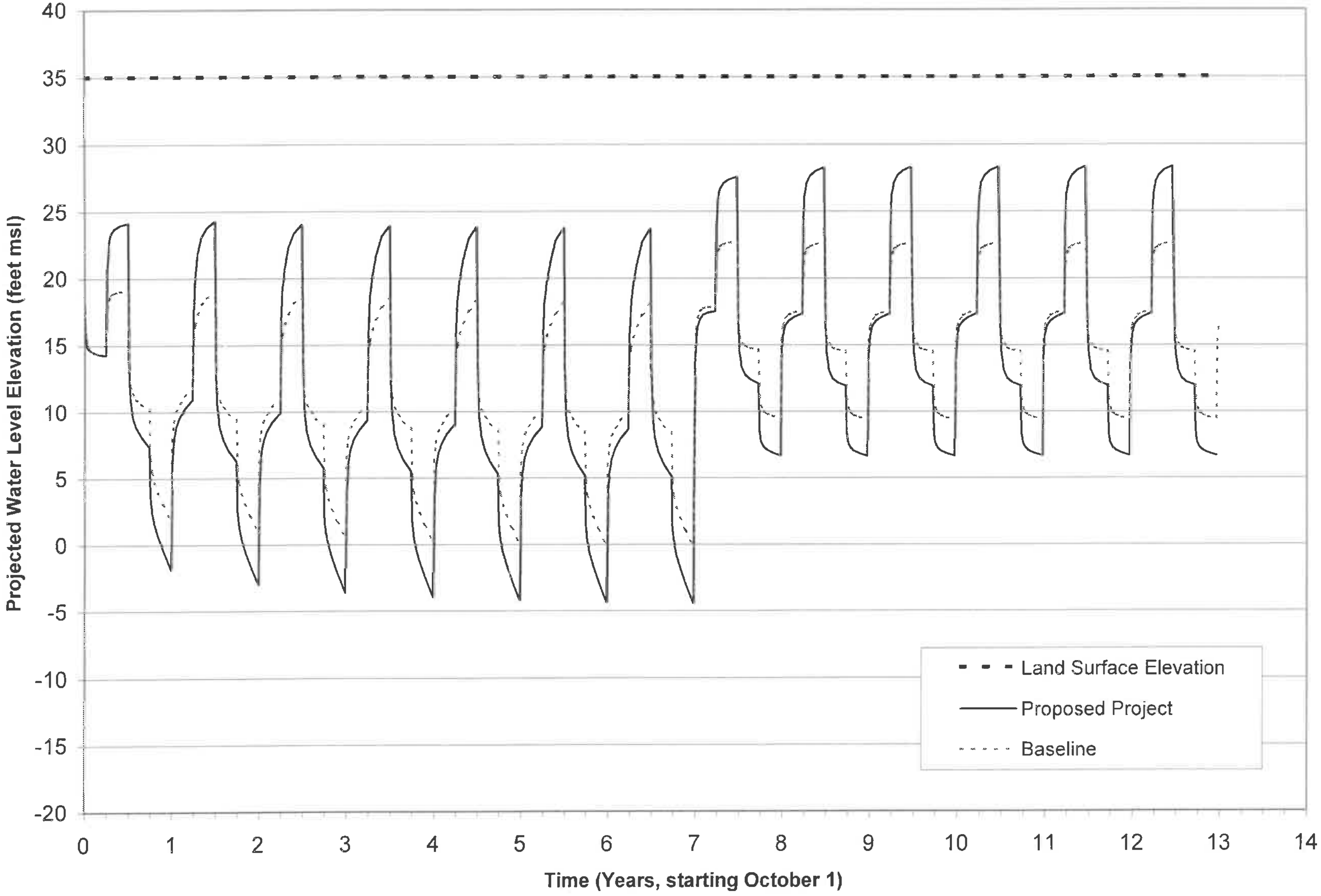

FIGURE J-28. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - 32RA LAYER 3

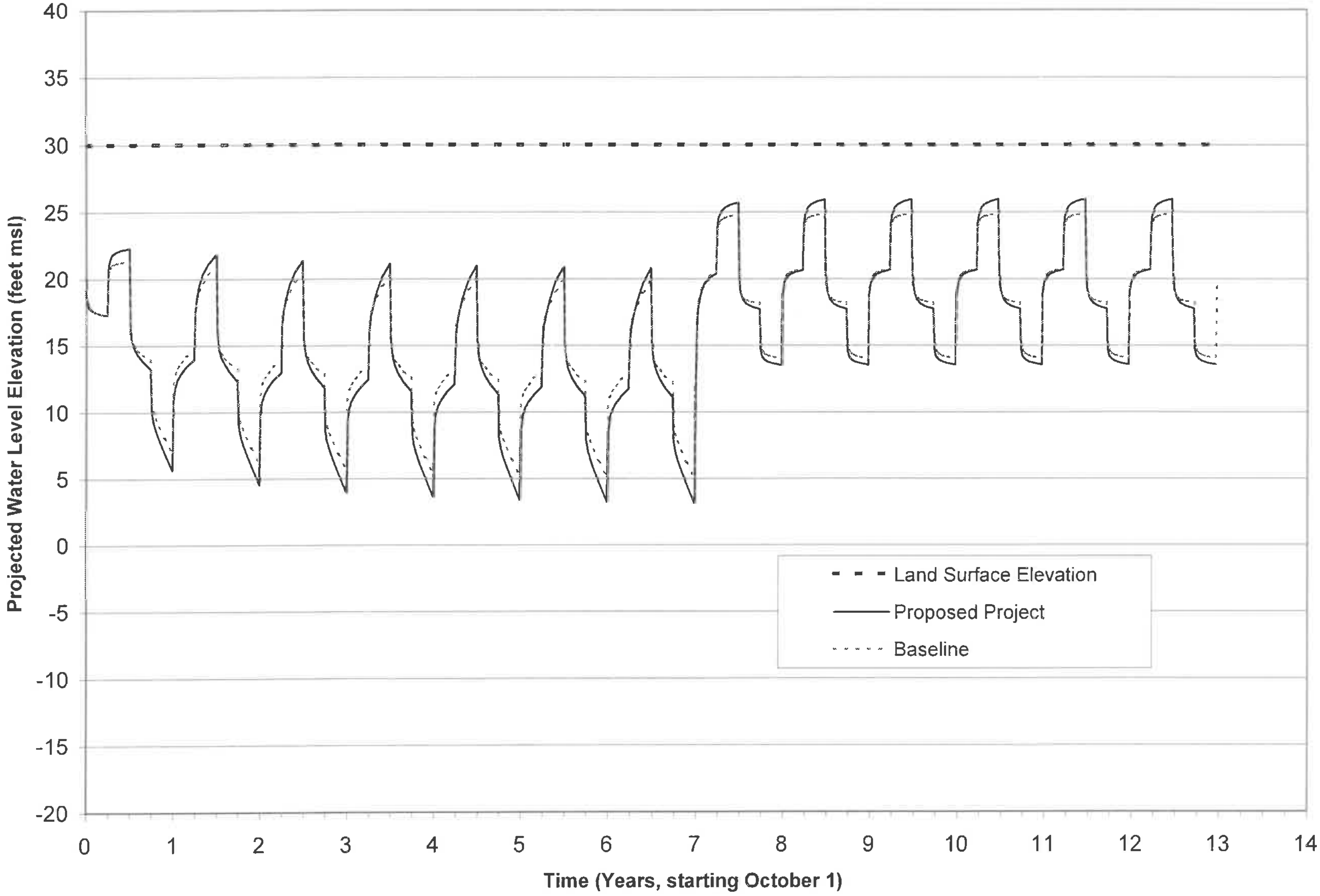

FIGURE J-29. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - 33EA LAYER 3

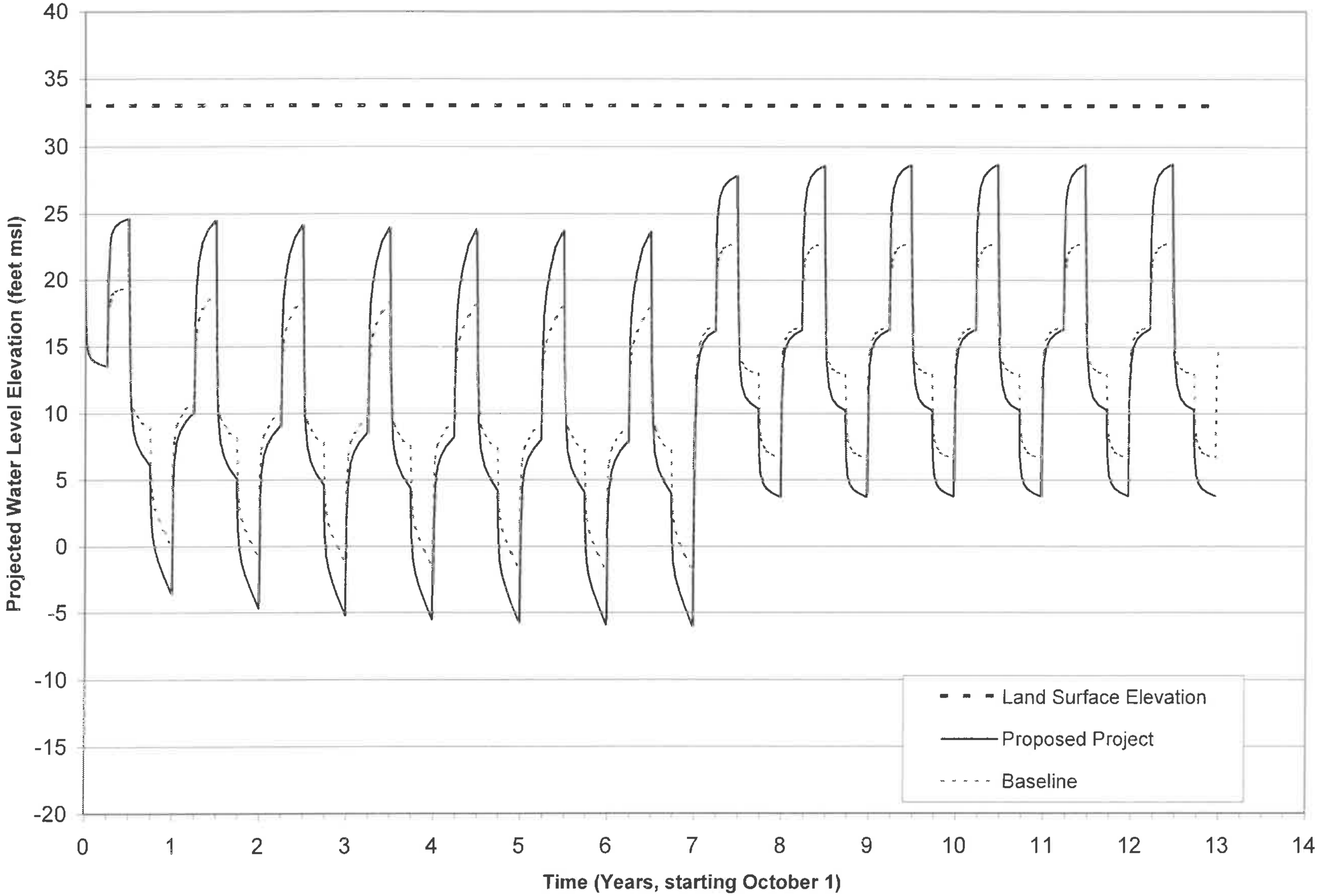

FIGURE J-30. ASR PROJECT MODEL PROJECTED
WATER LEVEL ELEVATIONS - 33NC LAYER 3

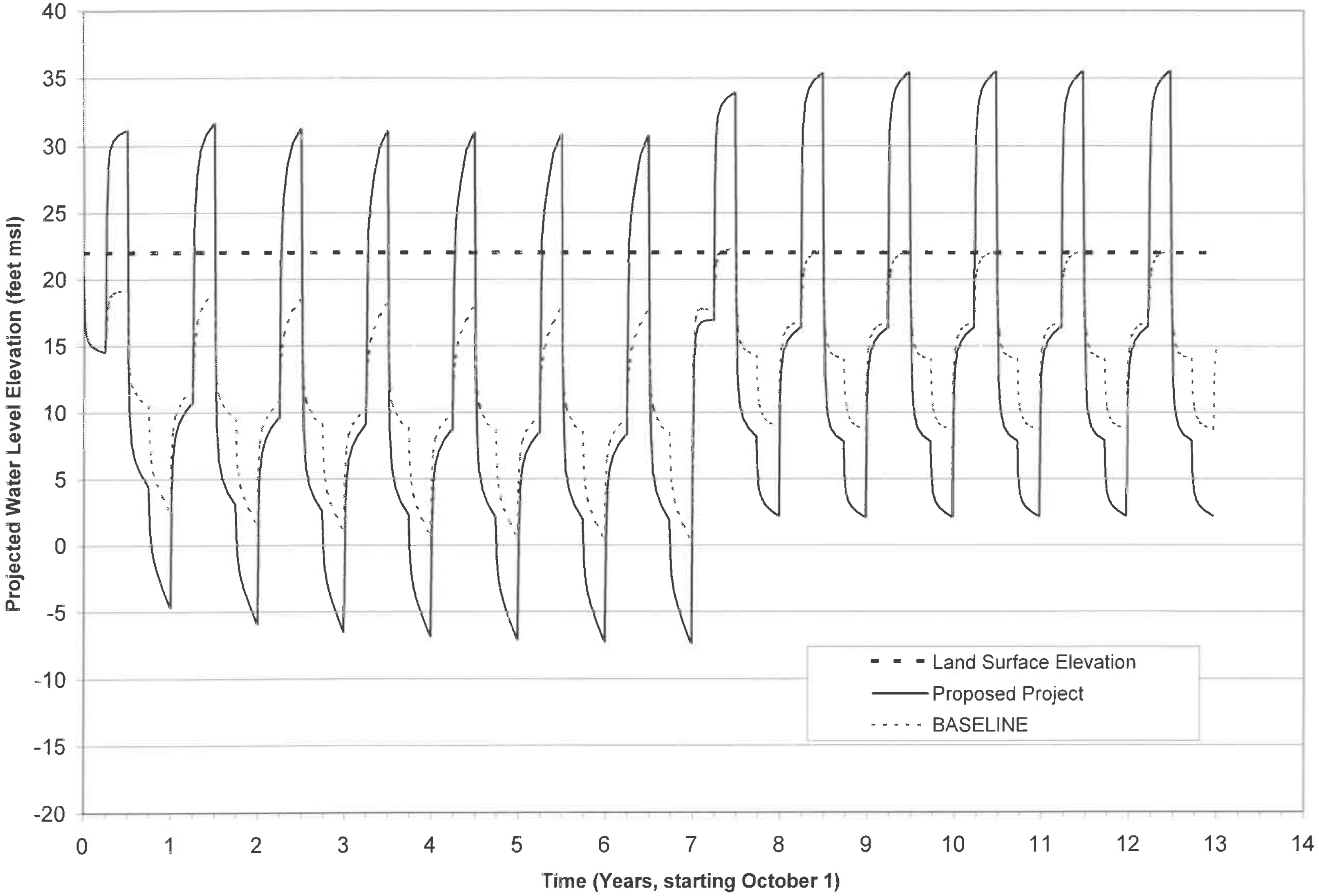

FIGURE J-31. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - P-11D LAYER 3

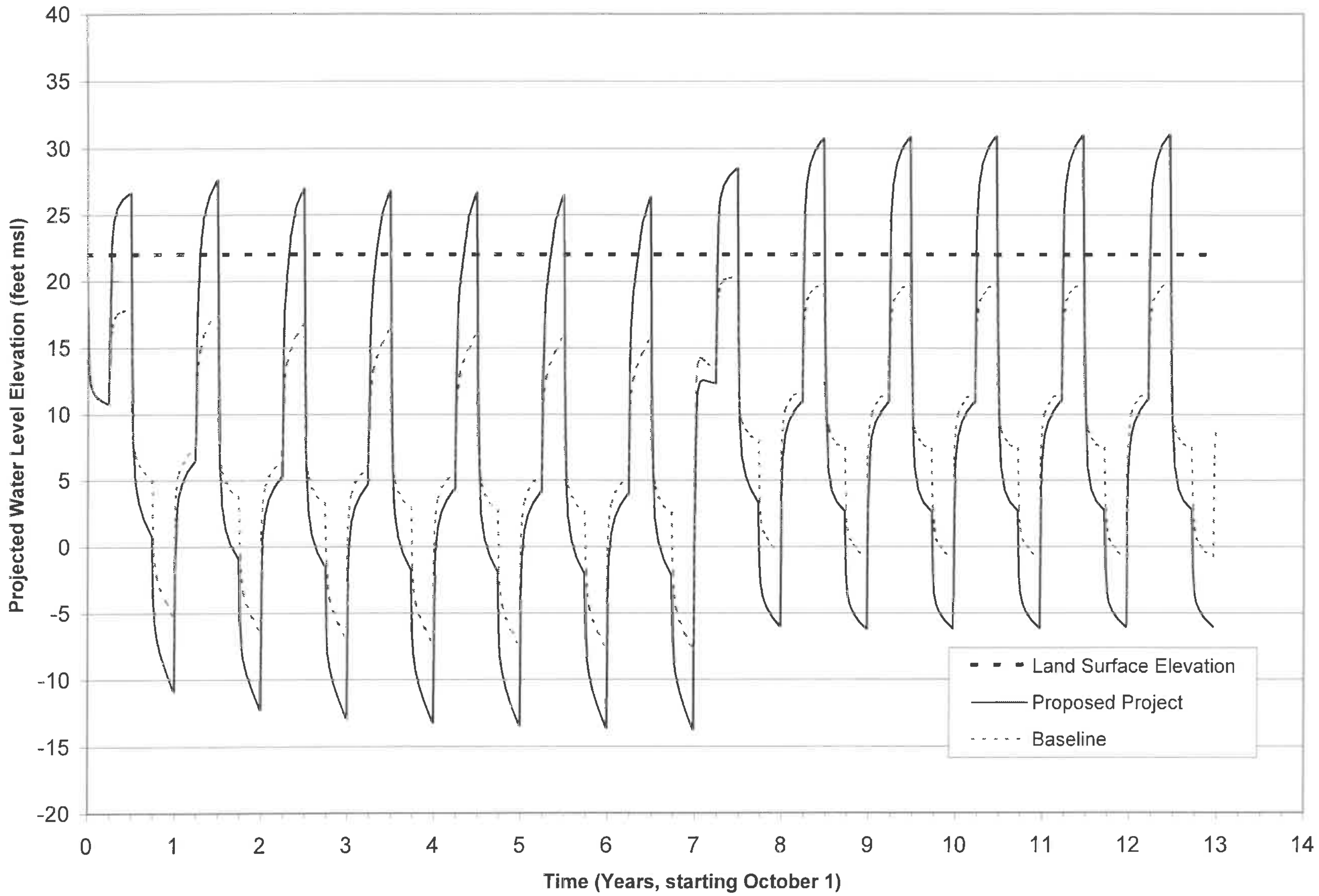

FIGURE J-32. ASR PROJECT MODEL PROJECTED
WATER LEVEL ELEVATIONS - 5-FC LAYER 3

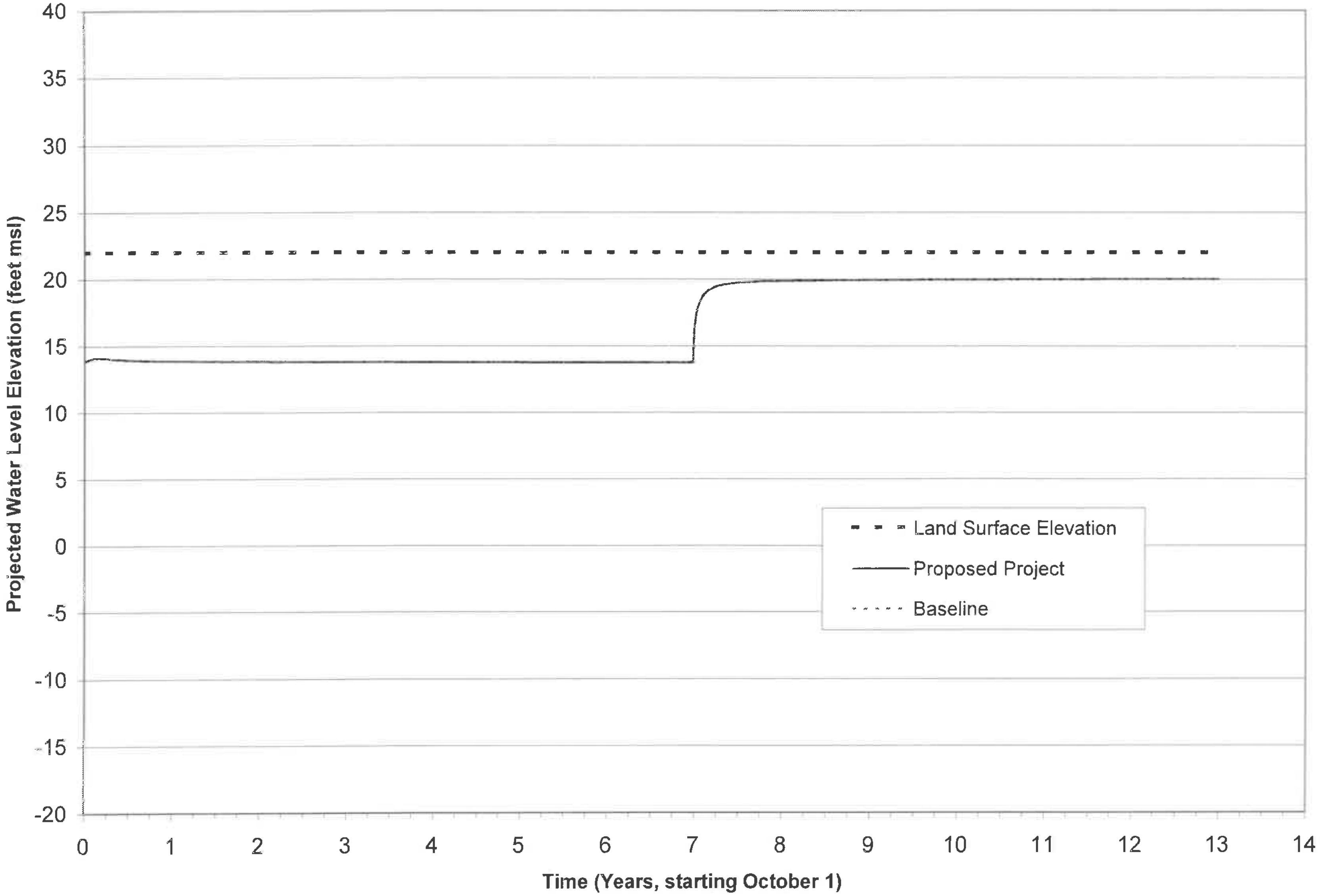

FIGURE J-33. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - P-11S LAYER 1

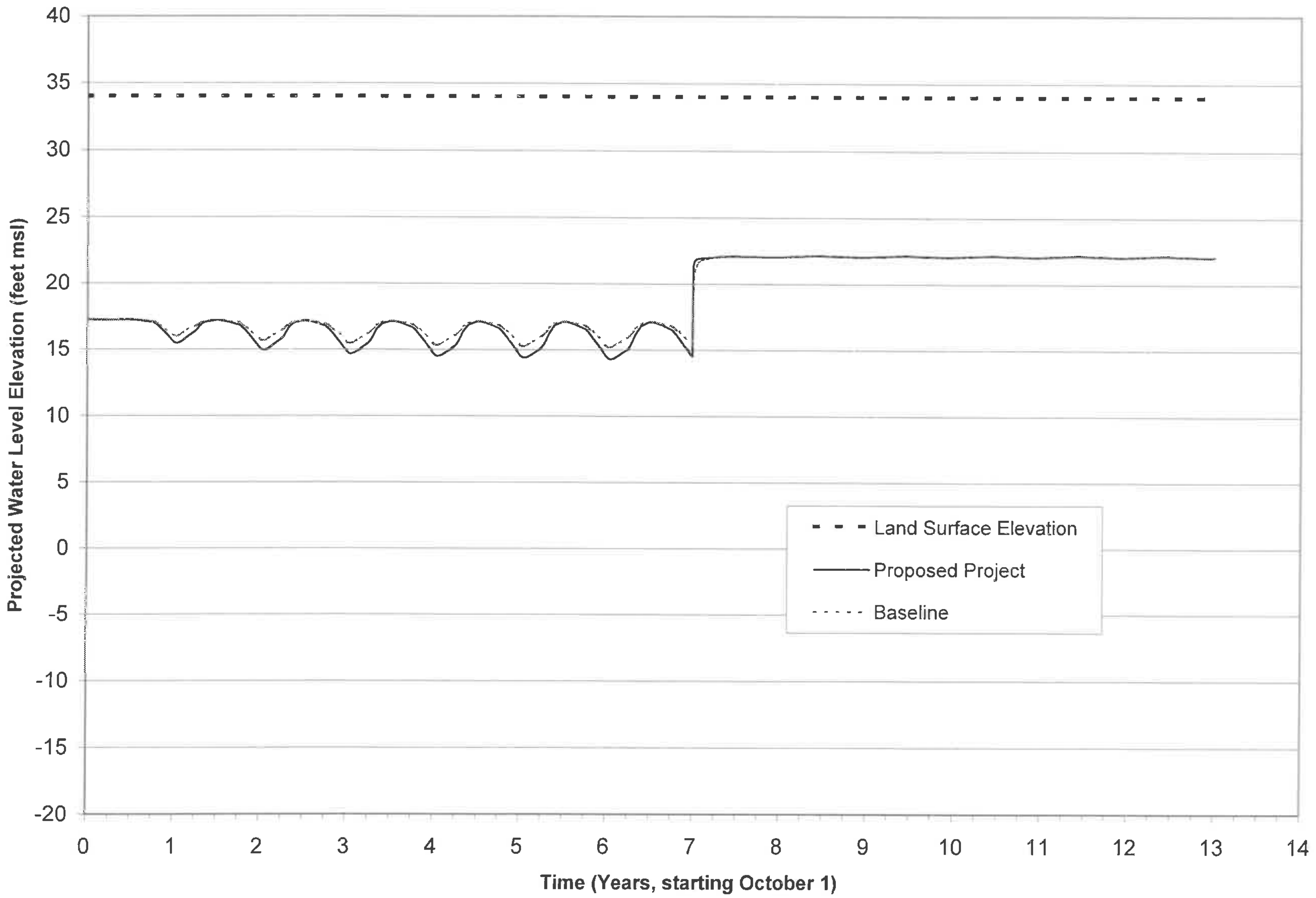

FIGURE J-34. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - P-9 LAYER 1

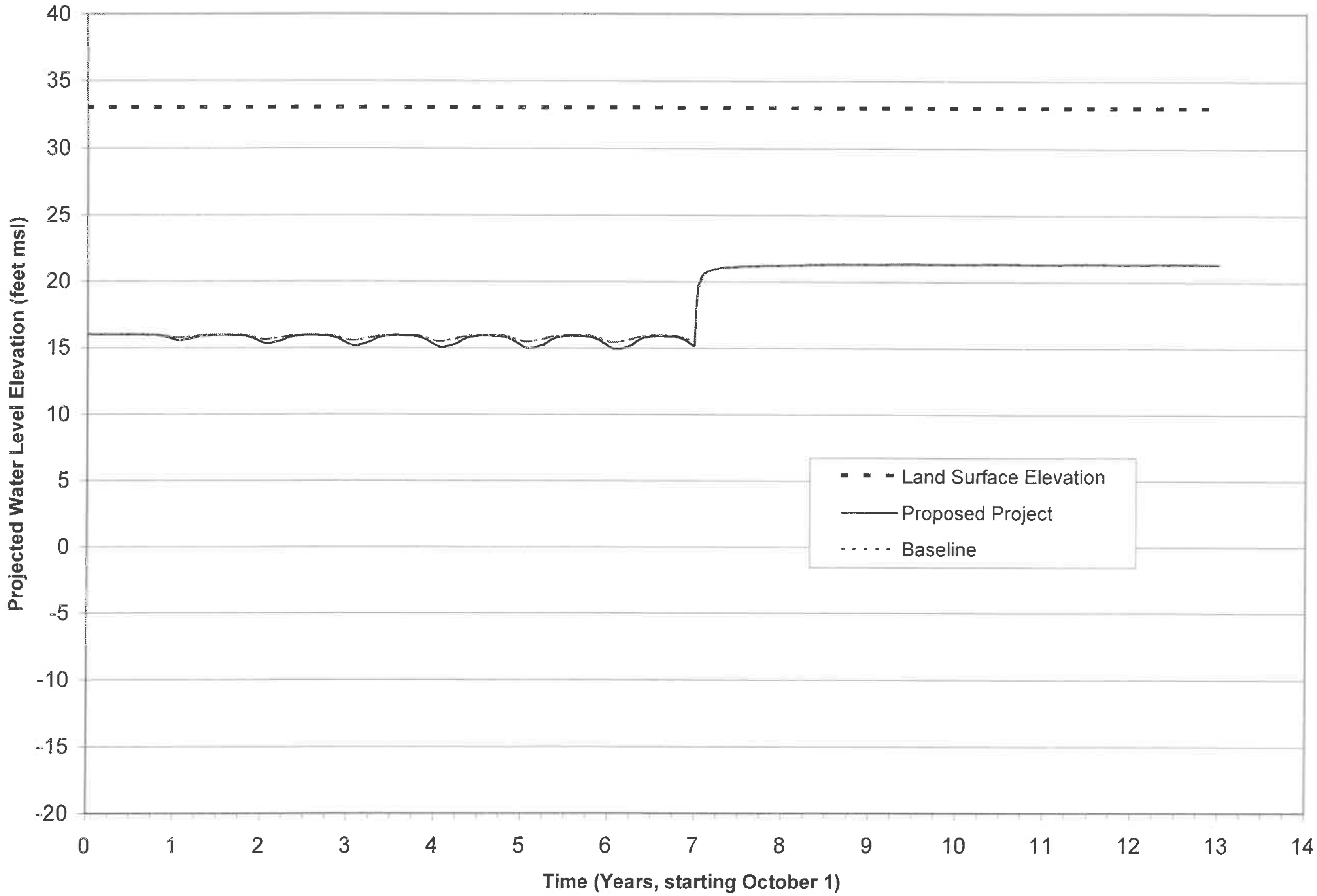

FIGURE J-35. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEATIONS - P-4S LAYER 1

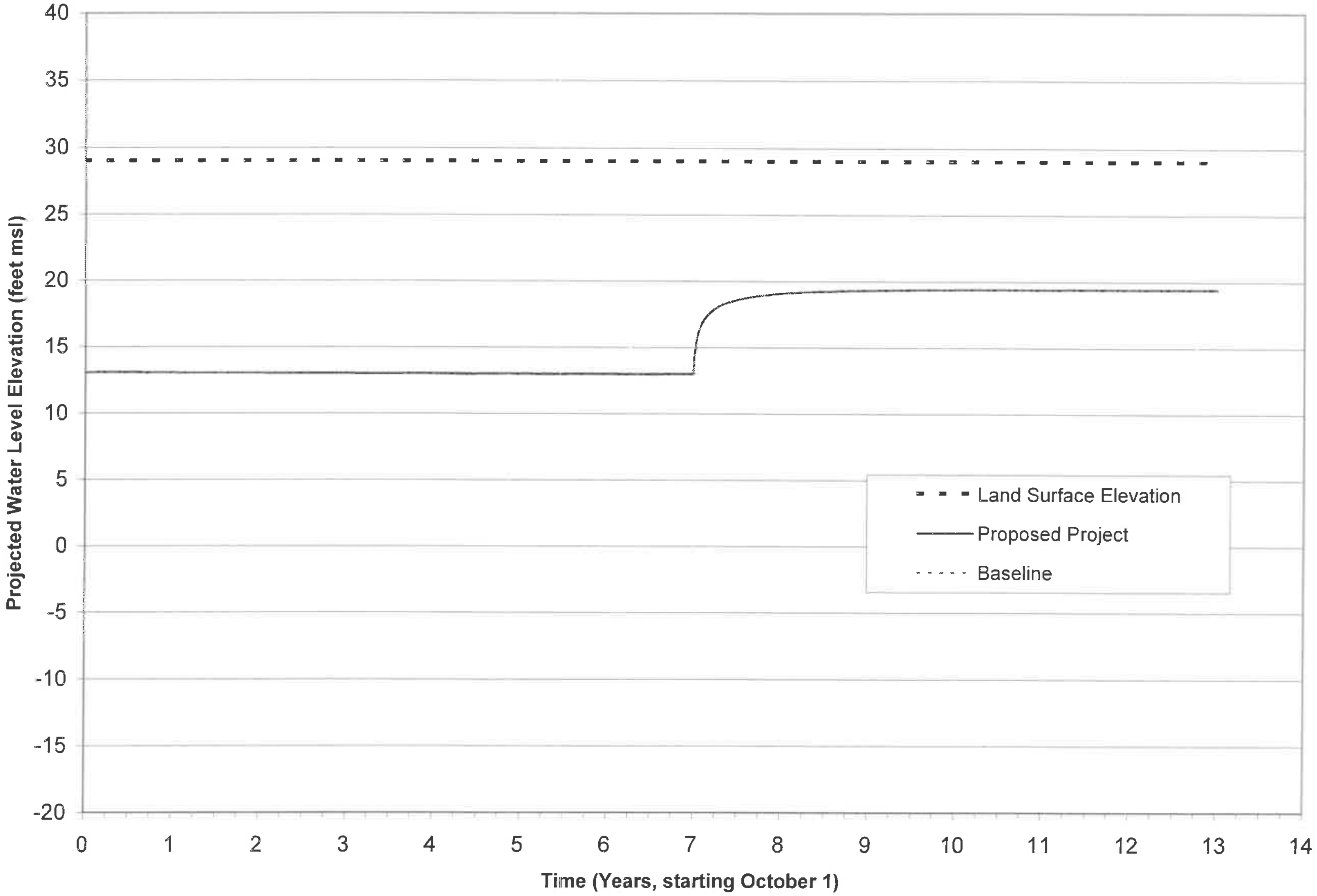

FIGURE J-36. ASR PROJECT MODEL PROJECTED
WATER LEVEL ELEVATIONS - P-6 LAYER 1

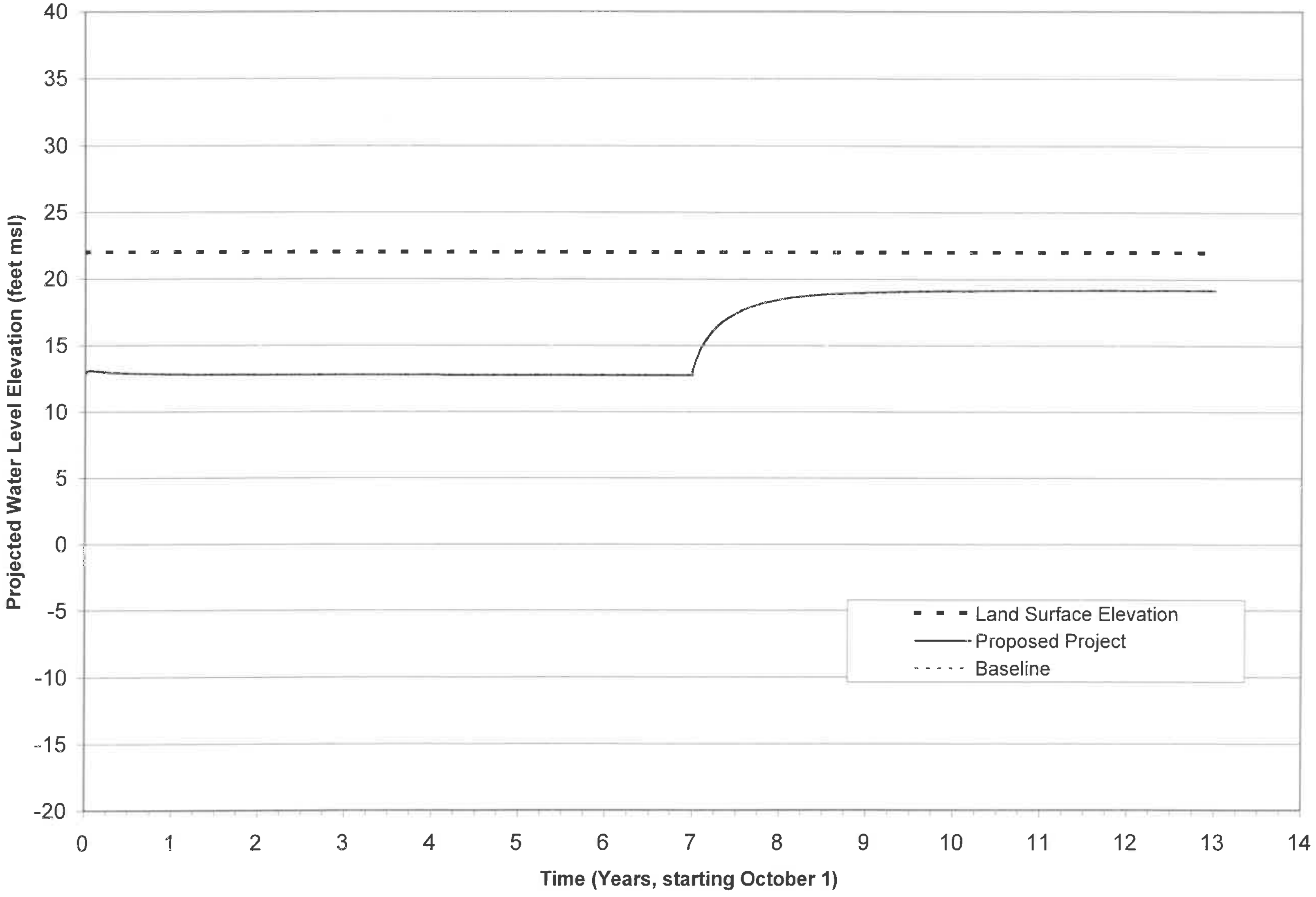

FIGURE J-37. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - LAYER 1 NEAR 5-FC

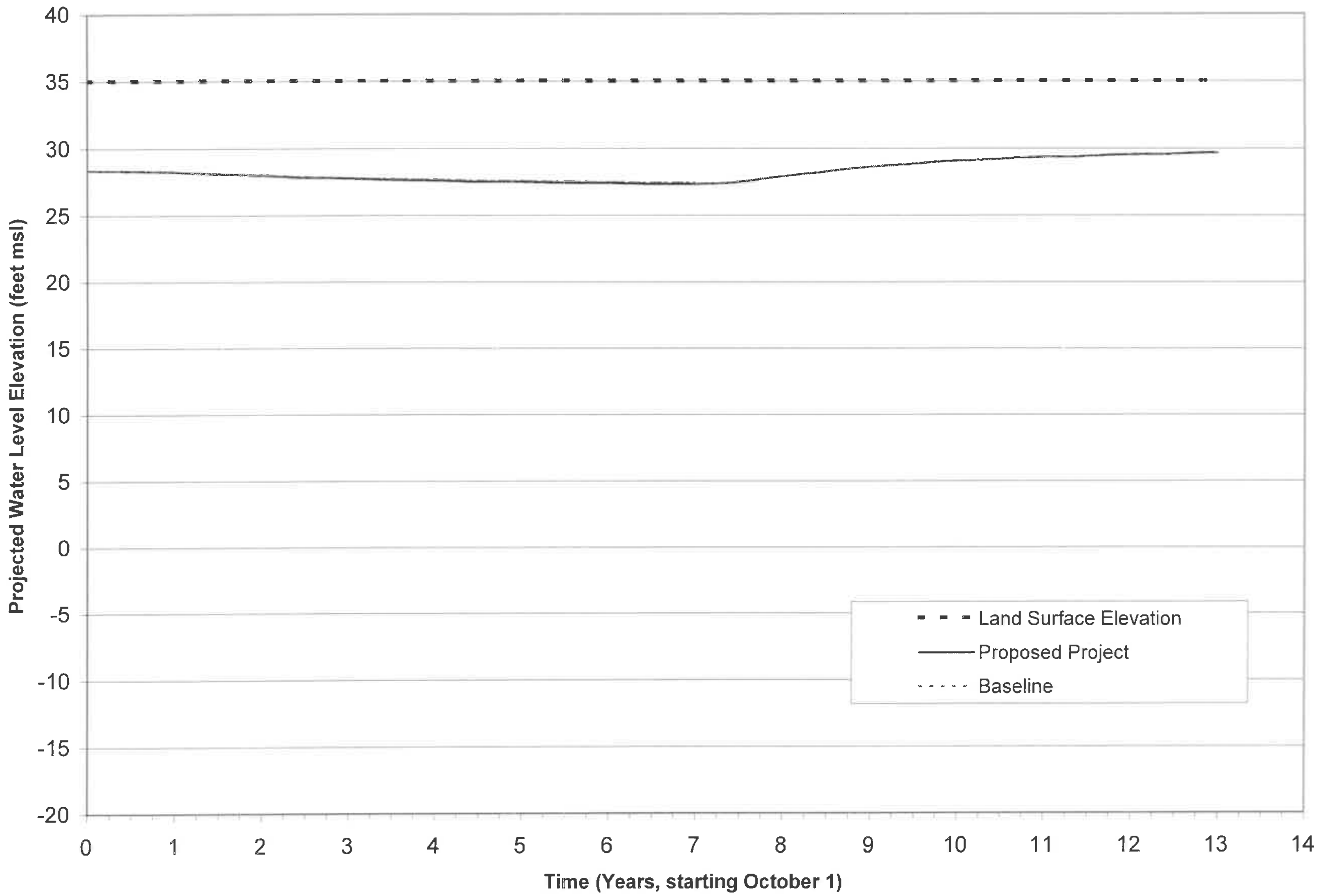

FIGURE J-38. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - LAYER 1 AT RANCHO PASEANA

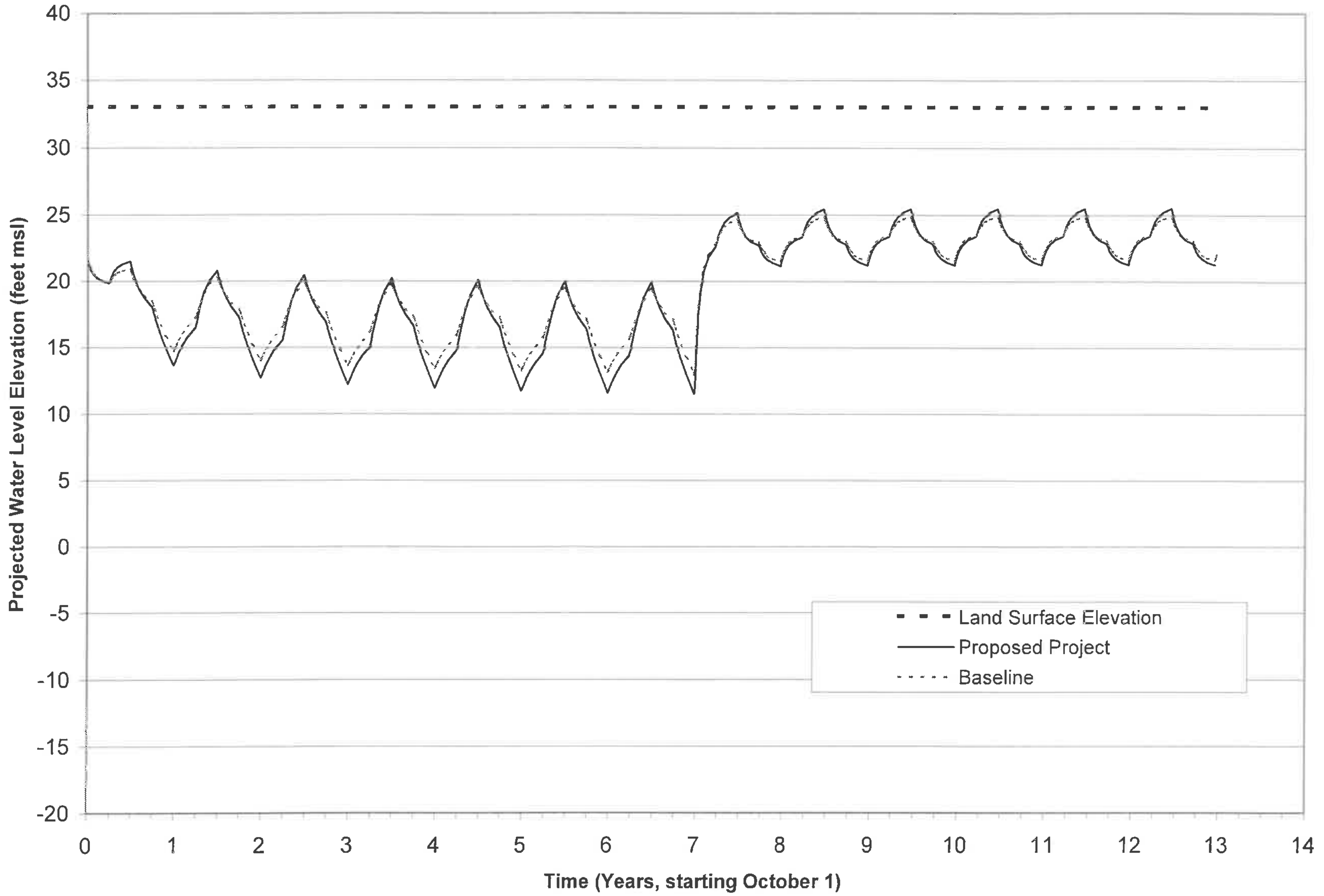

FIGURE J-39. ASR PROJECT MODEL PROJECTED WATER LEVEL ELEVATIONS - LAYER 1 NEAR 33MC

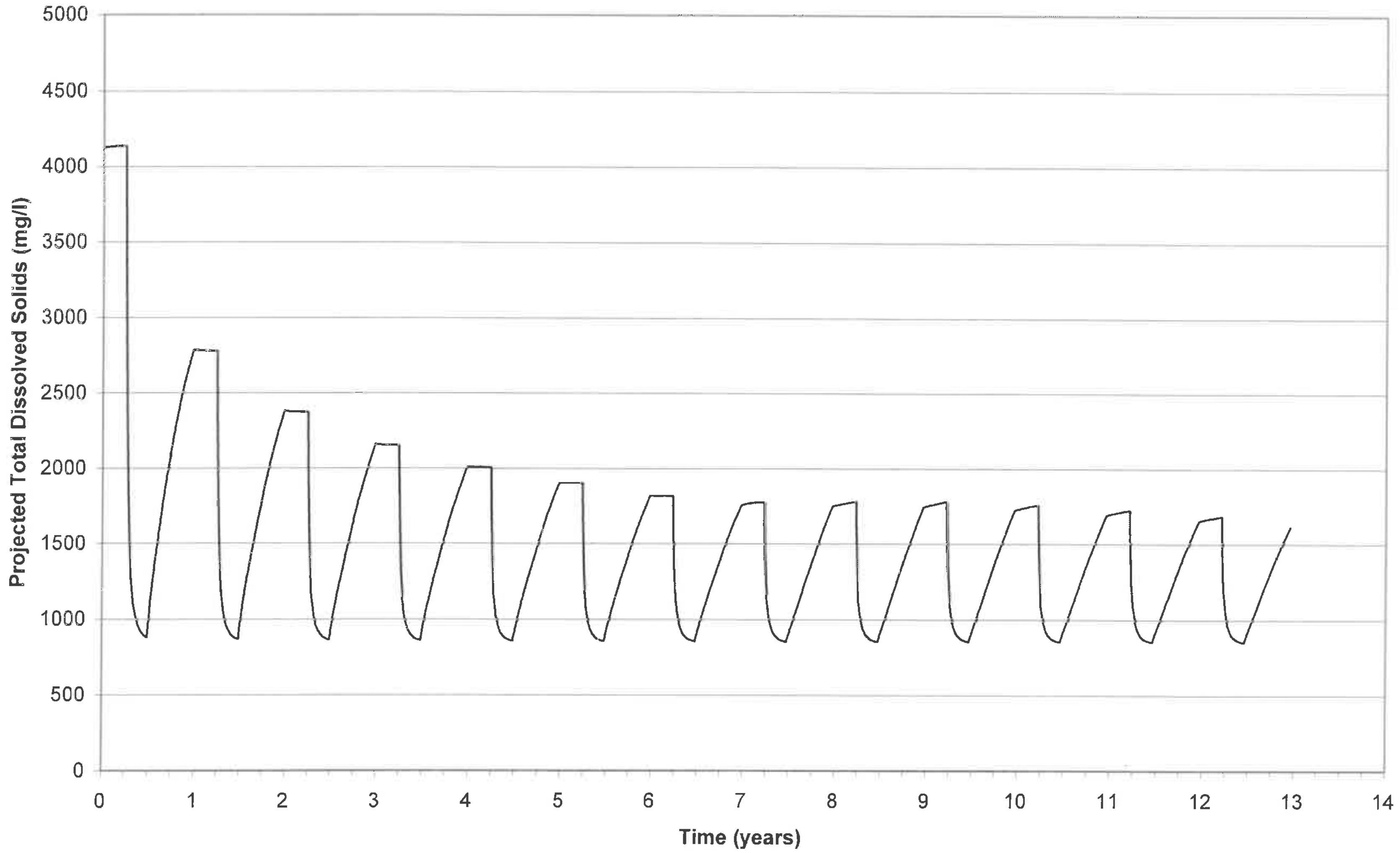

FIGURE J-40. MODEL PROJECTED TOTAL DISSOLVED SOLIDS - TEST WELL

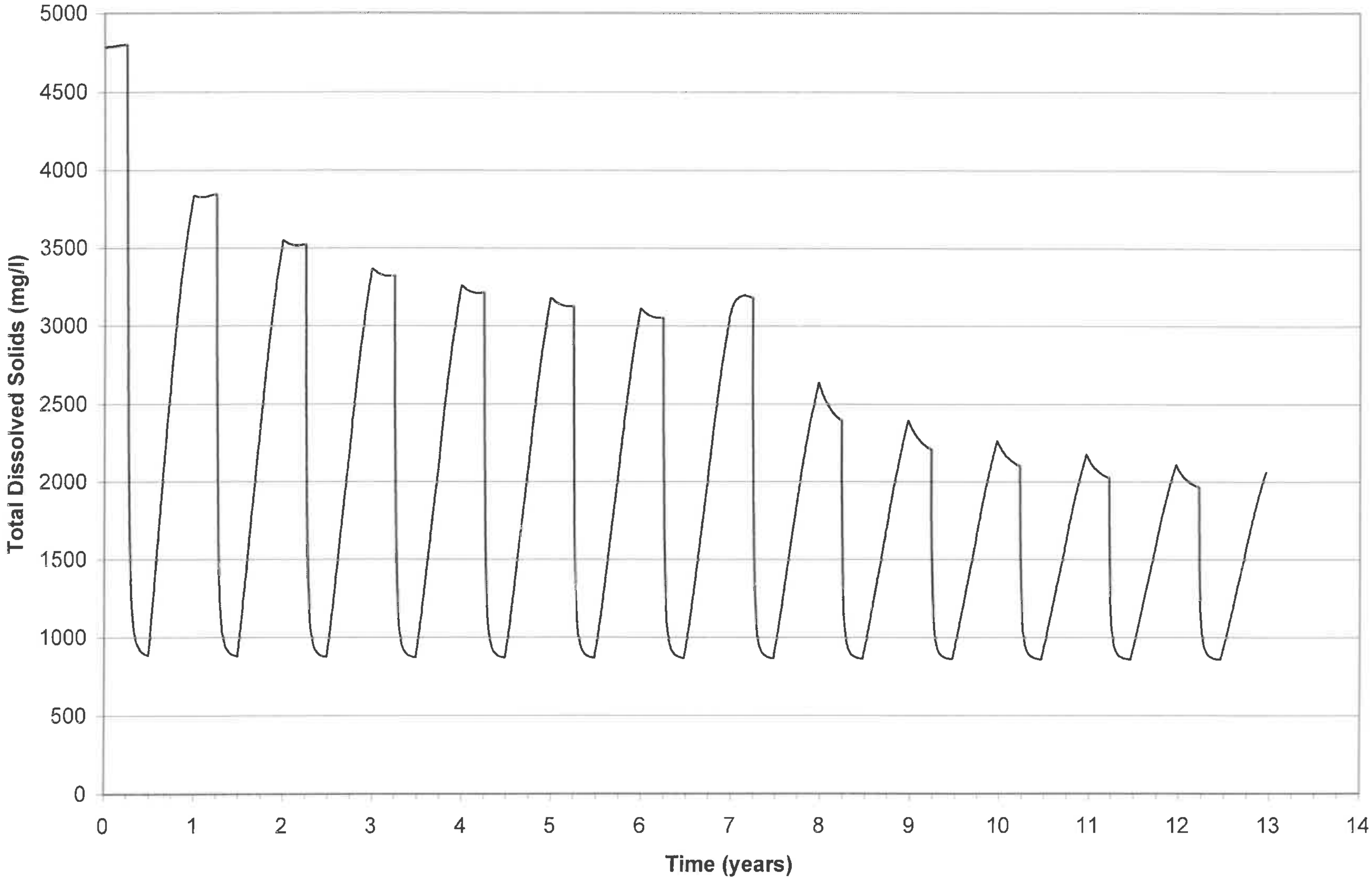

FIGURE J-41. MODEL PROJECTED TOTAL DISSOLVED SOLIDS - PROPOSED PROJECT WELL

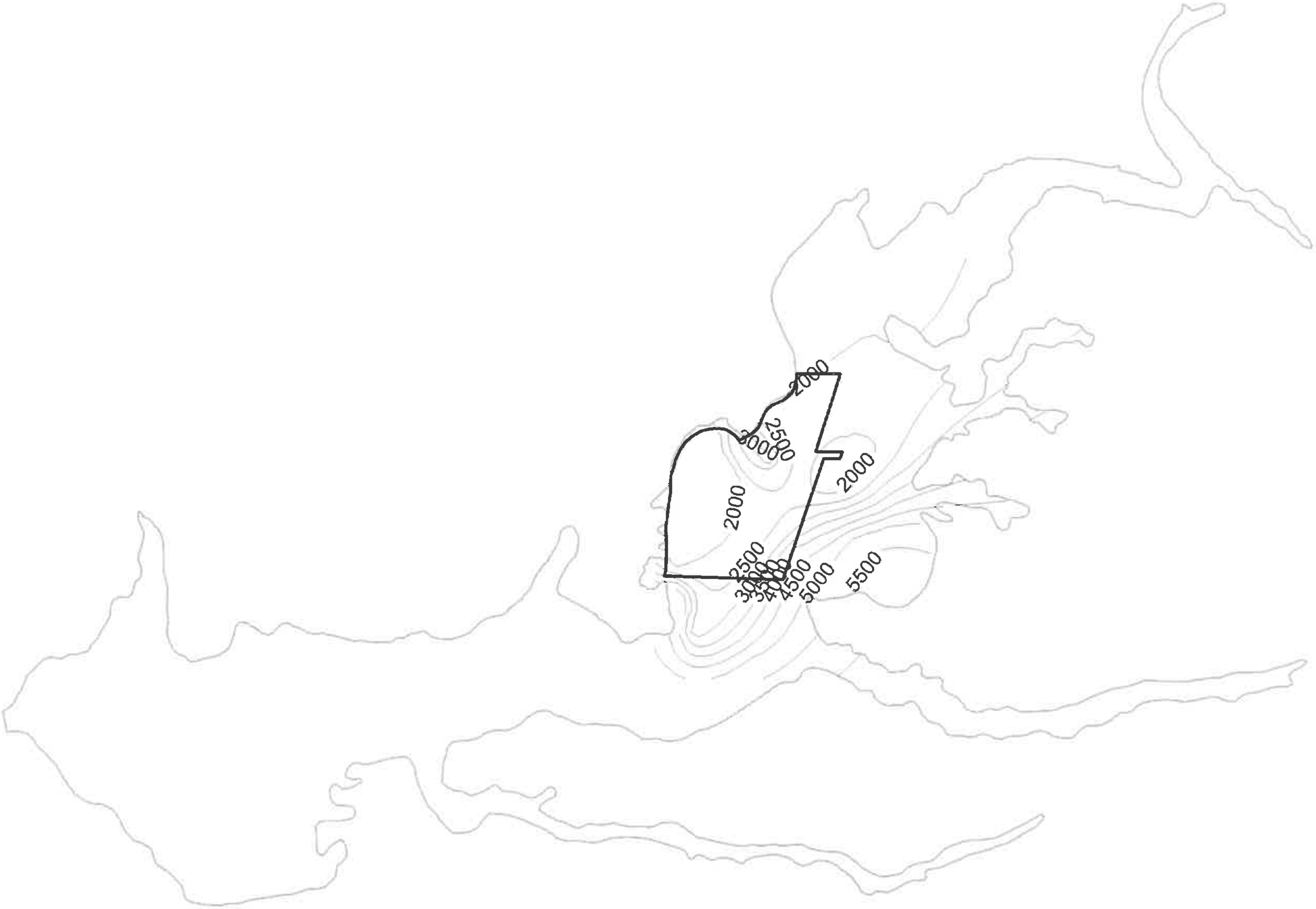

FIGURE J-42. CURRENT TOTAL DISSOLVED SOLIDS (mg/l) IN GROUNDWATER - LAYER 1

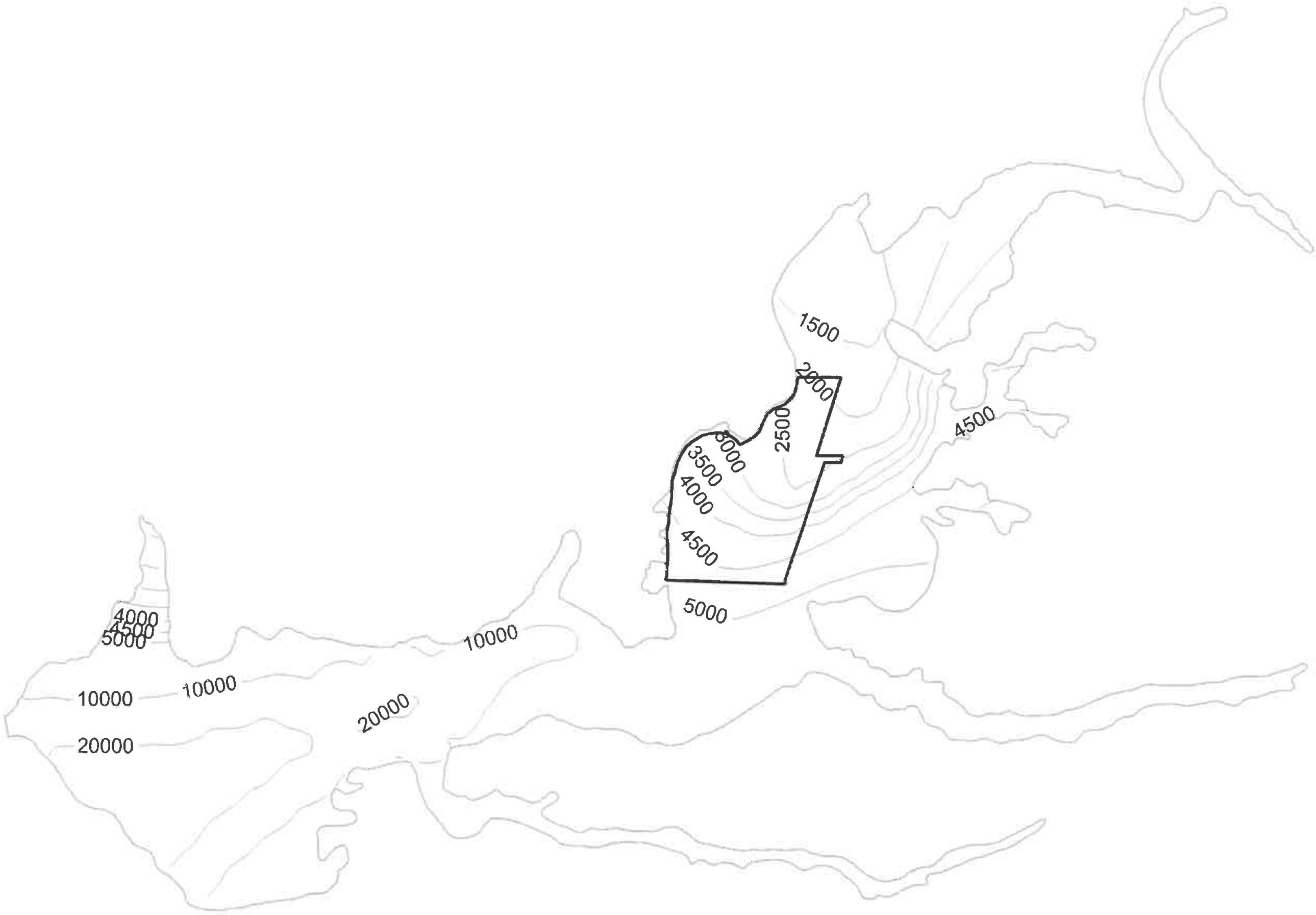

FIGURE J-43. CURRENT TOTAL DISSOLVED SOLIDS (mg/l) IN GROUNDWATER - LAYER 3

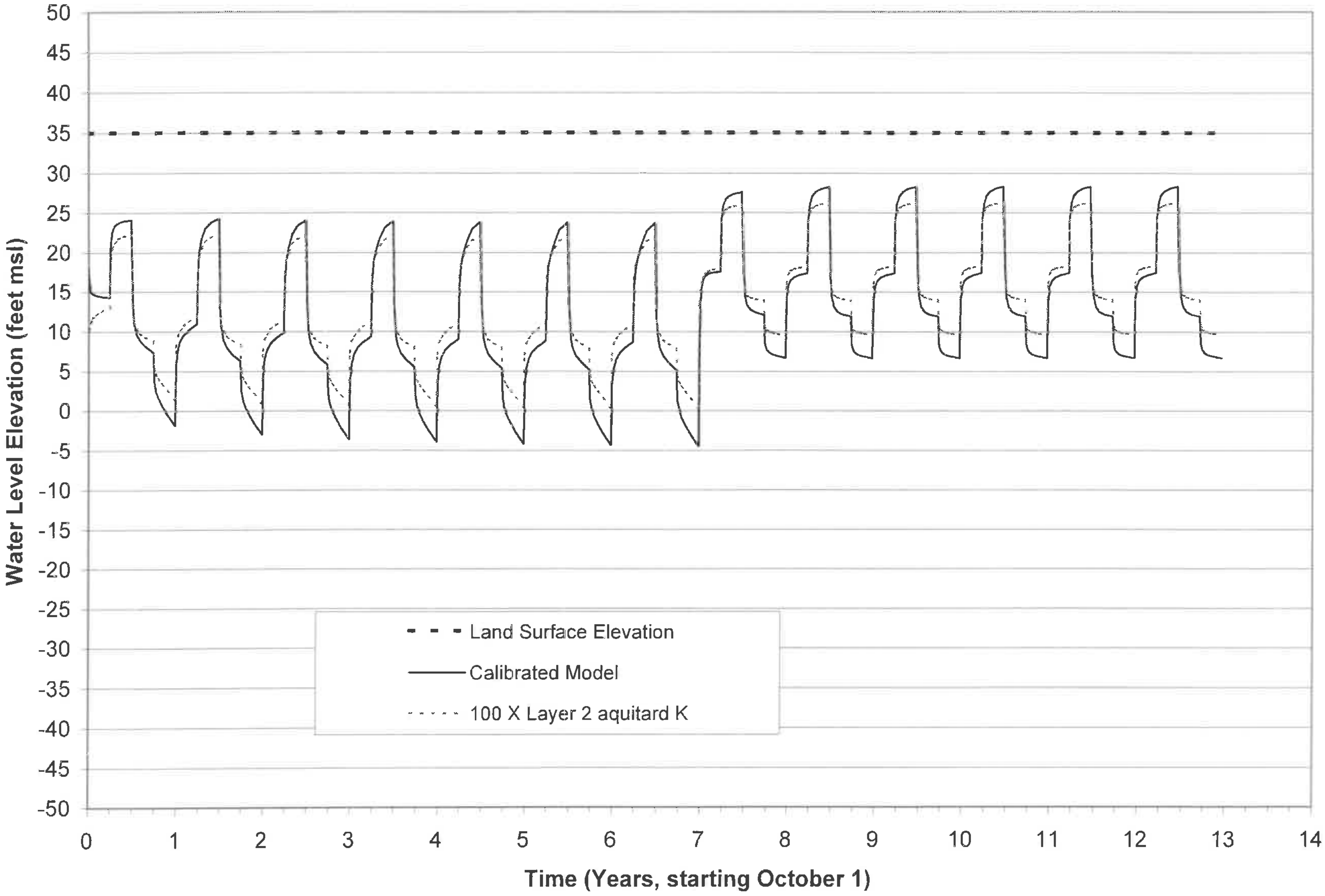

FIGURE J-44. LAYER 3 WELL 32RA - LAYER 2
AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

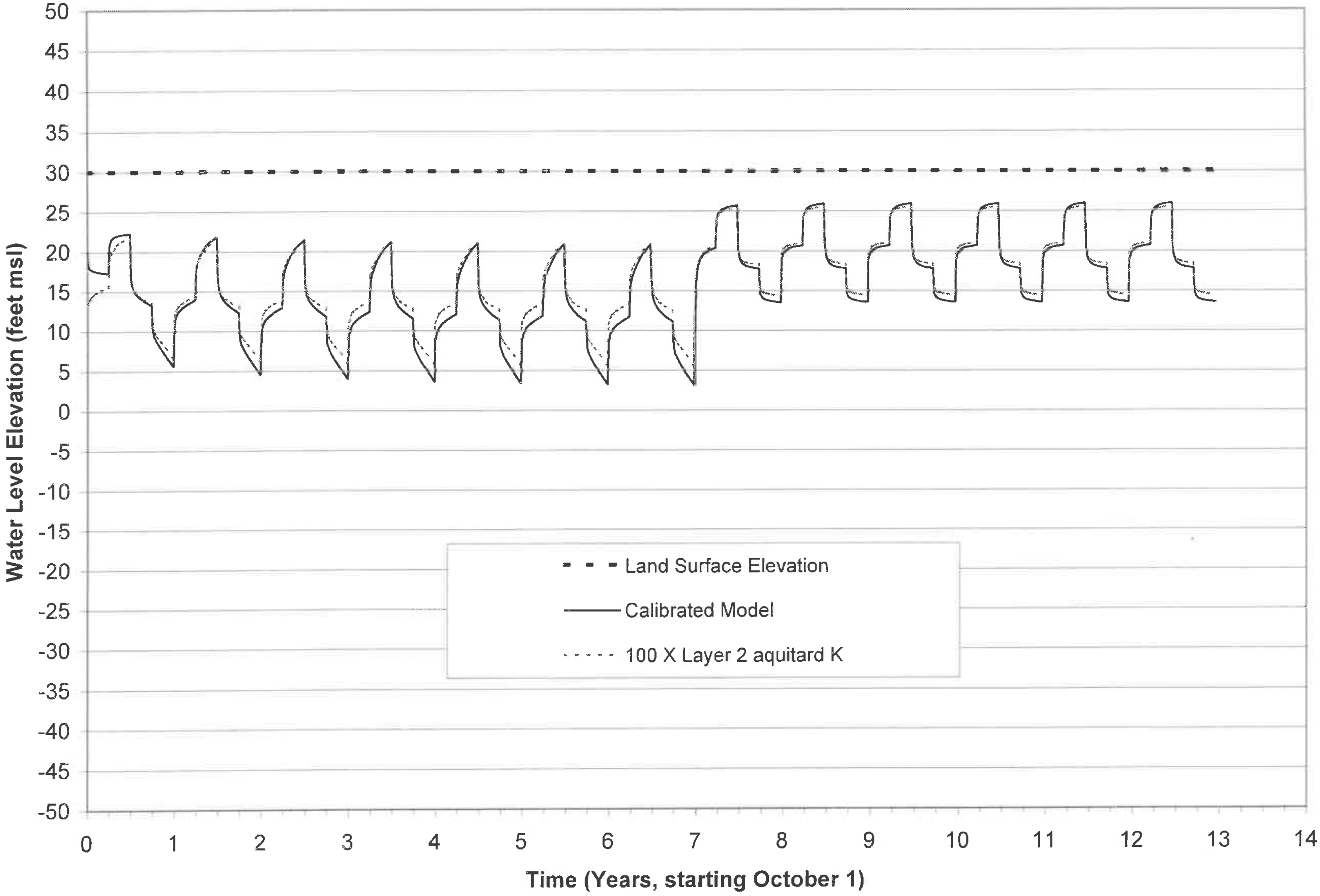

FIGURE J-45. LAYER 3 WELL 33EA - LAYER 2
AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

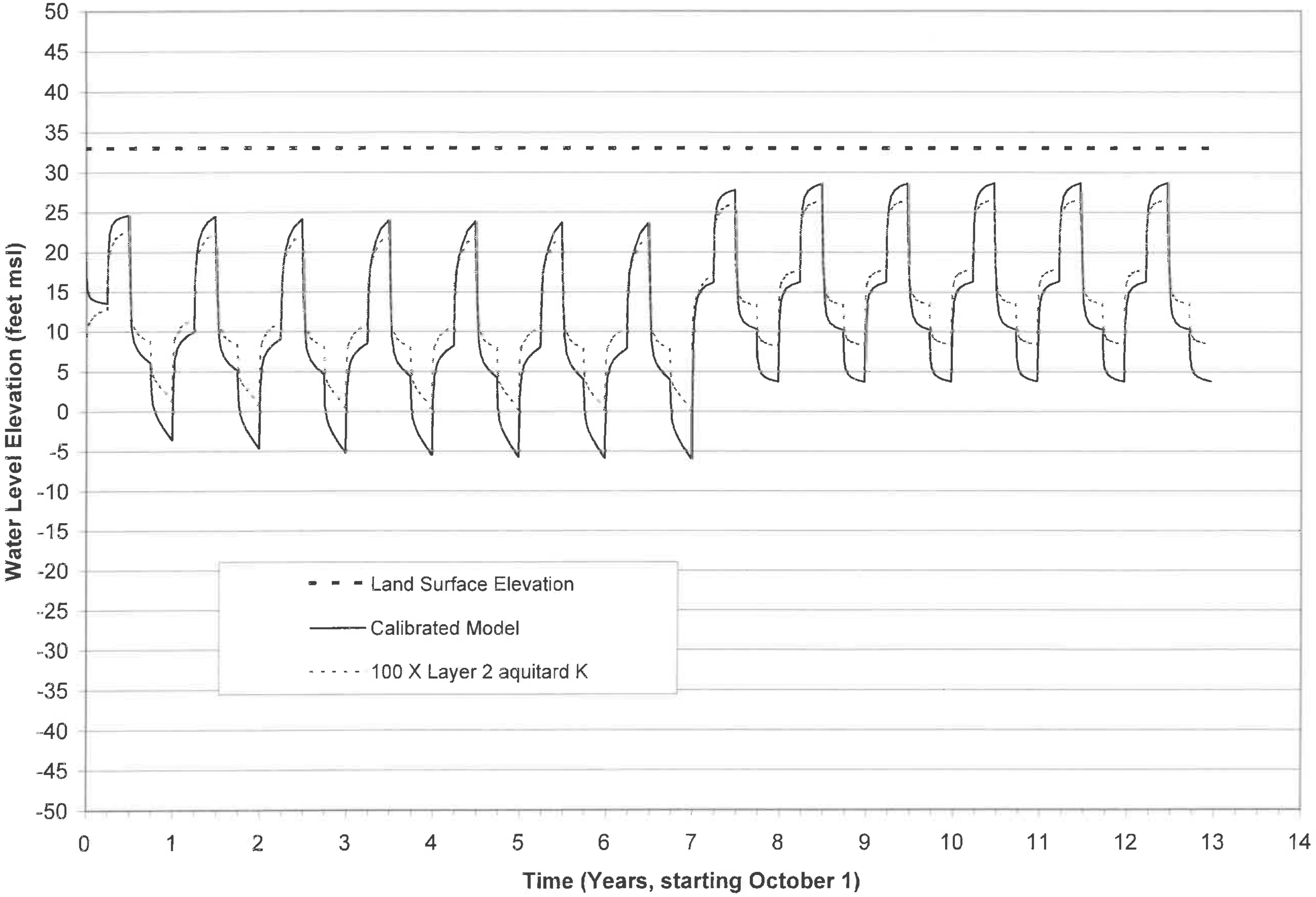

FIGURE J-46. LAYER 3 WELL 33NC - LAYER 2
AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

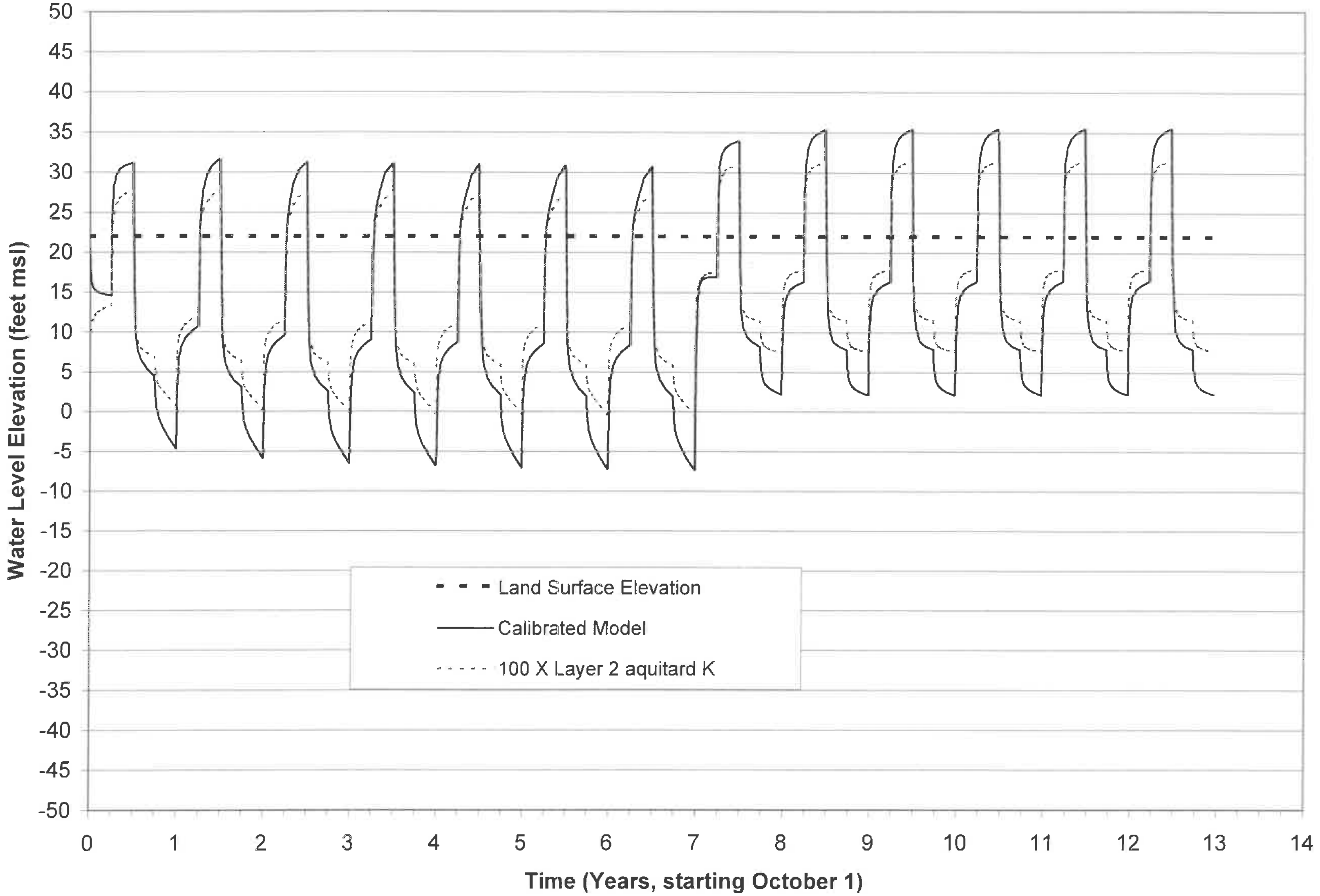

FIGURE J-47. LAYER 3 PIEZOMETER P-11C - LAYER 2 AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

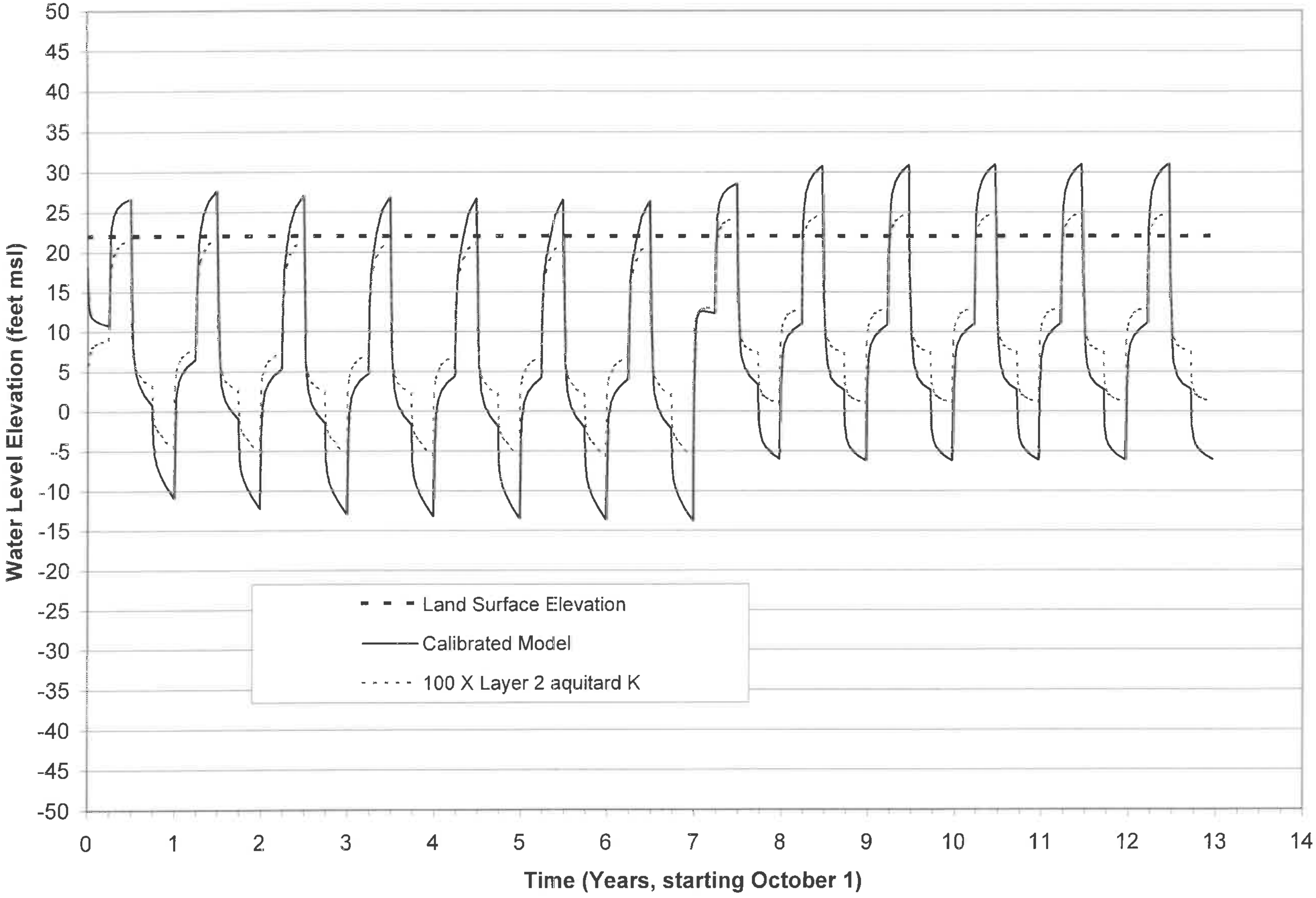

FIGURE J-48. LAYER 3 WELL 5FC - LAYER 2
AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

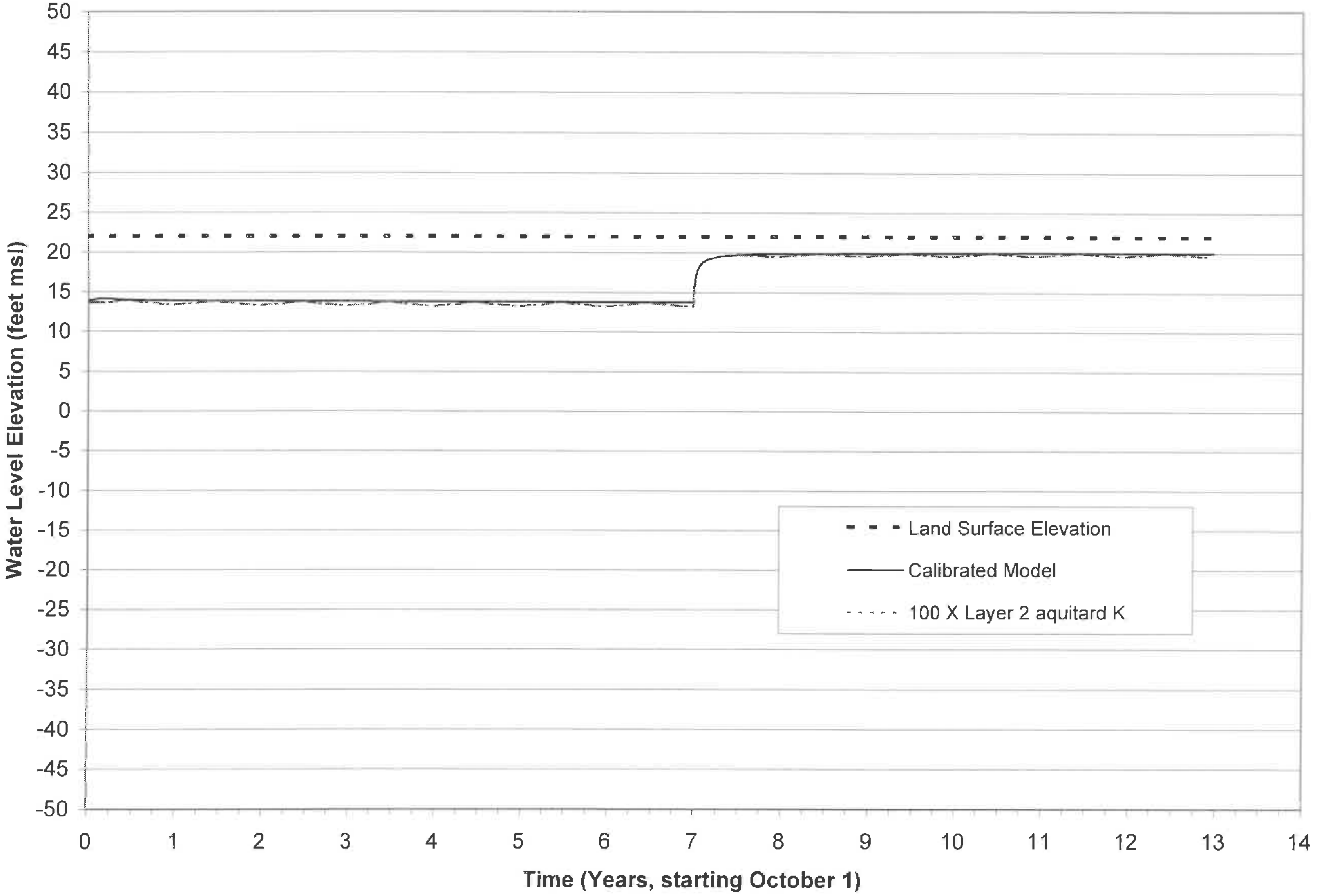

FIGURE J-49. LAYER 1 PIEZOMETER P-11A - LAYER 2
AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

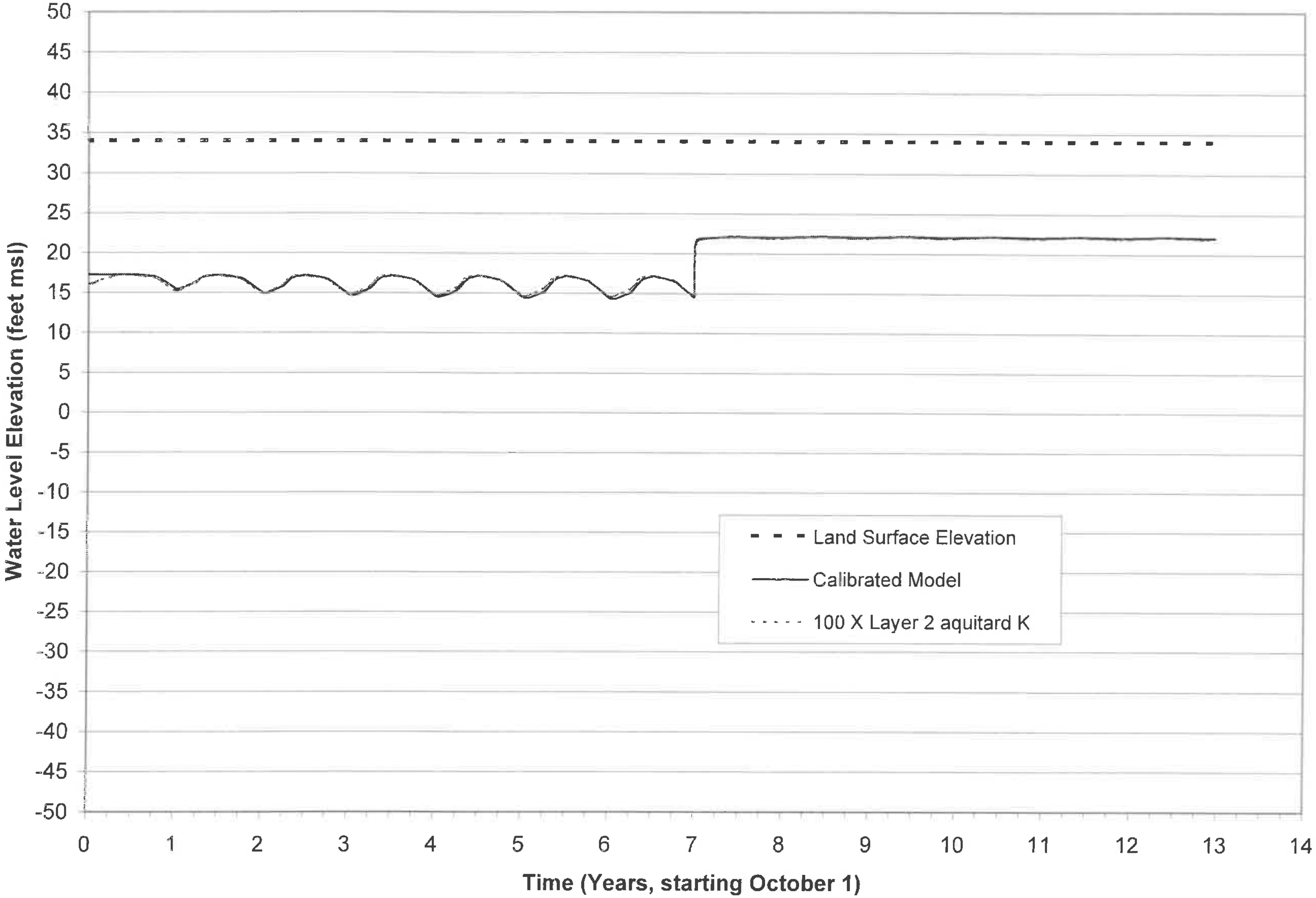

FIGURE J-50. LAYER 1 PIEZOMETER P-9 - LAYER 2 AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

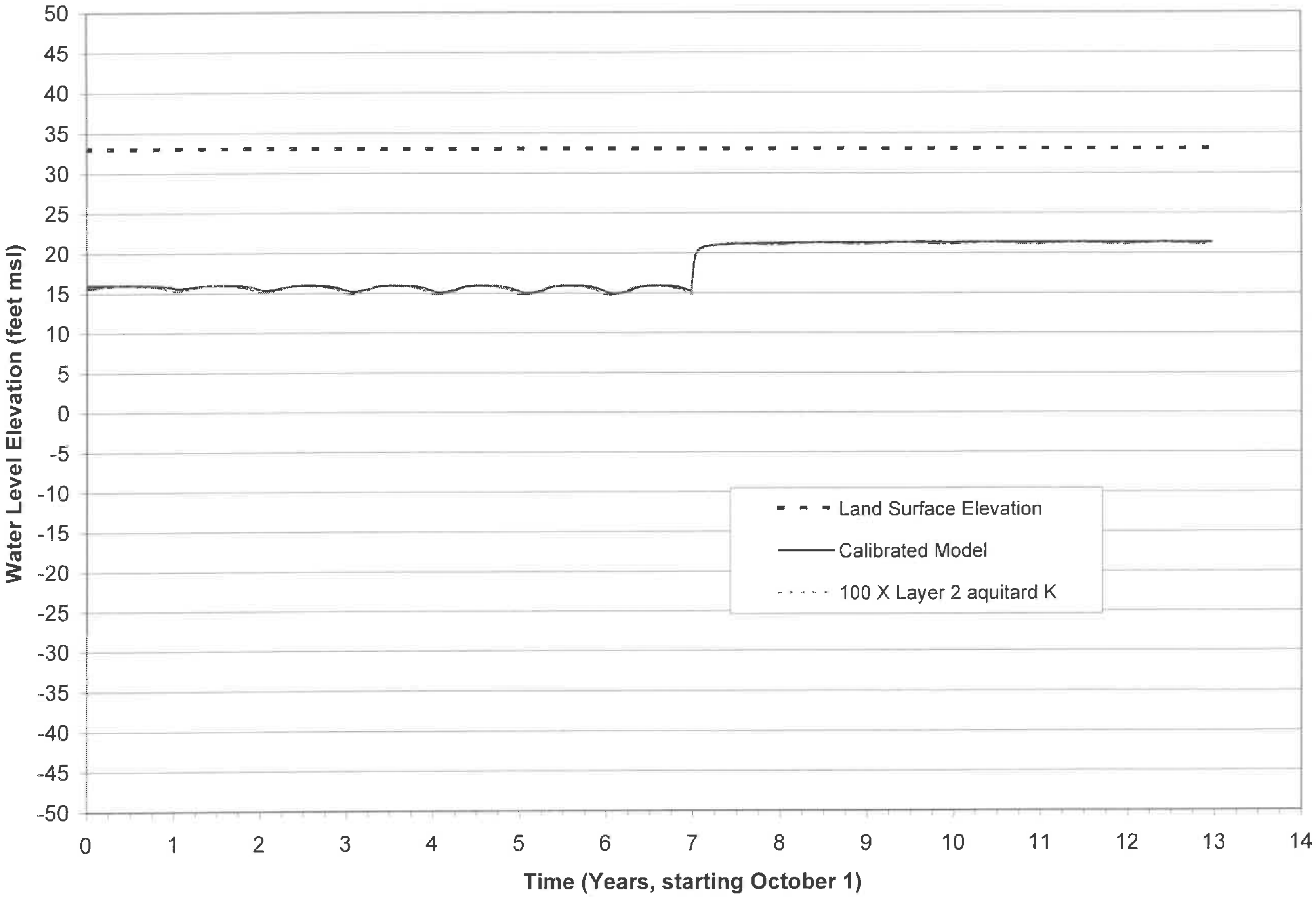

FIGURE J-51. LAYER 1 PIEZOMETER P-4S - LAYER 2
AQUITARD HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

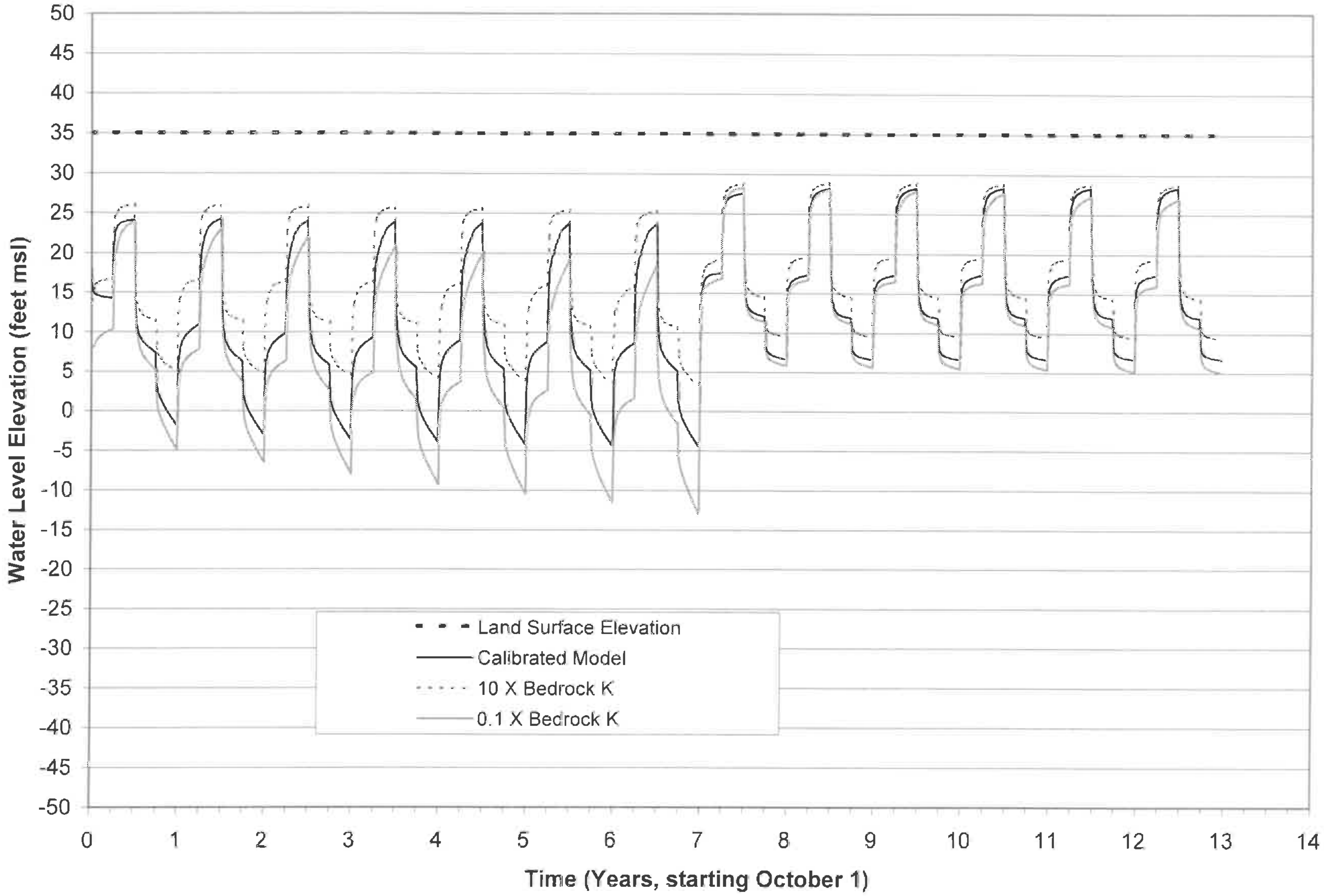

FIGURE J-52. LAYER 3 WELL 32RA - BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

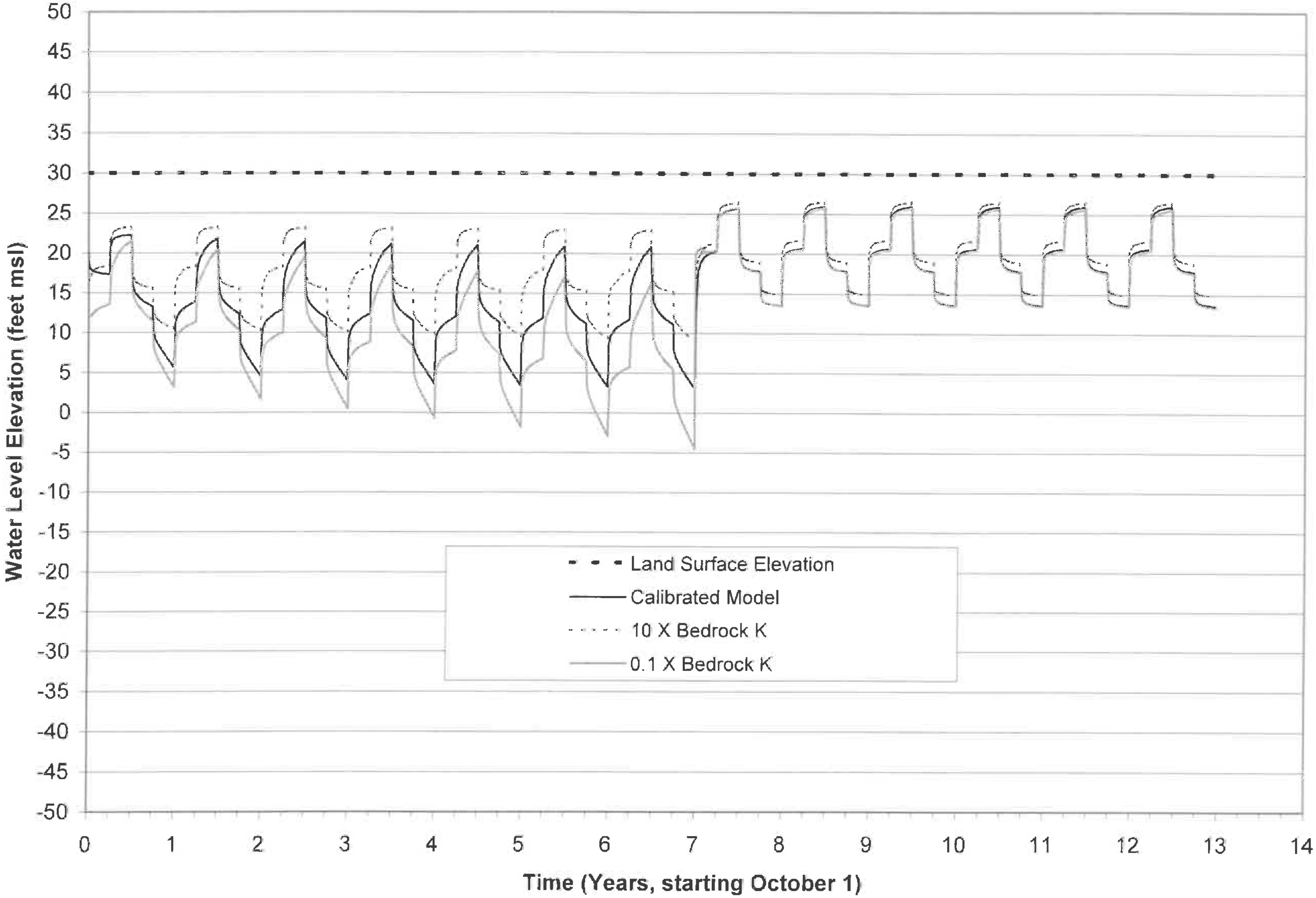

FIGURE J-53. LAYER 3 WELL 33EA - BEDROCK
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

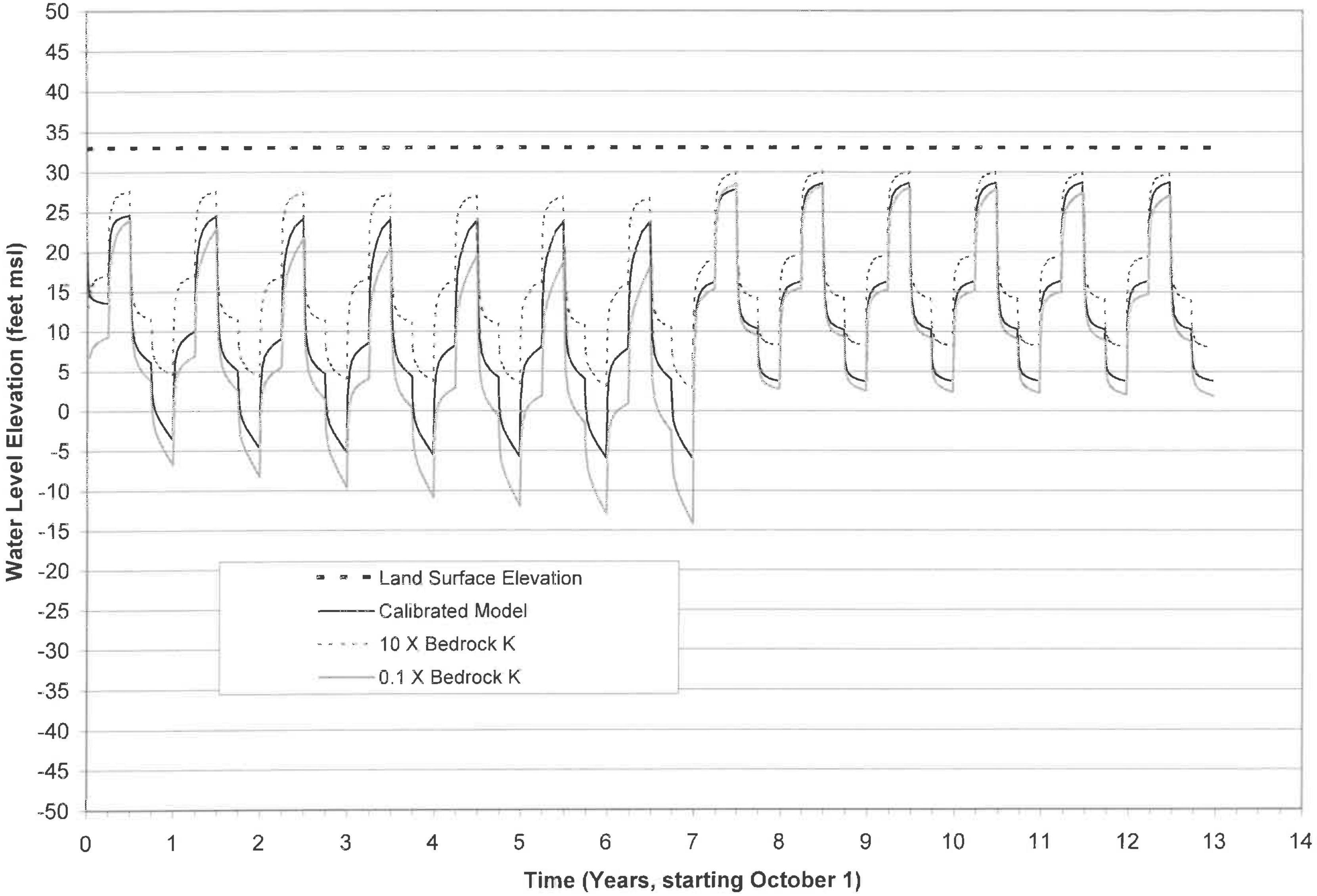

FIGURE J-54. LAYER 3 WELL 33NC - BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

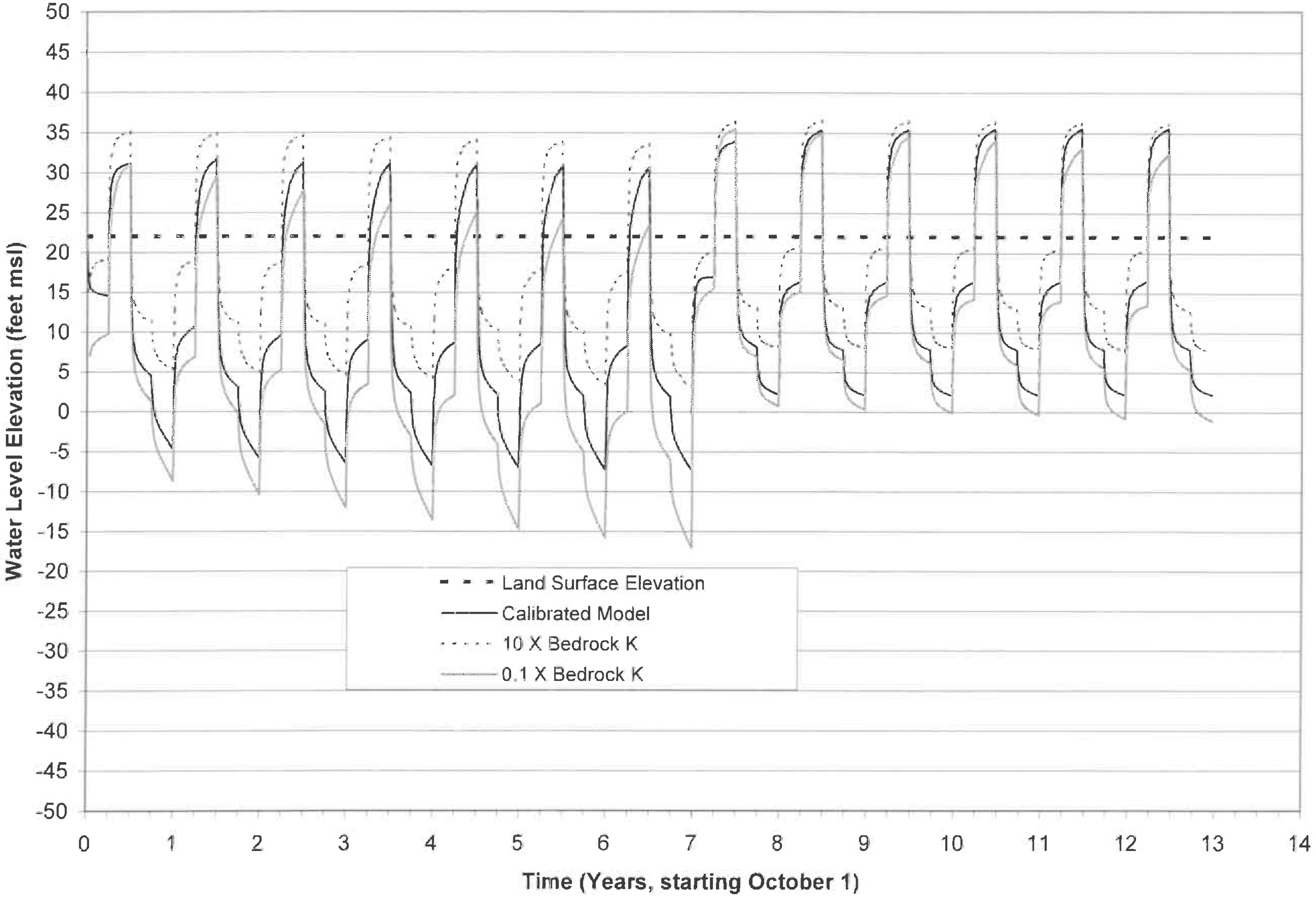

FIGURE J-55. LAYER 3 PIEZOMETER P-11C - BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

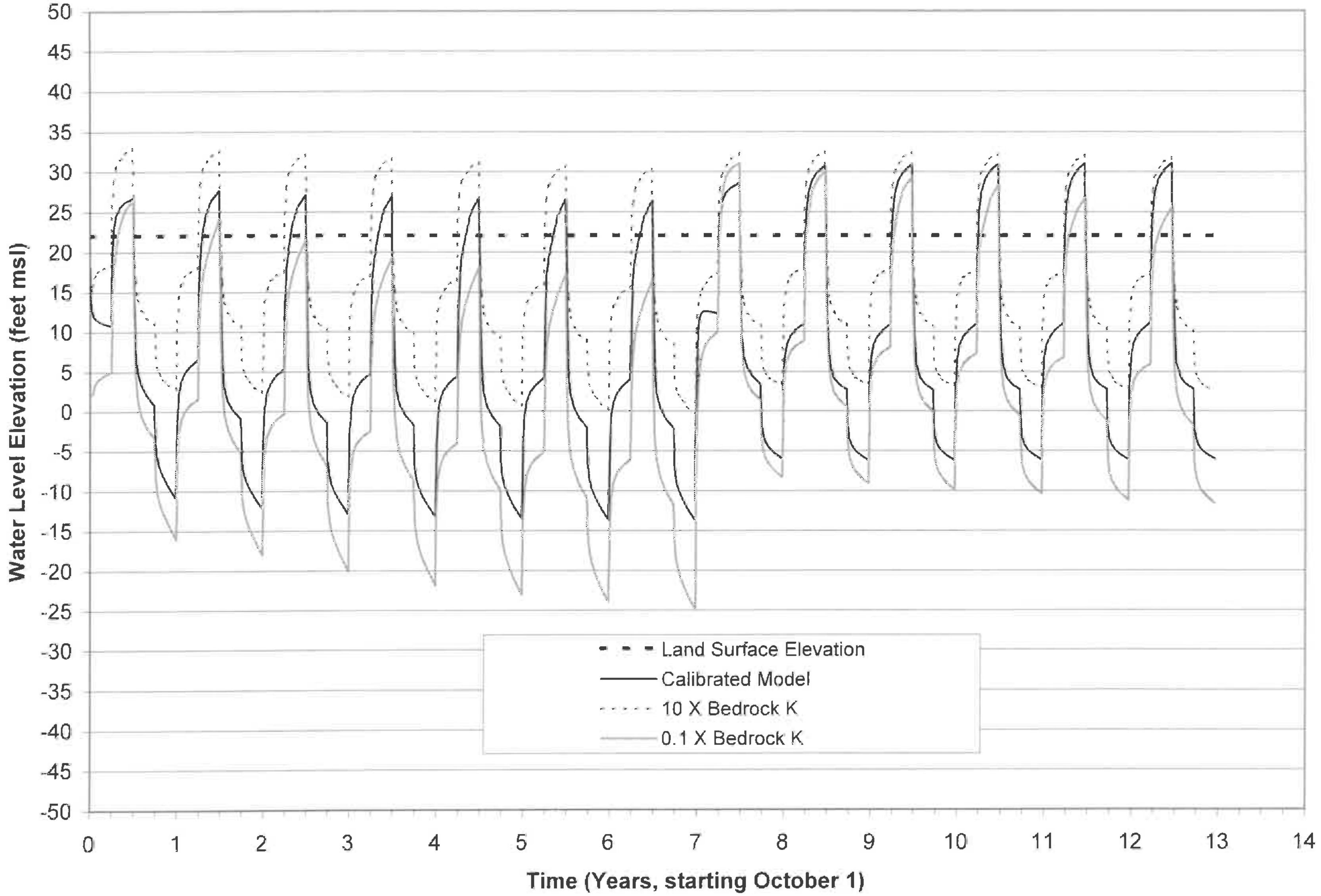

FIGURE J-56. LAYER 3 WELL 5FC - BEDROCK
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

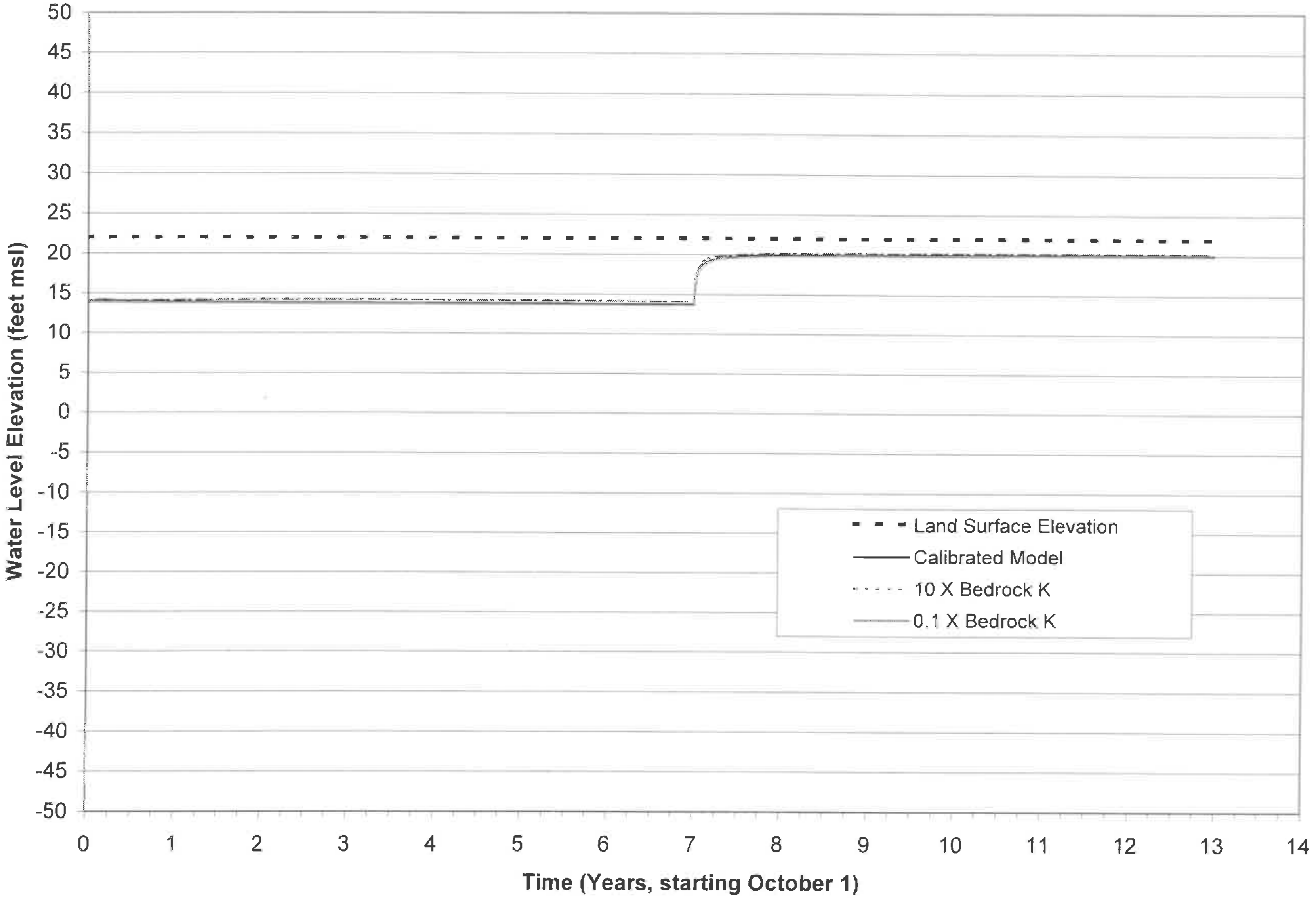

FIGURE J-57. LAYER 1 PIEZOMETER P-11A - BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

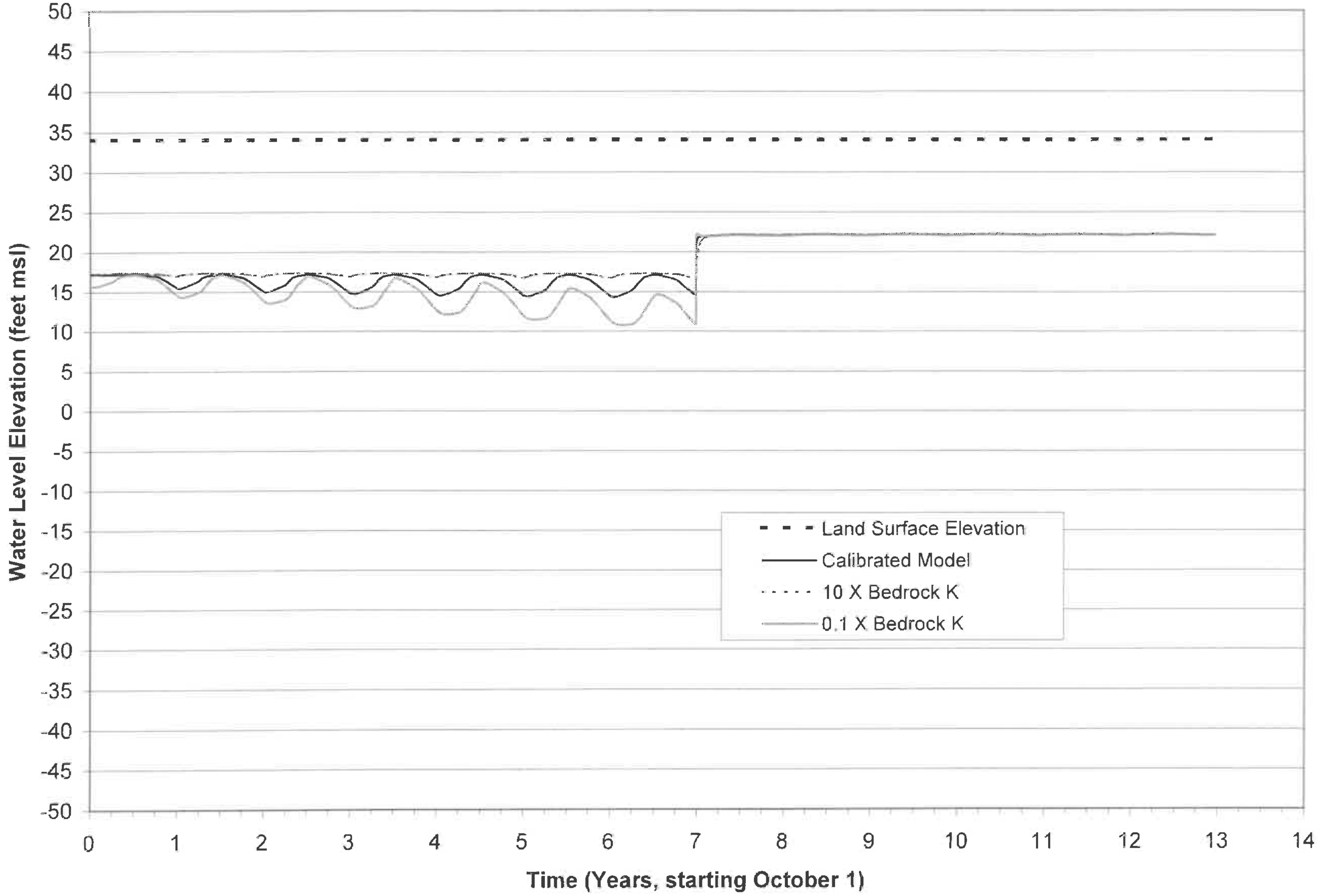

FIGURE J-58. LAYER 1 PIEZOMETER P-9 - BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

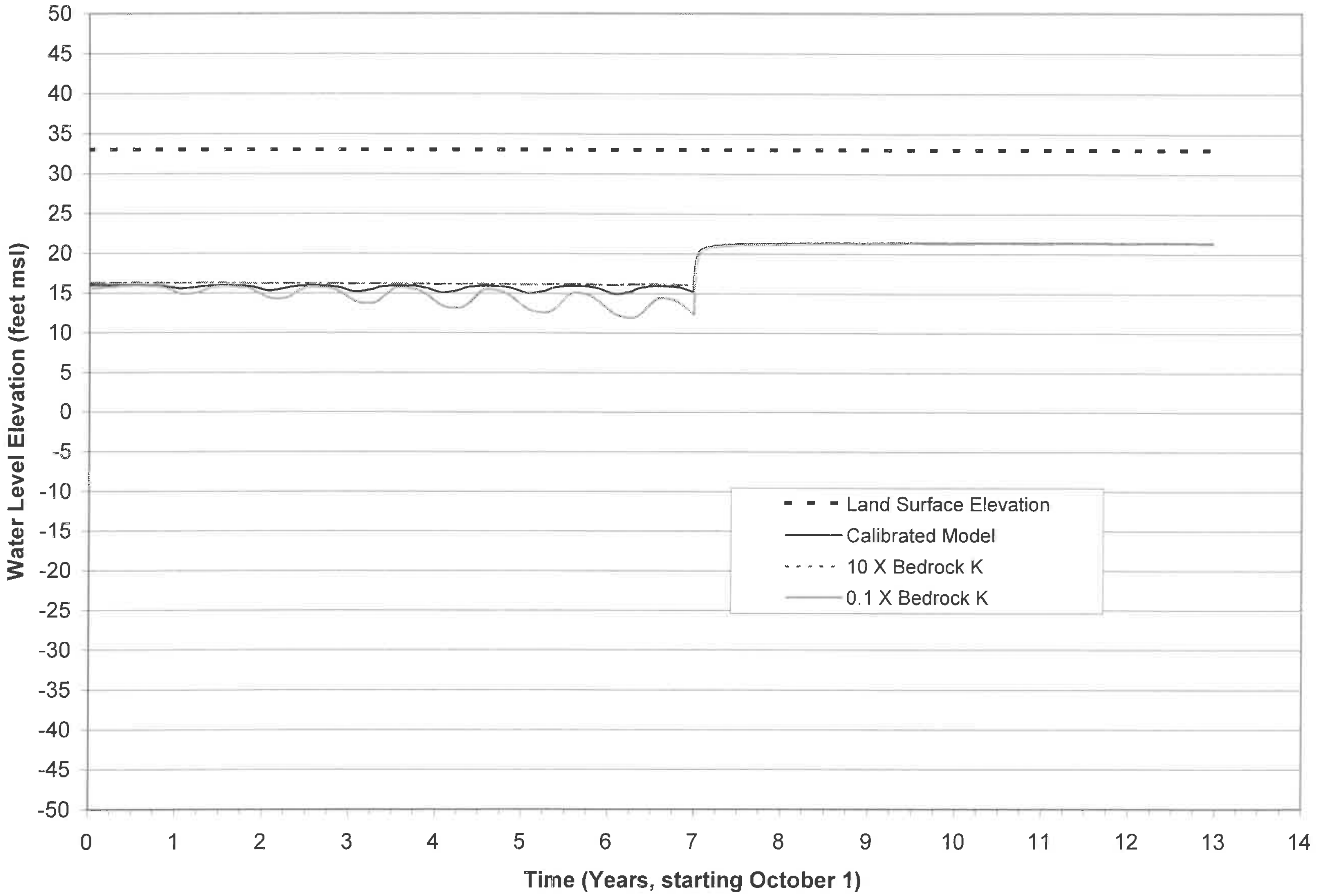

FIGURE J-59. LAYER 1 PIEZOMETER P-4S - BEDROCK HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

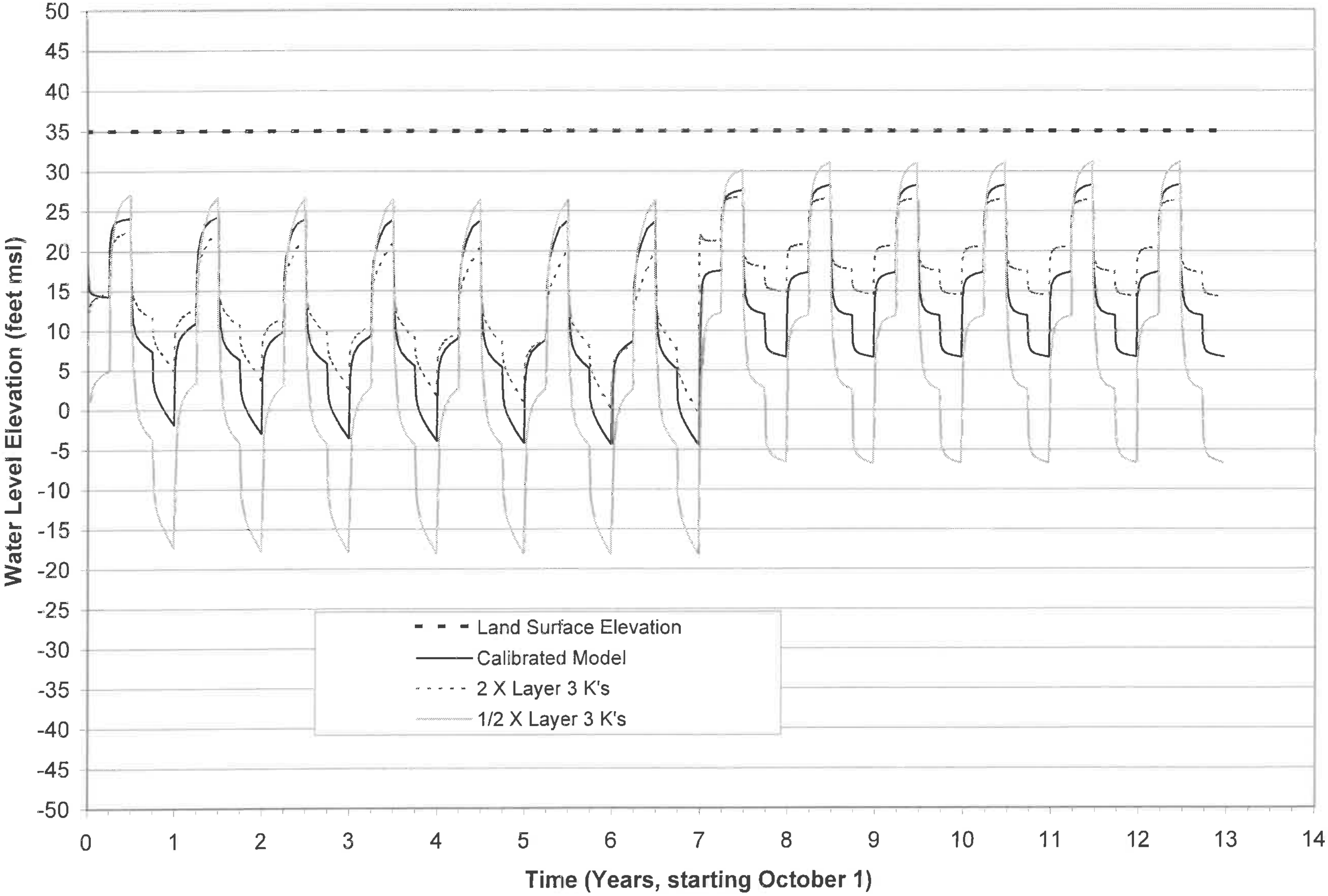

FIGURE J-60. LAYER 3 WELL 32RA - LAYER 3
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

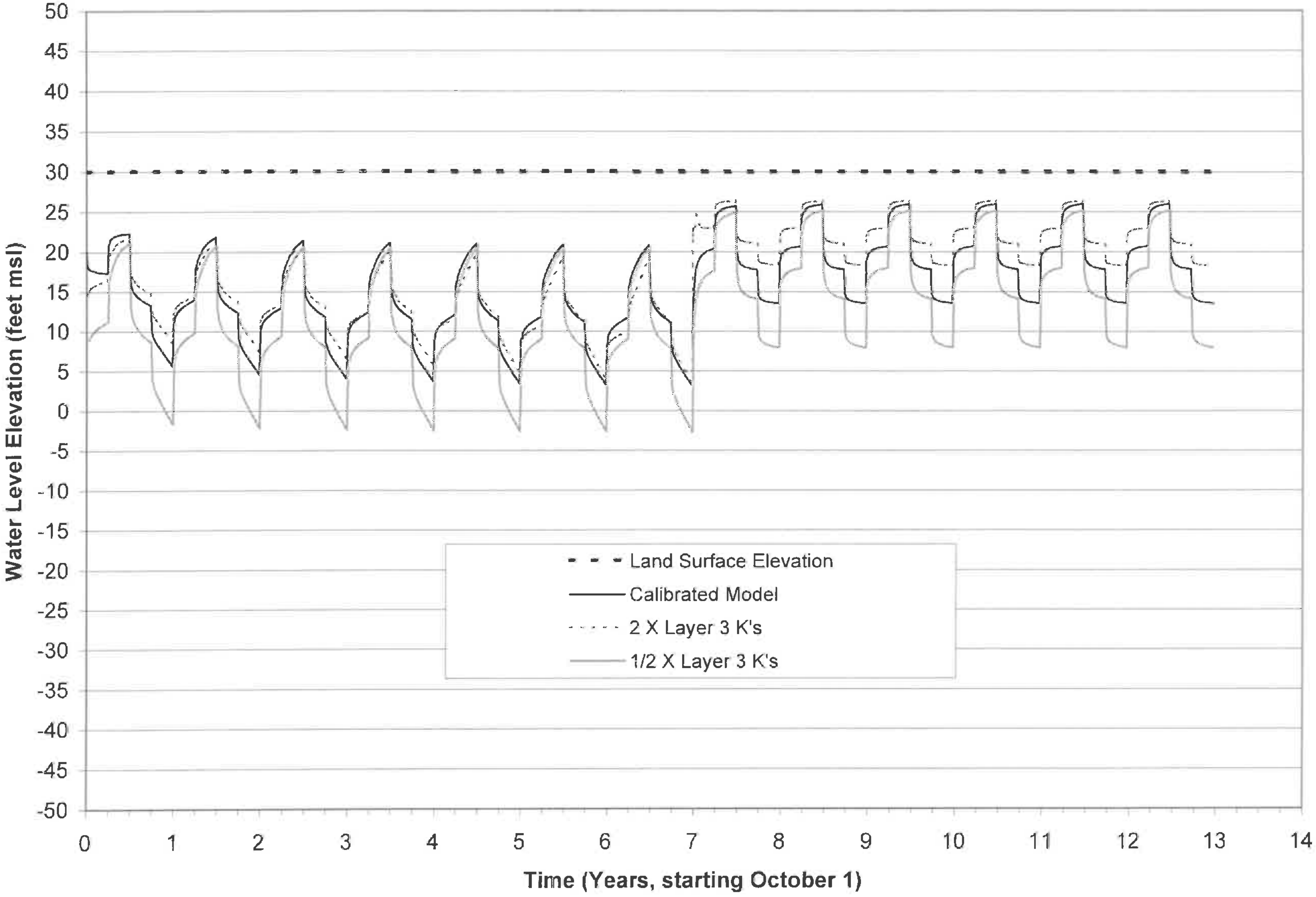

FIGURE J-61. LAYER 3 WELL 33EA - LAYER 3
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

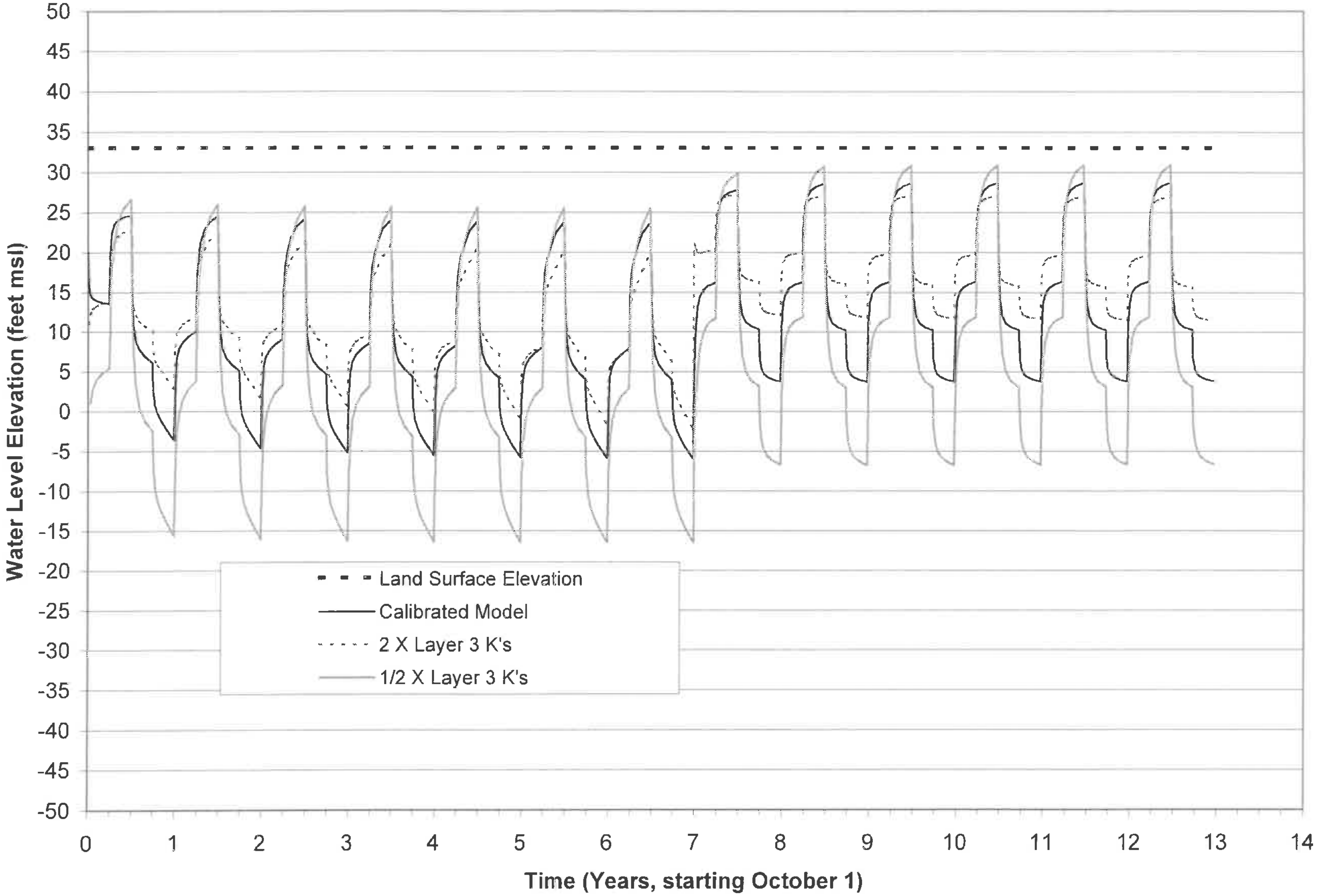

FIGURE J-62. LAYER 3 WELL 33NC - LAYER 3
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

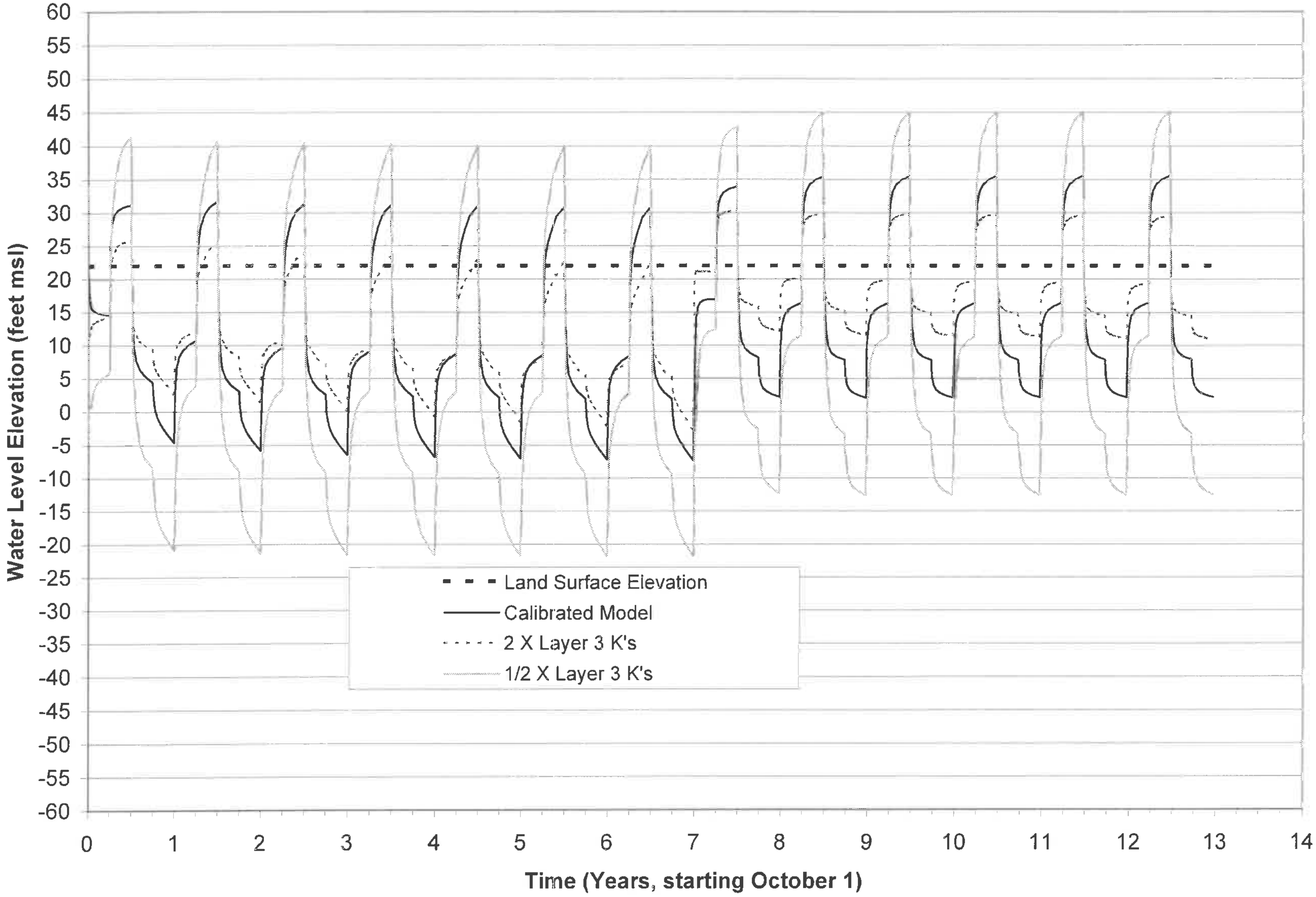

FIGURE J-63. LAYER 3 PIEZOMETER P-11C - LAYER 3 HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

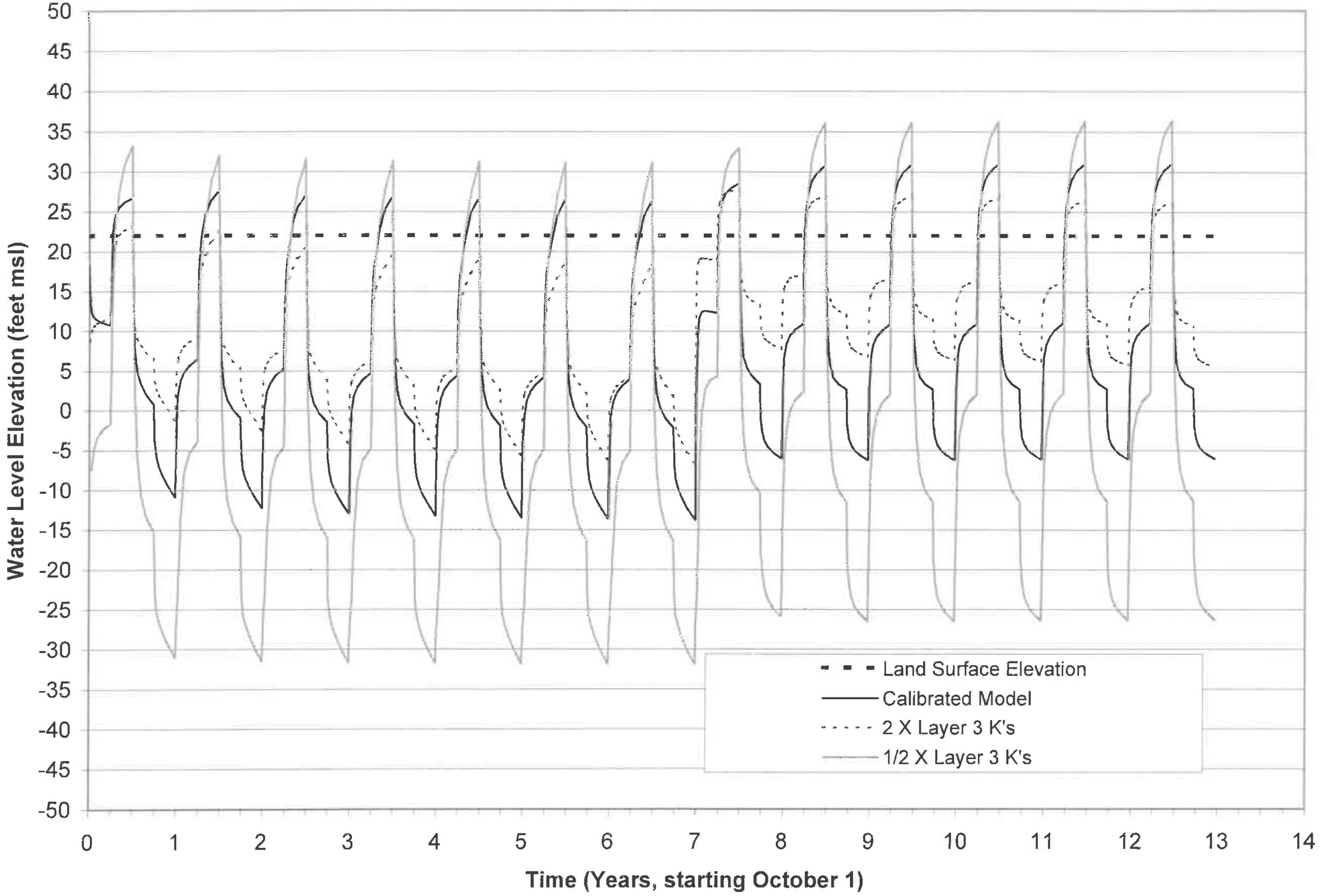

FIGURE J-64. LAYER 3 WELL 5FC - LAYER 3
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

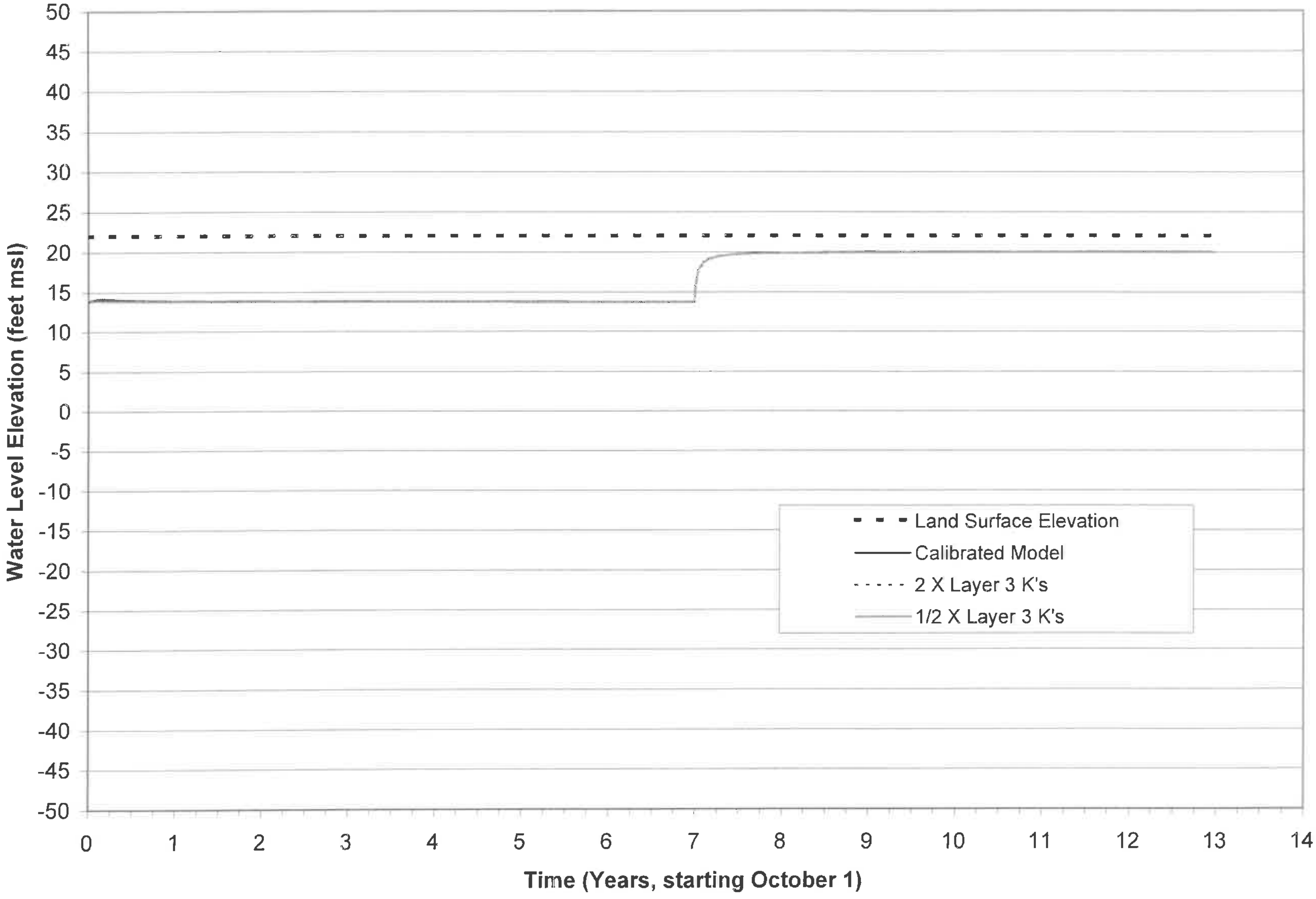

FIGURE J-65. LAYER 1 PIEZOMETER P-11A - LAYER 3 HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

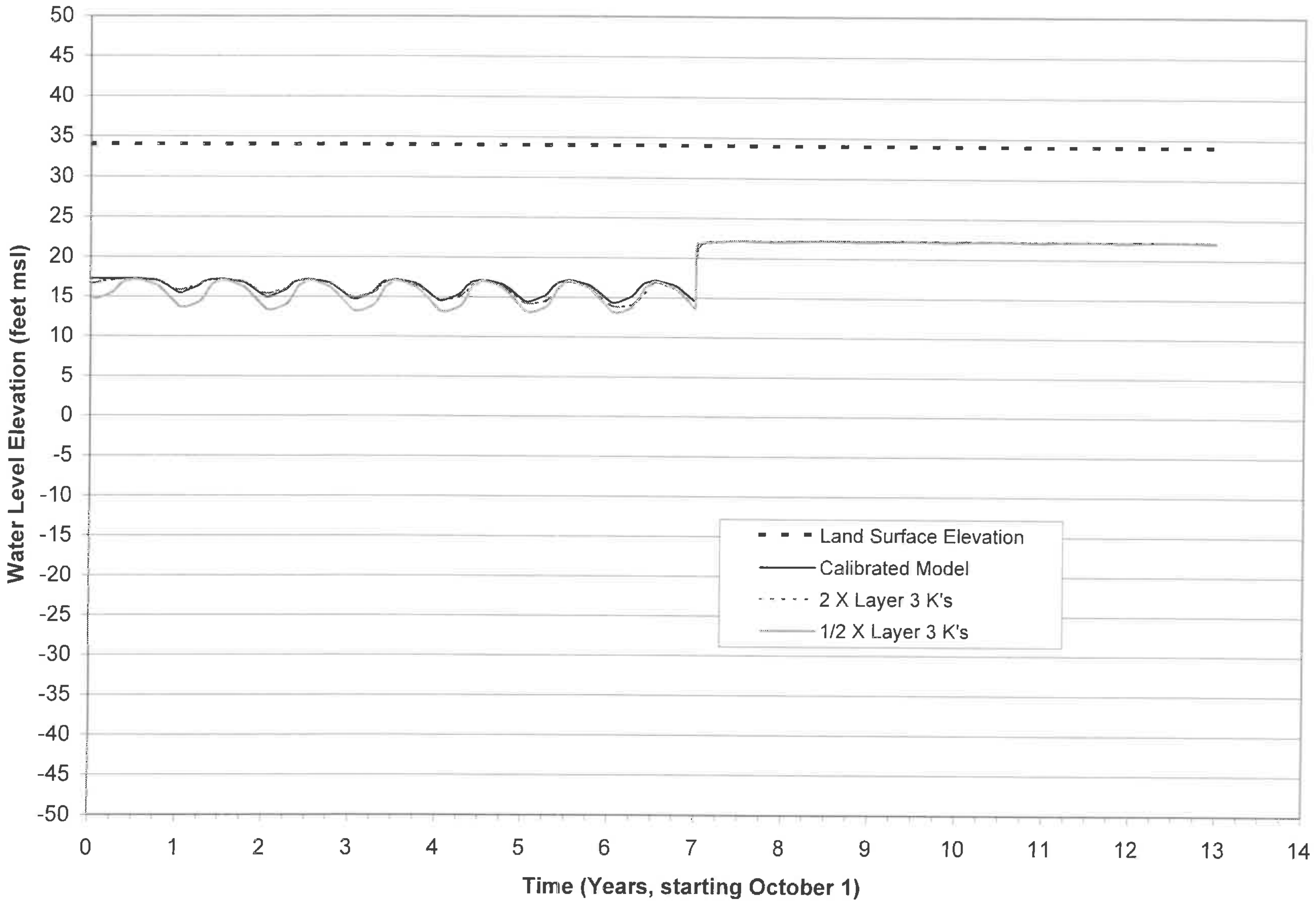

FIGURE J-66. LAYER 1 PIEZOMETER P-9 - LAYER 3
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS

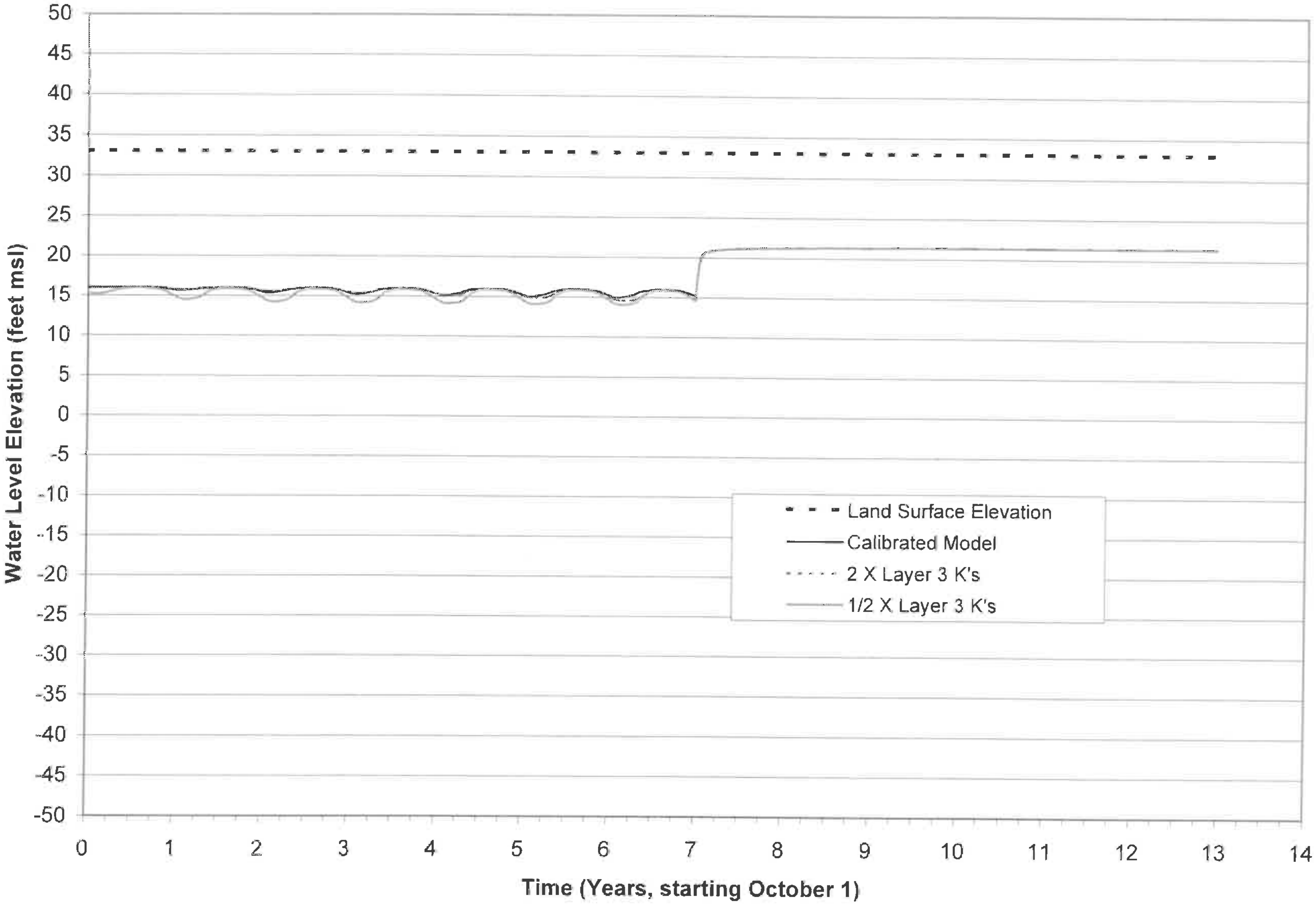

FIGURE J-67. LAYER 1 PIEZOMETER P-4S - LAYER 3
HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS