AD-A243 215

DTIC
ELECTE
NOV 2 0 1991
S C D

# REMEDIAL INVESTIGATION REPORT

FOR

USATHAMA - RATSS
LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

VOLUME II

DAAA15-85-D 0015

Work Order No. 2281-09-07

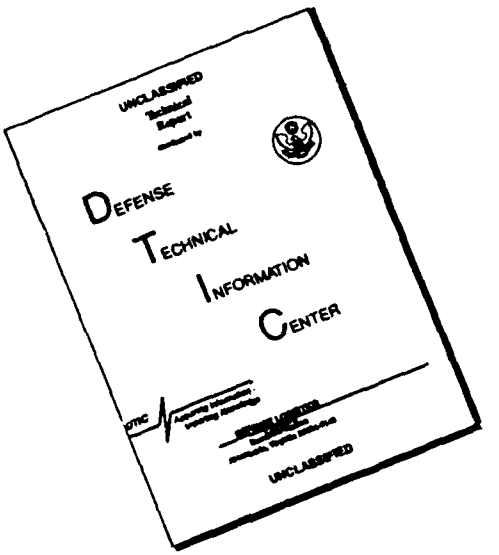
Prepared By

Roy F. Weston, Inc.
West Chester, Pennsylvania

June 1990

91-14796

# DISCLAIMER NOTICE




THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

VOLUME II

LIST OF APPENDICES

**Appendix**

| | |
|---|---|
| A | Well Development Information |
| B | Monitoring Wells and Staff Gauging Elevations |
| C | Geologic Drill Logs |
| D | Geotechnical Data |
| E | Equations Used for Analysis of Pumping Test Data |
| F | Statistical Background Values |
| G | Chemical Data |
| H | Toxicity Summaries |
| I | List of Common and Scientific Names of Wildlife Species at LCAAP |

Statement A per telecon
Denise Hancsak USATHAMA/CETHA-IR-A
Aberdeen Proving Ground, MD 21010-5401

NWW 11/8/91

Accession For
NTIS GRA&I
DTIC TAB
Unannounced
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1 | 23

# APPENDIX A

# WELL DEVELOPMENT INFORMATION

## WELL DEVELOPMENT INFORMATION

| Well # | Total Depth | WLBD | WLAD | D&D | TWR | DDW | Method |
|---|---|---|---|---|---|---|---|
| 14-3 | 25' | 11' | 16' | 2/22-1 hr | 65 gal | cloudy | bailed |
| 2-8 | 29' | 8' | 29' | 2/22-1 hr | 118 gal | cloudy | bailed |
| 5-7 | 36' | 12' | 24' | 2/22-2.5 hr | 135 gal | cloudy | bailed |
| 12-5 | 34' | 25' | 26' | 2/23-1hr | 55 gal | cloudy | bailed |
| 7-13 | 32' | 24' | 24.5' | 2/23-1hr | 45 gal | cloudy | bailed |
| 8-7 | 39' | 27' | 39' | 2/23-1.5 hr | 67 gal | cloudy | bailed |
| 8-8 | 43' | 28' | 33' | 2/23-2 hr | 84 gal | cloudy | bailed |
| 16-6 | 31' | 13' | 13' | 2/19-5hr | 100 gal | cloudy | pumped |
| 16-7 | 90' | 13' | 13' | 2/2-45 min | 425 gal | clear | pumped |
| 17-8 | 85' | 13' | 11' | 2/20-35 min | 376 gal | clear | pumped |
| 17-7 | 17' | 6' | 9' | 2/20-2 hr | 65 gal | cloudy | bailed |
| 16-8 | 22' | 10' | 16.5' | 2/21-1.5 hr | 80 gal | cloudy | bailed |
| 17-10 | 31' | 9' | 11' | 2/21-2.5 hr | 125 gal | cloudy | bailed |
| 17-9 | 19' | 9' | 10.5 | 2/21-1.5 hr | 55 gal | cloudy | bailed |
| 14-1 | 28' | 19' | 26' | 2/22-1.5 hr | 65 gal | cloudy | bailed |
| 16-11 | 23' | 11' | 16' | 2/22-1 hr | 65 gal | cloudy | bailed |
| 7-11 | 28' | 18' | 20' | 2/22-1 hr | 60 gal | cloudy | bailed |
| 8-6 | 35' | 25' | 25' | 2/23-1 hr | 55 gal | cloudy | bailed |
| 16-13 | 23' | 7' | 12' | 2/24-2 hr | 55 gal | clear | pumped |
| 16-12 | 31' | 14' | 26' | 2/24-5 hr | 90 gal | cloudy | pumped |
| 18-7 | 85.5' | 12.8' | -- | 2/21-2 hr | 500 gal | clear | pumped |
| 16-9 | 50.5' | 24.2' | -- | 2/21-2 hr | 160 gal | clear | pumped |
| 14-4 | 81' | 15.2' | -- | 2/21-2 hr | 400 gal | clear | pumped |

## WELL DEVELOPMENT INFORMATION (Continued)

| Well # | Total Depth | WLBD | WLAD | D&D | TWR | DDW | Method |
|---|---|---|---|---|---|---|---|
| 12-6 | 88' | 22.5' | -- | 2/21-1 hr | 360 gal | clear | pumped |
| 14-2 | 26' | 13.3' | -- | 2/22-1.5 hr | 85 gal | cloudy | pumped |
| 3-8 | 85' | 22.3' | -- | 2/22-1.5 hr | 350 gal | clear | pumped |
| 7-12 | 85' | 20' | -- | 2/22-1 hr | 360 gal | clear | pumped |
| 16-10 | 62' | 16' | -- | 2/22-1.5 hr | 400 gal | clear | pumped |



WLBD - Water level before development
WLAD - Water level after development
D & D - Date and duration of development
TWR - Total water removed
DDW - Description of development water

# APPENDIX B

## MONITORING WELLS AND STAFF GAUGING ELEVATIONS

TABLE B-1
Summary of Ditch Water Elevations
All Values Recorded at MSL

1 June 1988

| Staff Gauge | Gauge Elevation | Surface Water Elevation |
|---|---|---|
| 1 | 758.89 | 755.6 |
| 2 | 768.72 | 764.85 |
| 3 | 732.99 | 740.14 |
| 4 | 738.67 | 735.12 |
| 5 | 738.87 | -- |
| 6 | 734.65 | -- |
| 7 | 732.65 | 729.15 |
| 8 | 737.05 | 733.4 |
| 9 | 740.24 | -- |
| 10 | 742.22 | 740.28 |
| 11 | 742.13 | -- |

Locations of Staff Guages are shown in Figure 3-3

TABLE B-2
Summary of Groundwater Elevations
All Values Recorded at Feet Above MSL
1 June 1988

| Monitoring Well | Ground Elevation | Top of PVC Elevation | Top of Screen Elevation | Bottom of Screen Elevation | Groundwater Elevation |
|---|---|---|---|---|---|
| 1-1 | 774.9 | 776.78 | 760 | 755 | 772.28 |
| 1-2 | 763.53 | 765.15 | 756 | 746 | 760.61 |
| 1-3 | 762 | 763.16 | 728 | 718 | 759.16 |
| 1-4 | 772.72 | 775.35 | 764 | 747 | 762.72 |
| 1-5 | 784.2 | 786.47 | 778 | 764 | 778.81 |
| 1-6 | 762.6 | 764.69 | 739 | 726 | 758.51 |
| 1-7 | 796.08 | 797.83 | 773 | 743 | 781.31 |
| 1-7A | -- | -- | 769 | 739 | -- |
| 1-8 | 763.2 | 764.95 | 744 | 729 | 758.67 |
| 1-9 | 761.7 | 764.2 | 748 | 733 | 756.44 |
| 1-10 | 765.2 | 765.99 | 745 | 730 | 759.34 |
| 2-1 | 756 | 757.35 | 730 | 720 | 752.4 |
| 2-2 | 764 | 766.54 | 724 | 714 | 753.03 |
| 2-3 | 762.3 | 762.5 | 735 | 730 | 757.12 |
| 2-4 | 762.1 | 764.45 | 730 | 725 | 757.67 |
| 2-5 | 759.4 | 761.95 | 744 | 729 | 742.76 |
| 2-6 | -- | -- | 748 | 733 | -- |
| 2-7 | 756.2 | 758.23 | 744 | 729 | 749.34 |
| 2-8 | 763.6 | 766.19 | 744 | 734 | -- |
| 3-1 | 742.6 | 743.69 | 697 | 692 | 723.55 |
| 3-2 | 743.0 | 744.57 | 723 | 708 | 723.77 |
| 3-3 | 742.3 | 743.92 | 722 | 717 | 725.58 |
| 3-4 | 742.9 | 744.49 | 700 | 695 | 723 |
| 3-5 | 745.5 | 746.07 | 725 | 710 | 723.47 |
| 3-6 | 744.7 | 746.64 | 722 | 712 | 723.69 |
| 3-7 | 741.7 | 743.86 | 724 | 714 | 724.22 |
| 3-8 | 742.7 | 744.8 | 670 | 660 | 723.77 |
| 4-1 | 762.92 | 764.01 | 741 | 726 | 740.04 |
| 4-2 | 757.17 | 758.38 | 731 | 717 | 745.80 |
| 4-3 | 759.66 | 760.8 | 724 | 719 | 732.12 |
| 4-4 | 763.24 | 764.34 | 736 | 731 | 746.30 |
| 4-5 | 764.2 | 765.78 | 743 | 738 | 757.41 |
| 4-6 | 777.74 | 777.74 | 743 | 728 | 770.42 |
| 5-1 | 752.25 | 753.79 | 722 | 717 | 736.63 |
| 5-2 | 754.22 | 755.49 | 730 | 725 | 738.81 |
| 5-3 | 755.36 | 756.5 | 718 | 713 | 735.59 |
| 5-4 | 754.17 | 755.44 | 722 | 717 | 742.24 |
| 5-5 | 751.2 | 753.34 | 734 | 724 | 741.47 |
| 5-6 | 759.2 | 761.66 | 742 | 732 | 745.54 |
| 5-7 | 773.1 | 775.75 | 747 | 737 | 763.05 |
| 6-1 | 775.33 | 777.31 | 755 | 750 | 766.93 |
| 6-2 | 788.37 | 790.16 | 764 | 759 | 769.25 |
| 6-3 | 788.08 | 789.32 | 769 | 764 | 785.60 |
| 6-4 | 781.05 | 782.59 | 768 | 758 | 776.49 |
| 6-5 | 779 | 781.48 | 748 | 733 | 763.73 |
| 6-6 | 779.22 | 780.87 | 756 | 741 | 765.77 |
| 6-7 | 799.47 | 800.75 | 790 | 775 | 791.09 |
| 7-1 | 747.8 | 748.91 | 723 | 708 | 725.47 |
| 7-2 | 747.5 | 748.82 | 729 | 709 | 729.22 |
| 7-3 | 744.1 | 745.68 | 719 | 704 | 739.60 |
| 7-4 | 742.1 | 743.84 | 717 | 712 | 725.52 |
| 7-5 | 748.1 | 749.35 | 728 | 708 | 725.69 |

A0039

TABLE B-2 (Cont.)
Summary of Groundwater Elevations
All Values Recorded at Feet Above MSL
1 June 1988

| Monitoring Well | Ground Elevation | Top of PVC Elevation | Top of Screen Elevation | Bottom of Screen Elevation | Groundwater Elevation |
|---|---|---|---|---|---|
| 7-6 | 745.5 | 746.84 | 712 | 717 | 725.51 |
| 7-7 | 741.8 | 743.82 | 724 | 714 | 725.29 |
| 7-8 | 742.8 | 745.12 | 726 | 716 | 725.01 |
| 7-9 | 745.8 | 748.08 | 728 | 718 | 726.22 |
| 7-10 | 743.9 | 746.2 | 727 | 717 | 725.41 |
| 7-11 | 741.56 | 743.55 | 726 | 716 | 724.97 |
| 7-12 | 741.6 | 744.03 | 669 | 659 | 722.60 |
| 7-13 | 746.8 | 749.45 | 725 | 715 | 725.46 |
| MW-1 | 821.37 | 822.58 | -- | -- | 789.77 |
| MW-2 | 811.17 | 812.21 | -- | -- | 789.44 |
| MW-3 | 780.05 | 781.2 | -- | -- | 768.53 |
| MW-4 | 766.28 | 767.51 | -- | -- | 759.84 |
| MW-5 | 820.76 | 804.84 | -- | -- | 794.09 |
| 8-1 | 751.26 | 750.51 | 726 | 711 | 732.04 |
| 8-2 | 753.42 | 755.96 | 743 | 713 | 733.48 |
| 8-3 | 752.56 | 751.83 | 730 | 715 | 743.48 |
| 8-4 | 762.06 | 764.28 | 750 | 742 | 748.88 |
| 8-5 | 783.86 | 785.81 | 772 | 756 | 770.27 |
| 8-6 | 751.84 | 754.57 | 730 | 720 | 729.58 |
| 8-7 | 750.7 | 753.14 | 722 | 712 | 725.87 |
| 8-8 | 751.67 | 754.02 | 718 | 708 | 725.71 |
| 9-1 | 740.16 | 741.29 | 728 | 701 | 728.22 |
| 9-2 | 740.56 | 741.62 | 706 | 701 | 726.07 |
| 9-3 | 739.46 | 740.86 | 706 | 701 | 728.66 |
| 9-4 | 743.16 | 744.67 | 729 | 701 | 729.67 |
| 10-1 | 855.72 | 856.9 | 842 | 837 | 838.77 |
| 10-2 | 854.41 | 854.99 | 826 | 821 | 830.72 |
| 10-3 | 836.43 | 837.61 | 817 | 812 | 828.26 |
| 10-4 | 842.78 | 843.88 | 813 | 808 | 818.48 |
| 10-5 | 830.28 | 832.13 | 820 | 815 | 817.73 |
| 10-6 | 854.73 | 856.49 | 821 | 806 | 832.53 |
| 11-1 | 790 | 791.3 | 771 | 766 | 785.06 |
| 11-2 | 790.89 | 792.12 | 772 | 767 | 782.71 |
| 11-3 | 806.82 | 808.72 | 783 | 778 | 790.45 |
| 11-4 | 794.15 | 795.15 | 775 | 770 | 786.40 |
| 12-1 | -- | -- | -- | -- | -- |
| 12-2 | 742.3 | 744.49 | 725 | 715 | 724.17 |
| 12-3 | 742.5 | 744.45 | 726 | 716 | 723.05 |
| 12-4 | 743.3 | 745.30 | 726 | 716 | 724.83 |
| 12-5 | 746.2 | 748.22 | 722 | 712 | 724.06 |
| 12-6 | 743.3 | 745.26 | 667 | 657 | 723.96 |
| 14-1 | 745 | 746.93 | 727 | 717 | 726.74 |
| 14-2 | 735.83 | 737.78 | 723 | 713 | 725.00 |
| 14-3 | 735.33 | 737.78 | 725 | 715 | 724.96 |
| 14-4 | 736.13 | 738.6 | 667 | 657 | 724.82 |
| 16-1 | 855.7 | 857.93 | 828 | 818 | 832.66 |
| 16-2 | 762.6 | 764.38 | 739 | 729 | 754.39 |
| 16-3 | 765 | 766.56 | 741 | 731 | 755.26 |
| 16-4 | 763 | 764.91 | 731 | 721 | 754.81 |
| 16-5 | 761.6 | 763.04 | 738 | 728 | 749.96 |
| 16-6 | 738.26 | 740.27 | 659 | 649 | 726.84 |
| 16-7 | 738.3 | 740.43 | 719 | 709 | 728.06 |
| 16-8 | 747.1 | 749.94 | 735 | 725 | 737.38 |
| 16-9 | 747.1 | 750.01 | 709 | 699 | 727.73 |
| 16-10 | 762.7 | 765.45 | 710 | 700 | 750.59 |
| 16-11 | 762.9 | 765.06 | 712 | 702 | 721.91 |

TABLE B-2 (Cont.)
Summary of Groundwater Elevations
All Values Recorded at Feet Above MSL
1 June 1988

| Monitoring Well | Ground Elevation | Top of PVC Elevation | Top of Screen Elevation | Bottom of Screen Elevation | Groundwater Elevation |
|---|---|---|---|---|---|
| 16-12 | 773.8 | 776.17 | 753 | 743 | 762.02 |
| 16-13 | 773.38 | 775.4 | 766 | 756 | 767.57 |
| 17-1 | 838.59 | 842.42 | 779 | 754 | 808.87 |
| 17-2 | 821.29 | 824.91 | 766 | 741 | 799.10 |
| 17-3 | 776.42 | 780.04 | 712 | 687 | 763.75 |
| 17-4 | 782.32 | 785.82 | 710 | 685 | 774.54 |
| 17-5 | 785.2 | 787.66 | 773 | 763 | 778.51 |
| 17-6 | 788.2 | 790.46 | 771 | 761 | 760.57 |
| 17-7 | 746.1 | 748.6 | 730 | 720 | 736.69 |
| 17-8 | 745.4 | 748.14 | 662 | 652 | 737.47 |
| 17-9 | 737.45 | 740.05 | 736 | 726 | 732.82 |
| 17-10 | 737.45 | 740.04 | 728 | 718 | 720.07 |
| 18-1 | 738.2 | 740.30 | 726 | 716 | 727.03 |
| 18-2 | 737.5 | 739.73 | 725 | 715 | 731.17 |
| 18-3 | 740.12 | 738.0 | 728 | 718 | 729.01 |
| 18-4 | 739.2 | 741.51 | 727 | 717 | 727.23 |
| 18-5 | 739.9 | 741.96 | 727 | 717 | 727.55 |
| 18-6 | 736.5 | 738.59 | 724 | 714 | 726.67 |
| 18-7 | 737.4 | 739.26 | 654 | 644 | 726.85 |

Note: Some of the screen depths have been estimated from boring logs.

# APPENDIX C

# GEOLOGIC DRILL LOGS

TABLE C-1
SUMMARY OF NEW (1988) WELL CONSTRUCTION DATA

| WELL NUMBER | SURFACE ELEVATION | TOP OF RISER ELEVATION | TOTAL DEPTH | BOTTOM HOLE ELEVATION | BOTTOM SCREEN ELEVATION | TOP OF SCREEN ELEVATION | SCREEN LENGTH | TOP OF SAND PACK |
|---|---|---|---|---|---|---|---|---|
| 2-8 | 763.6 | 766.19 | 59.0 | 704.6 | 734.6 | 744.6 | 10 | 748.6 |
| 3-8 | 742.7 | 744.8 | 82.0 | 660.7 | 660.7 | 670.7 | 10 | 675.2 |
| 5-7 | 773.1 | 775.75 | 50.0 | 723.1 | 737.1 | 747.1 | 10 | 751.4 |
| 7-11 | 741.56 | 743.55 | 26.0 | 715.56 | 715.56 | 725.56 | 10 | 727.56 |
| 7-12 | 741.6 | 741.6 | 83.0 | 658.6 | 659.1 | 669.1 | 10 | 673.6 |
| 7-13 | 746.8 | 749.45 | 32.0 | 714.8 | 714.8 | 724.8 | 10 | 728.3 |
| 8-6 | 751.84 | 754.57 | 32.0 | 719.84 | 719.84 | 729.84 | 10 | 733.44 |
| 8-7 | 750.7 | 753.14 | 40.0 | 710.7 | 711.7 | 721.7 | 10 | 727.2 |
| 8-8 | 751.67 | 754.02 | 45.0 | 706.67 | 708.67 | 718.67 | 10 | 724.07 |
| 12-5 | 746.2 | 748.22 | 34.0 | 712.2 | 712.2 | 722.2 | 10 | 728.2 |
| 12-6 | 743.3 | 745.26 | 86.5 | 656.8 | 656.8 | 666.8 | 10 | 671.7 |
| 14-1 | 745.0 | 746.93 | 34.5 | 710.5 | 717.0 | 727.0 | 10 | 734.2 |
| 14-2 | 735.83 | 737.78 | 23.5 | 712.33 | 712.83 | 722.83 | 10 | 725.83 |
| 14-3 | 735.33 | 737.38 | 20.5 | 714.83 | 715.33 | 725.33 | 10 | 727.33 |
| 14-4 | 736.13 | 738.60 | 78.5 | 657.63 | 657.63 | 667.63 | 10 | 673.13 |
| 16-6 | 738.26 | 740.27 | 30.0 | 708.26 | 709.26 | 719.26 | 10 | 720.26 |
| 16-7 | 738.3 | 740.43 | 94.0 | 644.3 | 649.3 | 659.3 | 10 | 664.3 |
| 16-8 | 747.1 | 749.94 | 24.0 | 723.01 | 725.1 | 735.1 | 10 | 738.1 |
| 16-9 | 747.1 | 750.01 | 50.0 | 697.1 | 699.1 | 709.1 | 10 | 714.1 |
| 16-10 | 762.7 | 765.45 | 64.0 | 698.7 | 700.2 | 710.2 | 10 | 715.2 |
| 16-11 | 762.9 | 765.06 | 63.0 | 699.9 | 701.9 | 711.9 | 10 | 715.9 |
| 16-12 | 773.8 | 776.17 | 32.0 | 741.8 | 742.8 | 752.8 | 10 | 755.8 |
| 16-13 | 773.38 | 775.4 | 20.0 | 753.38 | 755.38 | 765.38 | 10 | 767.38 |
| 17-7 | 737.45 | 740.05 | 17.5 | 719.95 | 720.45 | 730.45 | 10 | 731.45 |
| 17-8 | 737.45 | 740.05 | 86.0 | 651.45 | 651.95 | 661.95 | 10 | 666.45 |
| 17-9 | 746.1 | 748.6 | 20.5 | 725.6 | 726.1 | 736.1 | 10 | 738.1 |
| 17-10 | 745.4 | 748.14 | 28.0 | 717.4 | 717.9 | 727.9 | 10 | 760.4 |
| 18-7 | 737.4 | 739.26 | 94.0 | 643.4 | 643.9 | 653.9 | 10 | 658.4 |

NOTE: ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: 2-8

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/2/88 | 2/3/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 59.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 766.19 | 763.60 | 26.50'/737.10' Drilling |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 5 | 3 9 5 | | | | | CL | | SILTY CLAY : trace of silt and lignite fragments, low plasticity, moist, trace red mottling, medium brown | |
| 2 | SS | 14 | 4 5 8 | 760 | | | | CL | | abundant mottling | |
| 3 | SS | 18 | 4 5 6 | | 5 | | | ML | | CLAYEY SILT : well sorted, abundant clay, trace of lignite fragments, moist, abundant mottling, red-brown | |
| 4 | SS | 18 | 3 4 6 | 755 | | | | ML | | same as above | |
| 5 | SS | 18 | 3 6 4 | | 10 | | | ML | | some clay, trace carbonised small nodules | |
| 6 | SS | 18 | 3 4 5 | 750 | | | | CL | | SILTY CLAY: well sorted, some silt, trace lignite fragments moderately plastic, moist to wet, red-brown | |
| 7 | SS | 18 | 4 5 5 | | 15 | | | CL | | same as above | |
| 8 | SS | 18 | 4 4 5 | 745 | | | | CL | | abundant silt | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 3 | HOLE NO.: 2-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 18 | 6<br>6<br>6 | 740 | 25 | | | CL | | as above, medium gray | |
| 10 | SS | 14 | 8<br>7<br>10 | 735 | 30 | | | ML | | CLAYEY SILT: well sorted, trace clay, saturated, medium gray, no mottling | |
| 11 | SS | 16 | 5<br>5<br>7 | 730 | 35 | | | ML | | same as above | |
| 12 | SS | 18 | 5<br>5<br>6 | 725 | 40 | | | ML | | same as above | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 3 | HOLE NO.: 2-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 2-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | SS | 18 | 6<br>6<br>8 | 720 | 45 | | | ML | | same as above | |
| 14 | SS | 18 | 10<br>12<br>14 | 715 | 50 | | | CL | | SILTY CLAY: well sorted, trace silt, low plasticity, moist, trace mottling, dark gray | |
| | | | | | | | | | | SHALE: well sorted, trace silt, friable, moist, dark gray | |
| 15 | SS | 4 | 40<br>50<br>50/1" | 710 | 55 | | | Sh | | | |
| 16 | SS | 3 | 50/5" | 705 | | | | Sh | | light gray | |
| | | | | | | | | | | End of boring @ 59.0 feet | |

*ASTM D1586
SS = SPLIT SPOON
D = DENNISON
ST = SHELBY TUBE
C = CORE
CT = CUTTINGS
CS = CONTINUOUS SAMPLER
OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 4 | HOLE NO.: 3-8

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/19/88 | 2/20/88 | Layne-Western | Mud Rotary | 7 7/8" | 4" PVC | 82.50' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 744.80 | 742.70 | 21.03'/721.67' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS# | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 8 | 3 4 6 | 740 | | | | CL | | SILTY CLAY: well sorted, trace silt, roots and lignite, low plasticity, moist, trace mottling, medium gray | |
| 2 | SS | 10 | 3 3 5 | | 5 | | | CL | | medium brown | |
| 3 | SS | 18 | 5 6 9 | 735 | | | | SM | | SAND: medium, well sorted, some silt, saturated, trace mottling, medium brown, moist, with some thin lenses of silt, trace clay | |
| 4 | SS | 18 | 7 11 16 | | 10 | | | SM | | finer | |
| 5 | SS | 8 | 5 4 6 | 730 | | | | SM | | same as above | |
| 6 | SS | 0 | 3 1 1 | | 15 | | | SM | | | NO RECOVERY |
| 7 | SS | | 2 2 2 | 725 | | | | SM | | red-brown, saturated | |
| 8 | SS | | 6 5 7 | | | | | SM | | no silt lenses | |

#AUTH DRIVE ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVE/SOIL CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 4 | HOLE NO.: 3-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 4 | HOLE NO.: 3-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 720 | | | | | | | |
| 9 | SS | 8 | 9<br>8<br>5 | | 25 | | | SM | | trace silt, medium gray | |
| | | | | 715 | | | | | | | |
| 10 | SS | 14 | 2<br>4<br>13 | | 30 | | | SM | | some lignite fragments | |
| | | | | 710 | | | | | | | |
| 11 | SS | 18 | 14<br>20<br>26 | | 35 | | | SM | | interbedded thin lenses of abundant lignite fragments | |
| | | | | 705 | | | | | | | |
| 12 | SS | 10 | 45<br>28<br>30 | | 40 | | | SM | | well sorted | |

*USCS OTHER: SS = SPLIT SPOON; ST = SHELBY TUBE; C = CORE; CS = CONTINUOUS SAMPLER; CT = CUTTINGS; OT = OTHER

LCAAP Independence, Mo. | PAGE NO.: 2 of 4 | HOLE NO.: 3-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 4 | HOLE NO.: 3-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV. | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 700 | | | | | | | |
| 13 | SS | 14 | 10<br>10<br>14 | | 45 | | | SM | | very abundant lignite fragments, sand size with fine sand, saturated | |
| | | | | 695 | | | | | | | |
| 14 | SS | 18 | 23<br>30<br>41 | | 50 | | | SM | | SAND, fine to medium with trace lignite and fine gravel | |
| | | | | 690 | | | | | | | |
| 15 | SS | 6 | 32<br>36<br>39 | | 55 | | | SM | | trace coarse sand, no lignite | |
| | | | | 685 | | | | | | | |
| 16 | SS | 12 | 20<br>23<br>19 | | 60 | | | SM | | abundant lignite alluvium, sand is medium gray | |
| | | | | 680 | | | | | | | |
| 17 | SS | 16 | 17 | | | | | SM | | poorly sorted, trace silt, medium gravel and thin lignite lenses, medium to dark gray | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO.: 3 of 4 | HOLE NO.: 3-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 4

HOLE NO.: 3-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS# | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 20<br>18 | | 65 | | | | | see above | |
| | | | | 675 | | | | | | | |
| 18 | SS | 16 | 19<br>18<br>19 | | 70 | | | SM | | no lignite lenses | |
| | | | | 670 | | | | | | | |
| 19 | SS | 10 | 20<br>16<br>18 | | 75 | | | SM | | medium to coarse | |
| | | | | 665 | | | | | | | |
| 20 | SS | 10 | 14<br>16<br>16 | | 80 | | | SM | | fine to coarse, abundant fine to coarse gravel | |
| | | | | | | | | | | LIMESTONE BEDROCK<br>End of boring @ 82.0 feet | |

*ASTM D1586 — ST = SHELBY TUBE; SS = SPLIT SPOON; C = CORE; CS = CONTINUOUS SAMPLER; D = DENNISON; CT = CUTTINGS; OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: 5-7

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/5/88 | 2/5/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 50.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 775.75 | 773.10 | 12.70'/760.40' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 4 | 6<br>5<br>5 | | | | | CL | | SILTY CLAY: well sorted, trace silt, low plasticity, moist, trace mottling, red-brown | |
| | | | | 770 | | | | | | | |
| 2 | SS | 14 | 7<br>12<br>16 | | | | | CL | | trace roots, abundant mottling | |
| | | | | | 5 | | | | | | |
| 3 | SS | 18 | 5<br>5<br>5 | | | | | CL | | same as above | |
| | | | | 765 | | | | | | | |
| 4 | SS | 18 | 4<br>4<br>5 | | | | | CL | | trace lignite | |
| | | | | | 10 | | | | | | |
| 5 | SS | 18 | 10<br>12<br>14 | | | | | CL | | abundant silt and lignite, moist brown, some vertical solution channels | |
| | | | | 760 | | | | | | | |
| 6 | SS | 18 | 10<br>9<br>8 | | | | | CL | | same as above | |
| | | | | | 15 | | | | | | |
| 7 | SS | 18 | 10<br>12<br>12 | | | | | CL | | trace lignite | |
| | | | | 755 | | | | | | | |
| 8 | SS | 18 | 7<br>10<br>9 | | | | | CL | | same as above | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
C = CORE CS = CONTINUOUS SAMPLER
O = OTHER CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: 5-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 3

HOLE NO.: 5-7

| SAMPLE NO. | SAMPLE TYPE | SAMPLE RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 750 | | | | | | | |
| 9 | SS | 18 | 5<br>7<br>8 | | | | | CL | | no lignite, trace silt | |
| | | | | | 25 | | | | | saturated at 26.0 feet during drilling | |
| | | | | 745 | | | | | | | |
| 10 | SS | 18 | 9<br>11<br>13 | | | | | CL | | trace coarse sand, fine gravel, lignite alluvium | |
| | | | | | 30 | | | | | | |
| | | | | 740 | | | | | | | |
| 11 | SS | 18 | 12<br>12<br>14 | | | | | CL | | abundant silt | |
| | | | | | 35 | | | | | | |
| | | | | 735 | | | | | | | |
| 12 | SS | 18 | 18<br>13<br>16 | | | | | CL | | same as above | |
| | | | | | 40 | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 3

HOLE NO.: 5-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 5-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | SS | 8 | 13<br>23<br>50/5" | 730 | 45 | | | ML | | CLAYEY SILT: well sorted, abundant clay, moist, abundant mottling, red-brown, thin clay lenses | |
| | | | | | | | | | | SHALE BEDROCK: well sorted, friable, moist, light gray | |
| 14 | SS | 6 | 50<br>50/5" | 725 | 50 | | | Sh | | End of boring @ 50.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DEMMISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 5-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 7-11

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/7/88 | 2/7/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 26.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 743.55 | 741.56 | 18.58'/722.98' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | CLASSIFICATION | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|
| 1 | SS | 12 | 3 5 7 | 740 | | OL | TOPSOIL: clayey humus, well sorted, low plasticity, moist, black | |
| 2 | SS | 12 | 5 6 7 | | | CL | SILTY CLAY: some silt, abundant roots, low plasticity, moist, abundant mottling, black | |
| 3 | SS | 18 | 4 6 7 | 735 | 5 | CL | abundant silt and lignite alluvium, some clay nodule formation, vertical solution channels, red-brown | |
| 4 | SS | 18 | 3 5 8 | | | ML | CLAYEY SILT: abundant clay, trace fine sand, some black clay nodules, abundant mottling, wet, red-brown | |
| 5 | SS | 18 | 1 2 2 | 730 | 10 | ML | interlayed clay lenses, medium gray | |
| 6 | SS | 18 | 1 2 2 | | | ML | | |
| 7 | SS | 16 | 3 6 8 | 725 | 15 | SM | SAND: fine, well sorted, trace silt, saturated, abundant mottling, medium brown | |
| 8 | SS | 18 | 1 2 2 | | | SM | some interlayed silt lenses | |

*ASTM D1586 — SS = SPLIT SPOON, D = DENNISON, ST = SHELBY TUBE, C = CORE, CT = CUTTINGS, CS = CONTINUOUS SAMPLER, OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 7-11

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 7-11

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 720 | | | | | | | |
| 9 | SS | 18 | 2<br>6<br>8 | | 25 | | | SM | | SAND: fine, well sorted, trace of medium sand and silt, no mottling, saturated, medium brown | |
| | | | | | | | | | | End of boring @ 26.0 feet | |

*ASTM D1586
SS = SPLIT SPOON
D = DENNISON
ST = SHELBY TUBE
C = CORE
CS = CONTINUOUS SAMPLER
CT = CUTTINGS
OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 7-11

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 4 | HOLE NO.: 7-12

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/9/88 | 2/10/88 | Layne-Western | Gardner Davr 500 | 8" | 4" PVC | 83.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 744.03 | 741.60 | 21.43'/720.17' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 740 | | | | | | FOR INFORMATION FROM 0 - 25 FEET, SEE GEOLOGIC LOG 7-11 | |
| | | | | | 5 | | | | | | |
| | | | | 735 | | | | | | | |
| | | | | | 10 | | | | | | |
| | | | | 730 | | | | | | | |
| | | | | | 15 | | | | | | |
| | | | | 725 | | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

WESTON

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 4 | HOLE NO.: 7-12

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 720 | | | | | | FOR INFORMATION FROM 0 - 25 FEET, SEE GEOLOGIC LOG 7-11 | |
| | | | | | 25 | | | | | | |
| | | | | 715 | | | | | | | |
| 1 | SS | 7 | 3<br>8<br>10 | | | | | SM | | SAND: fine to medium, well sorted, saturated, medium brown with lenses of dark brown | |
| | | | | | 30 | | | | | | |
| | | | | 710 | | | | | | | |
| 2 | SS | 0 | 8<br>8<br>11 | | | | | SM | | | No Recovery |
| | | | | | 35 | | | | | | |
| | | | | 705 | | | | | | | |
| 3 | SS | 13 | 30<br>44<br>42 | | | | | SM | | SAND: same as above | |
| | | | | | 40 | | | | | | |
| | | | | 700 | | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 4 | HOLE NO.: 7-12

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 4 | HOLE NO.: 7-12

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | SS | 5 | 17<br>17<br>1 | | 45 | | | SM | | SAND: same as above | |
| | | | | 695 | | | | | | | |
| 5 | SS | 8 | 23<br>27<br>30 | | 50 | | | SM | | fine, well sorted, trace of silt, saturated, medium brown | |
| | | | | 690 | | | | | | | |
| 6 | SS | 6 | 8<br>9<br>11 | | 55 | | | SM | | SAND: medium to coarse, well sorted, saturated, medium brown | |
| | | | | 685 | | | | | | | |
| 7 | SS | 10 | 17<br>21<br>25 | | 60 | | | SM | | SAND: fine to coarse, poorly sorted, trace of fine gravel, saturated, gray-brown, interbedded with lignite alluvium | |
| | | | | 680 | | | | | | | |
| 8 | SS | 9 | 20 | | | | | SM | | SAND: same as above, small lenses of abundant silt and clay above lignite layer | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO.: 3 of 4 | HOLE NO.: 7-12

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 4

HOLE NO.: 7-12

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 38 | | 65 | | | | | see above | |
| | | | | 675 | | | | | | | |
| 9 | SS | 9 | 18<br>32<br>43 | | | | | SM | | SAND: medium, well sorted, trace of large gravel, saturated, medium gray, interbedded with lignite alluvium | |
| | | | | | 70 | | | | | | |
| | | | | 670 | | | | | | | |
| 10 | SS | 6 | 20<br>19<br>21 | | | | | SM | | coarse, abundant medium to coarse gravel, trace of limestone fragments, saturated, medium gray | |
| | | | | | 75 | | | | | | |
| | | | | 665 | | | | | | | |
| 11 | SS | 6 | | | | | | SM | | SAND: same as above, increase in limestone fragments | |
| | | | | | 80 | | | | | | |
| | | | | 660 | | | | | | | |
| | | | | | | | | | | LIMESTONE: bedrock at 82.0' | |
| | | | | | | | | | | End of boring @ 83.0 feet | |

*ASTM D1586
SS = SPLIT SPOON
D = DENNISON
ST = SHELBY TUBE
C = CORE
CT = CUTTINGS
CS = CONTINUOUS SAMPLER
OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 4 of 4

HOLE NO.: 7-12

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 7-13

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/8/88 | 2/8/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 32.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 749.45 | 746.80 | 23.99'/722.81' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 5 | 3<br>4<br>6 | 745 | | | | OL | | TOPSOIL: clayey humus, trace silt, roots, moist, trace mottling, black | |
| 2 | SS | 12 | 6<br>8<br>12 | | 5 | | | ML | | CLAYEY SILT: well sorted, some clay, moist, trace mottling, friable, dark gray | |
| 3 | SS | 14 | 5<br>11<br>13 | 740 | | | | CL | | SILTY CLAY: well sorted, trace roots and humus, very low plasticity, moist, abundant mottling, black | |
| 4 | SS | 16 | 7<br>8<br>11 | | 10 | | | CL | | trace mottling | |
| 5 | SS | 18 | 4<br>7<br>8 | 735 | | | | CL | | trace silt | |
| 6 | SS | 18 | 4<br>5<br>6 | | 15 | | | ML | | CLAYEY SILT: well sorted, abundant clay, trace roots and carbonised nodules, some vertical solution channels, moist, trace mottling, dark gray | |
| 7 | SS | 18 | 3<br>4<br>6 | 730 | | | | ML | | interbedded with silty clay | |
| 8 | SS | 18 | 4<br>4<br>4 | | | | | ML | | same as above | |

*SPLIT SPOON SAMPLER; CS = CONTINUOUS SAMPLER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2 | HOLE NO.: 7-13

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 725 | | | | | | | |
| 9 | SS | 18 | 5<br>14<br>18 | | | | | SM | | SAND: medium, well sorted, trace fine sand and silt, saturated, medium brown | |
| | | | | | 25 | | | | | | |
| | | | | 720 | | | | | | | |
| 10 | SS | 18 | 3<br>7<br>12 | | | | | SM | | fine grained | |
| | | | | | 30 | | | | | | |
| | | | | 715 | | | | | | End of boring @ 32.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
R = REMOLDED CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2 | HOLE NO.: 7-13

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: B-6

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/8/88 | 2/9/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 32.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 754.57 | 751.84 | 24.99'/726.85' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 8 | 7<br>10<br>16 | 750 | | | | FILL | | FILL: mixed clay and silt | |
| 2 | SS | 14 | 8<br>8<br>10 | | 5 | | | CL | | CLAY: well sorted, abundant humus, trace roots, low plasticity, moist, trace mottling, black | |
| 3 | SS | 18 | 4<br>7<br>9 | 745 | | | | CL | | trace large gravel, medium brown | |
| 4 | SS | 18 | 6<br>7<br>9 | | 10 | | | CL | | SILTY CLAY: abundant silt, trace coarse sand, fine gravel, lignite alluvium, low plasticity, abundant red and yellow mottling, red-brown | |
| 5 | SS | 18 | 4<br>6<br>8 | 740 | | | | CL | | trace vertical solution channels | |
| 6 | SS | 18 | 2<br>4<br>3 | | 15 | | | CL | | moderate plasticity | |
| 7 | SS | 18 | 2<br>3<br>3 | 735 | | | | CL | | medium brown | |
| 8 | SS | 18 | 3<br>3<br>3 | | | | | CL | | trace silt | |

*AUSTIN DYSON
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: B-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: B-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 730 | | | | | | | |
| 9 | SS | 18 | 2<br>4<br>5 | | | | | CL | | SILTY CLAY: well sorted, trace silt and lignite alluvium, trace red and yellow mottling, wet, medium brown, vertical solution channels | |
| | | | | | 25 | | | | | | |
| | | | | 725 | | | | | | | |
| 10 | SS | 18 | 4<br>4<br>6 | | | | | CL | | no lignite | |
| | | | | | 30 | | | | | | |
| | | | | 720 | | | | | | End of boring @ 32.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CB = CONTINUOUS SAMPLER
D = DRIVE SAMPLER CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: B-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 8-7

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/10/88 | 2/15/88 | Layne-Western | B-61/HSA 10"ID | 14" | 4" PVC | 40.00' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 753.14 | 750.70 | 27.27'/723.43' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 750 | | | | | | | |
| 1 | SS | 6 | 4<br>7<br>5 | | | | | FILL | | FILL: mixed clay, silt, shale fragments, moist | |
| 2 | SS | 10 | 2<br>4<br>7 | | | | | | | same as above | |
| | | | | | 5 | | | | | | |
| | | | | 745 | | | | | | | |
| 3 | SS | 6 | 13<br>10<br>12 | | | | | | | same as above | |
| 4 | SS | 14 | 8<br>10<br>8 | | | | | | | same as above | |
| | | | | | 10 | | | | | | |
| | | | | 740 | | | | | | | |
| 5 | SS | 8 | 2<br>3<br>4 | | | | | CL | | CLAY: abundant humus, trace roots, moist, trace mottling, black, old soil horison | |
| 6 | SS | 14 | 2<br>3<br>4 | | | | | CL | | trace humus, dark gray | |
| | | | | | 15 | | | | | | |
| | | | | 735 | | | | | | | |
| 7 | SS | 18 | 2<br>2<br>4 | | | | | CL | | abundant carbonized nodules oxidized red and yellow | |
| 8 | SS | 18 | 2<br>3<br>4 | | | | | CL | | same as above | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 8-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 730 | | | | | | | |
| 9 | SS | 18 | 2<br>3<br>3 | | | | | CL | | SILTY CLAY: trace silt, low plasticity, moist to wet, trace mottling, dark gray | |
| | | | | | 25 | | | | | | |
| | | | | 725 | | | | | | | |
| 10 | SS | 18 | 2<br>2<br>3 | | | | | CL | | abundant silt, trace fine sand, saturated | |
| | | | | | 30 | | | | | | |
| | | | | 720 | | | | | | | |
| 11 | SS | 18 | 2<br>2<br>2 | | | | | ML | | CLAYEY SILT: trace clay and fine sand, saturated, dark gray | |
| | | | | | 35 | | | | | | |
| | | | | 715 | | | | | | | |
| 12 | SS | 14 | 1<br>2<br>3 | | | | | ML | | some thin lenses of fine sand | |
| | | | | | 40 | | | | | End of boring @ 40.0 feet | |

*BLOWS/6" ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
B = BOREHOLE CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 8-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: S-8

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/16/88 | 2/17/88 | Layne-Western | B-61/HSA 10"ID | 14" | 4" PVC | 45.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 754.02 | 751.67 | 28.31'/723.36' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 18 | 12<br>21<br>7 | 750 | | | | FILL | | FILL: clayey silt, trace sand, very stiff, moist, medium brown | |
| 2 | SS | 18 | 15<br>15<br>22 | | 5 | | | | | trace shale fragments, small gravel, roots and mottling | |
| 3 | SS | 18 | 12<br>13<br>17 | 745 | | | | | | gray to brown-green | |
| 4 | SS | 18 | 3<br>4<br>4 | | 10 | | | CL | | SILTY CLAY: abundant silt, trace fine sand and roots, moist, dark brown | |
| 5 | SS | 18 | 3<br>3<br>4 | 740 | | | | CL | | trace fine gravel, dark brown to black | |
| 6 | SS | 18 | 1<br>2<br>1 | | 15 | | | CL | | high plasticity, black | |
| 7 | SS | 18 | 4<br>6<br>7 | 735 | | | | CL | | moderate plasticity, trace oxidation on fine gravel | |
| 8 | SS | 18 | 4<br>6<br>8 | | | | | CL | | medium gray | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
O = OBSERVATION C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: S-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 3

HOLE NO.: 8-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 18 | 4 6 5 | 730 | 25 | | | CL | | abundant silt | |
| 10 | SS | 18 | 2 3 3 | 725 | 30 | | | CL | | trace fine sand | |
| 11 | SS | 18 | 2 1 2 | 720 | 35 | | | ML | | CLAYEY SILT: well sorted, abundant clay, trace fine sand, high plasticity, wet, olive green-gray | |
| 12 | SS | 18 | 2 4 4 | 715 | 40 | | | ML | | same as above | |
| | | | | 710 | | | | | | | |

*ASTM D1586
SS = SPLIT SPOON
O = OSTERBERG
ST = SHELBY TUBE
C = CORE
CT = CUTTINGS
CS = CONTINUOUS SAMPLER
OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 3

HOLE NO.: 8-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 8-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | SS | 18 | 1<br>2<br>2 | | | | | SM | | wet, medium gray | |
| | | | | | | | | | | SAND: fine to medium, well sorted, trace silt, wet, medium gray | |
| | | | | | 45 | | | | | End of boring @ 45.0 feet | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

| PROJECT NAME AND LOCATION | PAGE NO. | HOLE NO. |
|---|---|---|
| LCAAP, Independence, Mo. | 1 of 2 | 12-5 |

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/1/88 | 2/2/88 | Layne-Western | B-61 HSA | 12" | 4" PVC | 34.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 748.22 | 746.20 | 24.16'/722.04' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 12 | 6<br>12<br>14 | 745 | | | | FILL | | FILL: silty clay, trace silt, roots and lignite alluvium, low plasticity, moist, abundant mottling, interlayed gray, red-brown, dark brown | |
| 2 | SS | 16 | 10<br>13<br>14 | | 5 | | | | | medium brown | |
| 3 | SS | 18 | 5<br>5<br>7 | 740 | | | | | | trace vertical solution channels | |
| 4 | SS | 16 | 3<br>3<br>6 | | 10 | | | SM | | SAND: fine, well sorted, abundant silt, abundant mottling, moist, trace vertical solution channels, medium gray | |
| 5 | SS | 18 | 3<br>3<br>6 | 735 | | | | SM | | some silt, no solution channels, moist to wet | |
| 6 | SS | 18 | 4<br>4<br>1 | | 15 | | | SM | | medium, medium brown | |
| 7 | SS | 14 | 3<br>2<br>1 | 730 | | | | ML | | SANDY SILT: abundant fine sand, moderately sorted, moist to wet, medium brown | |
| 8 | SS | 18 | 4<br>3<br>1 | | | | | ML | | SILTY SAND: fine, moderately sorted, abundant silt, moist to wet, medium brown | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO. 1 of 2
HOLE NO. 12-5

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 12-5

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV ' | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 18 | 3<br>4<br>5 | 725 | | | | SM | | fine, moderately sorted, abundant silt, wet, medium brown | |
| | | | | | 25 | | | | | | |
| 10 | SS | 18 | 4<br>3<br>2 | 720 | | | | SM | | trace silt | |
| | | | | | 30 | | | | | | |
| 11 | SS | 18 | 3<br>3<br>5 | 715 | | | | SM | | | |
| | | | | | | | | | | End of boring @ 34.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOOT C = CORE CS = CONTINUOUS SAMPLER
O = OTHER CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 12-5

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 5 | HOLE NO.: 12-6

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/15/88 | 2/16/88 | Layne-Western | HSA/Tri-cone | 8" | 4" PVC | 86.50' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 745.26 | 743.30 | 21.30'/722.00' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 8 | 4 4 6 | | | | | OL | | TOPSOIL: clayey humus, fine, abundant roots, moist, black | |
| 2 | SS | 12 | 4 5 6 | 740 | 5 | | | CL | | CLAY: trace silt, lignite alluvium and roots, moist, abundant mottling, red-brown | |
| 3 | SS | 16 | 3 5 6 | | | | | CL | | interlayered with sand | |
| 4 | SS | 16 | 6 7 9 | 735 | 10 | | | SM | | SAND: fine to medium, moderately sorted, trace silt and lignite fragments, some thin clay lenses, saturated, abundant mottling, red-brown | |
| 5 | SS | 18 | 1 1 1 | | | | | ML | | SILT: moderately sorted, trace lignite fragments, some thin clay lenses, saturated, abundant mottling, red-brown | |
| 6 | SS | 18 | 2 2 1 | 730 | 15 | | | ML | | same as above | |
| 7 | SS | 18 | 6 7 8 | | | | | SM | | SAND: fine to medium, well sorted, trace silt, saturated, brown | |
| 8 | SS | 14 | 12 15 15 | 725 | | | | SM | | same as above | |

*ASTM D1586
SS = SPLIT SPOON D = DENNISON ST = SHELBY TUBE C = CORE CT = CUTTINGS CS = CONTINUOUS SAMPLER = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 5 | HOLE NO.: 12-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 12-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 16 | 14<br>19<br>25 | 720 | 25 | | | SM | | same as above | |
| 10 | SS | 8 | 4<br>5<br>5 | 715 | 30 | | | SM | | fine, moderately sorted, trace medium sand and silt, trace lignite alluvium, dark brown, | |
| 11 | SS | 14 | 18<br>28<br>31 | 710 | 35 | | | SM | | medium brown, no lignite | |
| 12 | SS | 8 | 14<br>13<br>15 | 705 | 40 | | | SM | | same as above | |

*ASTM D1586
SS = SPLIT SPOON
D = DEFINITION
ST = SHELBY TUBE
C = CORE
CT = CUTTINGS
CS = CONTINUOUS SAMPLER
OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 12-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 5 | HOLE NO.: 12-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | SS | 14 | 15<br>16<br>19 | 700 | 45 | | | SM | | trace silt and coarse sand | |
| 14 | SS | 8 | 40<br>50/4" | 695 | 50 | | | SM | | fine, trace silt and medium sand | |
| 15 | SS | 14 | 27<br>25<br>29 | 690 | 55 | | | SM | | medium, trace silt and coarse sand | |
| 16 | SS | 16 | 30<br>28<br>33 | 685 | 60 | | | SM | | fine grained, well sorted, trace silt | |
| 17 | SS | 14 | 19 | 680 | | | | SM | | | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO.: 3 of 5 | HOLE NO.: 12-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 5 | HOLE NO.: 12-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 23<br>25 | | 65 | | | | | coarse, poorly sorted, trace silt, fine sand and fine gravel, trace light brown shale | |
| 18 | SS | 10 | 18<br>25<br>33 | 675 | 70 | | | SM | | same as above | |
| 19 | SS | 8 | 12<br>15<br>16 | 670 | 75 | | | SM | | same as above | |
| 20 | SS | 12 | 21<br>31<br>35 | 665 | 80 | | | SM | | fine to coarse | |
| 21 | SS | 10 | 12<br>25<br>16 | 660 | 85 | | | SM | | SAND: fine to coarse, poorly sorted, trace fine gravel, saturated, medium brown | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 4 of 5 | HOLE NO.: 12-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 5 of 5

HOLE NO.: 12-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | LIMESTONE<br>End of boring @ 86.5 feet | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 5 of 5

HOLE NO.: 12-6

# GEOLOGIC DRILL LOG

| PROJECT NAME AND LOCATION | PAGE NO. | HOLE NO. |
|---|---|---|
| LCAAP, Independence, Mo. | 1 of 2 | 14-1 |

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/24/88 | 1/26/88 | Layne-Western | HSA | 10" | 4" PVC | 35.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 746.93 | 745.00 | 20.19'/724.81' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 745 | | | | | | | |
| 1 | SS | 4 | 6 5 5 | | | | | FILL | | FILL: silty clay, abundant silt, trace roots, low plasticity, moist, trace mottling, dark brown | |
| 2 | SS | 18 | 4 4 6 | | | | | | | mixture clay, silt, and fine sand, trace coarse gravel, medium brown | |
| | | | | 740 | 5 | | | | | | |
| 3 | SS | 18 | 2 2 3 | | | | | CL | | SILTY CLAY: some silt and humus, moderate plasticity, wet, trace mottling, black, older soil horison | |
| 4 | SS | 18 | 2 3 2 | | | | | CL | | older soil horison | |
| | | | | 735 | 10 | | | | | | |
| 5 | SS | 18 | 3 6 5 | | | | | CL | | abundant silt, trace fine sand and lignite fragments, low plasticity, moist, some mottling, dark gray | |
| 6 | SS | 18 | 5 6 7 | | | | | CL | | trace silt and lignite, abundant mottling, medium gray | |
| | | | | 730 | 15 | | | | | | |
| 7 | SS | 18 | 2 4 4 | | | | | CL | | abundant lignite fragments | |
| 8 | SS | 10 | 6 10 8 | | | | | SM | | SAND: fine to medium, moderately sorted, trace silt and lignite, saturated, medium brown | |

SPLIT SPOON SAMPLER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2 | HOLE NO.: 14-1

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 745 | | | | | | | |
| 9 | SS | 18 | 4<br>5<br>6 | | | | | SM | | fine to medium, moderately sorted, silty clay at 25' | |
| | | | | 720 | 25 | | | | | | |
| | | | | | | | | | | | No sample taken here due to sand heave in augers |
| | | | | 715 | 30 | | | | | | |
| | SS | 12 | 6<br>8<br>15 | | | | | SM | | SAND: fine to coarse, poorly sorted, abundant silt and clay, saturated, medium gray | |
| | | | | | | | | | | End of boring @ 34.5 feet | |

*ASTM D1586 — SS = SPLIT SPOON, C = CORE, CS = CONTINUOUS SAMPLER, O = OBSERVATION, CT = CUTTINGS, OT = OTHER, ST = SHELBY TUBE

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2 | HOLE NO.: 14-1

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 14-2

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/27/88 | 1/28/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 23.50' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | Unknown | 735.83 | 12.78'/723.05' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 4 | 4 3 4 | 735 | | | | OL | | TOPSOIL: clayey humus, well sorted, moist, black | |
| 2 | SS | 14 | 4 7 10 | | 5 | | | CL | | CLAY: trace humus and roots, low plasticity, moist, trace mottling, black | |
| 3 | SS | 18 | 5 7 9 | 730 | | | | CL | | trace silt and lignite fragments, trace oxidized nodules | |
| 4 | SS | 18 | 4 4 5 | | 10 | | | CL | | abundant mottling, light gray | |
| 5 | SS | 18 | 3 3 3 | 725 | | | | CL | | same as above | |
| 6 | SS | 18 | 4 5 6 | | 15 | | | SM | | SAND: well sorted, fine, trace silt, saturated, light brown, some layered lignite alluvium | |
| 7 | SS | 18 | 4 3 4 | 720 | | | | SM | | medium brown | |
| 8 | SS | 18 | 2 0 7 | | | | | SM | | interbedded with silty clay lenses, saturated, medium gray | |

*ASTM D1586 — ST = SHELBY TUBE; SS = SPLIT SPOON; C = CORE; CS = CONTINUOUS SAMPLER; D = DRIVE/SOIL; CT = CUTTINGS; OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 14-2

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 18 | 4<br>9<br>7 | 715 | | | | SM | | SAND: with interbedded silty clay lenses as above | |
| | | | | | | | | | | End of boring @ 23.5 feet | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DRIVEN C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 14-2

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 14-3

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/29/88 | 2/1/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 20.50' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 737.78 | 735.33 | 12.82'/722.51' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 735 | | | | | | | |
| 1 | SS | 14 | 2<br>4<br>5 | | | | | OL | | TOPSOIL: clayey humus, trace roots, low plasticity, moist, trace oxidised nodules, black | |
| 2 | SS | 18 | 4<br>4<br>6 | | | | | | | trace lignite and mottling, dark gray | |
| | | | | 730 | 5 | | | | | | |
| 3 | SS | 18 | 4<br>4<br>5 | | | | | CL | | SILTY CLAY: trace silt and lignite fragments, low plasticity, moist, abundant mottling, medium gray | |
| 4 | SS | 18 | 1<br>2<br>1 | | | | | CL | | high plasticity, wet, dark gray | |
| | | | | 725 | 10 | | | | | | |
| 5 | SS | 18 | 4<br>3<br>2 | | | | | SM | | SAND: fine to medium, well sorted, trace silt and lignite alluvium lenses, saturated, abundant mottling, medium gray | |
| 6 | SS | 10 | 3<br>1<br>1 | | | | | SM | | | |
| | | | | 720 | 15 | | | | | | |
| 7 | SS | 18 | 1<br>1/2<br>1/2 | | | | | SM | | fine, very silty, interlayered silty clay lenses | |
| 8 | SS | 18 | 1<br>1<br>1 | | | | | SM | | continued interlayered silty clay | |

*ASTM D1586
SS = SPLIT SPOON | ST = SHELBY TUBE | C = CORE | CS = CONTINUOUS SAMPLER | D = DRIVEN | CT = CUTTINGS | OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 14-3

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 715 | | | | | | End of boring 20.5 feet | |

SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 14-3

# GEOLOGIC DRILL LOG

| PROJECT NAME AND LOCATION | PAGE NO. | HOLE NO. |
|---|---|---|
| LCAAP, Independence, Mo. | 1 of 4 | 14-4 |

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/17/88 | 2/18/88 | Layne-Western | Gardner-Denv 500 | 8" | .4" PVC | 78.50' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 738.60 | 736.13 | 13.78'/722.35' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 735 | | | | | | FOR INFORMATION FROM 0 - 20 FEET, SEE GEOLOGIC LOG 14-3 | |
| | | | | 730 | 5 | | | | | | |
| | | | | 725 | 10 | | | | | | |
| | | | | 720 | 15 | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 4 | HOLE NO.: 14-4

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 715 | | | | | | | |
| 1 | SS | 12 | 17<br>21<br>20 | | | | | SM | | SAND: fine, well sorted, trace silt and lignite alluvium, saturated, medium brown | |
| | | | | | 25 | | | | | | |
| | | | | 710 | | | | | | | |
| 2 | SS | 14 | 7<br>6<br>12 | | | | | SM | | medium grained | |
| | | | | | 30 | | | | | | |
| | | | | 705 | | | | | | | |
| 3 | SS | 14 | 20<br>36<br>38 | | | | | SM | | fine grained | |
| | | | | | 35 | | | | | | |
| | | | | 700 | | | | | | | |
| 4 | SS | 16 | 14<br>19<br>21 | | | | | SM | | fine to medium | |
| | | | | | 40 | | | | | | |
| | | | | 695 | | | | | | | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 4 | HOLE NO.: 14-4

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | SS | 16 | 6<br>12<br>14 | 690 | 45 | | | SM | | SAND: fine to medium, moderately sorted, trace silt and fine gravel, saturated, medium brown with interbedded lignite alluvium lenses | |
| 6 | SS | 4 | 9<br>11<br>12 | 685 | 50 | | | SM | | fine to coarse, poorly sorted, trace silt and coarse gravel | |
| 7 | SS | 1 | 12<br>12<br>12 | 680 | 55 | | | SM | | same as above | |
| 8 | SS | 14 | 14<br>14<br>18 | 675 | 60 | | | SM | | fine to medium, moderately sorted, trace silt, fine gravel and lignite alluvium | |
| 9 | SS | 18 | 13 | | | | | SM | | SAND: fine to medium, moderately sorted, trace silt and coarse sand, thin lenses of lignite alluvium | |

WASH BORING ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
R = REVERSE CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 4 | HOLE NO.: 14-4

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 4

HOLE NO.: 14-4

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19<br>17 | | | | | | | saturated, medium brown | |
| | | | | 670 | 65 | | | | | | |
| 10 | SS | 12 | 12<br>13<br>15 | | | | | SM | | fine to coarse, poorly sorted, no lignite | |
| | | | | 665 | 70 | | | | | | |
| 11 | SS | 10 | 18<br>12<br>11 | | | | | SM | | same as above | |
| | | | | 660 | 75 | | | | | | |
| | | | | | | | | | | LIMESTONE<br>End of boring @ 78.5 feet | |

*ASTM D1586
SS = SPLIT SPOON
D = DENNISON
ST = SHELBY TUBE
C = CORE
CT = CUTTINGS
CS = CONTINUOUS SAMPLER
OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 4 of 4

HOLE NO.: 14-4

# GEOLOGIC DRILL LOG

WESTON

| PROJECT NAME AND LOCATION | PAGE NO. | HOLE NO. |
|---|---|---|
| LCAAP, Independence, Mo. | 1 of 5 | 16-6 |

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/21/88 | 1/23/88 | Layne-Western | Gardner Davr 500 | 7 7/8" | 4" PVC | 94.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 740.73 | 738.30 | 13.43'/724.87' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 735 | 5 | | | | | FOR INFORMATION FROM 0 - 30 FEET, SEE GEOLOGIC LOG 16-7 | |
| | | | | 730 | 10 | | | | | | |
| | | | | 725 | 15 | | | | | | |
| | | | | 720 | | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
R = REVERSE CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 16-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV. | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 715 | | | | | | FOR INFORMATION FROM 0 - 30 FEET, SEE GEOLOGIC LOG 16-7 | |
| | | | | | 25 | | | | | | |
| | | | | 710 | | | | | | | |
| | | | | | 30 | | | | | | |
| 1 | SS | 10 | 18<br>16<br>15 | 705 | | | | SM | | SAND: medium, well sorted, loose, subrounded, wet, gray | |
| | | | | | 35 | | | | | | |
| 2 | SS | 14 | 9<br>9<br>10 | 700 | | | | SM | | fine grained | |
| | | | | | 40 | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 5 | HOLE NO.: 16-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | SS | 10 | | 695 | 45 | | | SM | | interbedded SAND and CLAY: sand is fine to medium, well sorted and rounded, loose, wet, gray; clay is silty, very soft, saturated, thin lenses, gray, trace wood debris | |
| 4 | SS | 13 | 11<br>11<br>13 | 690 | 50 | | | SM | | same as above | |
| 5 | SS | 9 | 14<br>14<br>17 | 685 | 55 | | | SM | | same as above | |
| 6 | SS | 7 | 9<br>10<br>11 | 680 | 60 | | | SM | | medium to coarse grained, large fragments of lignite | |
| 7 | SS | 8 | 14 | 675 | | | | SM | | well sorted, medium grained | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE C = CORE CS = CONTINUOUS SAMPLER
B = BORING CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 5 | HOLE NO.: 16-6

WESTON

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 5 | HOLE NO.: 16-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 18 18 | | 65 | | | | | | |
| 8 | SS | 8 | 12 17 14 | 670 | 70 | | | SM | | same as above<br>silty clay lense at 70' is very soft | |
| 9 | SS | 8 | 23 13 14 | 665 | 75 | | | SM | | SAND: medium, well sorted and rounded, loose, wet, gray | |
| 10 | SS | 8 | 12 12 17 | 660 | 80 | | | SM | | same as above | |
| 11 | SS | 12 | 13 19 20 | 655 | 85 | | | SM | | abundant lignite alluvium in thin layers | |

*WITH DRIVER: ST = SHELBY TUBE; SS = SPLIT SPOON; C = CORE; CS = CONTINUOUS SAMPLER; A = AUGER; CT = CUTTINGS; OT = OTHER

LCAAP, Independence, Mo. | PAGE NO.: 4 of 5 | HOLE NO.: 16-6

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 5 of 5 | HOLE NO.: 16-6

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | SS | 3 | 13<br>50/2" | 650 | 90 | | | Sh | | SHALE: weathered surface, sandy, slightly fissile | |
| 13 | SS | 0 | 100/2" | 645 | | | | Sh | | SHALE: as above, no recovery<br>End of boring @ 94.0 feet | NO RECOVERY |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
O = OBSERVATION CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 16-7

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/20/88 | 1/21/88 | Layne-Western. | CME 750 HSA | 10" | 4" PVC | 30.00' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 740.27 | 738.26 | 12.37'/725.89' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS/6" | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 8 | 6<br>7<br>16 | | | | | OL | | TOPSOIL: silty loam, well sorted, moist, dark brown | |
| 2 | SS | 17 | 5<br>5<br>15 | 735 | | | | CL | | SILTY CLAY: well sorted, abundant silt, low plasticity, moist, trace mottling, dark gray-brown | |
| 3 | SS | 17 | 3<br>4<br>6 | | 5 | | | CL | | same as above | |
| 4 | SS | 17 | 4<br>4<br>6 | 730 | | | | CL | | trace roots | |
| 5 | SS | 17 | 5<br>7<br>10 | | 10 | | | CL | | some mottling | |
| 6 | SS | 18 | 2<br>3<br>4 | 725 | | | | CL | | thin lense of very soft clay | |
| 7 | SS | 18 | | | 15 | | | CL | | trace fine sand, moderate plasticity, abundant mottling | |
| 8 | SS | 18 | 3<br>3<br>1 | 720 | | | | CL | | trace medium sand, wet | |

*PUSH DTS00 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
B = BARRETT Pr = PISTON OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 16-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 18 | 1<br>1<br>1 | | | | | CL | | trace fine sand, high plasticity, some thin silt lenses, wet, gray | |
| 10 | SS | 18 | 3<br>5<br>6 | 715 | | | | ML | | CLAYEY SILT: some clay, semi-soft, saturated, gray | |
| | | | | | 25 | | | | | SAND: fine to medium, well sorted, trace silt and clay, saturated, gray | |
| 11 | SS | 16 | | 710 | | | | SM | | | |
| | | | | | 30 | | | | | End of boring @ 30.0 feet | |

*WITH BLOWS
SS = SPLIT SPOON ST = SHELBY TUBE
C = CORE CS = CONTINUOUS SAMPLER
R = REMOLDED CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 16-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 16-8

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/21/88 | 1/22/88 | Layne-Western | B-61/HSA | 12". | 4" PVC | 24.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 749.94 | 747.10 | 12.56'/734.54' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 10 | 2 3 5 | 745 | | | | OL | | TOPSOIL: clayey humus, some roots, semi-soft, moist, dark gray to black | |
| 2 | SS | 12 | 5 10 8 | | 5 | | | | | trace red staining | |
| 3 | SS | 18 | 2 4 5 | 740 | | | | CL | | CLAY: trace lignite fragments, moderate plasticity, moist, brown, may be disturbed | |
| 4 | SS | 18 | 2 2 1 | | 10 | | | CL | | high plasticity | |
| 5 | SS | 18 | 1 1 1 | 735 | | | | CL | | wet, undisturbed | |
| 6 | SS | 18 | 1 1 2 | | 15 | | | CL | | trace silt | |
| 7 | SS | 18 | 2 2 2 | 730 | | | | CL | | trace fine gravel | |
| 8 | SS | 18 | 3 2 2 | | | | | CL | | no gravel | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
O = OBSERVATION CT = CUTTINGS OT = OTHER

WESTON

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 16-8

| SAMPLE NO. | SAMPLE TYPE | SAMPLE RECOVERY " | SAMPLE BLOWS* | ELEV. | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 18 | 2<br>2<br>2 | 725 | | | | CL | | trace silt and sand, trace lignite fragments, trace mottling, brown | |
| | | | | | | | | | | End of boring @ 24.0 feet | |

# GEOLOGIC DRILL LOG

WESTON

| PROJECT NAME AND LOCATION | PAGE NO. | HOLE NO. |
|---|---|---|
| LCAAP, Independence, Mo. | 1 of 3 | 16-9 |

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/27/88 | 1/27/88 | Layne-Western | Gardner-Denr 500 | 7 7/8" | 4" PVC | 50.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 750.01 | 747.10 | 22.28'/724.82' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 745 | | | | | | FOR INFORMATION FROM 0 - 20 FEET, SEE GEOLOGIC LOG 16-8 | |
| | | | | | 5 | | | | | | |
| | | | | 740 | | | | | | | |
| | | | | | 10 | | | | | | |
| | | | | 735 | | | | | | | |
| | | | | | 15 | | | | | | |
| | | | | 730 | | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
O = OBSERVATION CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 3 | HOLE NO.: 16-9

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 16 | 2<br>2<br>1 | 725 | 25 | | | CL | | SILTY CLAY: abundant silt, well sorted, soft, saturated, trace mottling, brown | |
| 2 | SS | 18 | 1<br>1<br>2 | 720 | 30 | | | CL | | very moist, gray | |
| 3 | SS | 18 | 1<br>1<br>1 | 715 | 35 | | | CL | | some silt, abundant wood debris, very soft | |
| 4 | SS | 16 | 1<br>1<br>1 | 710 | 40 | | | CL | | very silty, trace pebbles | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO.: 2 of 3 | HOLE NO.: 16-9

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 16-9

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 705 | | | | | | | |
| 5 | SS | 14 | 10<br>8<br>8 | | 45 | | | SM | | SAND: fine, well sorted, rounded, loose, wet, gray | |
| | | | | 700 | | | | | | | |
| 6 | SS | .6 | 14<br>18<br>17 | | 50 | | | Sh | | SHALE: weathered surface, fissile, trace sand, blue-green | |
| | | | | | | | | | | End of boring @ 50.0 feet | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
O = OTHER C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 16-9

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: 16-10

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/27/88 | 2/2/88 | Layne-Western | ATV/Tri-cone | 8" | 4" PVC | 64.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 765.45 | 762.70 | 14.86'/747.84' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS# | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 4 | 3 3 3 | | | | | CL | | SILTY CLAY: well sorted, soft, semi-moist, dark brown | |
| | | | | 760 | | | | | | | |
| 2 | SS | 15 | 3 4 5 | | | | | CL | | abundant black metallic small rounded concretions, brown matrix, semi-soft, cohesive, semi-moist | |
| | | | | | 5 | | | | | | |
| 3 | SS | 18 | 3 3 2 | | | | | CL | | much black mottling, some red-brown mottling, trace small deposits of very fine buff sand, uniform texture, semi-soft | |
| | | | | 755 | | | | | | | |
| 4 | SS | 17 | 3 3 3 | | | | | CL | | semi-moist with some wet zones, some dark gray silty clay where wet | |
| | | | | | 10 | | | | | | |
| 5 | SS | 18 | | | | | | CL | | more silt, lighter red-brown | |
| | | | | 750 | | | | | | | |
| 6 | SS | 18 | 3 4 6 | | | | | CL | | oily sheen on sample | |
| | | | | | 15 | | ▽ | | | | |
| 7 | SS | 16 | 3 3 10 | | | | | CL | | more silt | |
| | | | | 745 | | | | | | | |
| 8 | SS | 18 | 5 10 15 | | | | | ML | | CLAYEY SILT: firm, slightly shaley, drier, red-brown with occasional gray and dark gray zones | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 3 | HOLE NO.: 16-10

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 740 | | | | | | | |
| 9 | SS | 8 | 49<br>50/3" | | 25 | | | ML | | SILT: with clay, very compact, firm, crumbly, thinly bedded with dark laminations, semi-dry, light brown, may be weathered shale | |
| | | | | 735 | | | | | | | |
| 10 | SS | 8 | 50<br>44 | | 30 | | | ML | | some thin beds of maroon silt, overall olive-green | |
| | | | | 730 | | | | | | | |
| 11 | SS | 4 | 100/4" | | 35 | | | Sh | | SHALE: well sorted, uniform texture, semi-hard, blue-green | |
| | | | | 725 | | | | | | | |
| 12 | SS | 0 | 50/0" | | 40 | | | Sh | | same as above | |
| | CT | | | | | | | Sh | | | |

*ASTM D1586
SS = SPLIT SPOON D = DENNISON
ST = SHELBY TUBE C = CORE CT = CUTTINGS
CS = CONTINUOUS SAMPLER OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 3 | HOLE NO.: 16-10

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 720 | | | | | | observed cuttings 39.0 - 64.0 feet<br>SHALE: silty, variable hardness, uniform grain size and texture, blue-green | |
| | | | | | 45 | | | | | | |
| | | | | 715 | | | | | | | |
| | CT | | | | 50 | | | Sh | | same as above | |
| | | | | 710 | | | | | | | |
| | | | | | 55 | | | | | | |
| | | | | 705 | | | | | | same as above | |
| | | | | | 60 | | | | | | |
| | CT | | | | | | | Ls | | LIMESTONE | |
| | | | | 700 | | | | | | End of boring @ 64.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 3 | HOLE NO.: 16-10

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: 16-11

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/3/88 | 2/4/88 | Layne-Western | Gardner-Denver 500 | 8" | 4" PVC | 63.00' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 765.06 | 762.90 | 43.15'/719.75' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 14 | 8<br>13<br>15 | 760 | 5 | | | CL | | SILTY CLAY: moderately sorted, uniform texture and grain size, semi-moist, firm, semi-plastic, tan-brown, abundant black metallic rounded concretions | |
| 2 | SS | 17 | 7<br>8<br>11 | 755 | 10 | | | CL | | more silt, very firm, less plastic, no concretions, lighter tan-brown, olive | |
| 3 | SS | 18 | 7<br>9<br>12 | 750 | 15 | | | CL | | very silty, buff | |
| 4 | SS | 12 | 29<br>29<br>50/3" | 745 | | | | CL | | semi-brittle, very dense, some red-brown mottling | |

WASTE TYPES
SS = SPLIT SPOON ST = SHELBY TUBE C = CORE CS = CONTINUOUS SAMPLER D = DENSITOMETER CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 3 | HOLE NO.: 16-11

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 3 | HOLE NO.: 16-11

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | same as above | |
| | | | | 740 | | | | | | | |
| 5 | SS | 3 | 50/3" | | | | | Sh | | SHALE: uniform grain size and texture, thinly bedded, crumbly along bedding plane, semi-weathered, dry, gray, occasional thin brown beds | |
| | CT | | | | 25 | | | Sh | | | |
| | | | | 735 | | | | | | | |
| | | | | | 30 | | | | | maroon colored 30 - 31 feet | |
| | | | | | | | | | | gray color | |
| | | | | 730 | | | | | | | |
| | CT | | | | 35 | | | Sh | | | |
| | | | | 725 | | | | | | shale becoming harder, also observed small globules of oil in drill mud | |
| | | | | | 40 | | | | | | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DEFINITION C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 16-11

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 720 | | | | | | olive green-gray | |
| | CT | | | | 45 | | | Sh | | | |
| | | | | 715 | | | | | | | |
| | | | | | 50 | | | | | | |
| | | | | 710 | | | | | | | |
| | CT | | | | 55 | | | Sh | | Observed cuttings 24.0 to 61.0 feet | |
| | | | | 705 | | | | | | | |
| | | | | | 60 | | | | | | |
| | CT | | | | | | | Le | | LIMESTONE: massive, hard, gray | |
| | | | | 700 | | | | | | End of boring 63.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 3

HOLE NO.: 16-11

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 16-12

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/23/88 | 1/27/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 32.00' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 776.17 | 773.80 | 14.15'/759.65' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 18 | 7<br>22<br>14 | | | | | FILL | | FILL: clay with trace silt, abundant carbonized nodules, very stiff, moist, abundant oxidized staining, red-brown | |
| 2 | SS | 18 | 8<br>14<br>15 | 770 | | | | | | trace fine gravel | |
| | | | | | 5 | | | | | | |
| 3 | SS | 18 | 5<br>7<br>9 | | | | | CL | | CLAY: well sorted, trace silt, low plasticity, moist, trace mottling, red-brown | |
| 4 | SS | 18 | 5<br>6<br>8 | 765 | | | | CL | | more moist and plastic | |
| | | | | | 10 | | | | | | |
| 5 | SS | 18 | 4<br>9<br>11 | | | | | CL | | trace lignite fragments and roots, less moist and plastic | |
| 6 | SS | 18 | 5<br>9<br>14 | 760 | | | | CL | | trace gravel, becomes layered gray and brown, becomes very stiff, may be claystone or weathered shale | |
| | | | | | 15 | | | | | | |
| 7 | SS | 18 | 17<br>35<br>46 | | | | | Sh | | SHALE: same character as above, more cohesive, firm, gray and brown | |
| 8 | SS | 10 | 45<br>50/3" | 755 | | | | Sh | | gray | |

*ASTM D1586 — SS = SPLIT SPOON, D = DENNISON, ST = SHELBY TUBE, C = CORE, CT = CUTTINGS, CS = CONTINUOUS SAMPLER, OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2 | HOLE NO.: 16-12

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | SS | 2 | 50/6" | 750 | 25 | | | Sh | | SHALE: fine, well sorted, fissile, light gray | |
| 10 | SS | 2 | 50/2" | 745 | 30 | | | Sh | | same as above | |
| | | | | | | | | | | End of boring @ 32.0 feet | |

*ASTM D1586 SS = SPLIT SPOON D = DRIVEN ST = SHELBY TUBE C = CORE CT = CUTTINGS CS = CONTINUOUS SAMPLER OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2 | HOLE NO.: 16-12

# GEOLOGIC DRILL LOG

WESTON

| PROJECT NAME AND LOCATION | PAGE NO. | HOLE NO. |
|---|---|---|
| LCAAP, Independence, Mo. | 1 of 1 | 16-13 |

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/24/88 | 1/24/88 | Layne-Western | ATV/HSA | 10" | 4" PVC | 20.00' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 775.40 | 773.38 | 7.83'/765.55' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 8 | 12 20 30 | | | | | FILL | | FILL: clay, trace fine gravel and roots, very stiff, moist, trace mottling | |
| 2 | SS | 14 | 6 8 8 | 770 | 5 | | | | | abundant lignite fragments, gray and brown | |
| 3 | SS | 18 | 4 4 5 | | | | | CL | | CLAY: well sorted, stiff moist, trace mottling, red-brown | |
| 4 | SS | 18 | 4 4 3 | 765 | 10 | | | CL | | moderate plasticity, wet | |
| 5 | SS | 0 | 3 3 4 | | | | | CL | | | NO RECOVERY |
| 6 | SS | 18 | 3 3 3 | 760 | 15 | | | CL | | abundant lignite fragments, gray | |
| 7 | SS | 18 | 7 4 6 | | | | | CL | | trace silt, moist to wet | |
| 8 | SS | 18 | 1 1 2 | 755 | | | | CL | | SILTY CLAY: abundant silt, trace fine gravel, moderate plasticity, very moist, some oxidation and mottling, gray | |
| | | | | | | | | | | End of boring @ 20.0 feet | |

SPLIT SPOON SAMPLER

| LCAAP Independence, Mo. | PAGE NO. | HOLE NO. |
|---|---|---|
| | 1 of 1 | 16-13 |

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 1 | HOLE NO.: 17-7

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/20/88 | 1/20/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 17.50' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 740.05 | 737.45 | 11.91'/725.54' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 10 | 2 6 5 | 735 | 5 | | | OL | | TOPSOIL: silt, clay, humus, roots, moist, dark gray | |
| 2 | SS | 12 | 2 2 3 | | | | | | | | |
| 3 | SS | 18 | 2 1 3 | 730 | | | | CL | | CLAY: trace silt, fine gravel and lignite fragments, moderate plasticity, saturated, some mottling, dark gray to black | |
| 4 | SS | 18 | 2 1 1 | | 10 | | | CL | | some thin silt lenses, saturated | |
| 5 | SS | 18 | 2 2 1 | 725 | | | | CL | | no gravel, saturated | |
| 6 | SS | 18 | 2 2 1 | | 15 | | | CL | | abundant lignite fragments | |
| 7 | SS | 18 | 2 2 2 | 720 | | | | CL | | some silt, no lignite, saturated | |
| | | | | | | | | | | End of boring @ 17.5 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 1 | HOLE NO.: 17-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 5 | HOLE NO.: 17-8

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/24/88 | 1/26/88 | Layne-Western | Gardner-Denver 500 | 8" | 4" PVC | 86.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 740.04 | 737.45 | 10.67'/726.78' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 735 | 5 | | | | | FOR INFORMATION FROM 0 - 15 FEET, SEE GEOLOGIC LOG 17-7 | |
| | | | | 730 | 10 | | | | | | |
| | | | | 725 | 15 | | | | | | |
| | | | | 720 | | | | | | | |
| 1 | SS | 18 | | | | | | CL | | SILTY CLAY: well sorted, some brown mottling, soft, very moist to wet, gray | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 5 | HOLE NO.: 17-8

WESTON

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 17-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 715 | | | | | | | |
| 2 | SS | 18 | 5<br>11<br>11 | | 25 | | | CL | | very silty, silty sand lense at 24.5', very soft | |
| | | | | 710 | | | | | | | |
| 3 | SS | 6 | 1<br>2<br>2 | | 30 | | | SM | | SAND: medium, well sorted and rounded, abundant silt, grades to clean sand at 29.0', wet, loose, gray | |
| | | | | 705 | | | | | | | |
| 4 | SS | 6 | 12<br>12<br>14 | | 35 | | | SM | | trace small pebbles | |
| | | | | 700 | | | | | | | |
| 5 | SS | 8 | 14<br>26<br>26 | | 40 | | | SM | | SAND: medium, well sorted, abundant silt, trace of fine gravel, saturated, medium gray | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DEMMLSON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 17-8

WESTON

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 5 | HOLE NO.: 17-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 695 | | | | | | | |
| 6 | SS | 12 | 11<br>13<br>8 | | 45 | | | SM | | SAND: medium, well sorted, interlayered with beds of fine sand with abundant silt, saturated, medium gray | |
| | | | | 690 | | | | | | | |
| 7 | SS | 5 | 17<br>24<br>24 | | 50 | | | SM | | same as above, trace of fine gravel | |
| | | | | 685 | | | | | | | |
| 8 | SS | 12 | 18<br>27<br>21 | | 55 | | | SM | | SAND: same as above, fine grained | |
| | | | | 680 | | | | | | | |
| 9 | SS | 6 | 13<br>14<br>18 | | 60 | | | SM | | SAND: medium to coarse, moderately sorted, some gravel, trace lignite alluvium, loose, wet, gray | |
| | | | | 675 | | | | | | | |
| 10 | SS | 7 | 12 | | | | | SW | | SAND and GRAVEL: coarse grained, poorly sorted, trace shale fragments, loose, wet, gray | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO.: 3 of 5 | HOLE NO.: 17-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 5

HOLE NO.: 17-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 18<br>14 | | 65 | | | | | see above | |
| | | | | 670 | | | | | | | |
| 11 | SS | 3 | 17<br>21<br>9 | | 70 | | | SW | | more gravel | |
| | | | | 665 | | | | | | | |
| 12 | SS | 7 | 15<br>21<br>20 | | 75 | | | SM | | SAND: medium to coarse, moderately sorted, trace gravel, subrounded, loose, wet, gray | |
| | | | | 660 | | | | | | | |
| 13 | SS | 18 | 6<br>5<br>11 | | 80 | | | ML | | SILT: well sorted, thinly bedded, semi-soft, semi-moist, gray | |
| | | | | 655 | | | | | | | |
| 14 | SS | 6 | 20<br>13<br>11 | | 85 | | | ML | | with some coarse sand and gravel, medium to coarse, wet, gray | |

PASTH DITCH
SS = SPLIT SPOON
D = DRIVEN
ST = SHELBY TUBE
C = CORE
CT = CUTTINGS
CS = CONTINUOUS SAMPLER
OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 5 of 5 | HOLE NO.: 17-8

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Interbedded LIMESTONE and SHALE<br>End of boring @ 86.0 feet | |

*ASTM D1586
SS = SPLIT SPOON D = DENNISON
ST = SHELBY TUBE C = CORE CT = CUTTINGS
CS = CONTINUOUS SAMPLER OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 5 of 5 | HOLE NO.: 17-8

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 17-9

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/22/88 | 1/22/88 | Layne-Western | B-61/HSA | 12" | 4" PVC | 20.50' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| R. Bennett | 748.60 | 746.10 | 7.23'/738.87' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 5 | 3 6 8 | 745 | | | | OL | | TOPSOIL: clayey humus with some roots, well sorted, moist, dark brown to black | |
| 2 | SS | 6 | 3 4 5 | | 5 | | | CL | | CLAY: well sorted, trace lignite fragments, low plasticity, moist, trace mottling, red-brown | |
| 3 | SS | 16 | 2 3 2 | 740 | | | | CL | | same as above | |
| 4 | SS | 18 | 1 2 1 | | 10 | | | CL | | moderate to high plasticity, saturated | |
| 5 | SS | 18 | 2 2 2 | 735 | | | | CL | | SILTY CLAY: well sorted, high plasticity, saturated, some mottling, red-brown | |
| 6 | SS | 18 | 2 2 3 | | 15 | | | CL | | abundant lignite, medium gray | |
| 7 | SS | 18 | 4 4 6 | 730 | | | | CL | | same as above | |
| 8 | SS | 18 | 5 7 10 | | | | | CL | | trace mottling | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DEMISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 17-9

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | End of boring @ 20.5 feet | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 17-9

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 17-10

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 1/26/88 | 1/26/88 | Layne-Western | ATV (CME)/HSA | 10" | 4" PVC | 28.00' |

| LOGGER | TOP of CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 748.14 | 745.40 | 19.97'/725.43' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 745 | | | | | | | |
| | | | | | 5 | | | | | FOR INFORMATION FROM 0 - 15 FEET, SEE GEOLOGIC LOG 17-9 | |
| | | | | 740 | | | | | | | |
| | | | | | 10 | | | | | | |
| | | | | 735 | | | | | | | |
| | | | | | 15 | | | | | | |
| | | | | 730 | | | | | | | |
| 1 | SS | 16 | 11<br>14<br>17 | | | | | CL | | SILTY CLAY: well sorted, abundant silt, trace roots, mottled red-brown and gray, semi-firm, semi-plastic, semi-moist | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
O = OTHER CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 2 | HOLE NO.: 17-10

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 2

HOLE NO.: 17-10

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 725 | | | | | | | |
| 2 | SS | 18 | 7<br>10<br>13 | | | | | CL | | more mottling and carbonised wood fragments | |
| | | | | | 25 | | | | | | |
| | | | | 720 | | | | | | LIMESTONE: fissile, hard, gray | |
| | | | | | | | | | | End of boring @ 28.0 feet | |

*ASTM D1586
SS = SPLIT SPOON ST = SHELBY TUBE
D = DRIVEN C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 1 of 5 | HOLE NO.: 18-7

| START | FINISH | DRILLER | DRILL METHOD | BOREHOLE DIAMETER | WELL DIAMETER | TOTAL DEPTH |
|---|---|---|---|---|---|---|
| 2/7/88 | 2/8/88 | Layne-Western | Gardner-Denv 500 | 8" | 4" PVC | 94.00' |

| LOGGER | TOP OF CASING ELEV. | GROUND ELEVATION | DEPTH/ELEVATION GROUNDWATER - DATE MEASURED |
|---|---|---|---|
| P. Bartz | 739.26 | 737.40 | 12.41'/724.99' 6/1/88 |

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SS | 12 | 3 8 9 | 735 | 5 | | | CL | | SILTY CLAY: well sorted, abundant silt and roots, uniform texture, stiff, some mottling, semi-moist, dark gray | |
| 2 | SS | 17 | 5 6 7 | 730 | 10 | | | CL | | same as above | |
| 3 | SS | 18 | 1 1 2 | 725 | 15 | | | ML | | CLAYEY SILT: poorly sorted, some clay and very fine sand, abundant roots, increased silt at 15.0', soft, some mottling, very moist, dark gray | |
| 4 | SS | 17 | 4 3 1 | 720 | | | | CL | | SILTY CLAY: moderately sorted, semi-firm, semi-moist, some mottling, gray | |

*AUTH DRIVEN
SS = SPLIT SPOON ST = SHELBY TUBE
D = DENNISON C = CORE CS = CONTINUOUS SAMPLER
CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 1 of 5 | HOLE NO.: 18-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 18-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | SS | 18 | 2<br>2<br>3 | 715 | 25 | | | CL | | interbedded CLAY and SILT: semi-soft, moderately sorted, very moist, gray | |
| 6 | SS | 10 | 3<br>16<br>31 | 710 | 30 | | | SM | | SAND: clayey silt grades down to fine sand, well sorted, rounded, loose, wet, gray | |
| 7 | SS | 3 | 11<br>20<br>24 | 705 | 35 | | | SM | | interbedded SILT, CLAY, and SAND: thinly bedded, all soft, wet, gray, with abundant woody plants | |
| 8 | SS | 14 | 9<br>9<br>13 | 700 | 40 | | | SM | | SAND: fine, well sorted, rounded, loose, wet, green-gray | |

*ASTM D1586 — SS = SPLIT SPOON; ST = SHELBY TUBE; C = CORE; CS = CONTINUOUS SAMPLER; D = DENNISON; CT = CUTTINGS; OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 2 of 5

HOLE NO.: 18-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 3 of 5 | HOLE NO.: 18-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 695 | | | | | | | |
| 9 | SS | 8 | 11<br>20<br>24 | | 45 | | | SM | | SAND: fine, well sorted, saturated, green-gray | |
| | | | | 690 | | | | | | | |
| 10 | SS | 9 | 10<br>19<br>23 | | 50 | | | SM | | same as above | |
| | | | | 685 | | | | | | | |
| 11 | SS | 0 | 22<br>23<br>31 | | 55 | | | SM | | | NO RECOVERY |
| | | | | 680 | | | | | | | |
| 12 | SS | 9 | 33<br>23<br>27 | | 60 | | | SM | | SAND: fine to medium, well sorted, trace of coarse sand and fine gravel, saturated, medium gray | |
| | | | | 675 | | | | | | | |
| 13 | SS | 11 | 22 | | | | | SM | | SAND: fine to medium, fairly sorted, abundant lignite alluvium, trace large gravel, saturated, gray | |

*ASTM D1586 — ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 3 of 5 | HOLE NO.: 18-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 4 of 5 | HOLE NO.: 18-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY * | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASSIFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19<br>28 | | 65 | | | | | see above | |
| | | | | 670 | | | | | | | |
| 14 | SS | 11 | 23<br>25<br>27 | | | | | SM | | same as above | |
| | | | | | 70 | | | | | | |
| | | | | 665 | | | | | | | |
| 15 | SS | 6 | 10<br>20<br>21 | | | | | SM | | fine to coarse, trace lignite and fine gravel, very fine sand at 75.0' | |
| | | | | | 75 | | | | | | |
| | | | | 660 | | | | | | | |
| 16 | SS | 18 | 1<br>1<br>7 | | | | | CL | | CLAY: well sorted, plastic, very uniform texture, semi-soft, very moist, gray, becomes silty at 80.0' | |
| | | | | | 80 | | | | | | |
| | | | | 655 | | | | | | | |
| 17 | SS | 10 | 14<br>18<br>26 | | | | | SM | | SAND: fine to medium, poorly sorted, abundant lignite alluvium, trace limestone fragments, loose, wet, gray | |
| | | | | | 85 | | | | | | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DRIVEN CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.
PAGE NO.: 4 of 5 | HOLE NO.: 18-7

# GEOLOGIC DRILL LOG

PROJECT NAME AND LOCATION: LCAAP, Independence, Mo.

PAGE NO.: 5 of 5

HOLE NO.: 18-7

| SAMPLE NO. | SAMPLE TYPE | RECOVERY " | SAMPLE BLOWS* | ELEV | DEPTH | GRAPHIC LOG | WELL CONSTRUCTION | CLASS-IFICATION | SAMPLE INTERVAL | DESCRIPTION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | SS | 9 | 46<br>55/3" | 650 | 90 | | | SM | | fine, well sorted, trace lignite alluvium, subangular, tightly packed, wet, gray | |
| 19 | SS | 3 | 50/3" | 645 | | | | SM | | weathered surface of quarts and limestone rock | |
| | | | | | | | | | | LIMESTONE: hard, massive, fractured, gray<br>End of boring @ 94.0 feet | |

*ASTM D1586 ST = SHELBY TUBE
SS = SPLIT SPOON C = CORE CS = CONTINUOUS SAMPLER
D = DENNISON CT = CUTTINGS OT = OTHER

LCAAP
Independence, Mo.

PAGE NO.: 5 of 5

HOLE NO.: 18-7

# WELL CONSTRUCTION RECORDS OF PREVIOUSLY EXISTING LCAAP WELLS

MW16-3

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.0

Reference Elevation: _____

Reference Description: Mark on PVC Rim

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5732 | USATHAMA | LCAAP |

| | | | BORING NO. |
|---|---|---|---|
| DRILLING METHOD: Hollow Stem Auger, 8" O.D., 6.5" I.D. | | | 86-03 |
| CME 55 Rig | | | SHEET |
| SAMPLING METHOD: STAND. PENETRATION TEST - 18" driven split spoon-2OD | | | 1 of 2 |
| 140 lb hammer fall 30" | | | DRILLING |
| WATER LEVEL | 8.4' | 8.6' | START / FINISH |
| TIME | 1305 | 1615 | TIME: 750 / 1145 |
| DATE | 5-7-86 | 5-9-86 | DATE: 5-8-86 / 5-9-86 |
| REFERENCE | Ref | REF | |

SURFACE CONDITIONS: Overgrown Light - near tree line & base of hill

| SAMPLER TYPE | SAMPLER DRIVEN / RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 IN SAMPLER | P.I.D. ppm | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 0 | | |
| SPT | 1.5 / 0.9 | 0 | 1 / 1.0 | 8 / 7 | 0 | 1 | ML | Moist stiff clayey silt trace fine sand ML Olive gray - 5Y 3/2 (GSA) |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| SPT | 1.5 / 1.5 | 4.5 | 2 / 5.5 | 4 / 3 / 4 | 0 | 5 | ML | Moist medium stiff clayey silt, trace f. sand. ML Moderate olive gray brown 5Y 4/3 |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | ▽ | H2O on rods @ 8.0' - Water Bubbling into augers and rising |
| | | | | | | 9 | | |
| SPT | 1.5 / 1.5 | 9.5 | 3 / 10.5 | 2 / 2 / 3 | 0 | 10 | ML | Wet soft clayey silt, trace fine sand ML Dark yellowish brown - 10YR 4/2 |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| SPT | 1.5 / 1.5 | 14.5 | 4 / 15.5 | 2 / 1 / 2 | 0 | 5 | ML | Wet very soft clayey silt, tr. f. sand ML Dark yellowish brown 10YR 4/2 |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 20 | | |

C-81

SHEET

MW 16-3

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| 7143182 | USATHAMA | LCAAP |

DRILLING METHOD:

SAMPLING METHOD:

| | BORING NO. | SHEET | DRILLING START | DRILLING FINISH |
|---|---|---|---|---|
| | 86-03 | 2 of 2 | | |

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | | | | |
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

| SAMPLER TYPE | SAMPLE NO. / RECOVERED | DEPTH OF CASING | SAMPLE NO. / DEPTH | BLOWS/6 in. SAMPLER | PID ppm | DEPTH IN FEET | GRAPHIC LOG | SURFACE CONDITIONS: |
|---|---|---|---|---|---|---|---|---|
| SPT | 1.5 / 1.5 | 19.5 | 5 / 20.5 | 2<br>1<br>3 | 0 | 0 | ML | Wet soft clayey silt, trace fine sand. Yellowish brown 10 YR 5/2 |
| SPT | 1.5 / 1.5 | 24.5 | 6 / 25.5 | 3<br>2<br>2 | 0 | 5 | ML | Wet medium stiff clayey silt little fine sand, trace fine gravel. (gravel is pieces of shale - NOT horiz. oriented) Light olive gray - 5Y 5/2 |
| | | | | | | 6 | | B.O.H @ 24.5 B.O. Sampling @ 26.0 Finished sampling @ 930 |
| | | | | | | 7 | | |
| | | | | | | 8 | | Well Installation: Total depth = 25.5' |
| | | | | | | 9 | | riser = 15.0', screen = 10.0', plug = 0.5' |
| | | | | | | 30 | | 2.0' stick up |
| | | | | | | 1 | | - cleaned out augers by ramming auger plug through auger cutting head. |
| | | | | | | 2 | | - pulled augers up several feet and placed basal sand pack: 23.5-25.5' |
| | | | | | | 3 | | - installed well through augers and placed sand pack up to 9.0' then augers |
| | | | | | | 4 | | - pulled augers and placed bentonite pellets up to 2', then grout to surface |
| | | | | | | 5 | | - protective casing w/ locks set in grout |
| | | | | | | 6 | | |
| | | | | | | 7 | | - 2 hrs - no grout settlement |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

DRILLING CONTR: _____

DRILLER: _____

BY: _____ DATE: _____ CHKD BY: _____

MW16-4

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5182 | USATHAMA | LCAAP |

DRILLING METHOD: Hollow Stem Auger — BORING NO. 86-04
8" O.D., 5.5" I.D. — SHEET 1 of 2
CME '55 Rig
SAMPLING METHOD: Stand. Pen. Test — DRILLING START / FINISH
(SPT) 18" driven split spoon — TIME 800 / 1815
140 lb hammer falling 30" — DATE 5-8-86 / 5-8-86
WATER LEVEL: 33.0 / 5.36
TIME: 1755 / 1610
DATE: 5-8-86 / 5-9-86
REFERENCE: REF 257

Co-ordinates: _____
Surface Elevation: _____
Casing Above Surface: 2.5
Reference Elevation: _____
Reference Desription: Mark on PC Rim

DRILLING CONTR: EA — BY: Blank Blank — DATE: 5-8-86 — CHKD BY: GK

SURFACE CONDITIONS: Flat, overgrown field 15-20' from legible stream - marshy area

| SAMPLER TYPE | SAMPLE RECOVERY / LENGTH ATTEMPTED | DEPTH OF CASING | SAMPLE NO. / SAMPLE DEPTH | BLOWS/6 in. SAMPLER | P.I.D. ppm | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 5 | | 0 | | |
| SPT | 1.5 / 0.7 | 0 | 1 / 1.0 | 5 | 0 | 1 | ML | Moist medium stiff clayey silt - trace fine sand ML<br>Light olive gray 5Y 5/2 (GSA) |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| SPT | 1.5 / 1.5 | 4.5 | 2 / 5.5 | 4<br>7<br>9 | 0 | 5<br>6 | CL | Moist very stiff silty clay, trace f. sand CL<br>Olive brown 5Y 5/3 |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| SPT | 1.5 / 1.5 | 9.5 | 3 / 0.5 | 4<br>6<br>8 | 0 | 10<br>11 | CL | Moist stiff silty clay tr. f. sand CL<br>Light olive-brown. 5Y 5/4<br>Auger scraped f.- several revolutions @ 11.5' |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | encountered H2O on spoon @ 15.2' |
| SPT | 1.5 / 1.5 | 14.5 | 4 / 15.2 | 9<br>11<br>27 | 0 | 5<br>6 | CL | Most/wet hard & hard, some c-gravel (chert seams) little c-sand CL<br>Light olive brown, mottled - 5Y 5/6 & Sampled into hard weathered shale @ 15.9 (refusal, spoon) |
| | | | | | | 7 | | - hard auguring past 25'<br>- caved all night, little water was encountered above 21' - continued dry hole |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 20 | | C-83 = SUBSET |

MW16-4

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Desription: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TH4518-2 | USATHAMA | LCAAP |

DRILLING METHOD:

SAMPLING METHOD:

BORING NO. BG-04

SHEET 2 of 2

| | DRILLING START | DRILLING FINISH |
|---|---|---|
| WATER LEVEL | TIME | TIME |
| TIME | | |
| DATE | DATE | DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE # TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 in. SAMPLER | P.I.D. ppm | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| SPT | 1.5/1.5 | 19.5 | 5/20.5 | 23<br>31<br>36 | 0 | 20 | CL | Moist hard silty clay - weathered shale w/ horizontal orientation of chert stone @ 19.5 - 12.6' Lt olive gray yellow 5Y 6/3 |
| SPT | CA/0.4 | 24.5 | 6/25 | 50/4 | 0 | 5 | CL | Moist hard silty clay (weathered shale w/ horizontal partings) Lt. olive gray brown 5Y 5/3 |
| SPT | 1.4/1.4 | 29.5 | 7/30 | 13<br>25<br>50/4 | 0 | 30 | CL | Moist hard weathered shale (silty clay) Med. dark gray N5 |
| SPT | 0.4/1.4 | 34.5 | 8/35 | 50/4 | 0 | 5 | CL | Moist hard weathered shale (silty clay CL) Med. gray N5 - Finished sampling @ 1615 - dry hole - BOH @ 34.5, B.O. Samp @ 34.9' Well installation - 36.5' total depth, 20.5' slip 7.00 riser, 15.0 screen, 0.5' sump, pulled augers because hole was dry, placed 3.5' sand @ base + placed 2" PVC well couple 1.0 sand 12.5' up to 12.5' - intermittent amount resistance in stem placed bentonite pellets to 5.5' then grouted to surface and set protective casing w/ lock. |
| | | | | | | 0 | | 24 hrs - no water settlement |

C-84

MW16-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.0

Reference Elevation: _____

Reference Description: Mark on PVC rim

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5162 | USATHAMA | LCAAP |

DRILLING METHOD: HSA - 12" O.D & 5" I.D
CME 55 RIG

SAMPLING METHOD: Stand Pen. Test 18" driven split spoon, 2" O.D, 140 lb hammer falling 30"

BORING NO.: B6-05

SHEET: 1 of 2

| | | DRILLING START | DRILLING FINISH |
|---|---|---|---|
| WATER LEVEL | 9.82 | | |
| TIME | 1600 | TIME: 0800 | TIME: 1215 |
| DATE | 5-9-96 | DATE: 5-9-96 | DATE: 5-9-96 |
| REFERENCE | BGS | | |

SURFACE CONDITIONS: Grassed flat area, landfill area road

| SAMPLER TYPE | SAMPLER BLOWS/6 IN. | RECOVERY IN FEET | DEPTH OF CASING | SAMPLE NO. / SAMPLE DEPTH | BLOWS/6 in. SAMPLES | P.I.D. ppm | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 5 | | 0 | | Moist very stiff silty clay, trace organics, fr. fine gravel (FILL) CL |
| SPT | 1.5/0.9 | 0 | | 1/1.0 | 10/11 | 0 | 1 | CL | olive gray, 5Y 4/2 (GSA) |
| | | | | | | | 2 | | |
| | | | | | | | 3 | | |
| | | | | | | | 4 | | |
| SPT | 1.5/1.5 | 4.5 | | 2/5.5 | 5/9 | 0 | 5 | ML | Moist very stiff clayey silt, trace f. sand. olive brown 5Y 3/3 |
| | | | | | 9 | | 6 | | gray |
| | | | | | | | 7 | | |
| | | | | | | | 8 | | |
| | | | | | | | 9 | | |
| SPT | 1.5/1.5 | 9.5 | | 3/10.5 | 2/3/3 | 1 | 10 | ML | Moist medium stiff clayey silt, trace fine sand ML - possible saturated |
| | | | | | | | 11 | | Light olive gray 5Y 6/2 |
| | | | | | | | 12 | | NO P.I.D. positive readings in hole or cuttings |
| | | | | | | | 13 | | |
| | | | | | | | 14 | | ▽ Water on spoon @ 14.0' |
| SPT | 1.5/1.5 | 14.5 | | 4/15.5 | 11/16/20 | 0 | 15 | CL | Moist hard silty clay, tr. fine sand CL highly weathered shale |
| | | | | | | | 16 | | olive yellow 5Y 5/6 |
| | | | | | | | 17 | | Cased & let water bearing strata run advancing augers |
| | | | | | | | 18 | | |
| | | | | | | | 19 | | Lower sampling began @ 19.0' |
| | | | | | | | 20 | | |

C-85

NEXT SHEET

MW16-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Desription: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5132 | USATHAMA | LCAAP |

DRILLING METHOD:

SAMPLING METHOD:

BORING NO. 86-05

SHEET 2 of 2

DRILLING START TIME / FINISH TIME

| | | | | | |
|---|---|---|---|---|---|
| WATER LEVEL | | | | | |
| TIME | | | | | |
| DATE | | | | | |
| REFERENCE | | | | | |

DATE / DATE

| SAMPLER TYPE | SAMPLE NO. / INCHES RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 in. SAMPLER | P.I.D. ppm | DEPTH IN FEET | GRAPHIC LOG |
|---|---|---|---|---|---|---|---|
| SPT | 1.5 / 1.2 | 19.5 | S / 20.5 | 14 / 20 / 31 | 0 | 20 | CL |
| SPT | 1.3 / 1.0 | 24.5 | 6 / 25.5 | 29 / 41 / 2/3 | 0 | 5 | CL |

SURFACE CONDITIONS:

Moist hard silty clay - weathered shale w/ horizontal orientation
Grayish olive 10Y 5/2

Hollow auguring @ 22.0'

Moist hard silty clay - weathered shale
Grayish green 10GY 5/2 (Dusky red 5R 3/4 Streaks)
B.O. Hole @ 26.5' B.O. Sampling 25.8'
Completed sampling @ 10:15 - hole still dry
B.O. Well - 23.5'

Well Installation - 25.5 Ltd PVC
1.5" risers, 10.0' screen, 0.5' plug
2.0' stickup
- mixed auger 2.3'± - rammed out clay from auger head w/ auger plug
- placed 1' sand at base
- hydrated well through augers
- attempted to place bentonite and back through annulus, but due to hollow stem auger
- pulled augers and take reamed open - completed sand pack up to 9.0'
- Bentonite pellets 3.0 to 3.0', then grouted to surface
- Placed locking protective casing.

DRILLING CONTRACTOR _____

BY _____ DATE 10/86

MW3-6

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.4

Reference Elevation: _____

Reference Desription: Mark on Top of PVC casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| DLA-CIRC | USATHAMA | [illegible] |

DRILLING METHOD: 6.5 HSA, 6¼" I.D. HSA CME 750 Rig — BORING NO. 87-01

SAMPLING METHOD: SPT - Standard Penetration Test: 18" long split spoon (2" O.D., 1⅜" I.D.) driven by 140 lb. hammer falling 30" — SHEET 1 of 3

| | START | FINISH |
|---|---|---|
| WATER LEVEL | 21.5 / 18.2 | 17.82 / 18.09 |
| TIME | 1600 / 0805 | 1345 / 1130 |
| DATE | 1-21 / 1-22 | 1-22 / 1-23 |
| REFERENCE | SURF / SURF | REF / REF |
| DRILLING TIME | 815 | 1600 |
| DRILLING DATE | 1-21-87 | 1-21-87 |

DRILLING CONTR. Layne Western — Tom Burke

BY Lisa Nitzinger — CHKD BY _____ — DATE _____

SURFACE CONDITIONS: Engr. / Sand covered flat. Lockdown cover cast into concrete. Sand 50' South.

| SAMPLER TYPE | SAMPLES RECOVERED / ATTEMPTED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6 in. SAMPLER | P.I.D. | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 0 | ML | Dk Yell. brown moist soft silt, some sand (loose) (10 YR 4/2) |
| SPT | 18/18 | 0 | 1/0 | 3 | 0 | 1 | SW/SP | some moist fine sand, trace silt (SW) (loose) |
| | | | | 3 | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | 4 | | 5 | SW/SP | Yellowish brown moist medium sand, tr silt (SW) (10 YR 5/4) (medium dense) |
| SPT | 18/18 | 5 | 2/6 | 6 | 0 | 6 | | |
| | | | | 9 | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | 5 | | 10 | SW/SP | Dk yellowish brown moist medium sand, tr silt (SW) (10 YR 4/4) (med dense) |
| SPT | 18/14 | 10 | 3/11 | 7 | 0 | 1 | | |
| | | | | 8 | | 2 | | |
| | | | | | | 3 | | ▽ $H_2O$ on rods @ ≈ 3.0 |
| | | | | | | 4 | | |
| | | | | 3 | | 5 | SW/SP | Yellowish orange moist med-fine sand, trace silt (SW) (10 YR 6/6) (med. dense) |
| SPT | 18/16 | 15 | 4/16 | 7 | 0 | 6 | | |
| | | | | 10 | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 10 | ML | |

C-87

MW3-6

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| [illegible] | USATHAMA | LCAAAP/Area C |

DRILLING METHOD: HSA

SAMPLING METHOD: SPT

BORING NO: 87-01

SHEET: 2 of 3

DRILLING START / FINISH TIME: _____

| WATER LEVEL | | | | DATE | DATE |
|---|---|---|---|---|---|
| TIME | | | | | |
| DATE | | | | | |
| REFERENCE | | | | | |

SURFACE CONDITIONS:

| SAMPLE TYPE | INCHES DRIVEN / RECOVERED | DEPTH OF CASING | SAMPLE NO. | BLOWS/6 IN. SAMPLER | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2 | | 20 | | |
| SPT | 18/18 | 20 | S/21 | 3/3 | 0 | 1 | ML | Grayish olive gray moist clayey silt little fine sand (5GY5/1) (medium stiff) (ML) |
| | | | | | | 2 | | |
| | | | | | | 3 | | Sand run-up (2' to 3') in augers while drilling to 25' Washed water through rods to clean out (drilled till 2:30 PM) - last 50 gal 1½ min |
| | | | | | | 4 | | |
| | | | | 3 | | 5 | SM | |
| SPT | 18/3' | 25 | 6/26 | 2 | 0 | 6 | | Brown wet med sand, little silt (SM) (5YR 4/4) iron stained (very loose) |
| | | | | 2 | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | 2 | | 30 | SW/SP | |
| SPT | 18/12 | 30 | 7/31 | 2/4 | 0 | 1 | | Olive gray wet m-f sand, tr. silt (SW) (5Y 5/2) (loose) |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | SW/SP | Olive gray wet m-f sand tr. DART (SW) (5Y 4/2) (med dense) |
| | | | | | 0 | | | BOTTOM OF AUGER @ 35.0' |

C-88

MW3-6

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA 5186 | USA-HAMA | LAKE/AREA 6 |

DRILLING METHOD:

SAMPLING METHOD:

BORING NO: S7-01

SHEET: 3 of 3

DRILLING START: TIME _____ DATE _____

DRILLING FINISH: TIME _____ DATE _____

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

| SAMPLER TYPE (SAMPLES TAKEN / SAMPLES RECOVERED) | DEPTH OF CASING (SAMPLES TAKEN / SAMPLES RECOVERED) | BLOWS/6 in SAMPLER | DEPTH IN FEET | GRAPHIC LOG | SURFACE CONDITIONS: |
|---|---|---|---|---|---|
| | | | 0 | | WELL INSTALLATION: Through augers (1-22-87, 0800) |
| | | | 1 | | Augers flush joint threaded: 25.0 ft casing, 10.5 ft screen + plug, 35.5 ft total |
| | | | 2 | | |
| | | | 3 | | Backfill: 2.4' |
| | | | 4 | | Grout: surf - 11.5 |
| | | | 5 | | Bentonite: 11.5 - 16.5 |
| | | | 6 | | Sand pack: 16.5 - 35.0 |
| | | | 7 | | Screen: 22.5 - 32.5 |
| | | | 8 | | Sump @ 33.0 |
| | | | 9 | | - used 110 gal water down hole to wash sand into place |
| | | | 0 | | - completed grouting @ 12:15 |
| | | | 1 | | - set protective casing (+ locking cap) @ 13:30 |
| | | | 2 | | - SEE WELL CONSTRUCTION DIAGRAM |
| | | | 3 | | |
| | | | 4 | | |
| | | | 5 | | |
| | | | 6 | | |
| | | | 7 | | |
| | | | 8 | | |
| | | | 9 | | |
| | | | 0 | | |

BY _____ DATE 1-22-87 CHECKED BY _____

MW3-7

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: 2.5
Reference Elevation: _____
Reference Description: Mark on Top of PVC casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THE SIDE | USA-HAMA | Camp/AREA A |
| DRILLING METHOD: HSA 9¼" I.D 6¼" I.D CME 75 all terrain rig | | BORING NO. ET-02 |
| | | SHEET 1 OF 2 |
| SAMPLING METHOD: SPT w/ auto Sampling Tool 1.5" split spoon (2" O.D / 1.5" I.D) driven by a 140 lb hammer free falling 30" | | DRILLING START / FINISH |
| WATER LEVEL | 5.5' / 11.45 / 12.57 / 12.72 | TIME |
| TIME | 0930 / 1555 / 0825 / 0735 | 1555 / 1100 |
| DATE | 1-23-87 / 1-23 / 1-24 / 1-25 | DATE |
| REFERENCE | SURF / AE / REF / SEE | 1-23-87 / 1-27-87 |

SURFACE CONDITIONS: Small covered, fence to Dac-ville office 100's from road

| SAMPLE # / TYPE | SAMPLE RECOVERY / DESCRIPTION | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 IN. SAMPLE # | P.I.D. (ppm) | ENGLISH OR FIELD | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | 0 | | |
| SPT | 18/12 | 0 | 1/1 | 2 | 0 | | ML | Dusky brown moist clayey silt w/ little fine sand (5YR 2/2) (TOPSOIL) ML (med stiff) |
| | | | | 4 | | | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | 5 | | | | |
| SPT | 18/14 | 5 | 2/6 | 9 | 0 | 6 | CL | Lt olive gray moist silty clay to fine sand (5Y 5/2) CL (very stiff) |
| | | | | 11 | | | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | 3 | | 10 | | |
| SPT | 18/18 | 10 | 3/11 | 5 | 0 | 1 | ML | Lt olive gray moist clayey silt to f sand (5Y 6/4) ML (medium stiff) |
| | | | | | | 2 | | |
| | | | | | | 3 | | ▽ $H_2O$ on rod ≈ 12.0 |
| | | | | | | 4 | | |
| | | | | 3 | | 5 | SM | Yellowish brown wet m-f sand little silt (10YR 5/3) SM (very loose) |
| SPT | 18/16 | 15 | 4/16 | 2 | 0 | 6 | | |
| | | | | 1 | | | ML | Lt olive gray wet clayey silt to fine sand (5Y 5/2) ML (very soft) |
| | | | | | | 7 | | |
| | | | | | | 8 | | 11' sand run up while augering ± 20' |
| | | | | | | 9 | | |
| | | | | | | TD | SM | Yellowish brown wet medium fine sand little silt (10YR 5/6) SM |

C-90

MW3-7

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA 5183 | USATHAMA | LCAAP / KEY R |

BORING NO. 87-12

SHEET 2 OF 2

DRILLING METHOD:

SAMPLING METHOD:

Co-ordinates:

Surface Elevation:

Casing Above Surface:

Reference Elevation:

Reference Desription:

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

DRILLING START TIME / FINISH TIME / DATE / DATE

SURFACE CONDITIONS:

| SAMPLE TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6 IN SAMPLER | P.I.D (ppm) | DEPTH IN FEET | GRAPHIC LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| SPT | 18/18 | 20 | 5/21 | 2, 3, 7 | 0 | 20–21 | SM | Yellowish brown wet medium-fine sand, little silt (10YR 4/4) SM (Loose) |
| | | | | | | 23 | | Used 2n gal water in augers to abate sand run-up |
| SPT | 18/12 | 25 | 6/26 | 4, 6, 10 | 0 | 25–26 | SM | Lt olive gray wet m-f sand, tr. silt (5Y 5/3) SM (medium dense) |
| | | | | | | 27 | | [illegible] after 5-6 @ 1730 (continued drilling @ 1030 1-23) |
| SPT | 18/12 | 27.5 | 7/28.5 | | 0 | 28–29 | SM/SP | Yellowish brown wet medium sand, tr [illegible] (10YR 5/[illegible]) SW |
| | | | | | | 29 | | Augered to 29.0' |
| | | | | | | 30 | | WELL INSTALLATION Begin @ 1230 1-23-87 through augers. |
| | | | | | | 32 | | [illegible] PVC [illegible] [illegible] [illegible] [illegible] screen [illegible] [illegible] |
| | | | | | | 34 | | Stickup: 2.5 Grout: Surf - 5.0 Bentonite 5.0 - 12.0 Sand pack: 12.0 - 29.0 Screen: 17.5 - 27.5 BOW @ 28.0 |
| | | | | | | 38 | | Used 2 gal [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] - [illegible] [illegible] [illegible] @ 1535 - [illegible] [illegible] [illegible] @ [illegible] |
| | | | | | | 40 | | |

MW18-1

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5

Reference Elevation: _____

Reference Description: Mark on top of PVC Casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5188 | USATHAMA | LCAAP IAAAP E |

DRILLING METHOD: HSA 9422 6¾" I.D. — BORING NO. 87-03

CME 75 All-Terrain Rig — SHEET 1 of 2

SAMPLING METHOD: SPT 1⅜" split spoon (2.0 OD / 1⅜ ID) driven by a 140 lb. hammer free falling 30". — DRILLING START / FINISH

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | 12.6 | 7.4 | 8.62 | 8.74 |
| TIME | 1525 | 0750 | 0725 | 0735 |
| DATE | 1-25 | 1-26 | 1-27 | 1-28 |
| REFERENCE | SURF | SURF | SURF | REF |

TIME: 1355 / 1530 — DATE: 1-25 / 1-25

SURFACE CONDITIONS: Snow covered pasture - frozen

DRILLER: Tom Butler — LADUKE-WESTERN

INSPECTOR: Karl Mikkelsen

| SAMPLE ID | SAMPLE TYPE | NO. RECOVERED / LENGTH SAMPLED | BLOWS/6 IN. CASING | BLOWS/6 IN. SAMPLER | BLOWS/6 IN. SAMPLE ID | P.I.D (ppm) | GRAPHIC LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | | | |
| SPT | 18/6 | 0 | 1/0 | 2/3 | | 0 | CL | Dark yellowish brown moist clay and silt CL (10YR 3/2) (soft) (TOP SOIL) |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | 2 | | | |
| SPT | 18/18 | 5 | 2/6 | 4/6 | | 0 | CL | Brownish gray moist silty clay CL (5YR 3/1) (medium stiff) |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | 2 | | | |
| SPT | 18/16 | 10 | 3/11 | 3/6 | | 0 | CL | Olive gray moist (possible saturated) silty clay CL (5Y 3/2) (med stiff) |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | ▽ H.O fluctuation @ 14.5' |
| | | | | | 2 | | | |
| SPT | 18/18 | 15 | 4/16 | 2/3 | | 0 | CL | Olive gray wet silty clay CL (5Y 3/1) (soft) |
| | | | | | | | | |
| | | | | | | | | Water in augers |
| | | | | | | | | Gradational contact: clay to silt w/ depth |
| | | | | | | | ML | |

10 — 10.0

MW18-1

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TLA 5188 | USATHAMA | LCAAP / AREA E |

DRILLING METHOD: HSA — BORING NO: 87-03

SHEET: 2 of 2

SAMPLING METHOD: SPT

DRILLING START / FINISH TIME

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | | | | |
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

DATE DATE

SURFACE CONDITIONS:

| SAMPLE TYPE | SAMPLE DRIVEN / RECOVERED | DEPTH OF CASING | SAMPLE NO. / SAMPLE DEPTH | BLOWS/6 IN. SAMPLER | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2 | | 0 | | |
| SPT | 18/18 | 20 | 5/21 | 3 4 | 0 | 1 | ML | Greenish gray wet clayey silt, some medium (5GY 5/1) yellowish (10YR 5/6) mottling (ML) (medium stiff) |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | Augered to 25' and sampled |
| SPT | 18/18 | 25 | 6/26 | WOH 1 | 0 | 6 | SW/SP | olive brown wet medium to fine sand, trace silt (5Y 4/4) (very loose) SW |
| | | | | | | 7 | | BOTTOM OF AUGER @ 25.0' |
| | | | | | | 8 | | BOTTOM OF SAMPLE @ 26.5' |
| | | | | | | 9 | | WELL INSTALLATION DETAILS: |
| | | | | | | 30 | | Start: 1-26-89 1420 |
| | | | | | | 1 | | Finish: " 1545 |
| | | | | | | 2 | | Stickup: +2.5 |
| | | | | | | 3 | | Grout: 2.5 to 2.5 |
| | | | | | | 4 | | Bentonite: 2.5 to 7.5 |
| | | | | | | 5 | | Sand pack: 7.5 to 25.0 |
| | | | | | | 6 | | Screen: 12.5 to 22.5 Bow @ ~3.0' |
| | | | | | | 7 | | Casing: 15.0' (10.5' + 5.0' stickup) |
| | | | | | | 8 | | Screen + plug: 11.5 |
| | | | | | | 9 | | 25.5' |
| | | | | | | 40 | | -installed in an open hole - no caving after drilling auger |
| | | | | | | | | -set protective casing @ 1540 |

C-93

MW18-2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5'

Reference Elevation: _____

Reference Description: Mark on top of PVC Casing

| | | | |
|---|---|---|---|
| CB NO. THA 5139 | CLIENT USA Thermo | LOCATION LCAAP/AREA E | |
| DRILLING METHOD: HSA - Hollow Stem Auger 8¼" O.D. 6¼" I.D. CME 750 ATV | | BORING NO. 87-04 | |
| Terrain Rig | | SHEET 1 of 2 | |
| SAMPLING METHOD: SPT - Stand. Pen. Test: 18" Split Spoon (2" O.D. 1⅜" I.D.) driven by a 140 lb hammer free-falling 30" | | DRILLING START / FINISH | |
| WATER LEVEL | 12.2 | 7.93 | 7.83 |
| TIME | 1010 | 0740 | 0835 |
| DATE | 1-27 | 1-28 | 1-29 |
| REFERENCE | SURF | REF | REF |
| TIME | | | 0800 / 0925 |
| DATE | | | 1-28-87 / 1-28-87 |

DRILLING CONTR: LANE-WESTERN — DRILLER: Tom Butler

LOG: Lou McFarlane — DATE: 1-28-87

SURFACE CONDITIONS: Flat Area covered in grass, adjacent to Ditch "B-1"

| SAMPLE TYPE | SAMPLE NUMBER | BLOWS/6" ON SAMPLER | P.I.D. (ppm) | DEPTH (FEET) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|
| | | 3 | | 0 | | |
| SPT | 18/12 | 5 | 0 | 1 | CL | Olive black moist silty clay (topsoil) CL (5Y 2/1) (stiff) |
| | | 8 | | 2 | | |
| | | | | 3 | | |
| | | | | 4 | | |
| | | 4 | | 5 | | |
| SPT | 18/18 | 4 | 0 | 6 | CL | Olive gray moist silty clay CL (5Y 3/1) (medium stiff) |
| | | 5 | | 7 | | |
| | | | | 8 | | Water in the slug after drilling to 10' |
| | | | | 9 | | ▽ Water on rods @ ≈ 9.0' |
| | | 3 | | 10 | | |
| SPT | 18/19 | 4 | 0 | 1 | CL | Olive gray moist/wet silty clay (CL) with (5Y 4/1) (mod. stiff) some orange mottling |
| | | 12 | | 2 | | |
| | | | | 3 | | Auger resistance varying several times from 11' to 15': variable density layering? |
| | | | | 4 | | |
| | | 2 | | 5 | | |
| SPT | 18/18 | 4 | 0 | 6 | CL | Olive gray and moderate yellowish brown clayey silt 5Y 4/1 (mod. stiff) (10 YR 5/4) (wet) CL |
| | | 4 | | 7 | | |
| | | | | 8 | | GRADATIONAL CONTACT (CLAY Grading to silt with depth) |
| | | | | 9 | | |
| | | | | 10 | ML | |

C-94

MW18-2

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Desription: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5188 | USATHAMA | LRAAP/KRSA E |

| | |
|---|---|
| DRILLING METHOD: HSA | BORING NO. 87-04 |
| | SHEET 2 of 2 |
| SAMPLING METHOD: SPT | DRILLING START / FINISH |
| WATER LEVEL | TIME / TIME |
| TIME | |
| DATE | DATE / DATE |
| REFERENCE | |

SURFACE CONDITIONS:

| SAMPLE ID | SAMPLE TYPE | INTERVAL DRILLED | RECOVERY | SUSPENDED CASINGS | SAMPLE DEPTH | BLOWS/6 in. SAMPLER | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2 | | 0 | | |
| SPT | 18/18 | 20 | 5/24 | | | 1 | 0 | 1 | ML | Olive gray wet clayey silt ML (5Y 3/1) (very soft) |
| | | | | | | | | 2 | | |
| | | | | | | | | 3 | | |
| SPT | 18/18 | 23.5 | 6/24 | | | 3 | 0 | 4 | ML | Grayish green wet silt, trace fine sand ML (5GY 5/1) (stiff) |
| | | | | | | 5 | | 5 | | |
| | | | | | | 6 | | 6 | | |
| | | | | | | | | 7 | | |
| | | | | | | | | 8 | | |
| | | | | | | | | 9 | | |
| | | | | | | | | 30 | | |
| | | | | | | | | 1 | | |
| | | | | | | | | 2 | | |
| | | | | | | | | 3 | | |
| | | | | | | | | 4 | | |
| | | | | | | | | 5 | | |
| | | | | | | | | 6 | | |
| | | | | | | | | 7 | | |
| | | | | | | | | 8 | | |
| | | | | | | | | 9 | | |
| | | | | | | | | 40 | | |

Augered to 25.0 - Bottom of Hole @ 25.0

Well Installation: Pulled auger and installed 4" PVC - 0.02" casing

Start: 10-29-91 1015

Finish: 10-29-91 1110

Sticking: 2.5

Cement: Slicked to 2.5

Bentonite: 2.5 to 7.5

Sand pack: 7.5 to 25.0

Screen: 12.5 to 22.5

Bail: 23.0

Casing: 15.0' (10.5' stick up)

Screen: 10.5

Plug: 1.0

25.5

Set protective casing @ 1110

MW18-3

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5'

Reference Elevation: _____

Reference Description: Marks on Top of PVC Casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TIA-5188 | USATHAMA | LCAAP / Area E |

DRILLING METHOD: HSA. Hollow Stem Auger 8" OD, 6.5" ID ; CME 750 ATV mounted Rig

BORING NO. 87-05

SHEET 1 OF 2

SAMPLING METHOD: SPT. Standard Penetration Test: 18" split spoon (2" OD, 1 3/8" ID) driven by a 140 lb. hammer free falling 30"

DRILLING START / FINISH

| | | | |
|---|---|---|---|
| WATER LEVEL | 14.0 | 9.67 | 9.36 |
| TIME | 1325 | 0750 | 0850 |
| DATE | 1-27 | 1-28 | 1-29 |
| REFERENCE | SURF | TOC | TOC |

TIME: 1315 / 1430

DATE: 1-27 / 1-27

SURFACE CONDITIONS: Flat snow covered pasture inside of Ditch B and Ditch B-1 confluence

DRILLING CONTR: Layne-Western — Tom Butler

BY: Lou Mezzacappa — CHKD BY: WLZ — DATE: _____

| SAMPLE TYPE | SAMPLE NUMBER | SAMPLE DEPTH INTERVAL | RECOVERY (IN.) | BLOWS/6 IN. SAMPLER | D.I.D. (ppm) | GRAPHIC LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | 2 | | | |
| SPT | 18/6 | 0 | 1/0 | 4<br>1 | 0 | ML | Ditch yellowish brown moist and stiff clayey silt (TOPSOIL) ML |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | 3 | | | |
| SPT | 18/18 | 5 | 2/6 | 4<br>8 | 0 | CL | Olive brown moist stiff silty clay CL (5Y 2/1) |
| | | | | | | | |
| | | | | | | | Water or auger cuttings while drilling from 5'-10' |
| | | | | | | | ▽ Water @ ≈9.0' on rods |
| | | | | 1 | | | |
| SPT | 18/18 | 10 | 3/11 | 2<br>2 | 0 | ML | Olive gray wet soft clayey silt ML (5Y 5/2) - some orange brown iron concretions |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | 2 | | | |
| SPT | 18/16 | 15 | 4/16 | 3<br>4 | 0 | ML | Olive gray and Dark yellowish brown clayey silt (5Y 4/1) (10YR 4/2) - wet, mod stiff - some iron concretions (brown portions of sample) ML |
| | | | | | | | |
| | | | | | | | Traces of fine - medium sand on outside of rod from drilling 15'-20' |
| | | | | | | ML | |

MW18-3

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5136 | USATHAMA | LCAAP, AREA C |

DRILLING METHOD: HSA

BORING NO. 87-05

SHEET 2 of 2

SAMPLING METHOD: SPT

DRILLING START TIME / FINISH TIME

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

DATE / DATE

SURFACE CONDITIONS:

| SAMPLE TYPE | SAMPLE NUMBER / RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 in. SAMPLE | P.I.D (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| | | | | 2 | | | |
| SPT | 18/18 | 20 | 5/21 | 4/5 | 0 | ML | Medium blivish grey/ish grn wet silt and clay (5Y 5-G 5/1) - some bot material - medium stiff |
| | | | | | | | |
| | | | | | | | |
| SPT | 18/18 | 23.5 | 6/25 | 3/3 | 0 | ML | Medium blivish/grey/ish grn wet clay/silt (5Y 5-G 5/1) trace fine sand - med. stiff |
| | | | | 4 | | | Augered to 25' |
| | | | | | | | Bottom of Hole @ 25.0' |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | WELL INSTALLATION: open hole - drilled over |
| | | | | | | | start 1-27 1500 |
| | | | | | | | end 1-27 1535 |
| | | | | | | | |
| | | | | | | | Stickup: 2.5 |
| | | | | | | | Grout: 0 to 2.5 |
| | | | | | | | Bentonite: 2.5 to 7.5 |
| | | | | | | | Sand pack: 7.5 to 25.0 |
| | | | | | | | Screen: 12.5 to 22.5 |
| | | | | | | | 3.0 Nill: 23.0 |
| | | | | | | | |
| | | | | | | | Casing: 15.0' (10.0 + 5.0' sections) |
| | | | | | | | Screen: 10.5 |
| | | | | | | | Plug |
| | | | | | | | 2.5' total |
| | | | | | | | |
| | | | | | | | - protective casing installed @ 1535 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

C-97

MW18-4

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5'

Reference Elevation: _____

Reference Description: Mark on Top of PVC casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5138 | USATHAMA | LCAAP AREA C |

DRILLING METHOD: HSA - Hollow Stem Auger 9¼" O.D, 6¾" I.D. : CME 750 ATV - terrain rig

BORING NO.: 87-06

SHEET: 1 OF 2

SAMPLING METHOD: SPT - Standard Penetration Test:

DRILLING: START / FINISH

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | 13 | 10.52 | 1053 | |
| TIME | 1100 | 0825 | 1505 | 0930 / 1050 |
| DATE | 1-28 | 1-29 | 2-3 | DATE / DATE |
| REFERENCE | Surf | REF | REF | 1-28ST / 1-29 |

SURFACE CONDITIONS: Snow cover & moisture - berm on north side of Ditch "B"

| SAMPLE ID | SAMPLE TYPE | SAMPLE PENETRATION INCHES / BLOWS | SAMPLE RECOVERY INCHES / BLOWS | BLOWS/6 in. SAMPLE ID | P.I.D. (ppm) | GRAPHIC LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | | 2 | | | |
| SPT | 18/6 | 0 | 1/0 | 3<br>4 | 0 | ML | Disky yellowish brown moist medium stiff clayey silt (10YR5/2) ML |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | 4 | | ML | |
| SPT | 18/18 | 5 | 2/6 | 5<br>8 | 0 | | Dusky yellowish brown moist stiff clayey silt ML (10YR5/2) - probably fill from ditch excavation |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | 3 | | ML | |
| SPT | 18/18 | 10 | 3/11 | 4<br>5 | 0 | | Olive gray moist (possibly wet) med. stiff clayey (5Y4/1) silt - ML - some gravel, thick rich stains and small coarse gravel |
| | | | | | | | |
| | | | | | | | Small amount of wet mud - on auger flights after drilling to 15' |
| | | | | | | | ▽ Static wet @ 14.0 |
| | | | | 2 | | ML | |
| SPT | 18/18 | 15 | 4/16 | 1<br>1 | 0 | | Olive gray wet very soft silt and clay - ML |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | SM | |

C-98

Logged - Written
Tom Butler

Drilled
Paul McFarlane

MW18-4

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5138 | USATHAMA | LICOLN/AREA-E |

DRILLING METHOD: HSA — BORING NO. 97-06

SHEET 2 of 2

SAMPLING METHOD: SPT

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| | | | |
|---|---|---|---|
| WATER LEVEL | | | |
| TIME | | | |
| DATE | | | |
| REFERENCE | | | |

DRILLING START TIME / DATE — FINISH TIME / DATE

SURFACE CONDITIONS:

| SAMPLE TYPE | SAMPLE NO. / INTERVAL (IN. RECOVERED) | BLOWS/6 in. CASING | SAMPLER BLOWS | BLOWS/6 in. SAMPLER | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2 | | 0 | SM | Moderate olive brown wet fine sand and silt (SM) (5Y 3/4) |
| SPT | 18/11 | 20 | 5/21 | 3/7 | 0 | | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| SPT | 18/18 | 23.5 | 6/45 | WOH/14 | 0 | 4 | SW/SP | Moderate olive brown wet medium to fine sand. (5Y 3/4) trace silt (SW) |
| | | | | | | 5 | | Auger to 25' |
| | | | | | | | | Bottom of H2O @ 25.0' |
| | | | | | | 6 | | |
| | | | | | | 7 | | Well Installation: - through augers |
| | | | | | | 8 | | Start: 1100 1-27 |
| | | | | | | | | End: 1225 1-27 |
| | | | | | | 9 | | |
| | | | | | | 30 | | Stick up: 2.5 |
| | | | | | | | | Grout: 1 to 2.5 |
| | | | | | | 1 | | Bentonite: 2.5 to 7.5 |
| | | | | | | | | Sand pack: 7.5 to 25.0 |
| | | | | | | 2 | | Screen: 12.5 to 22.5 B.O.W @ 23.0 |
| | | | | | | | | Riser: 12.5 (12.0 + 5.0 Section) |
| | | | | | | 3 | | Screen: 10.5 |
| | | | | | | | | Plug: 1 |
| | | | | | | 4 | | 25.5 total |
| | | | | | | | | - Set Protective Casing @ 1225 |
| | | | | | | 5 | | |
| | | | | | | | | - Used 50 gals H2O to wash sand |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 40 | | |

C-99

MW18-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: ±2.5'

Reference Elevation: _____

Reference Description: Mark on TOP of PVC Casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TI45183 | USATHAMA | LOWRY/DENVER |

DRILLING METHOD: HSA - Hollow Stem Auger — 9¼" O.D., 6¼" I.D.; CME 750 All-hydraulic drill rig

SAMPLING METHOD: SPT - Standard Pen Test — 2"O.D.-1⅜" I.D. split spoon (18" max) driven by 140 lb hammer free-falling 30"

BORING NO.: 87-07

SHEET: 1 of 2

| | | | |
|---|---|---|---|
| WATER LEVEL | 16.0 | 10.11 | 10.32 |
| TIME | 1640 | 0745 | 1515 |
| DATE | 1-29 | 1-29 | 2-3 |
| REFERENCE | SURF | REF | REF |

DRILLING START: TIME 1520, DATE 1-28-87

DRILLING FINISH: TIME 1630, DATE 1-28-87

DRILLING CONTR: LANE-WESTERN — Tom Butler

LOGGED BY: Carl Mahrenholz

SURFACE CONDITIONS: Pasture - on berm South side of D.T.H "B"

| SAMPLE ID | TYPE | BLOWS PER 6" | DEPTH TO CASING | SAMPLE NO. | BLOWS/6" ON SAMPLER | P.I.D. (ppm) | ELEVATION OR DEPTH | GRAPHIC LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2 | | 0 | | |
| SPT | 10/9 | 0 | | 1/0 | 3/4 | 0 | 1 | ML | Dark yellowish brown moist clayey silt (10 YR 3/2) - medium stiff ML |
| | | | | | | | 2 | | |
| | | | | | | | 3 | | |
| | | | | | | | 4 | | |
| | | | | | 3 | | 5 | | |
| SPT | 18/14 | 5 | | 2/6 | 3/5 | 0 | 6 | ML | Dusky yellowish brown clayey silt with fine sand (10 YR 2/2) - medium stiff moist ML - probably fill from ditch excavation |
| | | | | | | | 7 | | |
| | | | | | | | 8 | | Water on auger plug after drilling to 10'. |
| | | | | | | | 9 | | ▽ Spoon wet @ 9.5' |
| | | | | | 1 | | 10 | | |
| SPT | 18/18 | 10 | | 3/11 | 2/2 | 0 | 1 | ML | Olive gray wet soft clayey silt ML (5Y 3/1) - some orange iron concretions |
| | | | | | | | 2 | | |
| | | | | | | | 3 | | |
| | | | | | | | 4 | | |
| | | | | | WOH | | 5 | | |
| SPT | 18/18 | 15 | | 4/16 | 2/2 | 0 | 6 | ML | Olive gray wet soft clayey silt ML (5Y 3/1) (Slightly coarser than S-3) |
| | | | | | | | 7 | | |
| | | | | | | | 8 | | |
| | | | | | | | 9 | | |
| | | | | | | | 10 | | |

MW18-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA 5138 | USATHAMA | LCAAP/KREC C |

DRILLING METHOD: HSA

BORING NO. 87-07

SHEET 2 of 2

SAMPLING METHOD: SPT

| | DRILLING START | DRILLING FINISH |
|---|---|---|
| WATER LEVEL | TIME | TIME |
| TIME | | |
| DATE | DATE | DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE ID / TYPE | SAMPLE NO. RECOVERED | DEPTH OF CASING | SAMPLE NO. DEPTH | BLOWS/6 in. SAMPLE ID | P.I.D. (ppm) | GRAPHIC LOG |
|---|---|---|---|---|---|---|
| | | | | 1 | | |
| SPT | 18/19 | 20 | 5/5.1 | 1 | 0 | ML |
| | | | | 2 | | |
| | | | | | | |
| | | | | | | |
| SPT | 18/19 | 23.5 | 6/26.5 | 1 | 0 | ML |
| | | | | 1 | | |
| | | | | 1 | | |

0 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Yellowish brown (with some olive gray) silt, trace fine sand (10YR 5/2) - very soft, wet (ML)

Medium bluish/greenish gray and moderate brown (5 B/G 5/1) (5YR 3/4) wet silt + rock soft (ML)

Augered to 25'

Bottom of Hole @ 25.0'

WELL INSTALLATION: Pulled augers + placed well in open hole

Start: 1640, 1-28

End: 1710, 1-28

Stickup: 2.5'

Grout: 0 to 2.5

Bent.: 2.5 to 7.5

Sand pack: 7.5 to 25.0

Screen: 12.5 to 22.5

Backfill: 23.0

- Placed protective casing @ 1710

- Used 20 gal $H_2O$ to wash sand down hole

C-101

MW18-6

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5

Reference Elevation: _____

Reference Description: Mark on Top of PVC Casing

| | | | |
|---|---|---|---|
| JOB NO. | CLIENT | LOCATION | |
| T1W5130 | USATHAMA | LCAAP IRPS E | |
| DRILLING METHOD: HSA - Hollow Stem Auger 9¼ I.D., 6¼ I.D. (CME 75) All terrain drill rig | | BORING NO. 87-08 | |
| SAMPLING METHOD: SPT - Standard Penetration Test 18" split spoon (2" OD 1⅜" I.D.) driven with 140 lb hammer free falling 30" | | SHEET 1 of 2 | |
| | | DRILLING START & FINISH | |
| WATER LEVEL | 4.5 / 7.37 / 7.57 / 7.73 | TIME | TIME |
| TIME | 1340 / 0835 / 0745 / 0800 | 1115 | 1535 |
| DATE | 1-29 / 2-3 / 2-4 / 2-5 | DATE | DATE |
| REFERENCE | Surf / REF / REF / REF | 1-29-87 | 1-29-87 |

SURFACE CONDITIONS: Open pasture - not irrigated

| SAMPLE TYPE | SAMPLE NUMBER / RECOVERY | DEPTH CASING | SAMPLE DEPTH | BLOWS/6 in. SAMPLER | P.I.D. (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| | | | | 2 | | 0 | |
| SPT | 18/9 | 0 | 1/0 | 5/5 | 0 | | CL olive black moist med. stiff silty clay CL (5Y 2/1) (TOPSOIL) |
| | | | | | | 1 | |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | 3 | | 5 | |
| SPT | 18/10 | 5 | 2/6 | 5/7 | 0 | 6 | CL olive gray moist silty clay CL (5Y 4/1) - stiff |
| | | | | | | 7 | Auger plug wet while drilling @ 7' |
| | | | | | | 8 | ▽ Water on rods @ 8.5' |
| | | | | | | 9 | |
| | | | | 2 | | 10 | |
| SPT | 18/12 | 10 | 3/11 | 1/1 | 0 | 1 | CL Medium dark gray/olive gray wet very soft silty clay (N4/5Y 4/1) CL |
| | | | | | | 2 | |
| | | | | | | 3 | Encountered harder drilling @ depth ≈ 12.5-13.5' |
| | | | | | | 4 | |
| | | | | 2 | | 5 | (N4 YR 5/6) |
| SPT | 18/18 | 15 | 4/16 | 2/2 | 0 | 6 | ML Light olive gray and moderate yellowish brown clay (5Y 5/2) (5YR 5/4 staining), wet soft clayey silt (ML) |
| | | | | | | 7 | Harder drilling beginning ≈ 17' and continuing to 20' |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | | | 20 | SM |

C-102

MW18-6

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THESIS | USATHAMA | LCAAP/AREA E |
| DRILLING METHOD: HSA | | BORING NO. 87-08 |
| | | SHEET 2 of 2 |
| SAMPLING METHOD: SPT | | DRILLING START / FINISH |
| WATER LEVEL | | TIME / TIME |
| TIME | | |
| DATE | | DATE / DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE ID / TYPE | INCHES DRIVEN / RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6" for SAMPLER | P.I.D. (ppm) | GRAPHIC LOG |
|---|---|---|---|---|---|---|
| | | | | 16 | | |
| SPT | 18/18 | 20 | 5/21 | 17 | 0 | SM |
| | | | | 24 | | |
| | | | | | | |
| | | | | | | |
| SPT | 18/18 | 23.5 | 6/23.5 | WOH/2 | 0 | SW/SP |
| | | | | 2 | | |

Brownish olive mod. brown alternating horizontal (10 YR 4/2) (5 YR 4/4) bands (¼" to 1") medium to fine sand, some silt - wet, very dense SM

Lt olive gray wet very loose med-fine sand, trace silt (5 Y 5/2) SW

Ground +25' - Sand run in augers pulled augers up to 20' - Light olive and redrilled to 25', used 15 gal H2O down augers. Sand ran in fast, olive - washed out with second set of rods down the hole - 10' sand then 30 gal H2O down hole - WOR

Bottom of Hole @ 250'

Well Installation - in stages with augers

Start: 1335 - hole full of water - no need

And: 1640 to wash sand down with more water

Stickup: 2.5

Apron: 0-2.5

Bentonite: 2.5 - 7.5

Sand pack: 7.5 - 25.0

Screen: 12.5 - 22.5

Bottom of well: 23.0

Screen slot - 10

Riser 15.0 (10.0 + 5.0 stickup)

- Inactive casing set @ 1640

MW17-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5

Reference Elevation: _____

Reference Description: Mark on Top of PVC Casing

* OILY SHEEN ON WATER, 2.1.2 100-200 ppm

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| 7165188 | USATHAMA | LCAAP/Area D |
| DRILLING METHOD: HSA - Hollow Stem Auger 9¼" O.D., 6¾" I.D.; CME 75 Drill Rig | | BORING NO. 87-09 |
| SAMPLING METHOD: SPT - Split Barrel Type; 1⅜" split spoon (1⅜" I.D. 1⅝" O.D.) driven by a 140 lb hammer free falling 30" | | SHEET 1 of 2 |
| WATER LEVEL | 16.5 / 3.9* / 2.9* / 2.5 | DRILLING START / FINISH |
| TIME | 1145 / 0800 / 0925 / 1605 | TIME 0855 / 1045 |
| DATE | 12-3 / 12-4 / 12-5 / 12-6 | DATE / DATE |
| REFERENCE | SURF REF / REF / REF | 12-3-87 / 12-3-87 |

SURFACE CONDITIONS: Cleared edge of dirt road adjacent to woods the access to the north

Logged by: Tom Butler

Driller: Lavale Hostetter

Date: 12-3-87

| SAMPLE ID TYPE | INCHES RECOVERED / INCHES DRIVEN | DEPTH FEET CASING | SAMPLE DEPTH | BLOWS ON SAMPLER | P.I.D. (ppm) | GRAPHIC LOG | GEOLOGIC LOGS |
|---|---|---|---|---|---|---|---|
| | | | | 3 | | 0 | |
| SPT | 19/16 | 0 | 1/1 | 3 4 | 0 | 1 | ML |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | 3 | | 6 | |
| SPT | 18/19 | 5 | 2/6 | 5 6 | 0 | 7 | CL |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | 6 | | 10 | |
| SPT | 13/18 | 10 | 3/11 | 9 7 | 0 | 1 | CL |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | 4 | | 6 | |
| SPT | 18/18 | 15 | 4/16 | 4 5 | 0 | 7 | ML |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | | | 10 | |

Dk. yellowish brown moist clayey silt ML (10YR 4/2) - wet, stiff

Lt. olive gray wet stiff silty clay (CL) (5Y 6/1) (some small orange iron staining)

(spoon wet @ 5')

Easy augering from 8' down to 13' saturated clay cuttings coming out of hole. Rods wet at 9' after augering to 10'

Olive gray wet stiff silty clay with orange to (5Y 5/1) dusky brown (5YR 2/2) iron staining CL

Drilling resistance varies 2'-1' down to 15' indicative of variable layer cake strata.

Lt olive gray and yellowish orange (iron staining) silty clay (5Y 6/1) (10YR5/6) ML - wet, medium stiff

Relatively softer materials encountered during drilling @ 7.2'

C-104

MW17-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TU87BB | USATHAMA | LCAAP/AREA D |
| DRILLING METHOD: HSA | | BORING NO. 87-09 |
| | | SHEET 2 of 2 |
| SAMPLING METHOD: SPT | | DRILLING START / FINISH |
| WATER LEVEL | | TIME / TIME |
| TIME | | |
| DATE | | DATE / DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE ID | SAMPLE TYPE | BLOWS/6" | RECOVERY (in) | P.I.D (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|
| | | 5 | | | | |
| SPT | 18/18 | 6/7 | 20 | 5/21 | 3.5 | ML |
| | | | | | | |
| | | | | | | |
| SPT | 18/18 | 5/6 | 23.5 | 6/14.5 | 4.6 | ML |
| | | 10 | | | | |

Moderate yellowish brown wet stiff clayey silt (10 YR 5/4) ML

(100 ppm on HNu registered maximum)

Moderate yellowish brown wet very stiff clayey silt ML

Augered to 25' B.G.H @ 25.0'

(2 ppm on HNu registered in augers)

WELL INSTALLATION – Pulled augers (5-30 in hole HNu) - breathing air OK suited up - definite solvent odor contained positive ridings cuttings

Start: 1150
End: 1300

in 55 gal drums provided by Olin.

Backfill 2.5
Grout: 1 - 2.5
Bentonite: 2.5 - 7.5
Sand pack: 7.5 - 25.0'
Screen: 12.5 - 22.5
O.D. IN @ 23.0'

Riser 15.0 (10.0 - 5.0 lengths)
Screen 10.5
Plug 1.0
25.5

10 - 20 ppm in well at completion

Set protective casing @ 1300

C-105

MW17-6

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5

Reference Elevation: _____

Reference Desnation: Mark on top of PVC casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THAS1B8 | USATHAMA | LCAAP/AREA D |

DRILLING METHOD: HSA - Hollow Stem Auger — BORING NO. 87-10

0±10 6¼" I.D. CME 750 All-terrain drill rig

SAMPLING METHOD: SPT - Standard Penetration Test, 1.9" split spoon (2" O.D., 1⅜" I.D.) driven by a 140 lb. hammer free falling 30"

SHEET 1 of 2

| | | | | | DRILLING START | DRILLING FINISH |
|---|---|---|---|---|---|---|
| WATER LEVEL | DRY | 3025.69 | 25.00 | | TIME | TIME |
| TIME | 1015 | 1310 | 0820 | 1400 | 0810 | 1010 |
| DATE | 7-6 | 7-6 | 7-5 | 7-6 | DATE | DATE |
| REFERENCE | SURF | REF | REF | REF | 7-6-87 | 7-6-87 |

SURFACE CONDITIONS: Flat grassed area next to mud

LOGGED BY: Lalake Wesseln

DRILLER: Zeke Sutter

| SAMPLE # / TYPE | BLOWS PER 6 INCHES | RECOVERED LENGTH (IN.) | SAMPLE DEPTH | BLOWS/6 IN. SAMPLE # | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 1 | | 0 | | |
| SPT | 18/8 | 0 | 1/0 | 2 | 0 | 1 | ML | Greenish brown moist soft clayey silt - ML (5YR 3/2) (TOPSOIL) |
| | | | | 3 | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | 4 | | 5 | | |
| SPT | 18/14 | 5 | 2/6 | 9 | 0 | 6 | ML | Lt olive gray moist very stiff silt (ML), some small orange iron staining (5Y 6/2) |
| | | | | 16 | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | 6 | | 10 | | |
| SPT | 18/16 | 10 | 3/11 | 13 | 0 | 11 | CL | Olive gray moist (possible saturated) very stiff (5Y 4/1) silty clay (CL), some orange iron staining |
| | | | | 16 | | 12 | | |
| | | | | | | 13 | | |
| | | | | | | 14 | | |
| | | | | 8 | | 15 | | |
| SPT | 18/18 | 15 | 4/16 | 12 | 0 | 16 | CL | Lt olive gray (with lt brown and orange iron staining) (5Y 5/2) / (5Y 6/1) silty clay moist, hard (CL) |
| | | | | 24 | | 17 | | |
| | | | | | | 18 | | |
| | | | | | | 19 | | |
| | | | | | | 20 | | |

MW17-6

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Desriotion: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TW5168 | USATHAMA | LCAAP/LCAA 7 |

DRILLING METHOD: HSA — BORING NO. B7-10

SHEET 2 of 2

SAMPLING METHOD: SPT

DRILLING START / FINISH

| | | |
|---|---|---|
| WATER LEVEL | TIME | TIME |
| TIME | | |
| DATE | DATE | DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE TYPE | SAMPLE NUMBER / RECOVERY | BLOWS/6 in. SAMPLE | 21.0 (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|
| | | 10 | | | |
| SPT | 18/18 2.0 | 15/23 | 0 | CL | Lt olive gray moist hard silty clay (CL) some (5Y 6/1) strong iron staining |
| | | | | | No water or mud encountered on rods, plug, or spoon during drillings from 0 to 30' |
| | | 11 | | ML | Yellowish orange moist hard clayey silt. (ML) (10YR 5/6) some dusky yell. brown iron staining (10YR 2/2) |
| SPT | 18/18 25 | 16/26 | 0 | | |
| | | | | | (.5" to 1" pieces of cherty limestone coming up on auger cuttings - angular) |
| SPT | 18/18 28.5 | 11/19/15 | 0 | ML | Med. yellowish brown moist (very dark brown saturated) very stiff clayey silt - ML |
| | | | | | Augered to 30' |
| | | | | | Bottom of Hole @ 30' |

WELL INSTALLATION: pulled auger - installed well in open hole. Water rising in boring hole after pulling auger

Start: 2-4 1135

End 2-4 1315

Stick up: 2.5

Grout: 1 to 4.0'

Bentonite: 4.0 to 9.0

Sand pack: 9.0 to 30.0

Screen: 17.5 to 27.5

B.H. Will: 28.0'

Riser 2.0 (to 10.5 screen)

Screen 12.5 (10.0 screen, 0.5 DIVA)

plug ~~40.5~~'

Completion Pulling Aug @ 1315

MW7-7

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: -2.5'

Reference Elevation: _____

Reference Desnation: Mark on Top of PVC Casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA 5139 | USATHAMA | LCAAP / AREA C |
| DRILLING METHOD: HSA - Hollow Stem Auger | | BORING NO. |
| 9¼" o.d. 6⅝" I.D. CME 750 Auger | | B7-11 |
| Tri-Cabin Drill Rig | | SHEET |
| SAMPLING METHOD: SPT - Standard Penetration Test | | 1 of 2 |
| Test: 18" split Spoon (2" O.D. 1⅜" I.D.) | | DRILLING |
| Driven by a 140 lb hammer free-falling 30" | | START / FINISH |

| | | | | | | |
|---|---|---|---|---|---|---|
| WATER LEVEL | 13.1 | 10.78 | 15.66 | 15.50 | TIME | TIME |
| TIME | 0710 | 1155 | 0750 | 0830 | 1605 | 0945 |
| DATE | 2-5 | 2-5 | 2-6 | 2-7 | DATE | DATE |
| REFERENCE | SURF | REF | REF | REF | 2-4-37 | 2-5-37 |

SURFACE CONDITIONS: Flat grassed area next to a dry shallow ditch (east-west) and soft loam fields to the west and north

| SAMPLE TYPE | SAMPLE NUMBER / RECOVERY | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6" ON SAMPLER | P.I.D. (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| | | | | 2 | | | |
| SPT | 18/5 | 0 | 1/0 | 5 | 0 | CL | Dusky yellowish brown moist stiff clay + silt (10 YR 2/2) CL |
| | | | | 7 | | | |
| | | | | 7 | | | |
| SPT | 18/18 | 5 | 2/6 | 7 | 0 | CL | Dusky yellowish brown moist stiff clay and silt (10 YR 2/2) CL |
| | | | | 8 | | | |
| | | | | 5 | | | |
| SPT | 18/18 | 10 | 3/11 | 9 | 0 | ML | Lt olive gray and yellowish orange moist very (5Y 6/1) (10 YR 5/6) stiff clayey silt ML |
| | | | | 10 | | | |
| | | | | | | | - Drilling started getting easier @ 12-13' and down - Dry auger after reaming to 15' |
| | | | | | | | 7 gallons wet grout |
| | | | | 14 | | | |
| SPT | 18/18 | 15 | 4/16 | 15 | 0 | SW/SP | DK. yellowish brown wet medium - fine sand + silt (10 YR 4/2) - medium dense SW |
| | | | | 14 | | | |
| | | | | | | | - Sand caved after drilling to 20' - used auger to clean out - TD 20' |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

C-108

LAYNE-WESTERN
TOM BYERS

IAN MACLACHLAN

MW7-7

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA-5188 | THAMA | ACAAP / AREA C |

DRILLING METHOD: HSA — BORING NO. 87-11

SAMPLING METHOD: SPT — SHEET 2 of 2

| | DRILLING START | DRILLING FINISH |
|---|---|---|
| WATER LEVEL | | |
| TIME | TIME | TIME |
| DATE | DATE | DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE ID / TYPE | NUMBER / RECOVERY | DEPTH BELOW CASING | SAMPLE DEPTH | BLOWS/6 in SAMPLE ID | P.I.D. (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| | | | | 3 | | | |
| SPT | 18/9 | 20 | 5/21 | 4 | 0 | SW/SP | Yellowish brown wet medium-fine sand (10 YR 5/2) - med. dense SW |
| | | | | 13 | | | |
| | | | | | | | Drilled to 25' - sand cave-up again - ran out of HSA - backfilled w/ @ 1745 before sampling 25' |
| | | | | | | | Resumed drilling @ 0500, 2-5-87, Washed out - used 100 gal H2O |
| | | | | 2 | | | |
| SPT | 18/10 | 25 | 6/26 | 1 | 0 | SW/SP | Moderate yellowish brown wet m-f sand SW (10 YR 5/6) - loose |
| | | | | 8 | | | |
| | | | | | | | Resumed @ 29' - sampled |
| | | | | WOH | | SW/SP | Moderate yellowish brown wet m-f sand SW (10 YR 5/6) - medium dense |
| SPT | 18/10 | 29 | 7/30 | 5 | 0 | | |
| | | | | 11 | | | |
| | | | | | | | Bottom of Auger @ 29.0' |
| | | | | | | | WELL INSTALLATION: Through augers |
| | | | | | | | Start: 1060, 2-5 |
| | | | | | | | End: 1110, 2-5 |
| | | | | | | | Stickup: 2.5' riser: 20.0' to +17.0' |
| | | | | | | | Grout: 0-4.0' screen: 19.5 |
| | | | | | | | Bentonite: 4.0-9.0 slot 22.5' |
| | | | | | | | Sand Pack: 9.0-29.0 |
| | | | | | | | Sand: 17.5-27.5 |
| | | | | | | | Bottom: 29.0 |
| | | | | | | | - Set temporary casing @ 1210 (2-5-87) |
| | | | | | | | - 75 gals used + wash sand down casing |

C-109

MW7-8

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.7'

Reference Elevation: _____

Reference Description: Mark on Top of PVC Casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TW 5189 | USATHAMA | LCAAP / Area C |
| DRILLING METHOD: HSA - Hollow Stem Auger | | BORING NO. |
| CME 750 ATV | | 87-12 |
| DRILLING AGENCY: Layne Drilling | | SHEET |
| SAMPLING METHOD: SPT - Standard Penetration | | 1 of 2 |
| Test: 13" spl. & sampler (3.0" I.D.) 13 3/8" I.D. Advanced by | | DRILLING |
| a 140 lb hammer free falling 30". | | START / FINISH |
| WATER LEVEL: 15.2 / 16.82 / 16.81 | | TIME: 1640 / 0900 |
| TIME: 0735 / 1710 / 1230 | | DATE: 2-5-87 / 2-6-87 |
| DATE: 2-6 / 2-7 / 2-8 | | |
| REFERENCE: SURF / ZED / REF | | |

SURFACE CONDITIONS: Flat wet grassy area

| SAMPLE ID / TYPE | SAMPLE RECOVERY / LENGTH | DEPTH BELOW CASING | SAMPLE NO. | BLOWS/6" OR BLOWS/FT | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2 | | 0 | | |
| SPT | 18/7 | 0 | 1 | 13 | 0 | 1 | CL | Dusky yellowish brown moist very stiff clayey silt (CL) (10YR2/2) |
| | | | | 10 | | | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | 3 | | | | |
| SPT | 18/18 | 5 | 2/6 | 5 | 0 | 6 | CL | Olive black moist stiff silty clay (CL) (5Y 2/1) |
| | | | | 7 | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | 6 | • | 10 | | |
| SPT | 18/18 | 10 | 3/11 | 11 | 0 | 1 | SM | Olive gray moist fine sand, some silt (5Y 3/1) - medium dense |
| | | | | 10 | | | | |
| | | | | | | 2 | | Augered hole wet after drilling to 15' |
| | | | | | | 3 | | |
| | | | | | | 4 | | ▽ $H_2O$ on spoon @ 14.5' |
| | | | | 9 | | 5 | | Yellowish brown (10YR 5/4) medium to fine sand, some silt - medium dense |
| SPT | 18/19 | 15 | 4/16 | 11 | 0 | 6 | SM | |
| | | | | 6 | | 7 | | |
| | | | | | | 8 | | No recovery |
| | | | | | | 9 | | |
| | | | | | | 20 | CL | Drilled to 20' and sampled started ~ 0745 resumed drilling 1900 2-5-87 |

MW7-8

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA 5138 | USATHAMA | LORING / ARSIC |

DRILLING METHOD: HSA — BORING NO. 87-12

SAMPLING METHOD: SPT — SHEET 2 of 2

| | DRILLING START TIME | DRILLING FINISH TIME |
|---|---|---|
| WATER LEVEL | 10.82 | |
| TIME | 1710 | |
| DATE | | DATE |
| REFERENCE | | DATE |

SURFACE CONDITIONS:

| SAMPLE TYPE | BLOWS PER 6 INCHES | SPT N VALUE | DEPTH OF CASING | SAMPLE NO. / SAMPLE DEPTH | BLOWS ON SAMPLER | PID (ppm) | ELEVATION IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2 | | 20 | CL | Yellowish brown wet soft clayey silt (CL) (10YR 4/4) |
| SPT | 18/18 | 20 | 5 | 5/7 | 1 | 0 | 1 | | 20.8' |
| | | | | | 3 | | | ML | Yellowish brown wet silt, some fine sand (ML) (10YR 4/4) |
| | | | | | | | 2 | | N1 clean-up - loaded augers with 20 gal H2O and 10 lbs |
| | | | | | | | 3 | | |
| | | | | | | | 4 | | |
| | | | | | | | 5 | | |
| | | | | | 3 | | | | Yellowish brown wet m-f sand, little silt (SM) |
| SPT | 18/18 | 25 | 10 | 10/12 | 5 | 0 | 6 | SM | (10YR 4/4) - medium dense |
| | | | | | 10 | | | | |
| | | | | | | | 7 | | N2 clean-up |
| | | | | | | | 8 | | |
| SPT | 18/18 | 28.5 | 7 | 7/8.5 | 9 | 0 | 9 | SM | Dark yellowish brown wet m-f sand, trace silt (SM) (10YR 4/4) - med. dense |
| | | | | | 12 | | | | Cleaned to 30' |
| | | | | | 10 | | 30 | | Bottom of H/O @ 30.0' |
| | | | | | | | 1 | | |
| | | | | | | | | | WELL INSTALLATION: Through Augers |
| | | | | | | | 2 | | Start: 19.5 2-3-87 |
| | | | | | | | | | End: 11.10 " |
| | | | | | | | 3 | | Backfill: 2.7 |
| | | | | | | | | | Grout: 0-3.5 1150# 20 gal H2O |
| | | | | | | | 4 | | Bentonite: 3.5 to 5.5 Hole to wash |
| | | | | | | | | | Sand pack: 5.5 - 30 Sand down |
| | | | | | | | 5 | | Screen: 17.3 to 27.3 |
| | | | | | | | | | O.D. Well: 27.8 |
| | | | | | | | 6 | | Riser: 0.0 (to 10.0') |
| | | | | | | | | | Bentonite: 10' |
| | | | | | | | 7 | | Filing: 30.5 sand |
| | | | | | | | | | Set cast. Casing @ 11.0 |
| | | | | | | | 8 | | |
| | | | | | | | 9 | | |
| | | | | | | | 0 | | |

C-111

MW7-9

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.5'

Reference Elevation: _____

Reference Desnation: Mark on top of PVC casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TURF BAY | USA-TAMPA | LCAAD/RR&C |

DRILLING METHOD: HSA - Hollow stem auger. 9± O.D., 6± I.D.; CME 75D All-terrain drill rig

BORING NO.: 87-13

SHEET: 1 of 2

SAMPLING METHOD: SPT - Standard Penetration Test: 18" split spoon (2" O.D. 1 3/8" I.D.) driven by a 140 lb hammer free falling 30"

DRILLING START / FINISH

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| WATER LEVEL | 15.3' | 18.82 | 17.97 | 17.80 | TIME | TIME |
| TIME | 0810 | 1045 | 1140 | 0905 | 1515 | 1705 |
| DATE | 2-7-87 | 2-7 | 2-9 | 2-9 | DATE | DATE |
| REFERENCE | SURF | REF | REF. | REF. | 2-6-87 | 2-6-87 |

SURFACE CONDITIONS: Grassed lawn between road and tank. On 10° incline dipping to the north (berm for tank)

| SAMPLE ID | SAMPLE TYPE | NUMBER AND DIAMETER OF BARRELS | BLOWS/6 in. | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | | | 2 | | 0 | | Brownish black moist soft clayey silt (ML) - topsoil (5Y 2/1) |
| SPT | 18/18 | 0 | 2 | 0 | 1 | | Moderate brown moist clayey silt, some m-f sand (5YR 3/4) - soft FILL ML |
| | | | 2 | | 2 | | |
| | | | | | 3 | | |
| SPT | 18/18 | 3.5 | 2/4.5 | 3 | 4 | SM | Yellowish brown moist med-fine sand, trace silt (10YR 5/4) - loose FILL SM |
| | | | | 4 | | | |
| | | | | 5 | 5 | | |
| | | | | | 6 | | |
| | | | | | 7 | | |
| | | | | | 8 | | |
| SPT | 18/18 | 8.5 | 3/4.5 | 3 | 9 | SW/SP | Yellowish brown moist m-f sand, med. dense (SW) (10YR 5/6) FILL - likely |
| | | | | 5 | | | |
| | | | | 6 | 10 | | |
| | | | | | 1 | | |
| | | | | | 2 | | |
| | | | | | 3 | | |
| SPT | 18/18 | 13.5 | 4/4.5 | 3 | 4 | SM | Dark yellowish brown moist loose fine sand, little silt (10YR 4/2) (SM) |
| | | | | 5 | | | ▽ $H_2O$ on rods @ 15.7' |
| | | | | 4 | 15 | | |
| | | | | | 6 | | |
| | | | | | 7 | | |
| | | | | | 8 | | |
| SPT | 18/13 | 18.5 | 5/4.5 | 1 | 9 | SM | Dk yellowish brown (10YR 3/2) moist loose fine sand, little silt (SM) |
| | | | | 6 | | | Dk yellowish brown (10YR 3/2) moist soft silty clay (CL) |
| | | | | 2 | 20 | ML | Yellowish brown (5Y 5/6) moist soft silt, some f-c sand (ML) |

C-112

MW16-1

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.6

Reference Elevation: _____

Reference Description: Mark on top of PVC

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA 5182 | USATHAMA | LCAAP |

DRILLING METHOD: Hollow Stem Auger — BORING NO.: 86-01

CME 55 Rig, 12" O.D., 6.5" I.D. HSA

SAMPLING METHOD: STANDARD PENETRATION — SHEET: 1 of 2

TESTS (SPT) - 18" Driven split — DRILLING

SPOON - 2" O.D. - 140 lb hammer falling 30" — START / FINISH

| | | | TIME | TIME |
|---|---|---|---|---|
| WATER LEVEL | 22.30 | 20.49 | | |
| TIME | 0805 | 1200 | 1040 | 1900 |
| DATE | 5-7-86 | 5-8-86 | DATE | DATE |
| REFERENCE | RSE | RSE | 5-8-86 | 5-8-86 |

SURFACE CONDITIONS: Grassed hillside @ top of hill

| SAMPLE ID / TYPE | SAMPLE RECOVERY / LENGTH | BLOW COUNTS PER 6" | PID / PPM | GRAPHIC LOG | USCS | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | 2 | | 0 | | |
| SPT | 1.5/1.0 | 0 | 0 | 1 | CL | Moist medium stiff silty clay - CL<br>Yellowish brown 10 YR 4/4 (GSA) |
| | | | | 2 | | |
| | | | | 3 | | DIFFICULT AUGERING - INTO WEATHERED SHALE |
| | | | | 4 | | |
| SPT | 1.5/1.1 | 4.3 | 0 | 5 | ML | Moist hard clayey silt, trace fine sand ML<br>(weathered shale - horizontal orientation)<br>Light olive Brown - 5Y 5/6 |
| | | | | 6 | | |
| | | | | 7 | | |
| | | | | 8 | | |
| | | | | 9 | | |
| SPT | 1.5/1.4 | 9.3 | 0 | 10 | ML | Moist hard clayey silt trace fine sand ML<br>(weathered shale - horizontal orientation)<br>Light olive yellow gray 5Y 5/3 |
| | | | | 1 | | |
| | | | | 2 | | |
| | | | | 3 | | |
| | | | | 4 | | 14.0 - 14.3 - easier augering |
| SPT | 1.4/1.4 | 14.3 | 0 | 5 | ML | Moist hard clayey silt trace fine sand ML<br>(weathered shale - horizontal structure)<br>Light olive yellow gray 5Y 5/3 |
| | | | | 6 | | |
| | | | | 7 | | |
| | | | | 8 | | |
| | | | | 9 | CL | Moist hard silty clay - numerous weathered shale<br>Medium gray - N5 CL |
| SPT | 0.3/1.3 | 19.3 | 0 | 20 | | |

C-113

MW16-1

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| | USATHAMA | LCAAD |

| DRILLING METHOD: | BORING NO. |
|---|---|
| | 86-01 |
| | SHEET |
| SAMPLING METHOD: | 2 of 2 |
| | DRILLING |
| | START / FINISH |
| WATER LEVEL | TIME / TIME |
| TIME | |
| DATE | DATE / DATE |
| REFERENCE | |

SURFACE CONDITIONS

| SAMPLE TYPE | SAMPLE NUMBER | BLOWS PER 6" | SAMPLE RECOVERY | P.I.D ppm | DEPTH | GRAPHIC LOG |
|---|---|---|---|---|---|---|
| SPT | 0.7/62 | 29.3 | 6/24.3 | 50.0 | 0 | CL |
| SPT | 0.7/62 | 29.0 | 7/29.5-31.2 | | 0 | |

Moist mottled light olive gray (5Y 6/2) and olive gray (5Y 4/1) silty CLAY with horizontal fracturing - CL

Hard driving @ 28.5

Auger refusal @ 29.0 @ 1515

$H_2O$ @ bottom of auger flight @ 1600

Wet very dense coarse SAND and GRAVEL around bottom of auger flight - SW

Light olive gray 5Y 6/2

BOH @ 29.0. BOTTOM SAMPLE - 29.2

WELL INSTALLATION - began 1615

Pipe length: screen - 13.0

plug - 0.6

riser - 20.0

30.6 total

B.O. Well - 28.0', 2.6' stickup

- Set 1' sand pack base
- installed PVC well
- Attempted to place sand through auger - set hung up on auger head - pulled auger - 0 hole strength after
- introduced sand pack to 13.0
- bentonite seal - pellets - 8.0 - 13.0
- poured water, 6 gal bottle - let set for 5 min
- placed grout to surface + set protective casing - 4 1/2 inch.

C-114

Set hrs - no apparent settlement

MW16-2

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC

# LOG OF SOIL BORING

| | |
|---|---|
| JOB NO. | THA 5782 |
| CLIENT | USATHAMA |
| LOCATION | LCAAP |
| DRILLING METHOD | HSA - 12" O.D, 6.5" I.D. CME 55 RIG |
| BORING NO. | 86-02 |
| SHEET | 1 of 2 |
| SAMPLING METHOD | STNDR. PEN. TEST (SPT) 18" drive split spoon 2" O.D, driven by 140 lbs falling 30" |
| DRILLING START / FINISH | |
| WATER LEVEL | 9.49' |
| TIME | 1210 |
| DATE | 5-9-86 |
| REFERENCE | TOC |
| TIME | 945 / 1630 |
| DATE | 5-7-86 / 5-7-86 |

Co-ordinates:
Surface Elevation:
Casing Above Surface: 2.0'
Reference Elevation:
Reference Description: Mark in PVC rim

*ceramic cap

SURFACE CONDITIONS: Grassy flat, North Sloping Ground, Asian road, 20-50' from stream

| SAMPLE TYPE | SAMPLE NO. | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 in. SAMPLE | P.I.D. ppm | GRAPHIC LOG | USCS | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | | |
| SPT | 1.5/1.0 | 0 | | 4/5 | 0 | | ML | Moist medium stiff clayey silt, trace fine sand, Olive gray, 5Y 3/2 (GSF) |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| SPT | 1.5/1.0 | 4.5 | 2/55 | 2/2/3 | 0 | | ML | Moist soft clayey silt, trace fine sand, Olive gray - 5Y 4/2 |
| | | | | | | | | Slightly harder augering @ 7.2' |
| | | | | | | | | H2O on rods @ 8.2 |
| SPT | 1.5/1.5 | 9.5 | 3/55 | 2/3/3 | 0 | | ML | Wet medium stiff clayey silt, trace fine sand, Light olive gray - 5Y 5/2 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| SPT | 1.5/1.5 | 14.5 | 4/55 | 2/2/3 | 50-400 | | ML | Wet soft clayey silt, trace M-F sand, Light olive gray - 5Y 5/2 |
| | | | | | | | | - dark oily sheen on outside of 2" of split spoon. |
| | | | | | | | | - P.I.D. in hole - 20-200 ppm |
| | | | | | | | | Breathing area OK - wind NW |
| | | | | | | | | Staged @ Level D. |

NEXT PAGE

MW16-2

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

**LOG OF SOIL BORING**

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5782 | USATHAMA | LCAAP |

DRILLING METHOD:

SAMPLING METHOD:

| | BORING NO. | SHEET | DRILLING START | DRILLING FINISH |
|---|---|---|---|---|
| | 86-02 | 2 of 2 | | |

| WATER LEVEL | TIME | DATE | REFERENCE |
|---|---|---|---|
| | | | |

| SAMPLE ID & TYPE | SAMPLE DEPTH INTERVAL | CASING DEPTH | SAMPLE RECOVERY | BLOW COUNTS OR SAMPLE ID | P.I.D. PPM | GRAPHIC LOG | GEOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| SPT | 1.5/1.5 | 19.5 | 5/20.5 | 2/3/4 | 20-200 | ML | Wet medium stiff clayey silt little c-f sand. Light olive gray - 5Y 5/3 ML |
| | | | | | | | P.I.D. in hole: 20-150 |
| | | | | | | | Breathing air OK |
| | | | | | | | 23.0'- Augering get hard |
| SPT | 0.5/0.5 | 24.5 | 6/24.5 | 50/5 | 5/30 | CL | Moist hard silty clay - weathered shale CL (horizontal structure dominent) |
| | | | | | | | Moderate olive brown - 5Y 4/4 |
| | | | | | | | B.O.H. @ 24.5' B.O. SAMP @ 25.0' |
| | | | | | | | B.O. Well @ 23.5' |
| | | | | | | | Finished sampling @ 1145 |
| | | | | | | | Well Installation: Total Pipe length = 25.5 |
| | | | | | | | 15.0' Riser, 10.0' Screen, 0.5' plug. |
| | | | | | | | 2.0' S-Crup |
| | | | | | | | - Drilled cuttings = Lesser time exposure to potentially hazardous materials |
| | | | | | | | - Used remained from placed 1' sand on bottom hole (23.5'-25.5') |
| | | | | | | | - Installed risers |
| | | | | | | | - Completed sand pack to 21.0 |
| | | | | | | | - Bentonite pellet seal 3.0' to 18.0' |
| | | | | | | | - Grout 0 to 3.0 |
| | | | | | | | - Set protective casing w/ grout, w/ lock |
| | | | | | | | - 24 hr - no grout settlement |
| | | | | | | | 5-9-86: P.I.D readings in PVC well head space = 80 to 200 ppm |
| | | | | | | | Cuttings: 0-80 ppm |
| | | | | | | | - Cuttings in drilled cuttings in 2 55 gal drums to await disposal |

BY IDM DATE _____ CHECKED BY _____

MW7-9

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Desination: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THASIBA | USATHAMA | LCAAAP/ARSA-2 |

DRILLING METHOD: HSA — BORING NO. B7-13

SHEET 2 of 2

SAMPLING METHOD: SPT

| | DRILLING START TIME | DRILLING FINISH TIME |
|---|---|---|
| WATER LEVEL | | |
| TIME | | |
| DATE | DATE | DATE |
| REFERENCE | | |

SURFACE CONDITIONS:

| SAMPLE ID / TYPE | SAMPLE DEPTH (ft) RECOVERED | DEPTH OF CASING | SAMPLE DEPTH (ft) DRIVEN | BLOWS/6 in. SAMPLER | P.I.D. (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| | | | | | | 20 ML | Cleaning 20 gal H2O in auger |
| | | | | | | 1 | |
| | | | | | | 2 | |
| | | | | | | 3 | |
| SPT | 18/18 | 23.5 | 6 | 4/4 | 0 | 4 ML | Yellowish brown silt, little f sand, trace (MH/OH) |
| | | | | 8 | | 5 X | Olive gray clay, trace silt (CH/MH) - wet, stiff |
| | | | | | | 6 | Loaded 20 gal H2O in auger |
| | | | | | | 7 | |
| | | | | | | 8 | |
| SPT | 18/16 | 28.5 | 7/9.5 | 2/3/2 | 0 | 9 SM | Dk yellowish brown fine sand, little silt (SM) (10 YR 4/2) - wet, loose |
| | | | | | | 30 X | Augered to 30' |
| | | | | | | 1 | WELL INSTALLATION - Through Auger |
| | | | | | | 2 | Start: 0905 2-7-87 |
| | | | | | | | End: 1050 2-7-87 riser: 20.0 (2"ø) |
| | | | | | | 3 | Stickup: 2.5' screen: 10.5' |
| | | | | | | | Grout: 0-3.5 plug 30.5' |
| | | | | | | 4 | Bentonite: 3.5 - 8.5 |
| | | | | | | | Sand Pack: 8.5 - 30' |
| | | | | | | 5 | Screen: 17.5-27.5 |
| | | | | | | | B.O. well: 28.0 |
| | | | | | | 6 | Flushed 40 gal H2O & Wash sand down hole |
| | | | | | | 7 | - set prot. casing @ 1.5' |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | | | 40 | |

MW7-10

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: 2.3

Reference Elevation: _____

Reference Description: Mark on Top of Our Casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TH5184 | USATHAMA | LCAAP/AREA C |

DRILLING METHOD: USA Hollow Stem Auger — BORING NO.: B7-14

9¾" O.D. 6¾" I.D. : CME 750 All-terrain drill rig — SHEET: 1 of 2

SAMPLING METHOD: SPT - Standard Pen. Test: 18" split spoon 2" O.D. / 1⅜" I.D. driven by a 140 lb hammer free falling 30" — DRILLING START / FINISH

| | | | | | |
|---|---|---|---|---|---|
| WATER LEVEL | 12.8' | 14.15 | 16.10 | 16.32 | |
| TIME | 0935 | 1105 | 0910 | 1440 | TIME: 1320 / 1505 |
| DATE | 2-8 | 2-8 | 2-9 | 2-10 | DATE: 2-7-87 / 2-9-87 |
| REFERENCE | SURF | REF | REF | REF | |

SURFACE CONDITIONS: Flat lawn area adjacent to a soybean field and substation 104-Y

| SAMPLE ID | SAMPLE TYPE | SAMPLE DEPTH INTERVAL | RECOVERY | CASING BLOWS/6" | SAMPLE BLOWS/6" | P.I.D. (ppm) | GRAPHIC LOG | DEPTH IN FEET | USCS | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | | | 0 | | |
| | SPT | 18/5 | 0 | 1/0 | 3 | 0 | | 1 | ML | Dusky yellowish brown moist med. stiff clayey silt (10YR 2/2) (ML) |
| | | | | | 4 | | | 2 | | |
| | | | | | | | | 3 | | |
| | | | | | | | | 4 | | |
| | | | | | 3 | | | 5 | | |
| | SPT | 18/18 | 5 | 2/4 | 4 | 0 | | 6 | ML | Dusky yellowish brown moist stiff clayey silt (10YR 2/2) (ML) |
| | | | | | 7 | | | 7 | | |
| | | | | | | | | 8 | | |
| | | | | | | | | 9 | | |
| | | | | | 3 | | | 10 | | (Grading from brown to olive gray @ 10.5' |
| | SPT | 18/18 | 10 | 3/11 | 4 | 0 | | 1 | ML | Olive gray moist med dense clayey silt with ML, (5Y 4/1) yellowish orange iron staining (10YR 7/6) |
| | | | | | 5 | | | 2 | | |
| | | | | | | | | 3 | | |
| | | | | | | | | 4 | | ▽ Water on spoon @ 14.5' |
| | | | | | 5 | | | 5 | | |
| | SPT | 18/18 | 15 | 4/14 | 10 | 0 | | 6 | SM | Yellowish brown wet med dense, micaceous fine to coarse silty SAND (10YR 4/4) (SM) |
| | | | | | 8 | | | 7 | | |
| | | | | | | | | 8 | | Loaded auger with 25 gal H2O |
| | | | | | | | | 9 | | |
| | | | | | | | | 10 | ML | |

MW7-10

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THAS189 | USATHAMA | LCAAP/ARSAC |

| | |
|---|---|
| DRILLING METHOD: HSA | BORING NO. B7-14 |
| | SHEET 2 of 2 |
| SAMPLING METHOD: SPT | DRILLING START / FINISH |
| WATER LEVEL | TIME / TIME |
| TIME | |
| DATE | DATE / DATE |
| REFERENCE | |

SURFACE CONDITIONS:

| SAMPLE TYPE | SAMPLE NUMBER / RECOVERY | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 in SAMPLER | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2 | | 20 | | Dark yellowish brown wet soft silt, 0.5' clay seam (10YR 4/4) ML @ 2' |
| SPT | 18/18 | 20 | 5/21 | 2 | 0 | 1 | ML | |
| | | | | 2 | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | Medium grayish/blueish green wet soft clayey silt (ML) (5GY 5/1) |
| | | | | 2 | | | ML | |
| SPT | 18/18 | 25 | 6/25.5 | 3 | 0 | 6 | | @ 5.7' |
| | | | | 5 | | | SM | Yellowish brown wet fine sand, some silt (SM) (10YR 5/4) - loose |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| SPT | 18/18 | 28.5 | 7/29.5 | 3 | 0 | 9 | SM | Yellowish brown wet med. dense medium to fine sand (10YR 5/4) little silt |
| | | | | 7 | | 30 | | Augered to 30' (SW) |
| | | | | 9 | | | | Bottom of Hole @ 30.0' |
| | | | | | | 1 | | WELL INSTALLATION: 2-3 - 3' sand pumped in annulus - washed out with 30 gal H2O but pumped dry - installed well through auger annulus |
| | | | | | | 2 | | Start: 1245 2-8-87 - used portion 20 gal to thin down water in hole. |
| | | | | | | 3 | | End: 1115 2-8-87 |
| | | | | | | 4 | | Stick up: 2.8 |
| | | | | | | 5 | | Grout: 0 to 2.5 Bags 70 (Quikrete) |
| | | | | | | 6 | | Bentonite: 2.5 to 7.5 Screen: 10 slot |
| | | | | | | 7 | | Sandpack: 7.5 to 30.0 Jus 30.5' |
| | | | | | | | | Screen: 17.2 to 27.2 |
| | | | | | | | | B.H. Well: 27.7 |
| | | | | | | 8 | | Set protective PVC casing @ 1115 |
| | | | | | | 9 | | |
| | | | | | | 40 | | |

MW 5-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TIA 5738 | USATHAMA | LCAAP/Area B |

DRILLING METHOD: HSA - 4¼" I.D. Stem Rock 9¼ O.D., 5⅝" I.D.; CME 750 All-terrain drill rig — BORING NO. 87-15

SAMPLING METHOD: SPT - Standard Penetration Test 18" split spoon (2" O.D. x 1⅜" I.D.) driven by a 140 lb. hammer free falling 30" — SHEET 1 of 2

Co-ordinates:

Surface Elevation:

Casing Above Surface: 2.5

Reference Elevation:

Reference Description: Mark on Top of PVC Casing

| | START | FINISH |
|---|---|---|
| DRILLING TIME | 1400 | 1515 |
| WATER LEVEL | 9.8 | 10.55 |
| TIME | 0921 | 1465 |
| DATE | 2-9 | 2-10 |
| REFERENCE | SURF | BGF |
| DATE | 2-8-87 | 2-8-87 |

SURFACE CONDITIONS: Grassy median between road and ditch

| SAMPLE TYPE | SAMPLE RECOVERED | BLOWS PER CASING | BLOWS PER SAMPLE | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| SPT | 19/24 | 0 | 1/0 | 0 | 0-1 | ML | Yellowish brown moist stiff clayey silt (ML) (10 YR 3/2) |
| SPT | 18/18 | 5 | 2/6 | 0 | 5-6 | ML | Blackish brown moist medium stiff clayey silt (ML) (5 YR 3/1) |
| SPT | 18/18 | 10 | 3/11 | 0 | 10-11 | ML | DK yellowish brown (same min. ok. as prev.) clayey silt (10 YR 4/2) (VC) (ML) — moist soft |
| SPT | 18/18 | 15 | 4/16 | 0 | 15-16 | ML | ▽ Seep met @ 15.0' Yellowish brown wet very soft clayey silt (ML) (10 YR 4/2) |

Logged By: Lorraine Westfall

Drilled By: Jack MacFarlane & Jim Geller

C-120

MW5-5

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____
Casing Above Surface: _____
Reference Elevation: _____
Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA-5781 | USCT Hanna | Lead / Area B |

| | |
|---|---|
| DRILLING METHOD: HSA | BORING NO. 87-15 |
| | SHEET 2 of 2 |
| SAMPLING METHOD: SPT | DRILLING START / FINISH |
| WATER LEVEL | TIME / TIME |
| TIME | |
| DATE | DATE / DATE |
| REFERENCE | |

SURFACE CONDITIONS:

| SAMPLE TYPE | SAMPLE NUMBER / RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 in. SAMPLE | P.I.D. (ppm) | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| | | | | 2 | | | |
| SPT | 18/18 | 20 | 5/21 | 3 2 | 0 | ML | Dark yellowish brown (10 YR 4/4) wet soft silt + clay, some fine gravel (angular to subangular fragments), trace coarse to fine sand. (ML) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | 2 | | | |
| SPT | 18/18 | 25 | 6/26 | 2 2 | 0 | ML | Moderate yellowish brown wet soft clayey silt (ML) (10 YR 5/4) |
| | | | | | | | |
| | | | | | | | |
| SPT | 18/18 | 28.5 | 7/25 | WOR 2 3 | 0 | ML | Brownish / olive gray wet soft silt + clay (ML) (5YR 4/1) Augered to 30' |
| | | | | | | | Bottom of Hole @ 30.0' |
| | | | | | | | WELL INSTALLATION — Pulled augers, drilled 10" dia. open hole |
| | | | | | | | Start: 1125, 2-9-87 |
| | | | | | | | End: 1215, 2-9-87 |
| | | | | | | | Stickup: 2.5' riser: 23.9 (2x10.0') |
| | | | | | | | Grout: 1-4.0' screen: 10.5 |
| | | | | | | | Bentonite: 4.0-9.0 plug 33.5' |
| | | | | | | | Sandpack: 9.1-31.0 |
| | | | | | | | Peagravel: 27.5-27.5 |
| | | | | | | | Bailed well: 2.5g |
| | | | | | | | Set penetrometer reading @ 1015 |

C-121

MW5-6

SA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

LOG OF SOIL BORING

Co-ordinates:

Surface Elevation:

Casing Above Surface: 2.5'

Reference Elevation:

Reference Description: Marks on Top of PVC casing

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| TEA5188 | USATHAMA | LCAAP/AREA B |

DRILLING METHOD: HSA - Hollow Stem Auger; 6¼ O.D. 6⅜" I.D. CME 750 All-Terrain drill Rig

SAMPLING METHOD: SPT - Standard 2in O.D. 1⅜" I.D. split spoon (2" OD, 1⅜" ID) driven by a 140 lb hammer free falling 30"

BORING NO. 87-16

SHEET 1 of 2

| | | | | DRILLING START | DRILLING FINISH |
|---|---|---|---|---|---|
| WATER LEVEL | 24.2 | 15.82 | 15.36 | | |
| TIME | 1455 | 1615 | 1450 | 1300 | 1405 |
| DATE | 2-9 | 2-9 | 2-10 | 2-9-87 | 2-9-87 |
| REFERENCE | SURF | REF | REF | | |

SURFACE CONDITIONS: Grassed lawn near Building 60A

DRILLED BY: Calvin Gilstrap / Terry Burgess

LOGGED BY: Karl D. MacFarlane

DATE: 2-9-87

| SAMPLE ID TYPE | SAMPLE RECOVERED / ATTEMPTED | DEPTH FEET OF CASING | SAMPLE BLOWS PER 6 IN | BLOWS/6 IN SAMPLE ID | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2 | | 0 | | |
| SPT | 18/6 | 0 | 1/0 | 2 | 0 | 1 | ML | Mod. yellowish brown moist soft clayey silt (10YR 4/4) ML |
| | | | | 2 | | | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | 8 | | | | |
| SPT | 18/18 | 5 | 2/6 | 9 | 0 | 6 | ML | Dusky yellowish brown moist stiff silt ML (10YR 2/2) |
| | | | | 10 | | | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 10 | | |
| | | | | 3 | | | | |
| SPT | 18/0 | 10 | 3/11 | 4 | 0 | 1 | ML | Yellowish brown moist medium stiff clayey silt ML (10YR 5/3) |
| | | | | 4 | | | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | ▽ Water on spoon @ 14.5' |
| | | | | | | 5 | | |
| | | | | 1 | | | | |
| SPT | 19/19 | 15 | 4/16 | 2 | 0 | 6 | ML | Yellowish brown wet soft clayey silt ML (10YR 5/3) |
| | | | | 2 | | | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 20 | | |

MW5-6

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

# LOG OF SOIL BORING

Co-ordinates:

Surface Elevation:
Casing Above Surface:
Reference Elevation:
Reference Description:

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| THA5168 | USATHAMA | LCAAP/AREA B |

DRILLING METHOD: HSA

BORING NO. 87-16

SHEET 2 of 2

SAMPLING METHOD: SPT

| DRILLING | |
|---|---|
| START | FINISH |
| TIME | TIME |
| DATE | DATE |

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

SURFACE CONDITIONS:

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO. / SAMPLE DEPTH | BLOWS/6 IN SAMPLER | P.I.D. (ppm) | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| SPT | 18/18 | 20 | 5/21 | 2, 2, 2 | 0 | 20–21.5 | ML | Yellowish brown wet soft clayey silt ML (10YR4/4) |
| SPT | 18/18 | 25 | 6/26 | 2, 4, 3 | 0 | 25–26.5 | ML | Yellowish brown wet med. stiff silt and clay, some (10YR 5/3) fine gravel (angular shale frags), trace coarse to fine sand (ML) |
| SPT | 18/18 | 28.5 | 7/29.5 | WOR, 3, 4 | 0 | 28.5–30 | ML | Yellowish brown wet med. stiff silt and clay (10YR 5/3) (ML) |

Augered to 30'
Bottom of Hole @ 30.0'

WELL INSTALLATION Pulled augers, installed well in 4.25" hole.

Start: 1445, 2-9-87
End: 1525, 2-9-87
Stickup: 2.5'
Grout 0-4.0
Bentonite: 4.0-9.0
Sandpack: 9.0 - 30.0
Screen: 17.5-27.5
B.O. well: 28.0'

Riser 20.0 (2×10.0')
Screen - 10.5
plug 30.5' total

Set protective casing @ 1630

C-123

MW12-2

# USATHAMA

## LOG OF SOIL BORING

Co-ordinates: _____

_____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| LCAAP | | Building 6 |

| | | | | BORING NO. |
|---|---|---|---|---|
| DRILLING METHOD: HSA 9¼" OD 6¼" ID | | | | 87-17 |
| CME 750 ALL TERRAIN RIG | | | | SHEET |
| SAMPLING METHOD: 5ft, 18" Split Spoon (2.0 OD 1.5 ID) driven by 140 lb hammer free fall 30" | | | | 1 OF 2 |
| | | | | DRILLING |
| WATER LEVEL | 13' | 17.1' | 18.6' | START / FINISH |
| TIME | 11:45 | 8:10 | 7:40 | TIME: 11:00 / 12:20 |
| DATE | 2/13/87 | 2/11/87 | 2/12/87 | DATE: 2/13/87 / 2/16/87 |
| REFERENCE | Datum | PVC | PVC | |

SURFACE CONDITIONS: Snow, Cloudy ~30° Ground even at Lake Street, flat

| SAMPLE TYPE | SAMPLE NO. / RECOVERED (inches) | DEPTH OF CASING / SAMPLE DEPTH | BLOWS ON SAMPLER | PID | DEPTH IN FEET | GRAPHIC LOG |
|---|---|---|---|---|---|---|
| SS | 8" | 5ft | 1 4 | 0 | 0 | |
| | | | 7 | | 1 | |
| | | | | | 2 | |
| | | | | | 3 | |
| | | | | | 4 | |
| SS | 18/18 | 1 / 5' | 12 | 0 | 5 | |
| | | | | | 6 | |
| | | | | | 7 | |
| | | | | | 8 | |
| | | | | | 9 | |
| SS | 18/16 | 2 / 10' | 2 3 6 | 0 | 10 | |
| | | | | | 11 | |
| | | | | | 12 | |
| | | | | | 13 | |
| | | | | | 14 | |
| SS | 18/18 | 3 / 15' | 1 2 2 | 0 | 15 | |
| | | | | | 16 | |
| | | | | | 17 | |
| | | | | | 18 | |
| | | | | | 19 | |
| | | | | | 20 | |

CH 5Y6/1 Mottled, organic material
Peat

Clay, medium plastic, some fine sand

CH 2.5Y5/2 Mottled with
to fine sand stone fragments
Peat 1" in order
Clay 1" in

CL 2.5Y5/2 Mottled Olive with reddish
Most Clay evident w/ Peat
Clay, trace

Water in Borehole

Drop CL 2.5Y5/4 medium
plasticity

MW12-2

# USATHAMA

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| | | |

DRILLING METHOD:

SAMPLING METHOD:

BORING NO: 87-17

SHEET: 2 of 2

DRILLING: START TIME / FINISH TIME

| | |
|---|---|
| WATER LEVEL | |
| TIME | |
| DATE | |
| REFERENCE | |

DATE / DATE

SURFACE CONDITIONS:

| SAMPLE TYPE | NUMBER / RECOVERY | DEPTH OF CASING | SAMPLE NO / DEPTH | BLOWS/6 in. SAMPLER | PID | DEPTH IN FEET | GRAPHIC LOG |
|---|---|---|---|---|---|---|---|
| SS | 18/18 | | 4/20 | 1<br>1<br>2 | 0 | 20 | |
| SS | 18/11 | | 5/25 | 9<br>1<br>3 | 0 | 25 | |
| SS | 18/2 | | 6/30 | 7<br>15<br>40 | | 30 | |

Sandy clay SC 2.5YR 6/4
Sand 6 to odors

Sand slide in
10 feet of water outside c.- 55 lbs
Wet SM 6/2.5YR 5/2

12:10 Set pump and 4 in hole
Pump water level in water
with sample set hole
12:30 Pull with well
to begin washing operations
12 cm 3 min. - 2 hr
13:05 finished flushing last gives 100 gals
5 F

Well installation page 1920 end 1540
bottom of hole at 30'
Screen at 22.5' - 17.5'
Sticking 2.5'
Sand 30 to 10
Bentonite to 5'
Grout

MW12-3

# USATHAMA

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Desription: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| LCAAP | | Bldg 6 |

DRILLING METHOD: HSA 9¼ OD 6¼ ID
CME 750 A/L Tarmac Rig

BORING NO. 87-18

SHEET 1 OF 2

SAMPLING METHOD: SS 18" Split Spoon (2.0" OD, 1 ⅜" ID) driven by 140 lb hammer falling 30"

| | | | |
|---|---|---|---|
| WATER LEVEL | 15' | 18.5' | |
| TIME | 10:05 | 7:35 | |
| DATE | 2/11 | 2/12 | |
| REFERENCE | Bot | GL | |

DRILLING START TIME 7:35 DATE 2/11/87
FINISH TIME 11:55 DATE 2/11/87

SURFACE CONDITIONS: Sunny cloudy 20's
Grassy area near well Bldg 6

| SAMPLE TYPE | SAMPLE NO. / INCHES RECOVERED | DEPTH OF CASING | SAMPLE DEPTH | BLOWS/6 IN. SAMPLER | PID | STRATA IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|---|
| SS | 18/8 | | 5'/7' | 2<br>4<br>5 | 0 | 0 | | Top soil & sand grass<br>CL<br>Brown |
| SS | 18/14 | | 1/5 | 3<br>4<br>7 | 0 | 5 | | Reddish brown clayey silt some fine sand<br>Within limits of ASTM D 2487<br>CL 2.5 YR 5/2<br>Dry<br>Good bail of clay from the auger<br>Material : Auger |
| SS | 16/16 | | 2/10 | 5<br>4<br>9 | 0 | 10 | | dense<br>Sand 2.5 YR 6/4 SM |
| SS | 11/4 | | 3/15 | 3<br>4<br>6 | 0 | 15 | | Dark Silt a little sand<br>gravel<br>CL 2.5 YR 5/2<br>Trace to mild moisture |

MW12-3

# USATHAMA

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Desription: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| LCAAP | | Building 6 |

DRILLING METHOD:

SAMPLING METHOD:

| BORING NO. | SHEET | DRILLING START TIME | DRILLING FINISH TIME |
|---|---|---|---|
| 87-18 | 2 of 2 | | |

| | | | |
|---|---|---|---|
| WATER LEVEL | | | |
| TIME | | | |
| DATE | | | |
| REFERENCE | | | |

| SAMPLER TYPE | NUMBER & TYPE / RECOVERY | DEPTH OF CASING / SAMPLE DEPTH | BLOWS/6 in. SAMPLER | PID | DEPTH IN FEET | GRAPHIC LOG |
|---|---|---|---|---|---|---|
| SS | 18/2 | 4/20 | 5<br>8<br>10 | 0 | 20<br>1<br>2<br>3<br>4 | |
| SS | 18/18 | 5/25 | 6<br>11<br>15 | 0 | 25<br>6<br>7<br>8<br>9 | |
| SS | 18/16 | 6/30 | 5<br>10<br>16 | 0 | 30<br>1<br>2<br>3<br>4<br>35<br>6<br>7<br>8<br>9<br>0 | |

SURFACE CONDITIONS:

Wet sand with little silt
yellowish gray
0 2.5Y 5/2 SM

Wet sand yellowish gray
2.5Y 5/2 SM

11.00 hit water level after drilling 5'
Changed to 4" x 2' SS barrel and drilled
11.30 start drilling back up
Water loss = 350 gal

Wet sand yellowish gray
2.5Y 5/2 SM

Well construction began 8:10
ended 10:15

C-127

MW12-C

# USATHAMA

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Description: _____

| JOB NO. | CLIENT | LOCATION |
|---|---|---|
| LCAAP | | Building 6 |

DRILLING METHOD: HSA 9¼ OD 4¼" ID
CME 750 All Terrain Rig

BORING NO.: 87-19

SHEET: 1 of 2

SAMPLING METHOD: SS 18" Split Spoon
2" OD 1⅜" ID Sample by 140 lb hammer
for Cohesive & 30" for Cohesionless

| | | | |
|---|---|---|---|
| WATER LEVEL | 18 | 1825 | |
| TIME | 1620 | 0925 | |
| DATE | 4/11 | 2/13 | |
| REFERENCE | Surf | PVC | |

DRILLING: START TIME 1555 DATE 2/11/85; FINISH TIME 1845 DATE 2/11/85

SURFACE CONDITIONS: Tall dead grass, 2-4" Sandy clay loam

| SAMPLER TYPE | SAMPLE NO. / INCHES RECOVERED | CASING BLOWS | SAMPLE NO. / SAMPLE DEPTH | BLOWS/6 IN. SAMPLER | DEPTH IN FEET | GRAPHIC LOG | |
|---|---|---|---|---|---|---|---|
| SS | 1 / 18 | | 1 / 2 | 2<br>4<br>5 | 0 | | Dark Brown Silty, topsoil with roots<br>CL 5YR3/1 |
| | | | | | 1 | | |
| | | | | | 2 | | |
| | | | | | 3 | | |
| | | | | | 4 | | |
| SS | 2 / 16 | | 3 / 4 | 3<br>4<br>6 | 5 | | Very Brown Silty clay stiff — — — —<br>No odor<br>some organic matter<br>CH 2.5 Y 5/0 |
| | | | | | 6 | | |
| | | | | | 7 | | |
| | | | | | 8 | | |
| | | | | | 9 | | |
| SS | 3 / 18 | | 4 / 10 | 4<br>4<br>4 | 10 | | Mottled Grayish orange clay with sand and silt<br>High plasticity, moist, Stiff<br>Has a little loose sand in matrix<br>CL 5YR 3/1 |
| | | | | | 1 | | |
| | | | | | 2 | | |
| | | | | | 3 | | |
| | | | | | 4 | | |
| SS | 4 / 18 | | 5 / 15 | 2<br>3<br>3 | 15 | | Clay with Brown interbeds<br>Some silt and sand near top<br>CL 2.5 Y 5/2 |
| | | | | | 6 | | |
| | | | | | 7 | | |
| | | | | | 8 | | Water table encountered at 18' |
| | | | | | 9 | | |
| | | | | | 0 | | |

C-128

MW12-

# USATHAMA

## LOG OF SOIL BORING

Co-ordinates: _____

Surface Elevation: _____

Casing Above Surface: _____

Reference Elevation: _____

Reference Desription: _____

| JOB # | CLIENT | LOCATION |
|---|---|---|
| LCAAP | | |

DRILLING METHOD:

SAMPLING METHOD:

BORING NO. RT-19

SHEET 2 of 2

DRILLING START FINISH

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | | | | |
| TIME | | | | |
| DATE | | | | |
| REFERENCE | | | | |

TIME TIME

DATE DATE

DRILLING CONTR: _____

BY _____ CHKD BY _____ DATE _____

| SAMPLER TYPE | SAMPLE NO. / RECOVERED | DEPTH OF CASING | SAMPLE NO. / DEPTH | BLOWS/6 in. SAMPLER | PID | DEPTH IN FEET | GRAPHIC LOG | SURFACE CONDITIONS: |
|---|---|---|---|---|---|---|---|---|
| SS | 16/12 | | 4 | 5<br>6<br>7 | 0 | 20<br>1<br>2<br>3<br>4 | | Wet sand reddish brown<br>2.5Y5/2 SM |
| SS | 18/16 | | 5 | 5<br>8<br>11 | 0 | 25<br>6 | | Wet sand reddish brown<br>2.5Y5/2SM stop<br>Hand auger start 16 SS<br>Start water 0 8 at 2/12<br>trying to just spoon down without hammering<br>augered to 30' Pull water to 27'<br>Bailer water at<br>0 8:15 water down to 5 minutes<br>10 gal bailer<br>8:35 finished |
| SS | 18/18 | | 6 | 1<br>9<br>14 | 0 | 30<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>40 | | Wet sand reddish brown<br>Well water down 09:35<br>end 0 [illegible] |

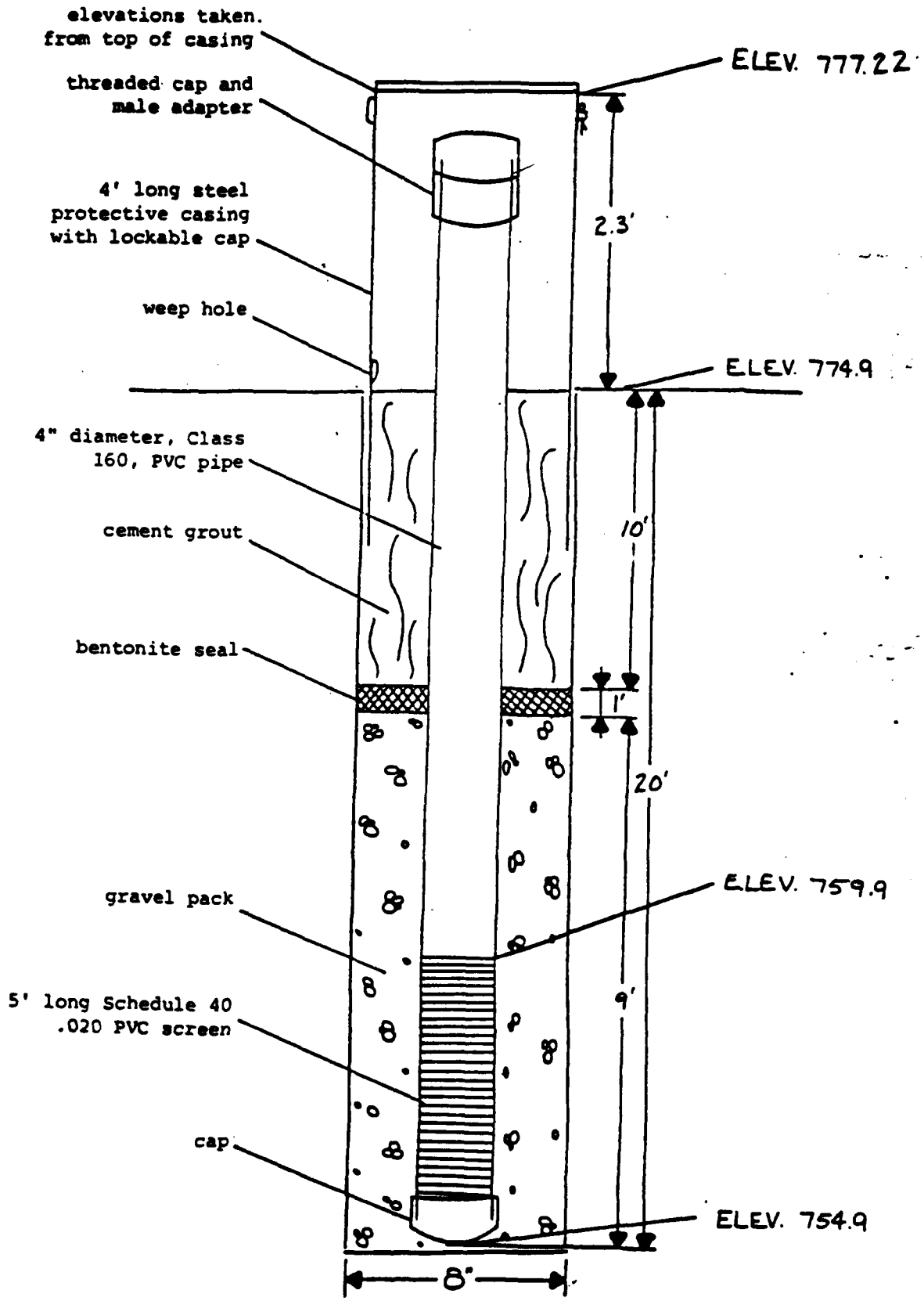
C-129

no paper-130
RSI—

these pages are already double sided

no
printer
here—
be sure this
starts on right

# CONSTRUCTION OF WELL




MW 1-1

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 1-1 Sheet: 1 of 1

Surface Elevation: 774.9 Offset:

Address:

Date Started: 8/11/81 Completed: 8/11/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 10.0' | WB | | | | Weathered sandy shale |
| 10.0' | 13.5' | WB | | | | Same |
| 13.5' | 19.5' | WB | | | | Gray & dark gray shale, med. to stiff |
| 19.5' | 23.0' | WB | | | | Same |
| 23.0' | 30.0' | WB | | | | Maroon shale, stiff |
| 30.0' | 40.0' | WB | | | | Light gray shale, stiff to hard |
| 40.0' | Total depth | | | | | |

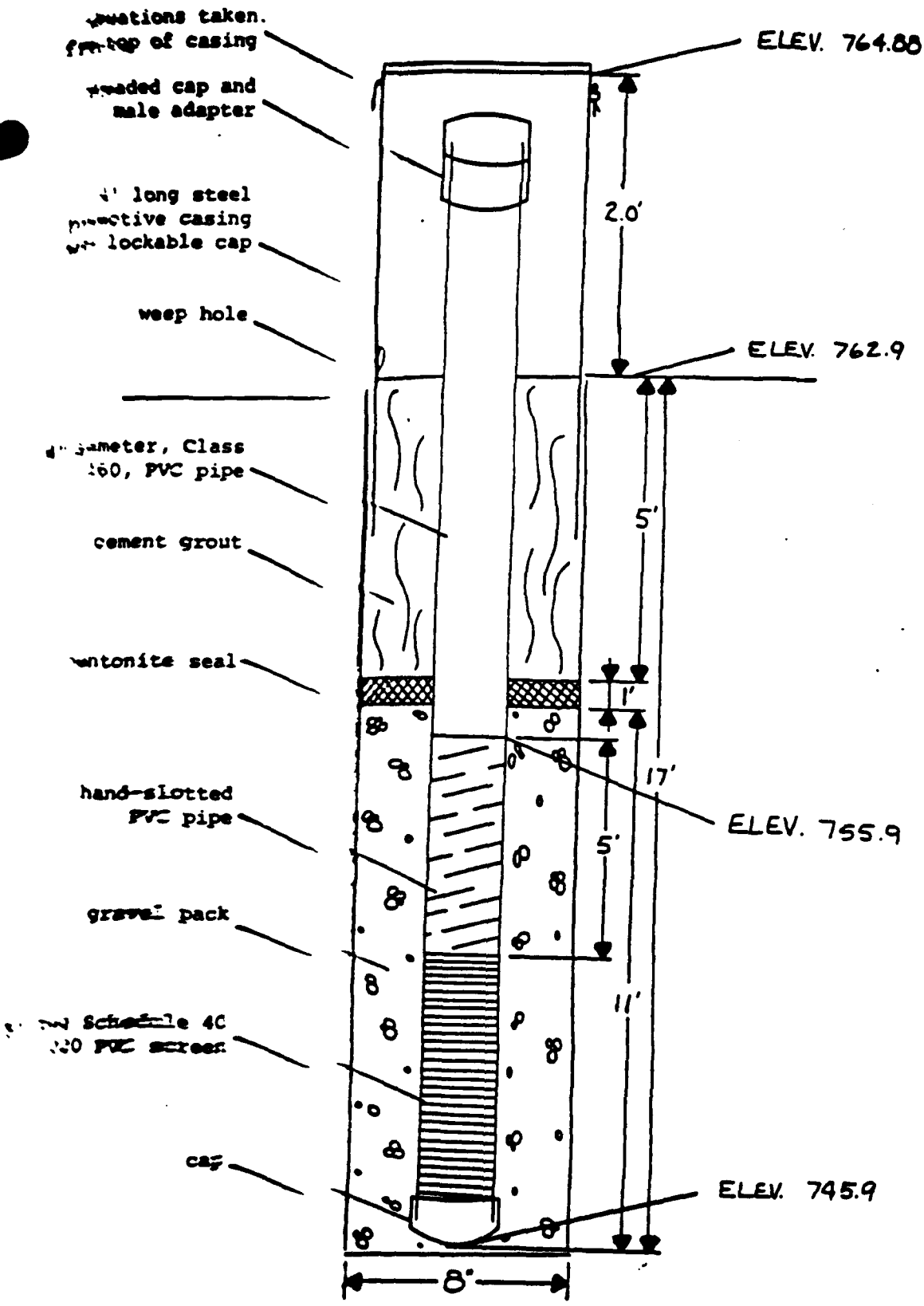
REMARKS: (Casing, Water Loss, Etc.)

Pumped 1-1/2 hour - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 1.7 | | 9/11/81 (Completion) |
| | | |

Wayne-Western Company, Inc.

# ...ONSTRUCTION OF WELL




MW 1-2

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 1-2 Sheet 1 of 1

Surface Elevation: 762.9 Offset:

Address:

Date Started: 7/29/81 Completed: 7/29/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

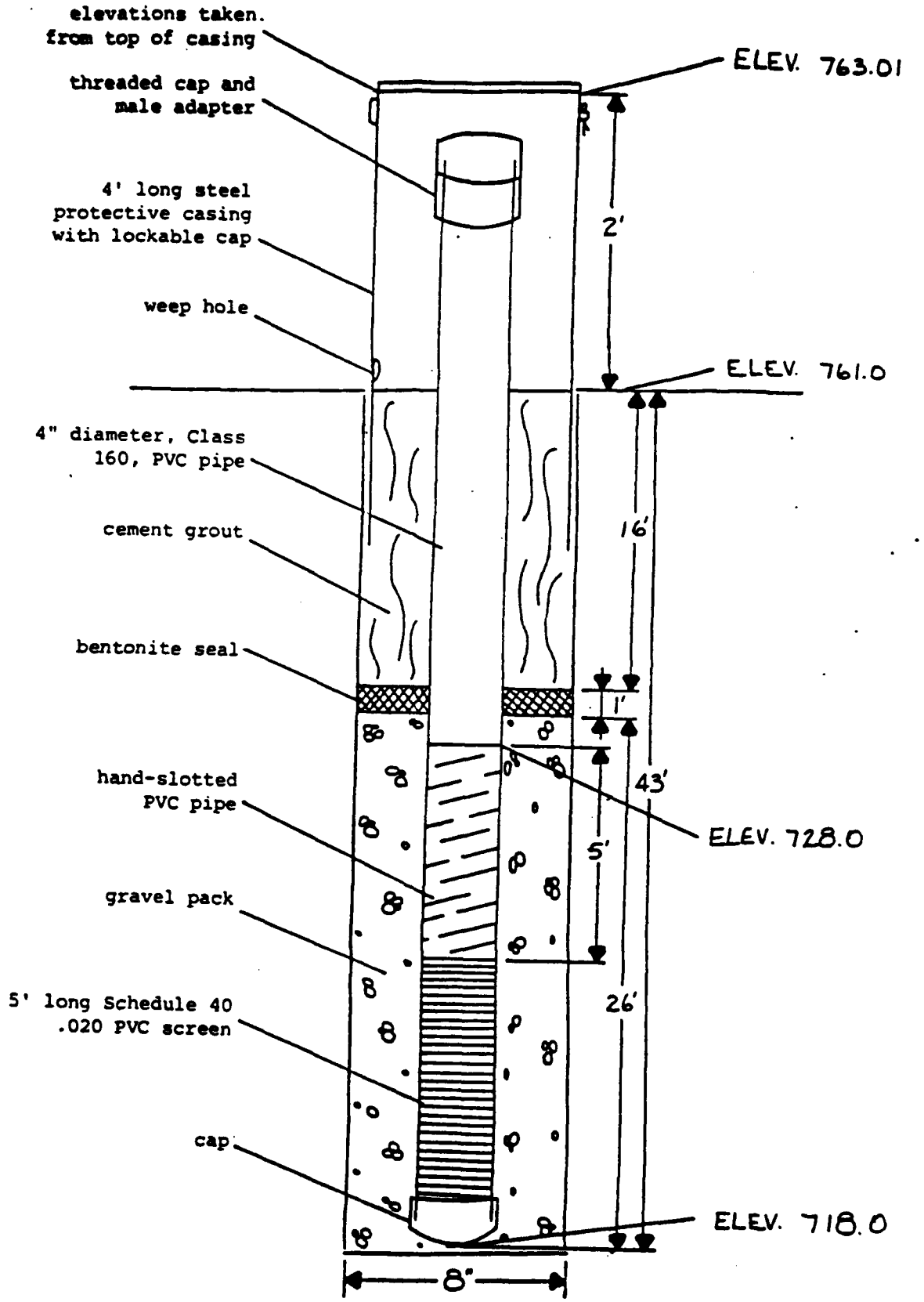
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit.

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 5.5' | WB | | | | Dark gray silty clay, med. to stiff |
| 5.5' | 10.0' | WB | | | | Dark gray silty clay, med. |
| 10.0' | 11.5' | SS1 | | | | Dark gray silty clay, med. to stiff |
| 11.5' | 17.0' | WB | | | | Weathered sandy shale, med. |
| 17.0' | 19.0' | WB | | | | Maroon shale, stiff to very stiff |
| 19.0' | 22.5' | WB | | | | Light tan & light gray shale, stiff to very stiff |
| 22.5' | 26.0' | WB | | | | Light gray shale, med. to stiff |
| [illegible].0' | 29.5' | WB | | | | Same |
| 29.5' | 35.0' | WB | | | | Same |
| [illegible]' | 37.5' | WB | | | | Same |
| [illegible]' | 40.0' | WB | | | | Maroon & light gray shale, med. to sti |
| 0' | Total | depth | | | | |

| REMARKS: (Casing, Water Loss, Etc.) | Static Water Level | Time | Date |
|---|---|---|---|
| umped 1-1/2 hour - 1 GPM | 1.6 | | 9/11/81 (Completion) |

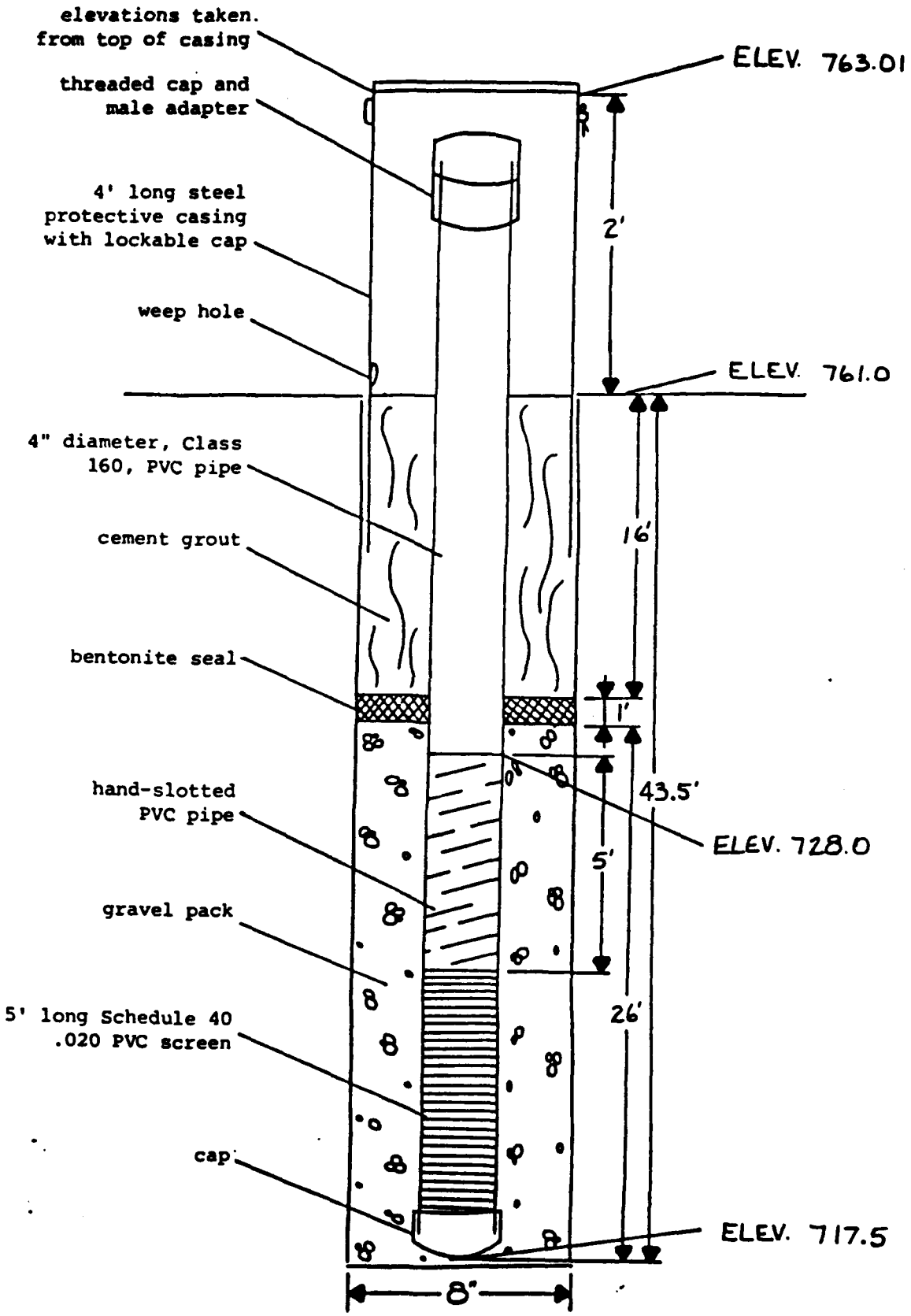
ne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 1-3

# CONSTRUCTION OF WELL




MW 1-3



REDEVELOPMENT 2/85

# TEST BORING LOG

Project: Lake City AAP — Boring No. MW 1-3 — Sheet 1 of 1

Surface Elevation 761.0 — Offset

Date Started 7/30/81 — Completed 7/30/81

State: Independence, Missouri — Driller T. Butler — Rig

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

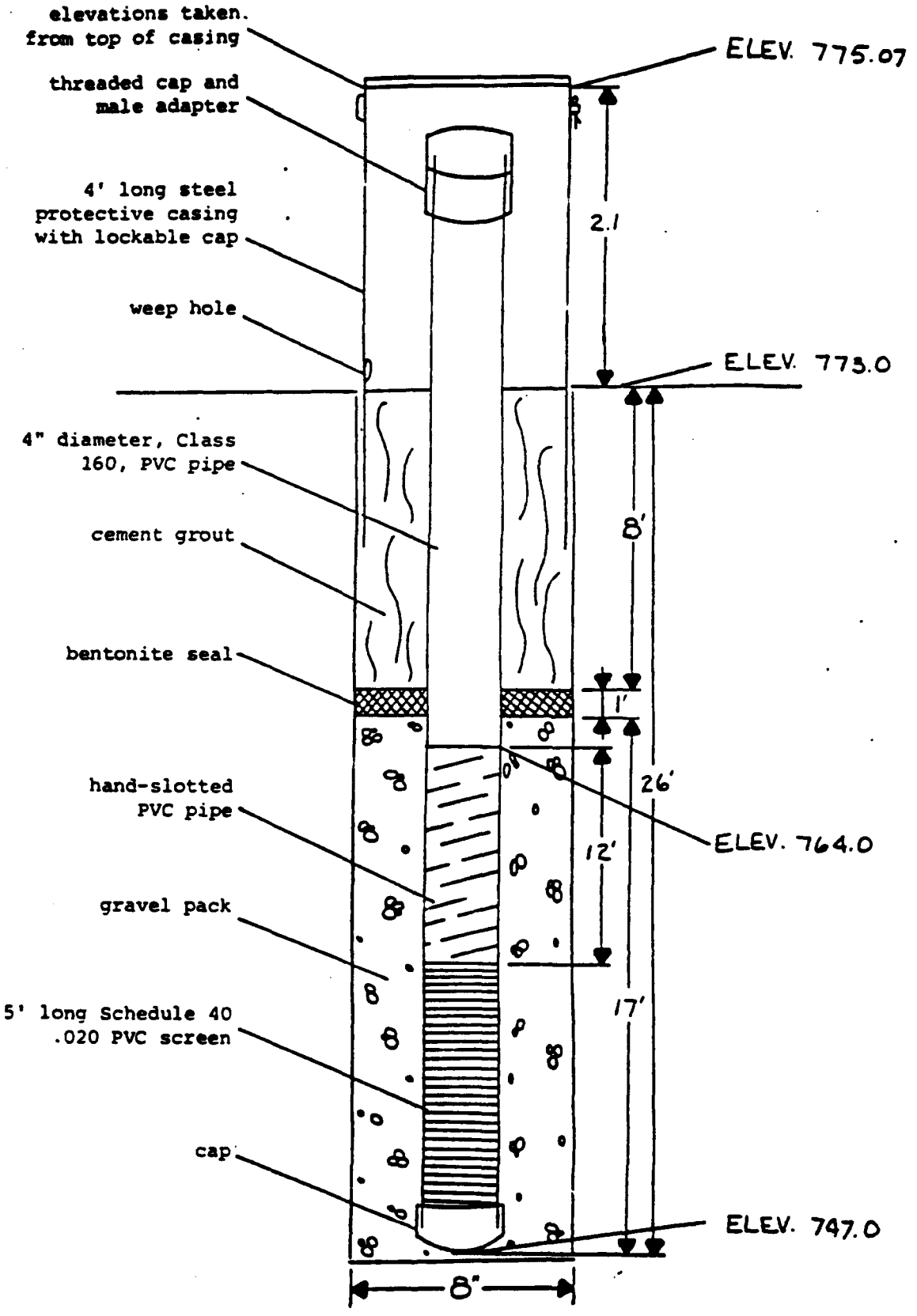
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| .0' | 1.5' | WB | | | | Topsoil |
| .5' | 6.0' | WB | | | | Dark brown silty clay, stiff |
| .0' | 8.5' | WB | | | | Brown silty clay, soft to med. |
| .5' | 11.0' | SS1 | | | | Same |
| 1.0' | 13.0' | WB | | | | Same |
| 8.0' | 20.0' | WB | | | | Brown silty clay w/trace sand, soft |
| .0' | 21.5' | SS2 | | | | Brown silty clay w/trace sand, soft |
| 21.5' | 25.5' | WB | | | | Brown & gray silty clay, soft to med. |
| 25.5' | 30.0' | WB | | | | Same |
| 30.0' | 31.5' | WB | | | | Gray silty clay, med. |
| 31.5' | 36.0' | WB | | | | Gray silty clay, soft to med. |
| 36.0' | 40.0' | WB | | | | Same |
| 40.0' | 43.5' | WB | | | | Gravel w/trace clay |
| 43.5' | 45.0' | WB | | | | Gray shale, hard |
| 45.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| nped for 1-1/2 hour - 6 GPM | 4.8 | | 9/14/81 (Completion) |

Wayne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 1-4

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 1-4 Sheet: 1 of 1

Surface Elevation: 773.0 Offset:

Address:

Date Started: 7/31/81 Completed: 7/31/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 2.5' | WB | | | | Light brown silty clay, med. to stiff |
| 2.5' | 4.5' | WB | | | | Light brown silty clay w/trace weathere shale, med. to stiff |
| 4.5' | 9.5' | WB | | | | Weathered shale & Light brown clay, med. to stiff |
| 9.5' | 10.0' | SS1 | | | | Gray shaly clay, med. to stiff. |
| 10.0' | 10.5' | SS1 | | 21-50/0.3 | | Light gray shale, med. to hard |
| 10.5' | 12.5' | WB | | | | Light gray shale, med. to hard |
| 12.5' | 17.0' | WB | | | | Light gray shale, soft to med. |
| 17.0' | 20.5' | WB | | | | Light & dark gray shale, soft to med. |
| 20.5' | 24.0' | WB | | | | Maroon shale, med. to stiff |
| 24.0' | 26.0' | WB | | | | Maroon & gray shale, med. to stiff |
| 26.0' | 27.5' | WB | | | | Gray shale, hard |
| 27.5' | 34.0' | WB | | | | Same |
| 34.0' | 40.0' | WB | | | | Gray shale, med. to hard |
| 40.0' | Total | depth | | | | |
| | | | | | | |
| | | | | | | |

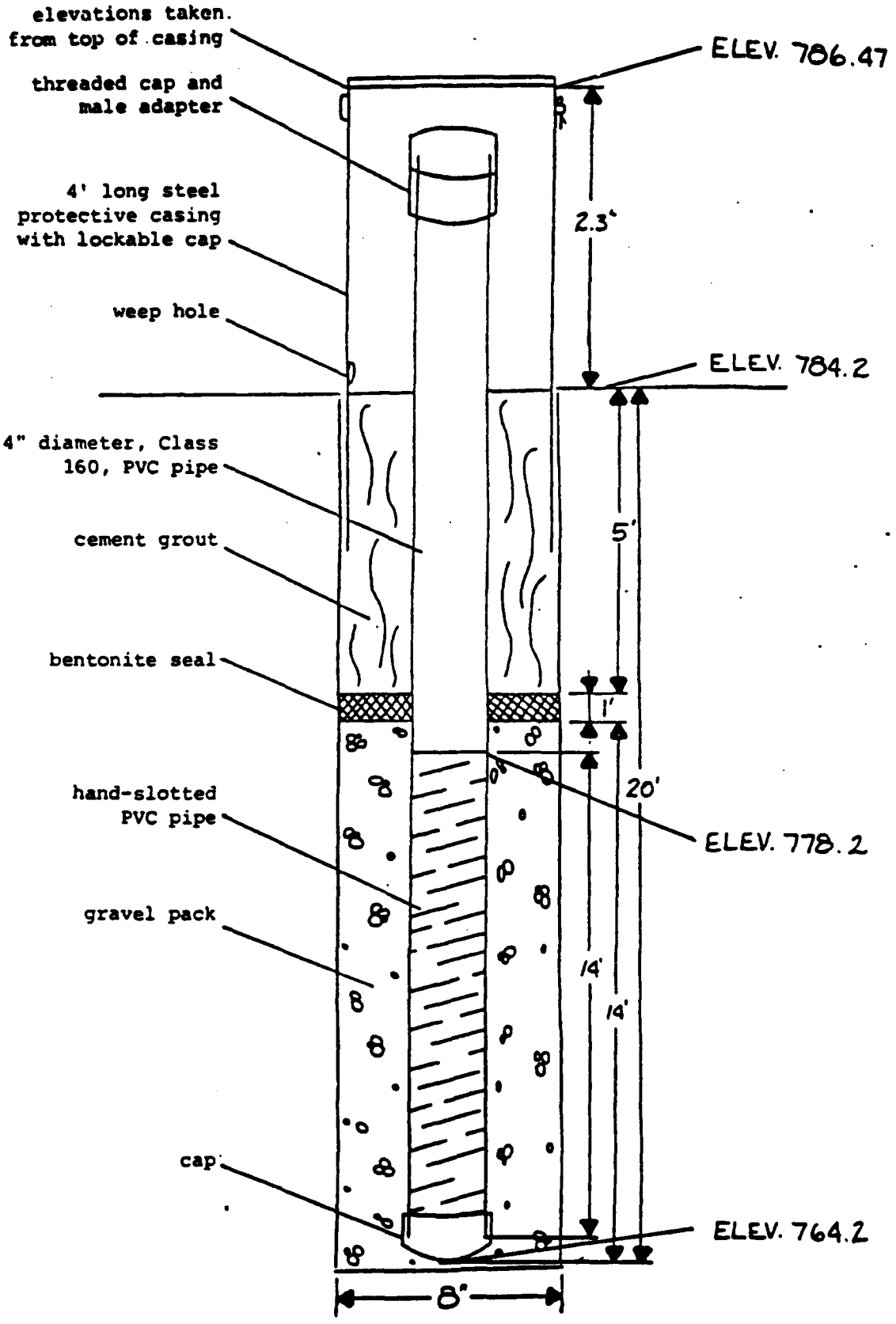
REMARKS: (Casing, Water Loss, Etc.)

| Static Water Level | Time | Date |
|---|---|---|
| 4.2 | | 9/14/81 (Completion) |

Pumped 1-1/2 hour - 1/2 GPM

Wayne-Western Company, Inc.

## CONSTRUCTION OF WELL




MW 1-5

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 1-S  Sheet: 1 of 1

Surface Elevation: 784.8  Offset:

Date Started: 9/4/81  Completed: 9/8/81

City & State: Independence, Missouri

Driller: T. Butler  Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.5' | WB | | | | Brown silty clay, soft to med. |
| 4.5' | 7.0' | WB | | | | Dark gray silty clay w/trace sand, soft to med. |
| 7.0' | 7.5' | WB | | | | Light tan shaly clay, soft to med. |
| 7.5' | 14.0' | WB | | | | Light tan sandy shale, med. hard |
| 14.0' | 26.5' | WB | | | | Light gray shale, med. to hard |
| 26.5' | 36.5' | WB | | | | Maroon shale, med. to hard |
| 36.5' | 40.0' | WB | | | | Light gray shale, hard |
| 40.0' | Total | depth | | | | |

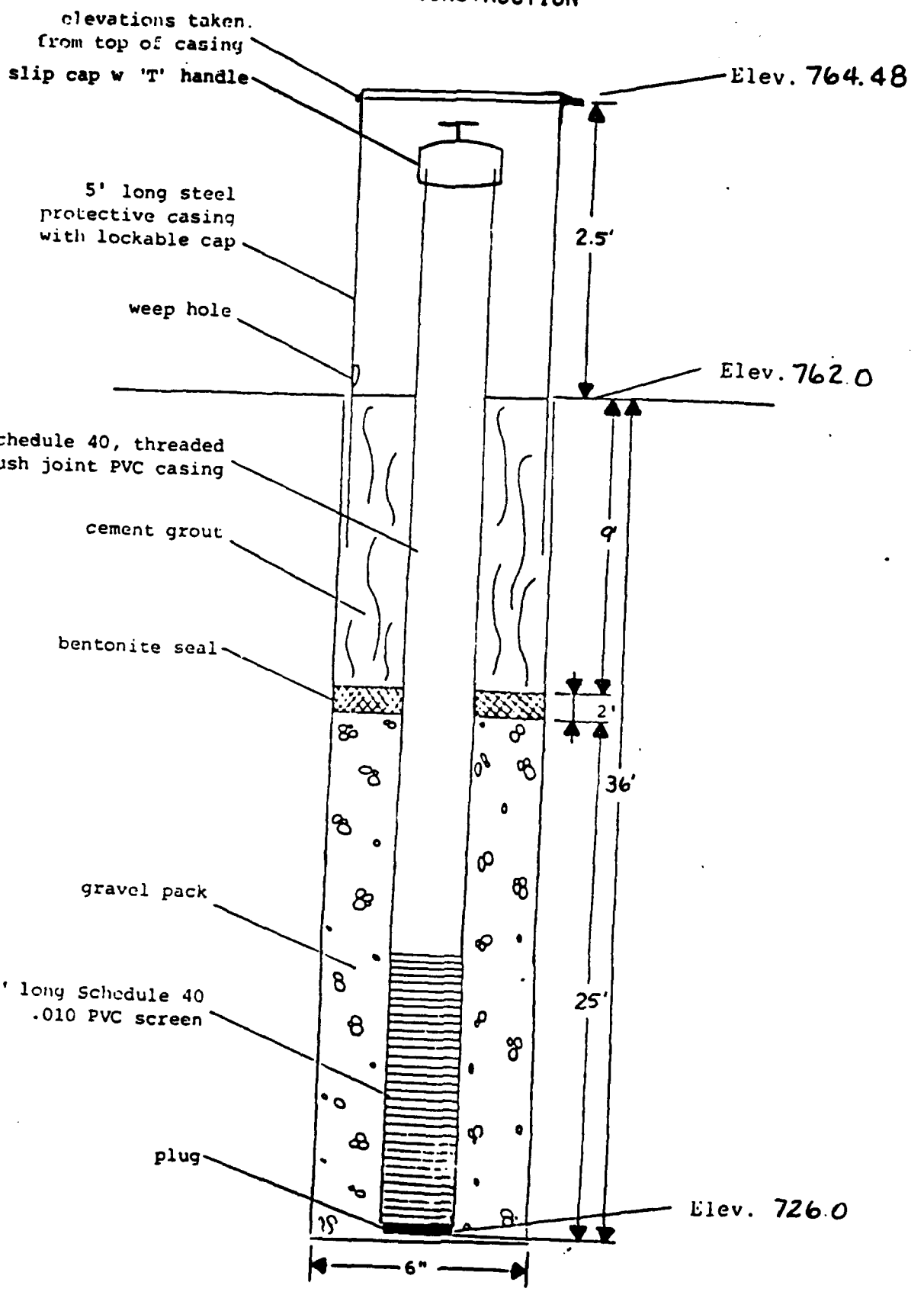
REMARKS: (Casing, Water Loss, Etc.)

Pumped 2 hours - 1/2 GPM

Static Water Level: 1.5  Time:  Date: 9/11/81 (Completion)

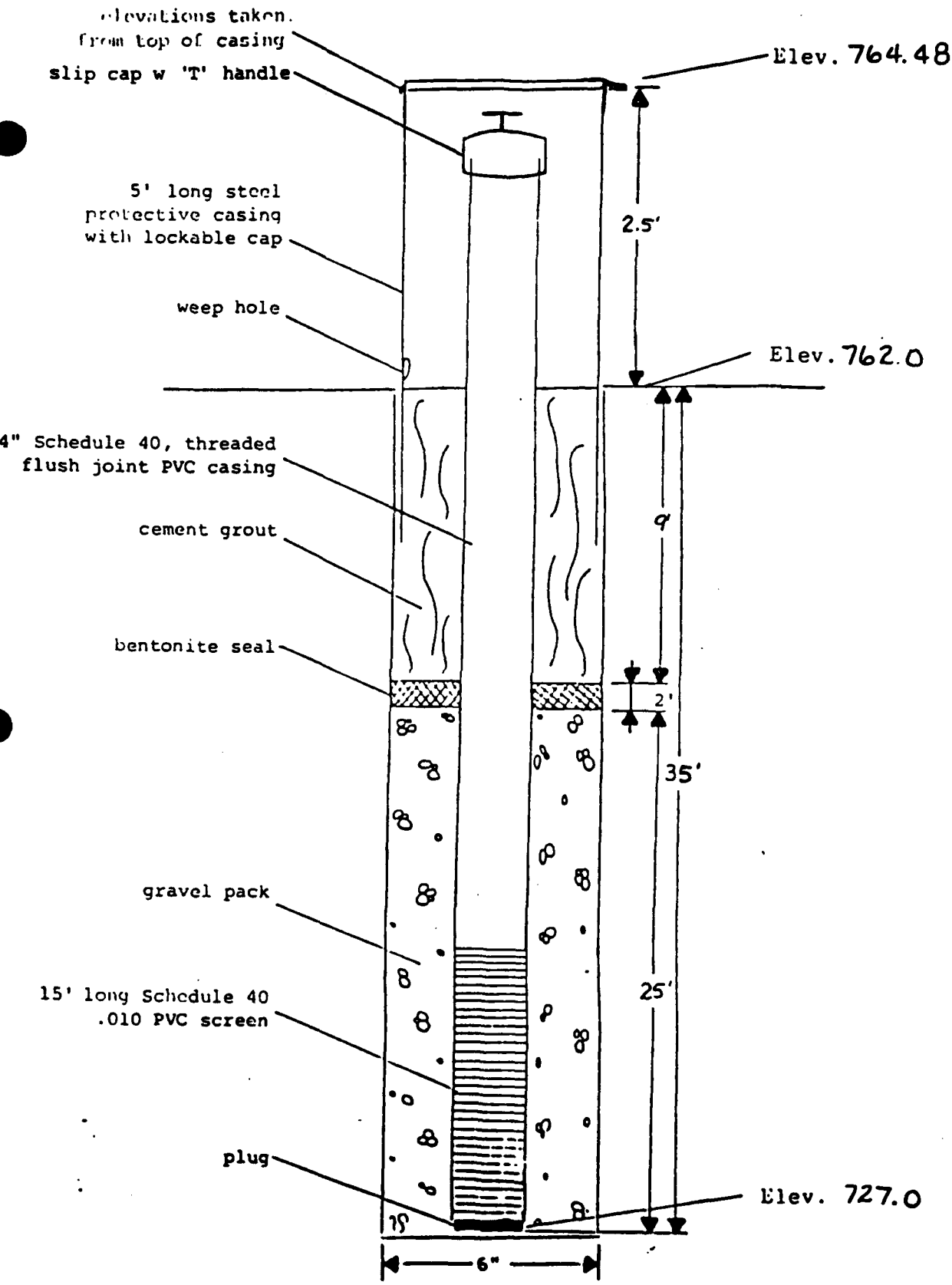
Wayne-Western Company, Inc.

# WELL CONSTRUCTION




MW 1-6

# WELL CONSTRUCTION




MW 1-6



Replacement 2 for

# TEST BORING LOG

Project: Lake City Army Ammunition Plant

Boring No.: MW 1-6 Sheet: 1 of 1

Surface Elevation: 762.0 Offset:

Date Started: 12/7/82 Completed: 12/7/82

City & State: Independence, Missouri

Driller: B. Blank Rig: AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

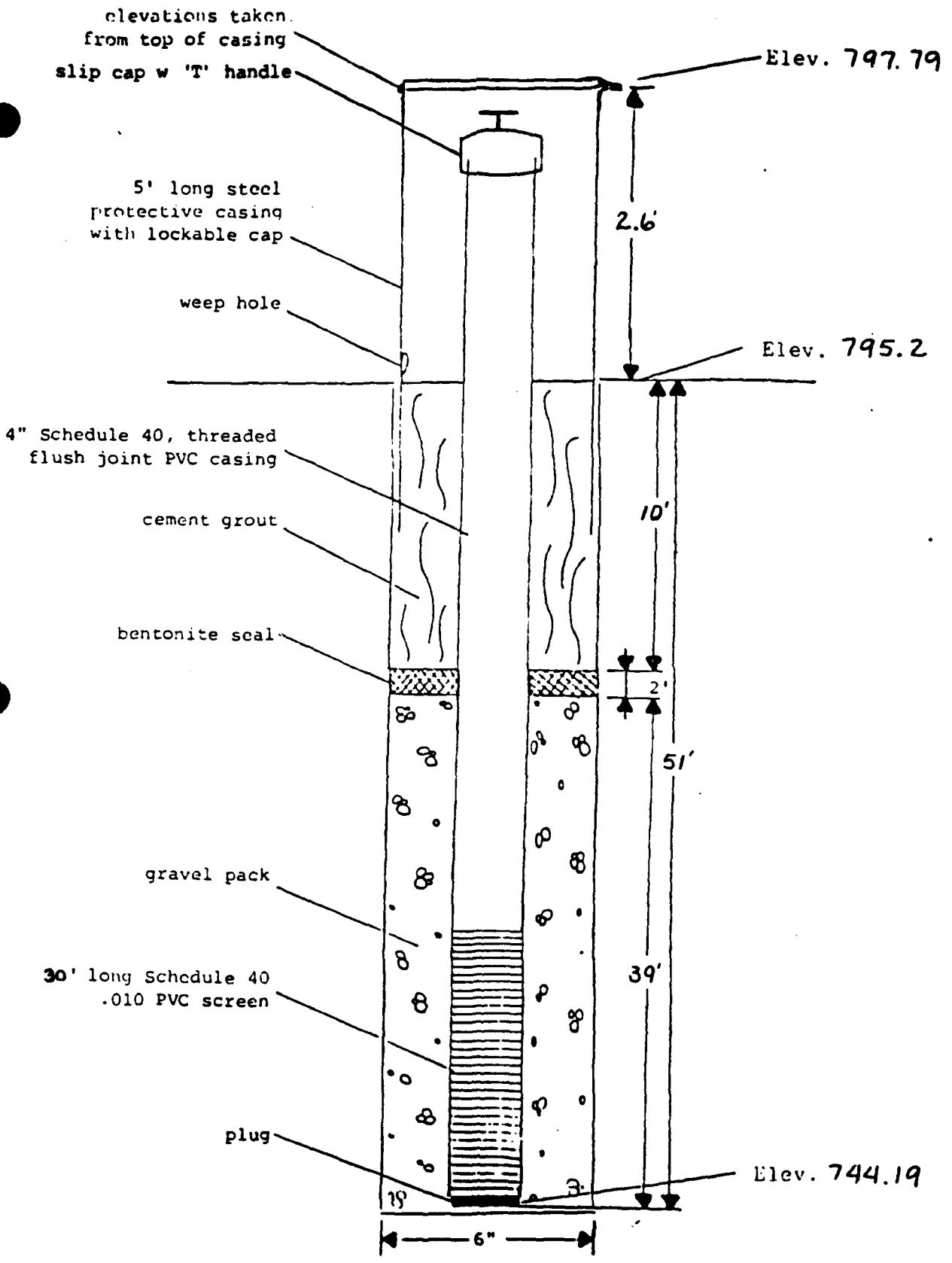
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | HA | | | | Topsoil |
| 1.0' | 2.5' | HA | | | | Dark brown silty clay, moist, med. |
| 2.5' | 4.5' | HA | | | | Brown silty clay, moist, med. |
| 4.5' | 6.0' | ST1 | 0.75 | | 1.2' | Brown & gray silty clay, moist, med. |
| 6.0' | 10.0' | HA | | | | Same |
| .0' | 14.5' | HA | | | | Same |
| 14.5' | 16.0' | ST2 | 1.25 | | 1.5' | Brown & gray silty clay, moist, stiff |
| 16.0' | 18.3' | HA | | | | Same |
| 18.3' | 24.5' | HA | | | | Dark gray silty clay, moist, med. |
| 24.5' | 26.0' | ST3 | 1.0 | | 1.5' | Same |
| 26.0' | 30.0' | HA | | | | Same |
| 30.0' | 30.5' | HA | | | | Light green shale, dry, med. to hard |
| 30.5' | 34.5' | HA | | | | Same |
| 34.5' | 36.0' | SS1 | | 20-50/0.4 | 0.9' | Same |
| 36.0' | Total depth | | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date | |
|---|---|---|---|---|
| Wet water at 12.5' | 11.5 | 1:30pm | 12/7/82 | (Completion) |
| | | | | |

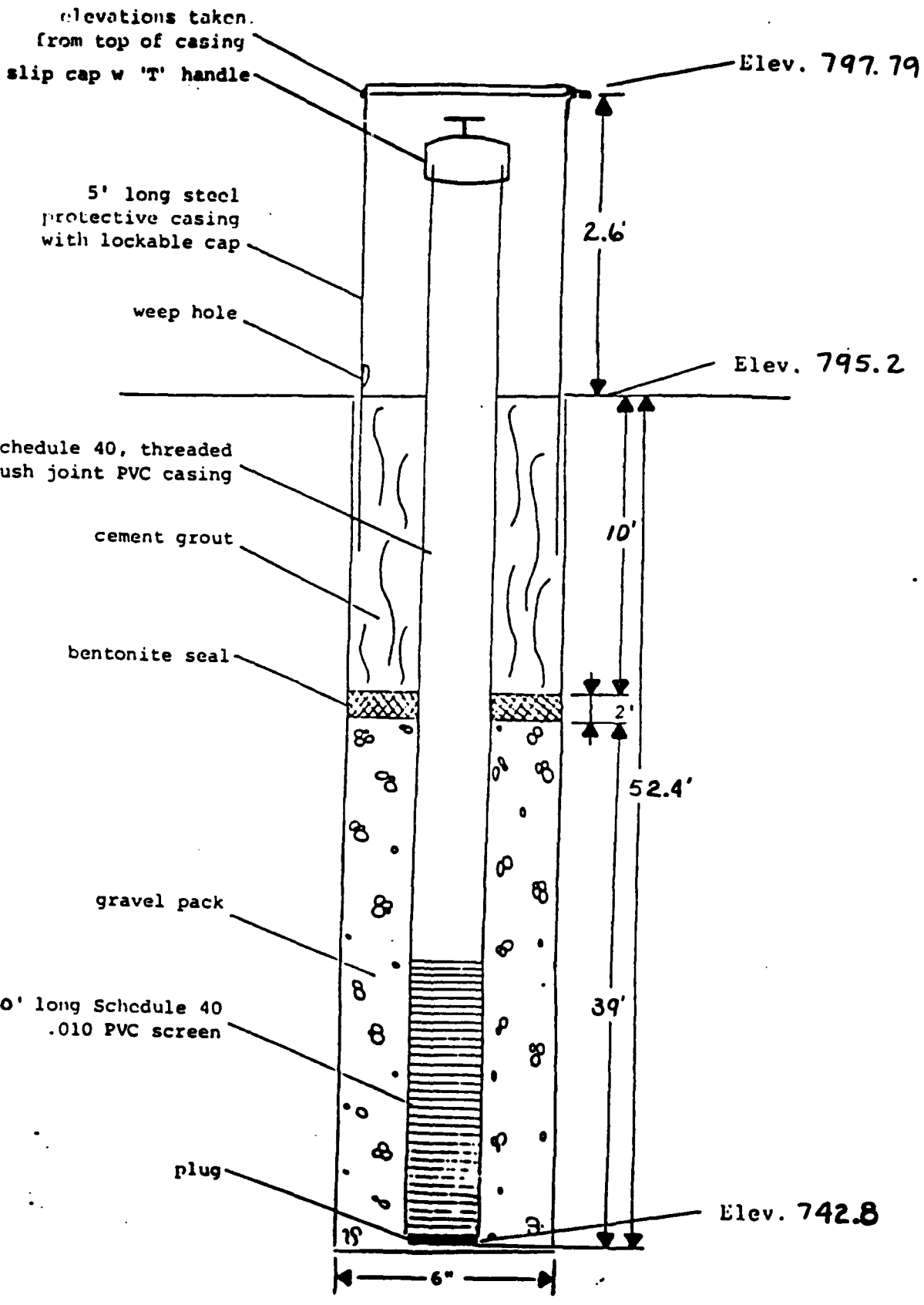
Dayne-Western Company, Inc. C-144

# WELL CONSTRUCTION




MW 1-7

WELL CONSTRUCTION




MW 1-7

# TEST BORING LOG

Project: Lake City Army Ammunition Plant

Boring No. 1-7 Sheet 1 of 1

Surface Elevation Approx. 795.0 Offset

Address

Date Started 12/8/82 Completed 12/8/82

City & State Independence, Missouri

Driller B. Blank Rig AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 1.5' | HA | | | | Dark brown silty clay w/gravel (fill), moist, very stiff |
| 1.5' | 9.5' | HA | | | | Brown silty clay, moist, very stiff |
| 9.5' | 11.0' | ST1 | 4.0 | | 1.5' | Brown & gray silty clay, moist, very stiff |
| 11.0' | 18.0' | HA | | | | Same |
| 18.0' | 19.5' | HA | | | | Light brown & gray weathered shale, dry, med. hard |
| 19.5' | 20.1' | ST2 | 4.5+ | | 0.6' | Same |
| 20.1' | 25.0' | HA | | | | Brown & gray weathered shale, dry, med. to hard |
| 25.0' | 29.5' | HA | | | | Same |
| 29.5' | 30.2' | SS1 | | 20-50/0.2 | 0.7' | Brown & gray shale, dry, med. to hard |
| 30.2' | 32.0' | HA | | | | Same |
| 32.0' | 41.5' | HA | | | | Same |
| 41.5' | 47.0' | HA | | | | Maroon shale, dry, med. to hard |
| 47.0' | 54.5' | HA | | | | Gray shale, dry, med. to hard |
| 54.5' | Refusal | | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| Dry | 11:45am | 12/8/82 | (Completion) |
| | | | |

Layne-Western Company, Inc.

# TEST BORING LOG

Project: Lake City Army Ammunition Plant

Address:

City & State: Independence, Missouri

Boring No.: MW 1-7 Sheet: 1 of 1

Surface Elevation: 795.2 Offset: 10' S. of 1-7

Date Started: 12/13/82 Completed: 12/14/82

Driller: B. Blank Rig: AD-2

Abbreviations: A.O. – Auger Only; R.B. – Rock Bit; C.W. – Core Water; H.A. – Hollow Auger; S.S. – Split Spoon; C.A. – Core Air; W.B. – Wash Bore; S.T. – Shelby Tube; F.B. – Finger Bit

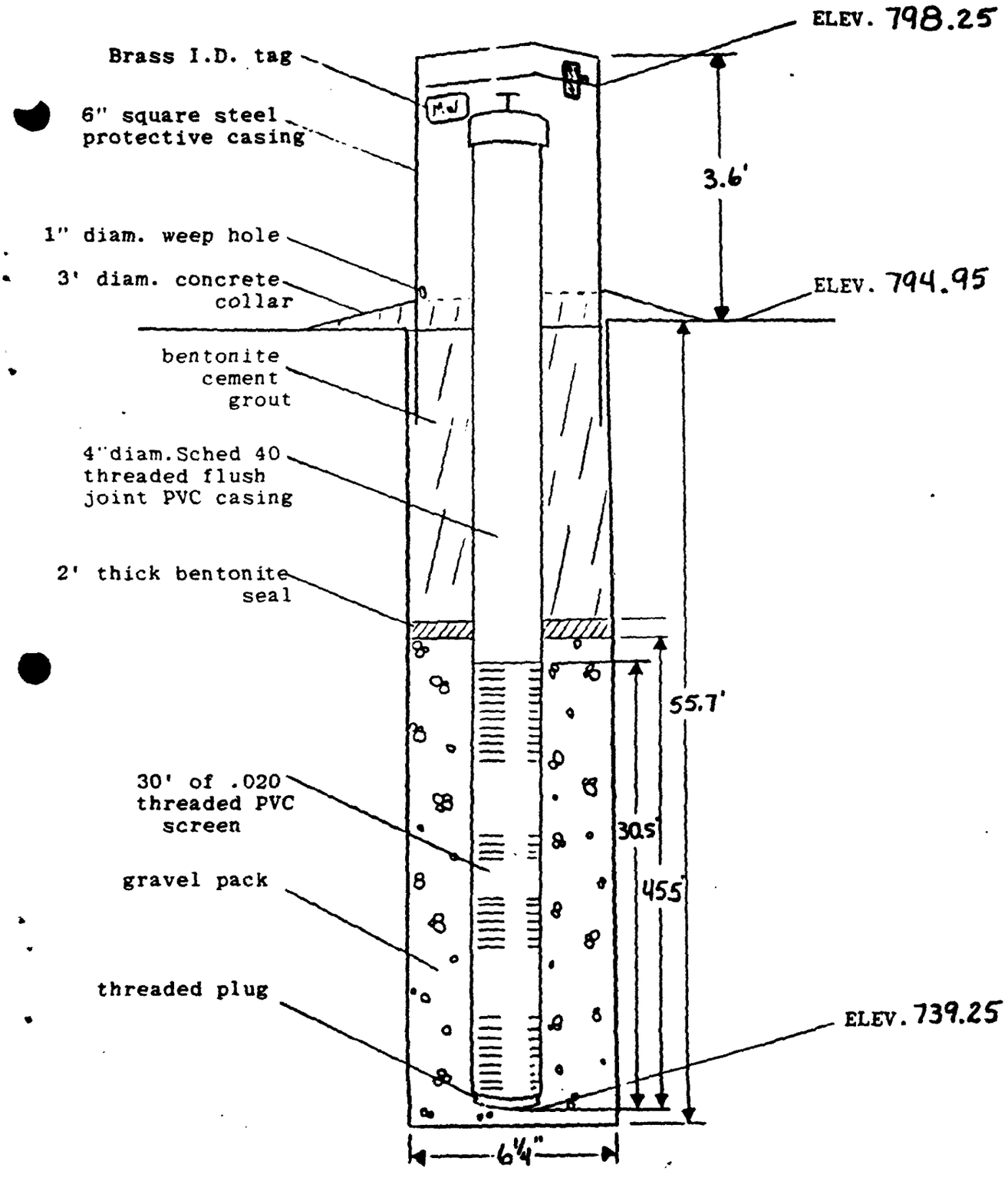
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | HA | | | | Topsoil |
| 1.0' | 2.5' | HA | | | | Dark brown silty clay, moist, stiff |
| 2.5' | 18.5' | HA | | | | Brown silty clay, moist, very stiff |
| 18.5' | 29.5' | HA | | | | Light brown weathered shale, moist, med. to ha |
| 29.5' | 36.0' | HA | | | | Maroon shale, moist, med. to hard |
| 36.0' | 51.0' | HA | | | | Gray shale, moist, med. to hard |
| 51.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| Dry | 9:30am | 12/14/82 (Completion) |

Layne-Western Company, Inc.

WELL CONSTRUCTION




MW 1-7A

# TEST BORING LOG

Project: Lake City Army Ammunition Plant — Boring No. 1-7A — Sheet 1 of 1

Replacement Wells — Surface Elevation _____ Offset _____

Address: [redacted] — Date Started 6/25/85 Completed 7/02/85

City & State: Independence, Missouri — Driller Buck Blank Rig AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

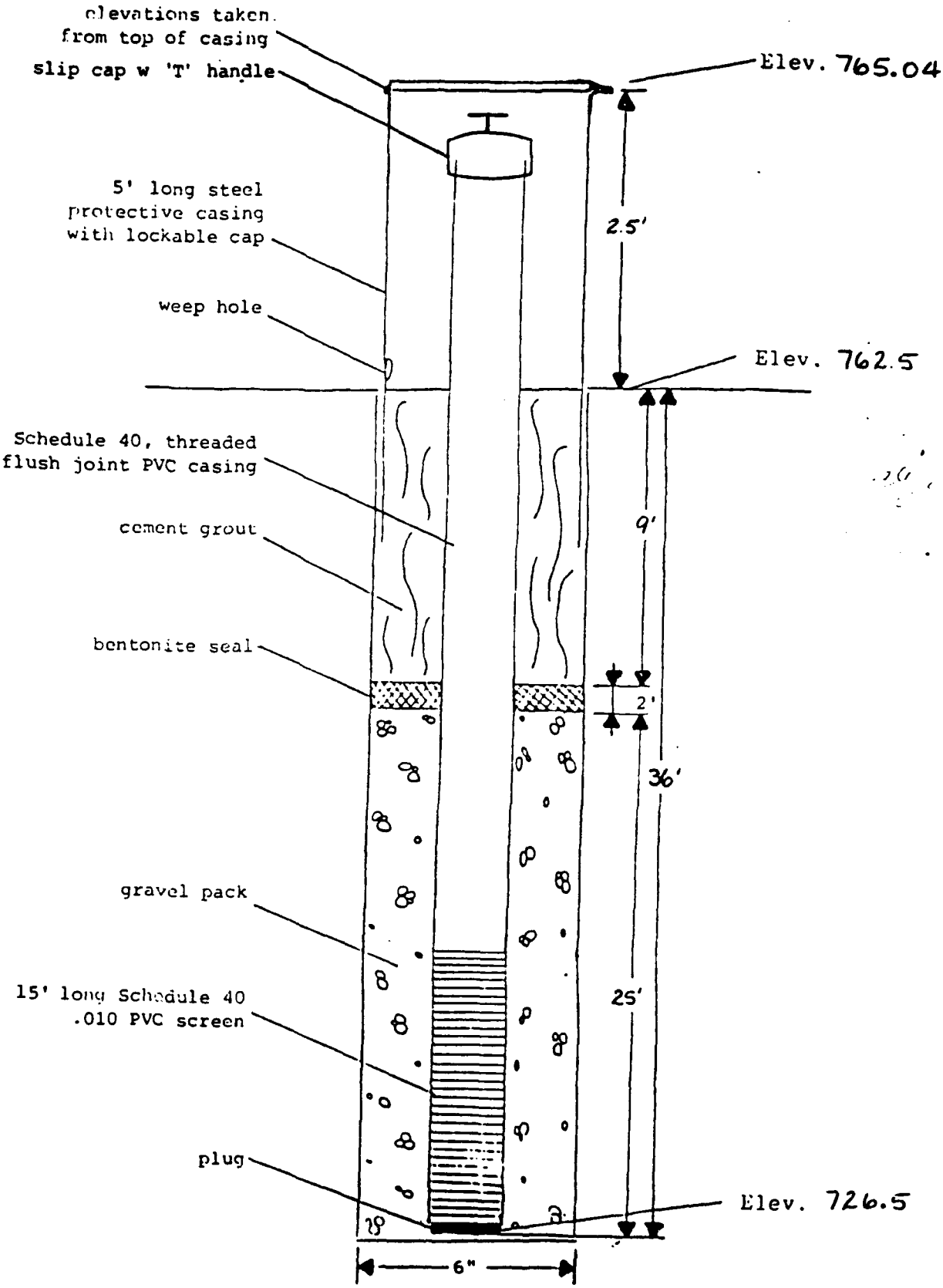
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0 | 0.6 | HA | | | | Topsoil |
| 0.6 | 2.5 | HA | | | | Dark brown silty clay, moist, stiff |
| 2.5 | 4.0 | HA | | | | Brown silty clay, moist, stiff |
| 4.0 | 11.5 | HA | | | | Light brown clayey silt, moist, stiff |
| 11.5 | 17.3 | HA | | | | Light brown clayey silt, with trace sand moist, very stiff |
| 3 | 22.5 | HA | | | | Olive-brown shale, dry, medium to hard |
| [redacted]5 | 24.3 | HA | | | | Same, with thin sandstone seams |
| 24.3 | 24.7 | HA | | | | Gray shale with thin limestone seams, hard |
| 24.7 | 32.0 | HA | | | | Olive-brown shale, dry, medium to hard |
| 32.0 | 37.1 | HA | | | | Dark gray shale, dry, medium to hard |
| 37.1 | 47.1 | HA | | | | Marroon shale, dry, medium to hard |
| 47.1 | 47.4 | HA | | | | Dark gray limestone |
| 47.4 | 57.0 | HA | | | | Gray shale, dry, medium to hard |
| 57.0 | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date | |
|---|---|---|---|---|
| Water level measured from top of casing | 19.7' | 3:30 pm | 7/2/85 | (Completion) |
| [redacted] | 15.8' | 4:45 pm | 7/3/85 | |

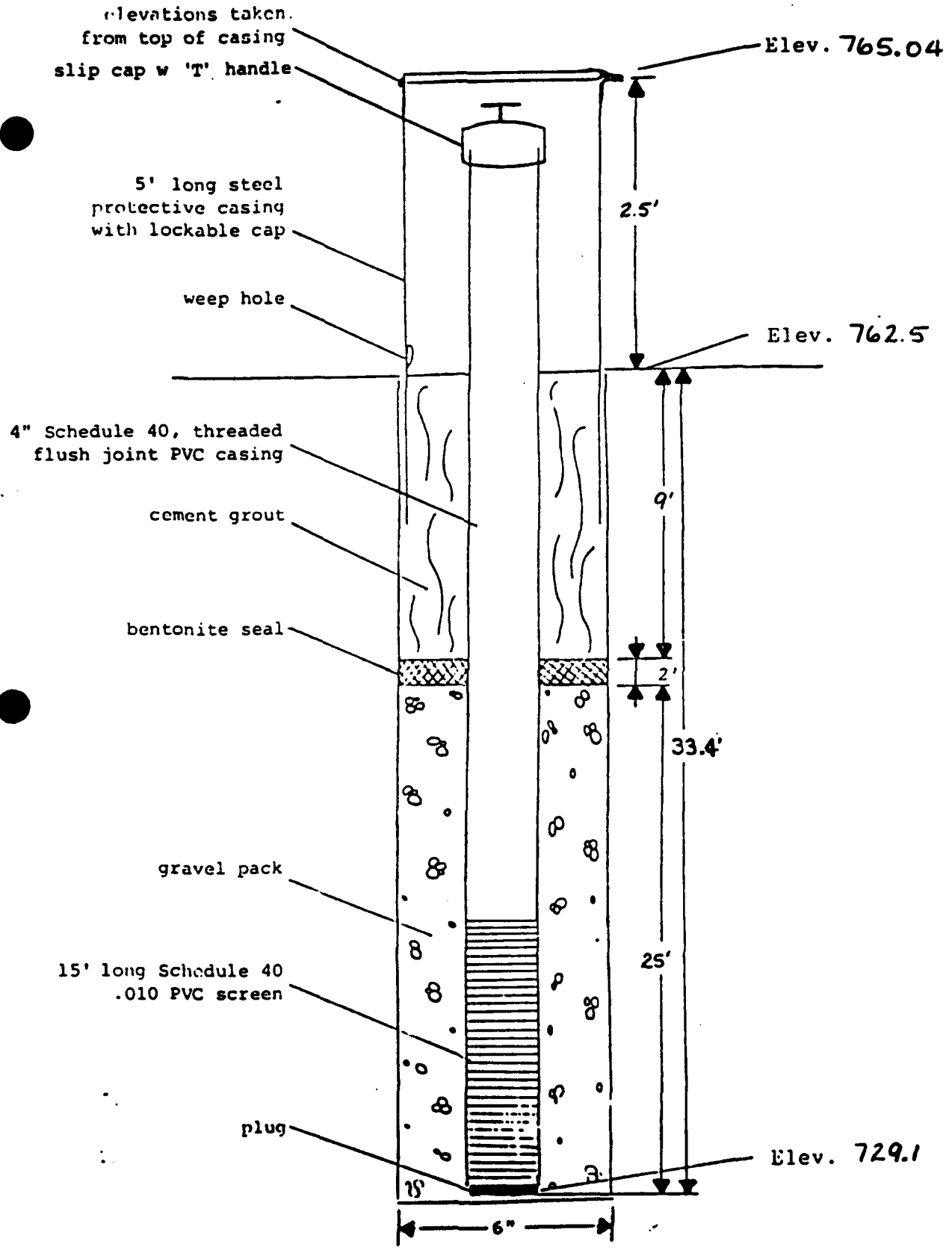
Wyne-Western Company, Inc.

# WELL CONSTRUCTION




MW 1-8

# WELL CONSTRUCTION




MW 1-8

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 1-8
Sheet: 1 of 1
Surface Elevation: 762.5
Offset:
Address:
Date Started: 12/8/82
Completed: 12/8/82
City & State: Independence, Missouri
Driller: B. Blank
Rig: AD-2

Abbreviations:
A.O. – Auger Only
H.A. – Hollow Auger
W.B. – Wash Bore
R.B. – Rock Bit
S.S. – Split Spoon
S.T. – Shelby Tube
C.W. – Core Water
C.A. – Core Air
F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY SAND CONSISTENCY DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.5' | HA | | | | Brown silty clay w/weathered shale (fill) moist, med. |
| 1.5' | 7.5' | HA | | | | Dark brown silty clay, moist, med. |
| 7.5' | 9.5' | HA | | | | Brown & gray silty clay, moist, stiff |
| 9.5' | 11.0' | ST1 | 1.25 | | 1.5' | Same |
| 11.0' | 15.0' | HA | | | | Same |
| 15.0' | 19.5' | HA | | | | Same |
| 19.5' | 21.0' | ST2 | 0.75 | | 1.2' | Brown & gray silty clay, moist, med. |
| 21.0' | 28.0' | HA | | | | Same |
| 28.0' | 34.5' | HA | | | | Dark gray very silty clay, moist, med. |
| 34.5' | 36.0' | ST3 | 1.0 | | 1.5' | Same |
| 36.0' | Total depth | | | | | |

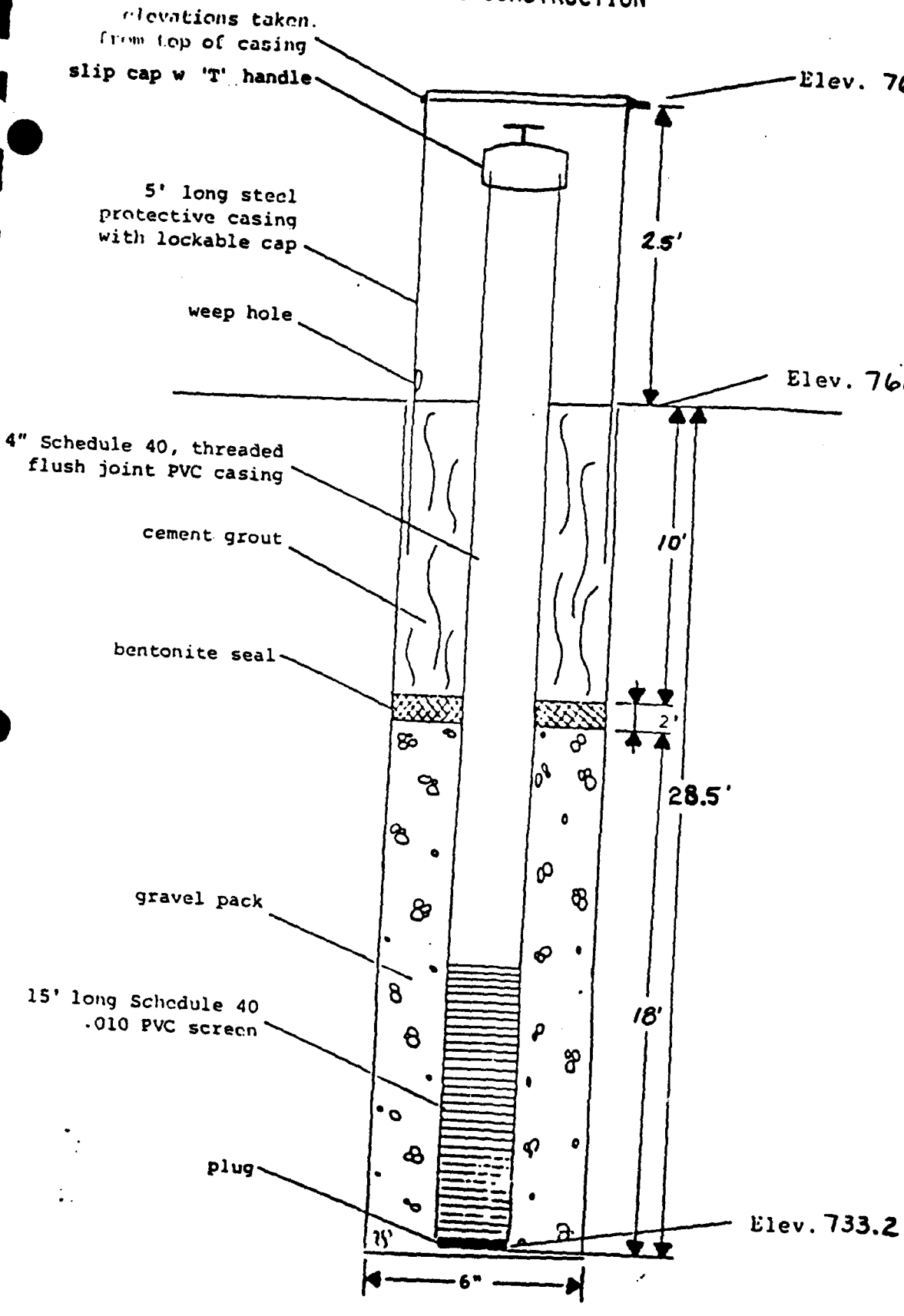
REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| Wet water at 9.0' | | | (Completion) |
| | | | |

Wayne-Western Company, Inc.

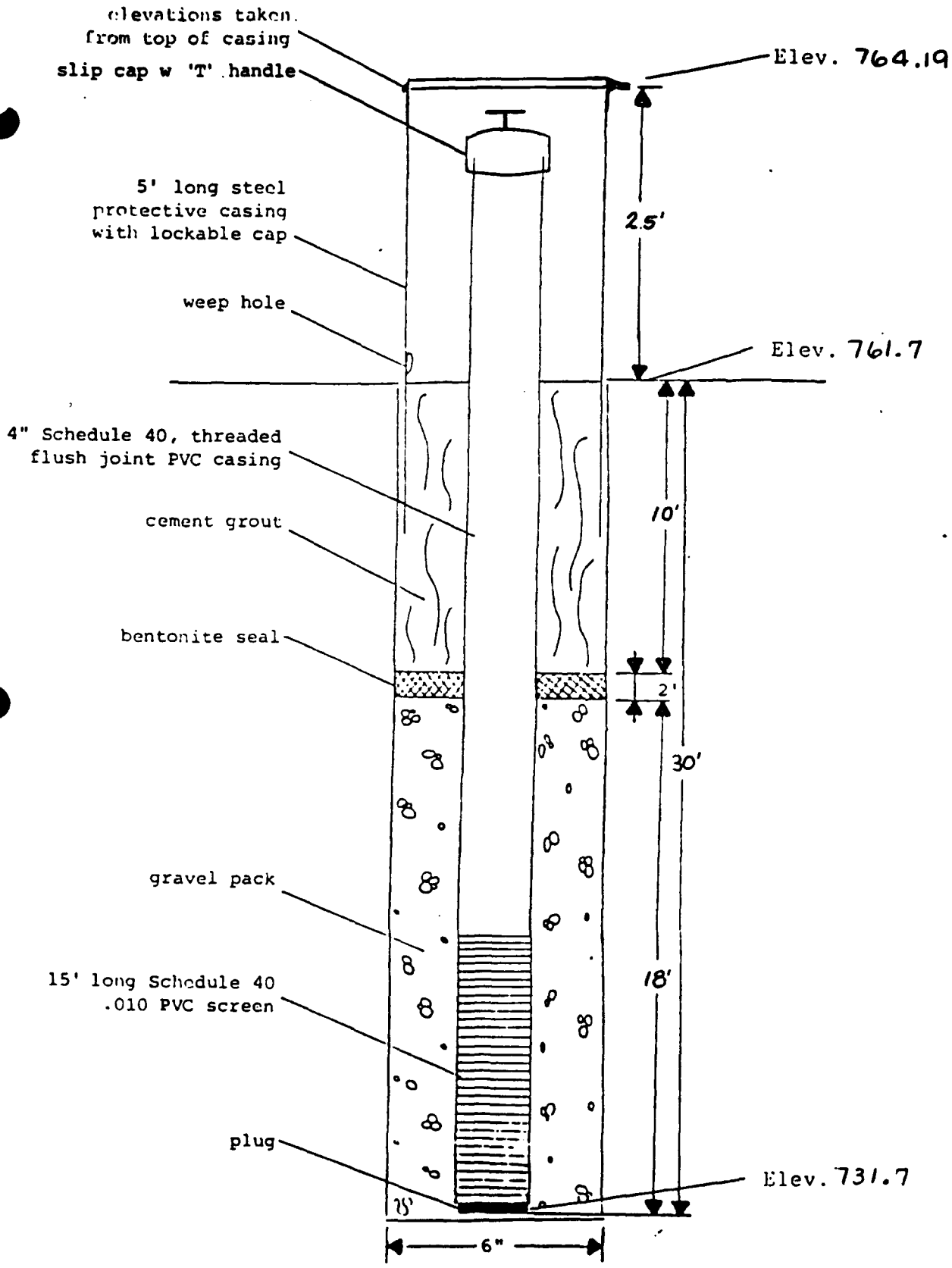
C-153

WELL CONSTRUCTION




MW 1-9

# WELL CONSTRUCTION




MW 1-9

# TEST BORING LOG

Project: Lake City Army Ammunition Plant

Boring No.: MW 1-9 Sheet 1 of 1

Surface Elevation: 761.7 Offset:

Address:

Date Started: 12/9/82 Completed: 12/9/82

City & State: Independence, Missouri

Driller: B. Blank Rig: AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

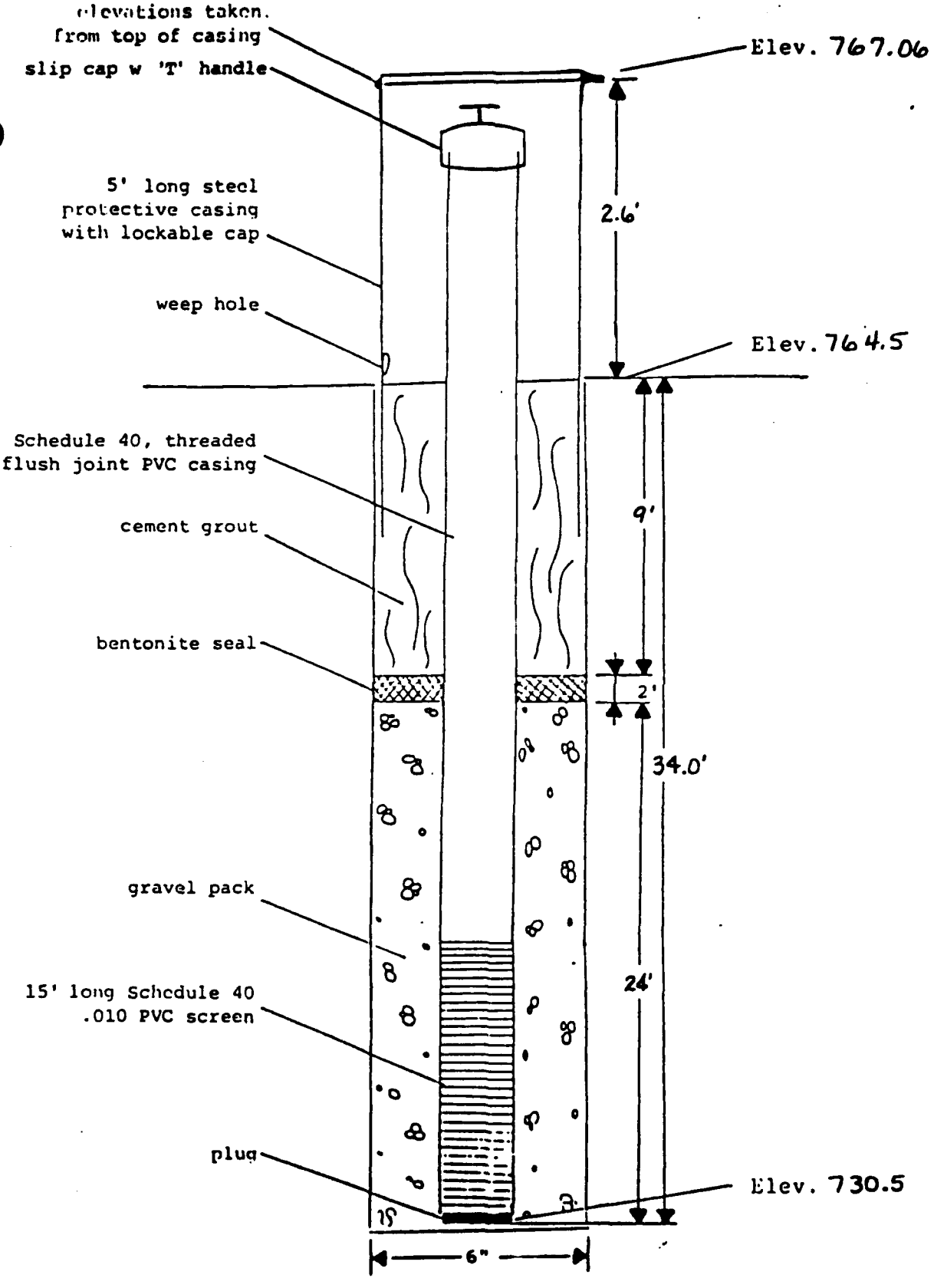
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.0' | HA | | | | Dark brown silty clay, moist, med. |
| 4.0' | 9.5' | HA | | | | Brown silty clay, moist, med. |
| 9.5' | 11.0' | ST1 | 0.75 | | 1.3' | Brown & gray silty clay, moist, med. |
| 11.0' | 15.0' | HA | | | | Same |
| 15.0' | 20.0' | HA | | | | Same |
| 20.0' | 21.5' | HA | | | | Same |
| 21.5' | 24.5' | HA | | | | Dark gray silty clay, moist, stiff |
| 24.5' | 26.0' | ST2 | 1.25 | | 1.5' | Same |
| 26.0' | 30.0' | HA | | | | Same |
| 30.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| Hit water at approximately 11.0' | | | (Completion) |
| | | | |

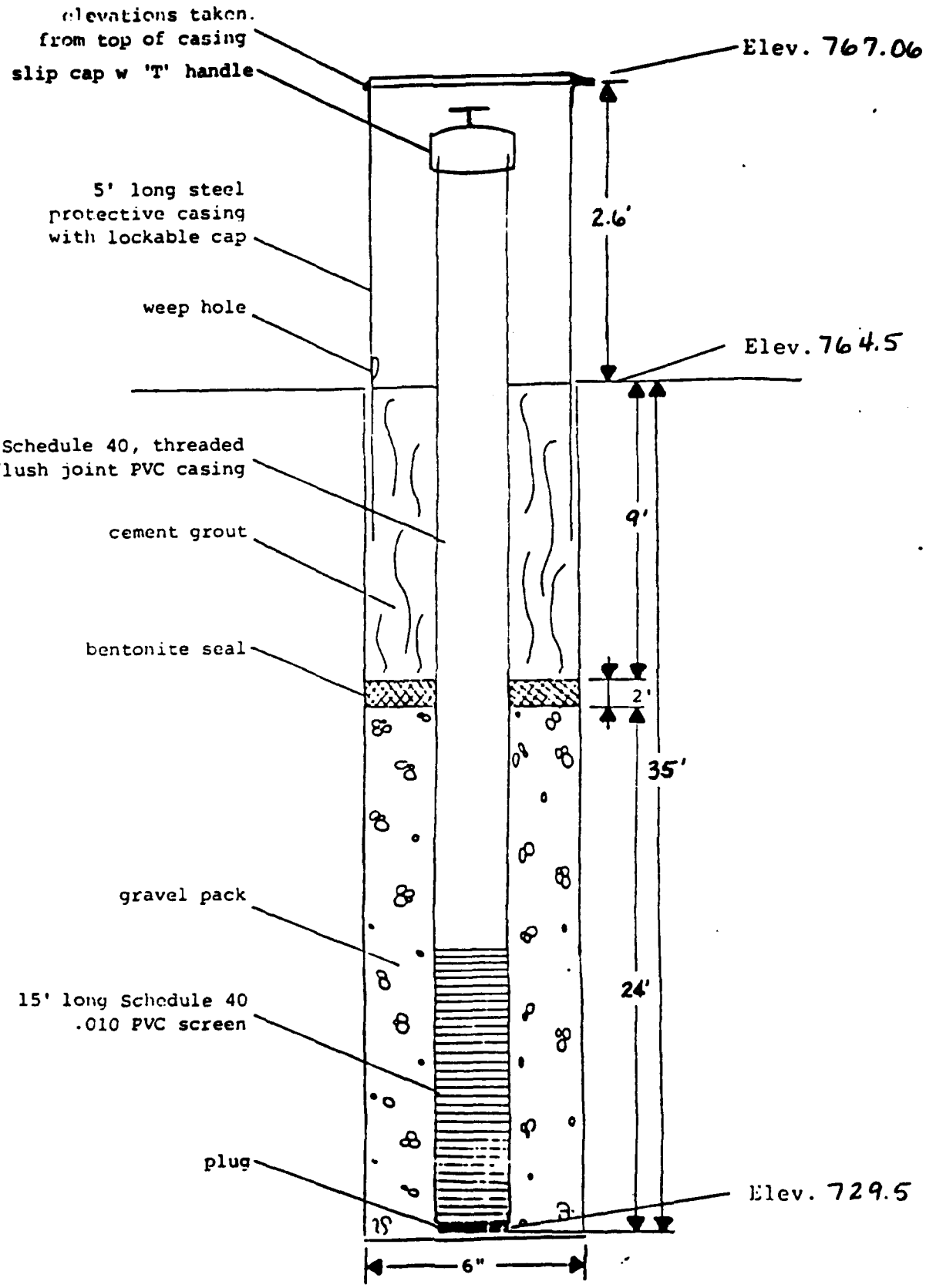
Layne-Western Company, Inc.

# WELL CONSTRUCTION




MW 1-10

# WELL CONSTRUCTION




MW 1-10

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 1-10
Sheet: 1 of 1
Surface Elevation: 764.5
Offset:
Date Started: 1/10/83
Completed: 1/10/83
City & State: Independence, Missouri
Driller: B. Blank
Rig: AD-2

Abbreviations:
A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 7.5' | HA | | | | Dark brown silty clay, moist, med. |
| 7.5' | 15.0' | HA | | | | Brown silty clay, very moist, med. |
| 15.0' | 16.5' | ST1 | 1.0 | | 1.5' | Brown silty clay w/trace sand, very moist, med. |
| 16.5' | 22.0' | HA | | | | Light brown siltyclay, moist, soft |
| 22.0' | 35.0' | HA | | | | Light brown to gray clayey shale, moist, med. |
| 0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

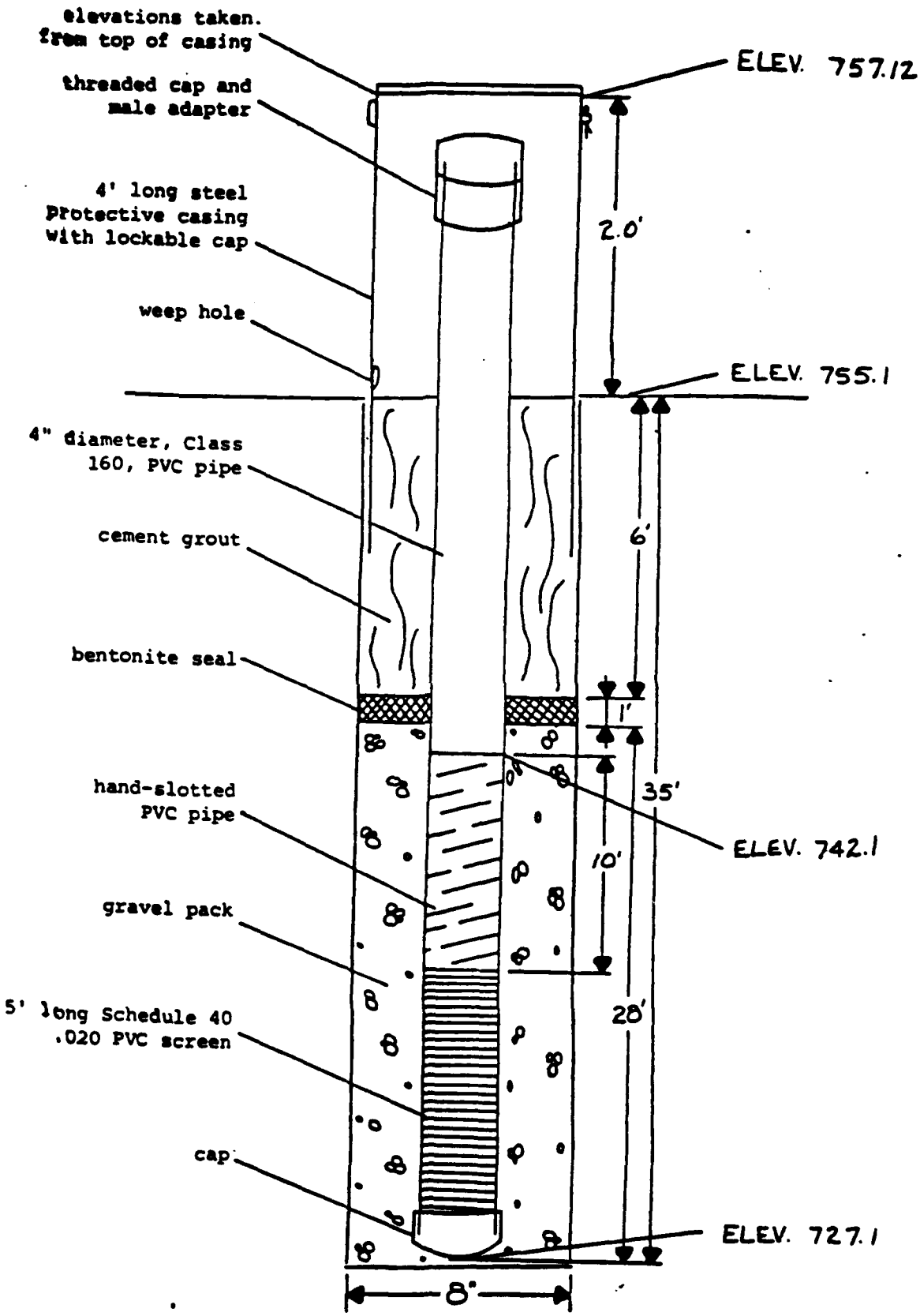
| Water Level | Time | Date |
|---|---|---|
| 8.2 | 12:00pm | 1/10/83 (Completion) |

Wayne-Western Company, Inc.

C-159

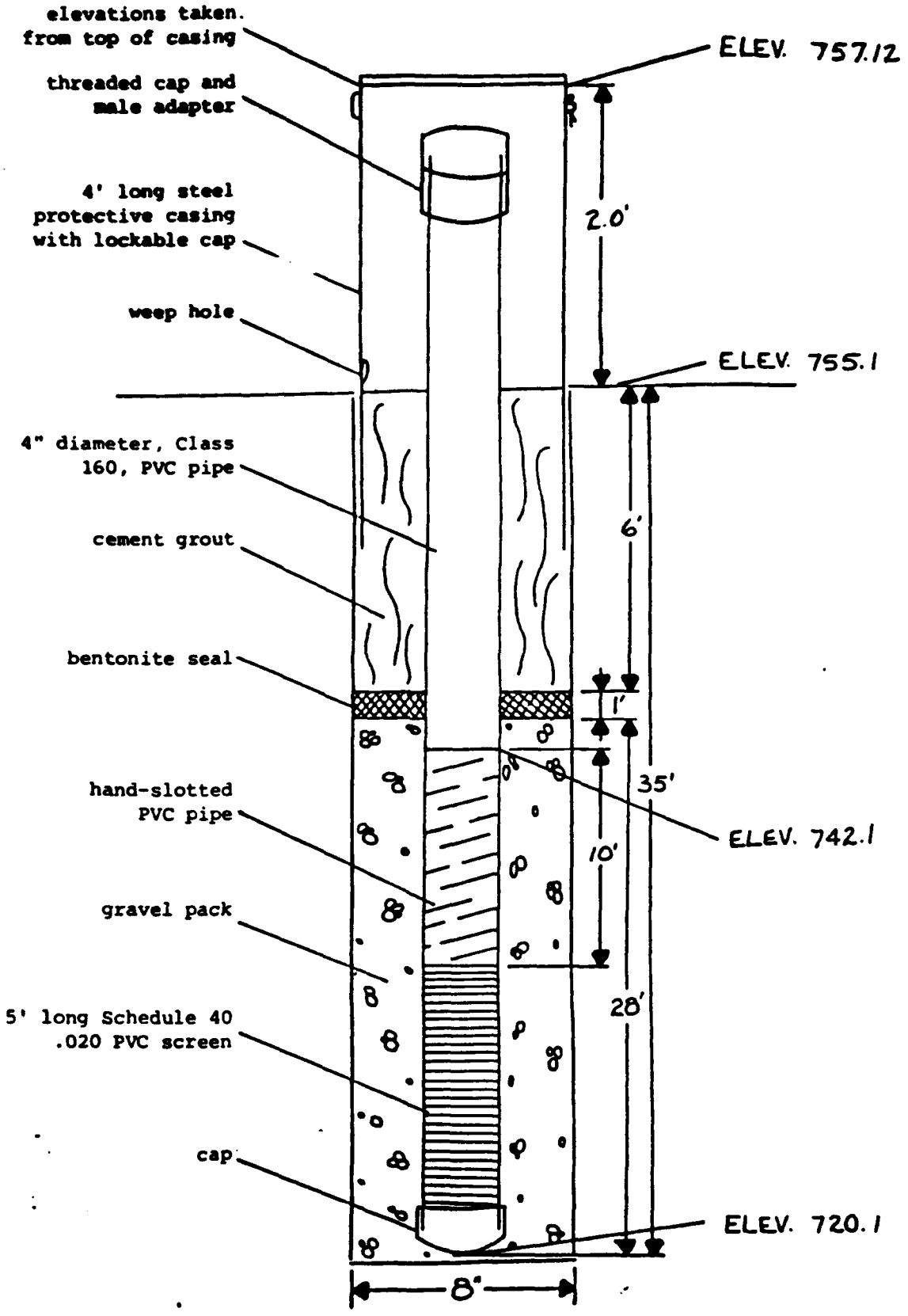
W-59A

## CONSTRUCTION OF WELL




MW 2-1

CONSTRUCTION OF WELL




MW 2-1



REDEVELOPMENT 2/85

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 2-1 Sheet 1 of 1

Surface Elevation: 755.1 Offset:

Address:

Date Started: 8/4/81 Completed: 8/4/81

City & State: Independence, Missouri

Driller: D. Vogt Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

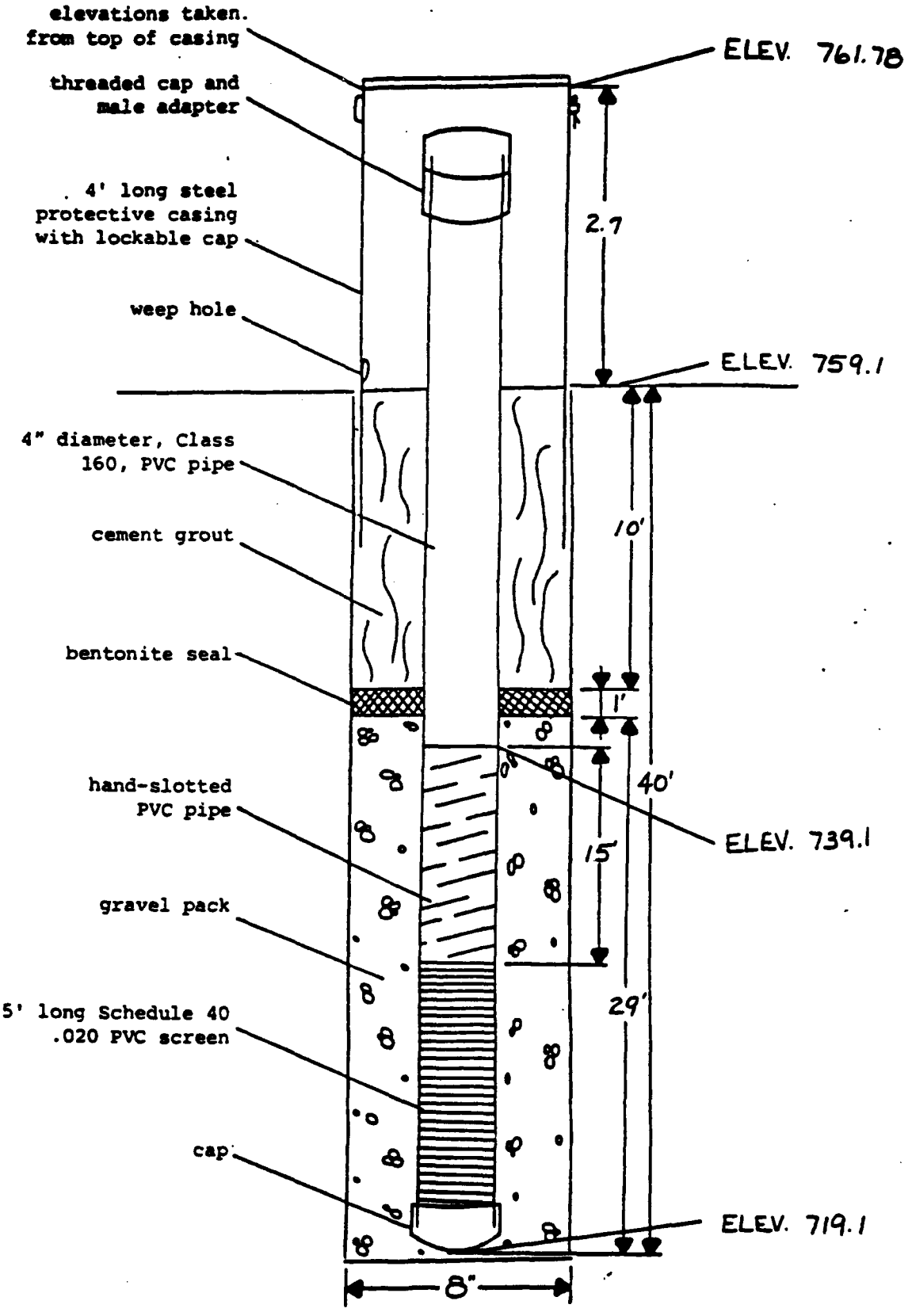
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 6.0' | WB | | | | Dark brown silty clay, stiff |
| 6.0' | 10.0' | WB | | | | Light brown silty clay, very stiff |
| 10.0' | 11.5' | ST1 | 1.5 | | 3.0' | Same |
| 11.5' | 30.0' | WB | | | | Same |
| 30.0' | 40.0' | WB | | | | Gray silty clay, very stiff |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 1 hour - 2-1/2 GPM | 2.9 | | 9/11/81 (Completion) |

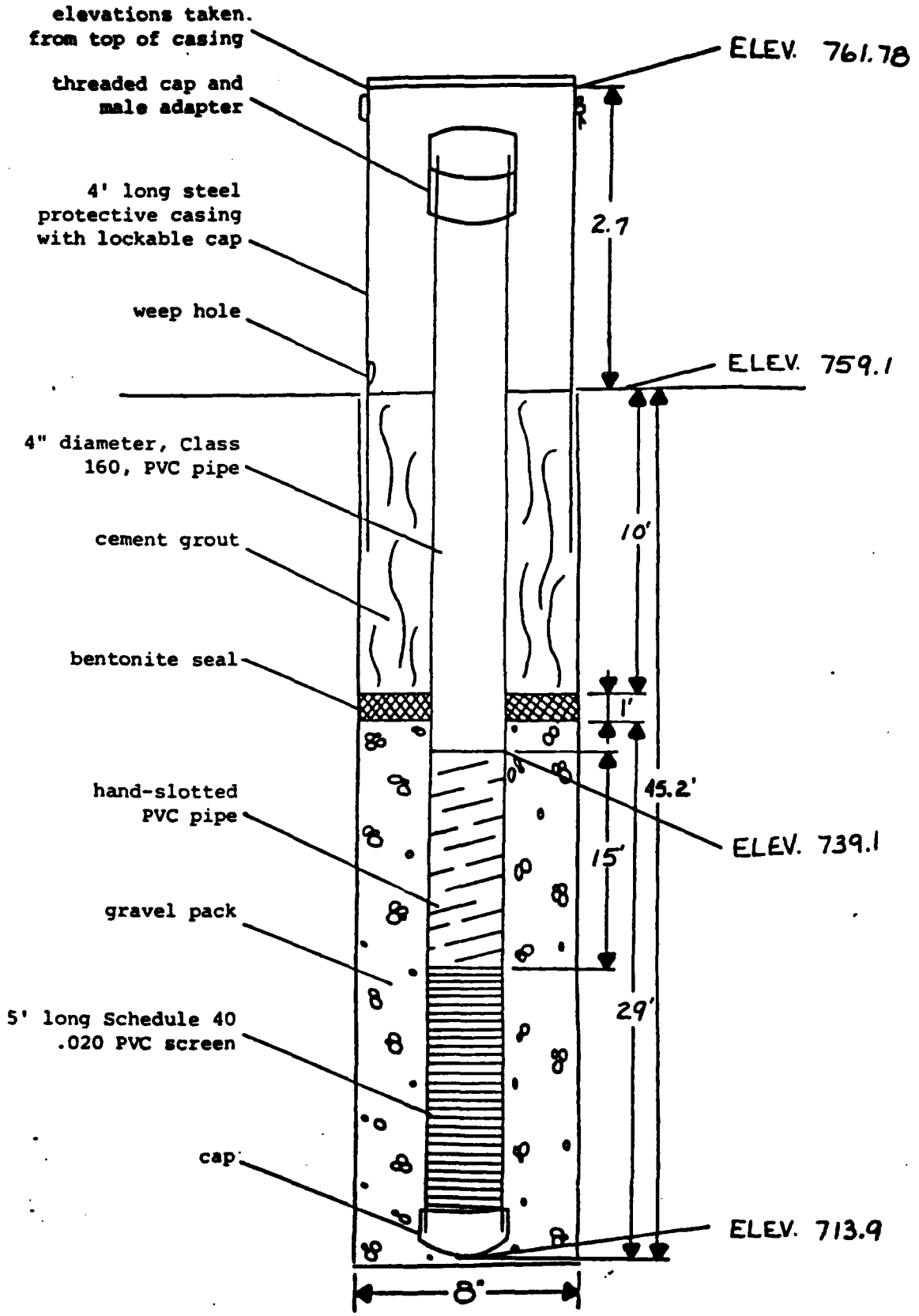
Wayne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 2-2

# CONSTRUCTION OF WELL




MW 2-2

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 2-2 Sheet: 1 of 1

Surface Elevation: 759.1 Offset:

Address:

Date Started: 8/4/81 Completed: 8/4/81

City & State: Independence, Missouri

Driller: D. Vogt Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Dark brown silty clay |
| 5.0' | 12.0' | WB | | | | Brown gray silty clay, stiff |
| 12.0' | 20.0' | WB | | | | Brown gray silty clay, soft to med. |
| 20.0' | 26.0' | WB | | | | Gray brown silty clay, soft to med. |
| 26.0' | 36.0' | WB | | | | Gray silty clay, soft to med. |
| [illegible].0' | 40.0' | WB | | | | Gray sandy silt w/clay seams, soft to |
| 40.0' | Total | depth | | | | |

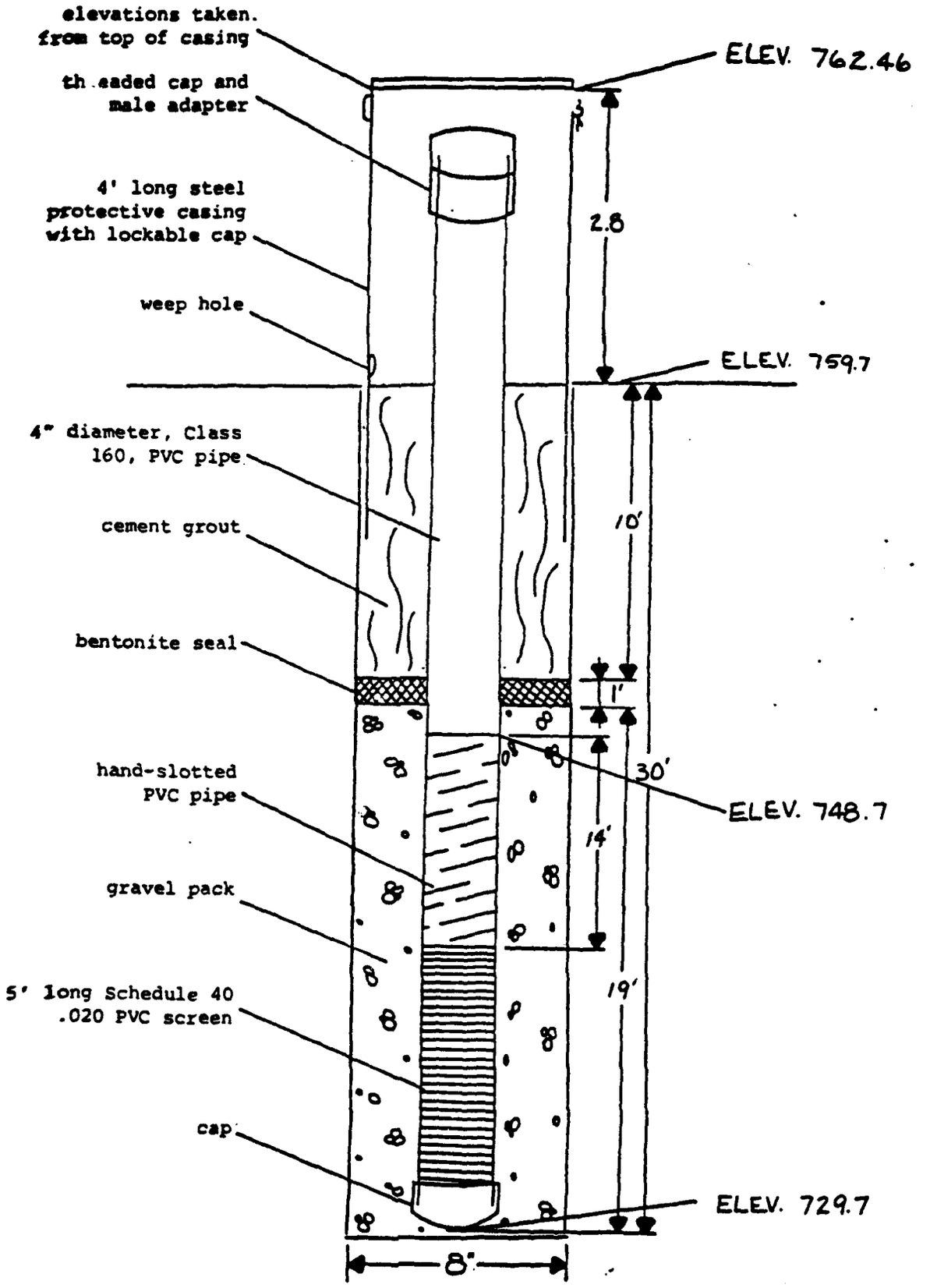
REMARKS: (Casing, Water Loss, Etc.)

Pumped 1 hour - 7 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 7.2 | | 9/11/81 (Completion) |

Wayne-Western Company, Inc.

CONSTRUCTION OF WELL




MW 2-3

# TEST BORING LOG

Project: Lake City AAP — Boring No.: MW 2-3 — Sheet 1 of 1

Surface Elevation: 759.7 — Offset:

Date Started: 8/7/81 — Completed: 8/7/81

City & State: Independence, Missouri — Driller: D. Vogt — Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 8.0' | WB | | | | Dark brown silty clay, med. |
| 8.0' | 10.0' | WB | | | | Brown silty clay, med. |
| 10.0' | 11.5' | ST1 | 1.5 | | 1.5' | Gray brown silty clay, stiff |
| 11.5' | 30.0' | WB | | | | Gray brown silty clay, stiff |
| 30.0' | 31.5' | ST2 | 4.5+ | | 1.5' | Gray brown silty clay w/sand & gravel, rock, hard |
| 31.5' | 40.0' | WB | | | | Gray shale, med. |
| 40.0' | Total | depth | | | | |

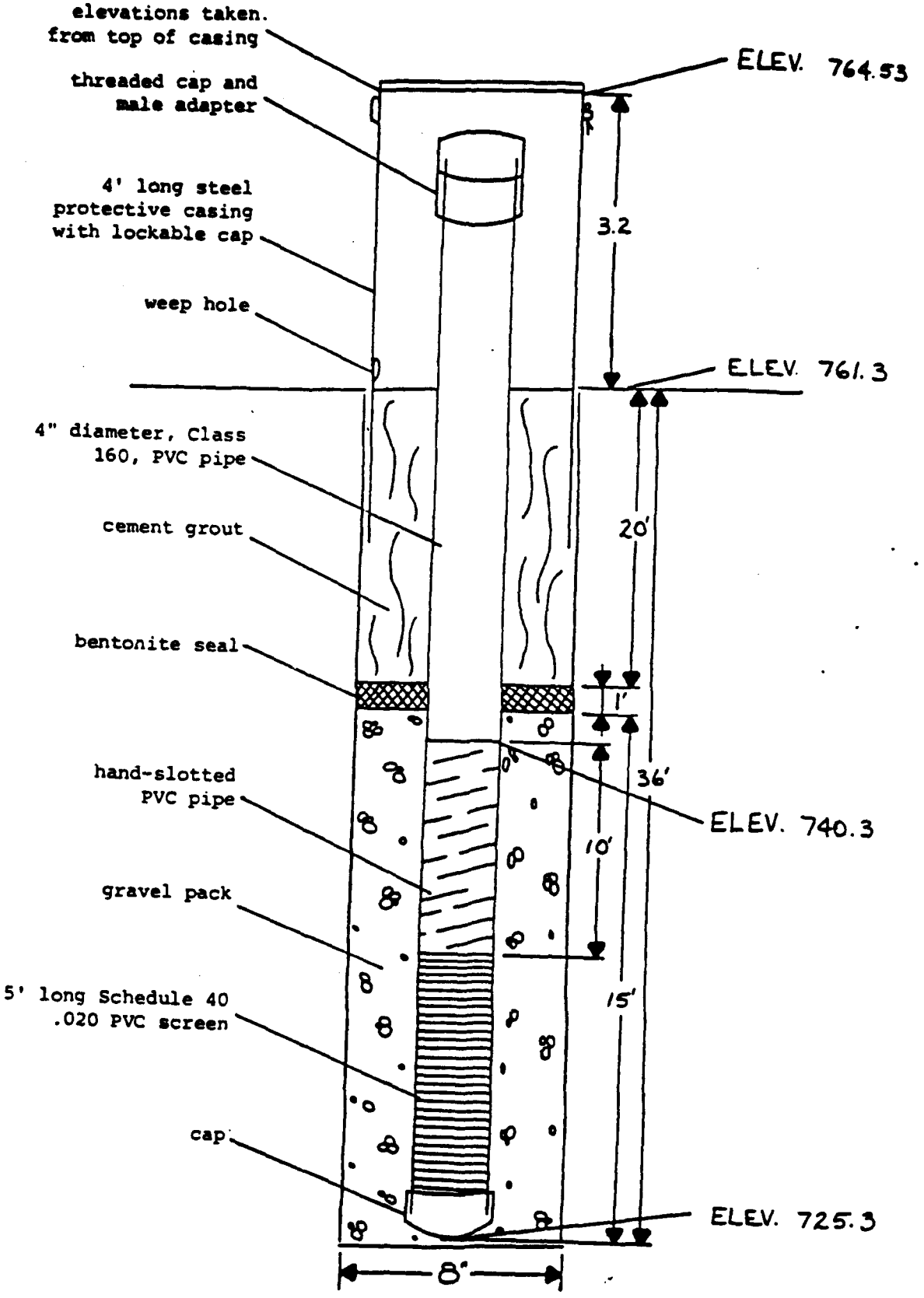
REMARKS: (Casing, Water Loss, Etc.)

Pumped 2 hours - 2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 1.9 | | 9/11/81 (Completion) |

Wayne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 2-4

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 2-4 Sheet 1 of 1

Surface Elevation: 761.3 Offset:

Date Started: 8/7/81 Completed: 8/7/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

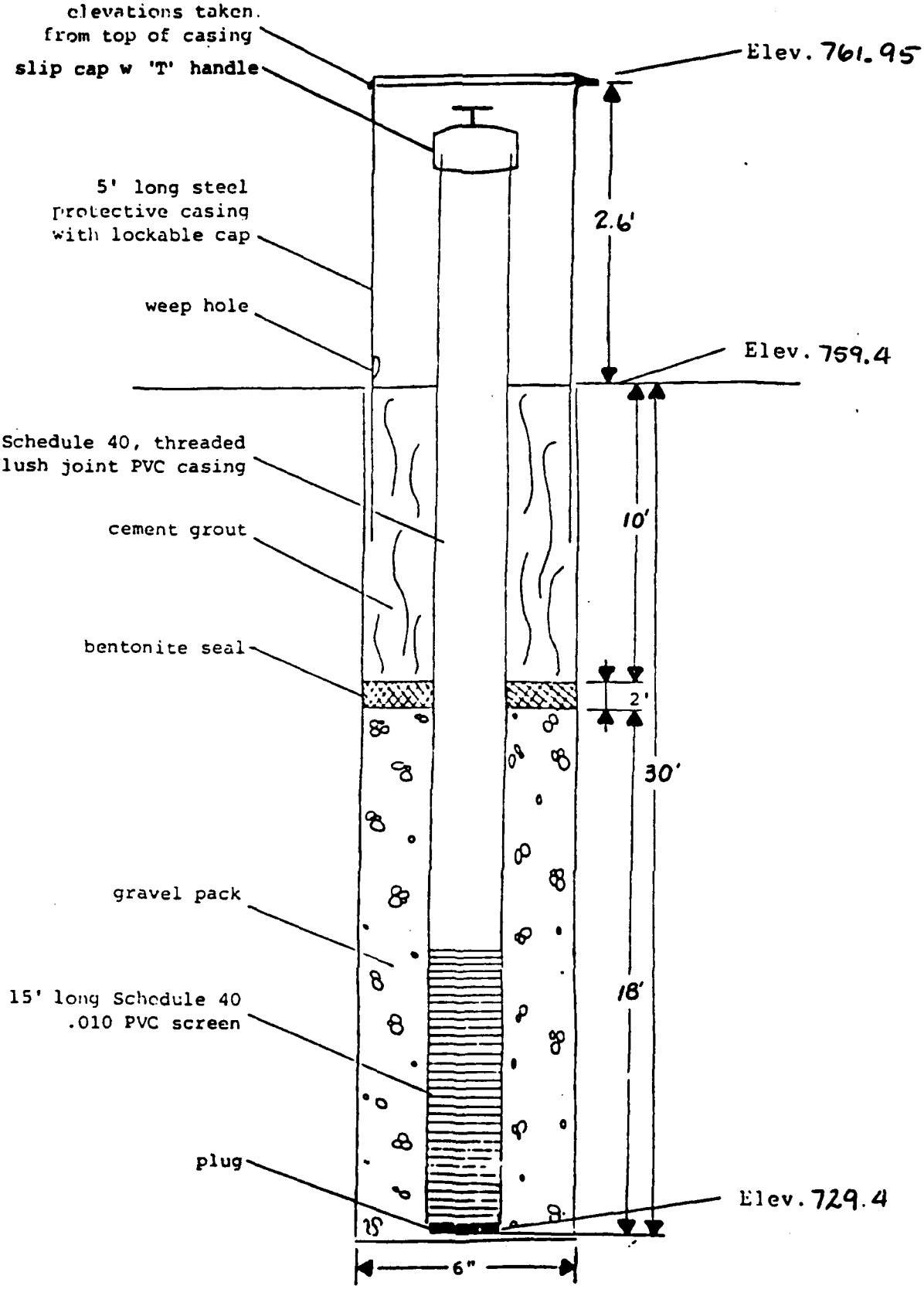
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.5' | WB | | | | Topsoil |
| 1.5' | 3.0' | WB | | | | Light brown silty clay, soft to med. |
| 3.0' | 9.5' | WB | | | | Dark gray silty clay, soft to med. |
| 9.5' | 11.0' | ST1 | 1.5 | | | Dark gray silty clay, stiff |
| 11.0' | 14.5' | WB | | | | Gray silty clay, soft to med. |
| 14.5' | 19.5' | WB | | | | Tan silty clay, soft to med. |
| 19.5' | 21.0' | ST2 | 1.5 | | | Tan & gray silty clay, stiff |
| 21.0' | 22.5' | WB | | | | Gray silty clay, med. to stiff |
| 22.5' | 29.5' | WB | | | | Tan silty clay w/trace sand, soft to me |
| 29.5' | 33.5' | WB | | | | Tan silty clay, med. to stiff |
| 33.5' | 40.0' | WB | | | | Tan silty clay, soft to med. |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 1 hour - 2-1/2 GPM | 3.0 | | 9/11/81 (Completion) |

Wayne-Western Company, Inc.

# WELL CONSTRUCTION




MW 2-6

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 2-5
Sheet: 1 of 1
Surface Elevation: 759.4
Offset:
Address:
Date Started: 12/9/82
Completed: 12/9/82
City & State: Independence, Missouri
Driller: B. Blank
Rig: AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 5.0' | HA | | | | Brown silty clay, moist, med. |
| 5.0' | 9.5' | HA | | | | Same |
| 9.5' | 11.0' | ST1 | 0.75 | | 1.0' | Brown & gray silty clay, moist, med. |
| 11.0' | 15.0' | HA | | | | Same |
| 15.0' | 20.0' | HA | | | | Same |
| [illegible].0' | 22.5' | HA | | | | Same |
| 22.5' | 24.5' | HA | | | | Brown & gray silty clay, moist, very stiff |
| 24.5' | 26.0' | ST2 | 2.25 | | 1.5' | Same |
| 26.0' | 30.0' | HA | | | | Same |
| 30.0' | Total depth | | | | | |

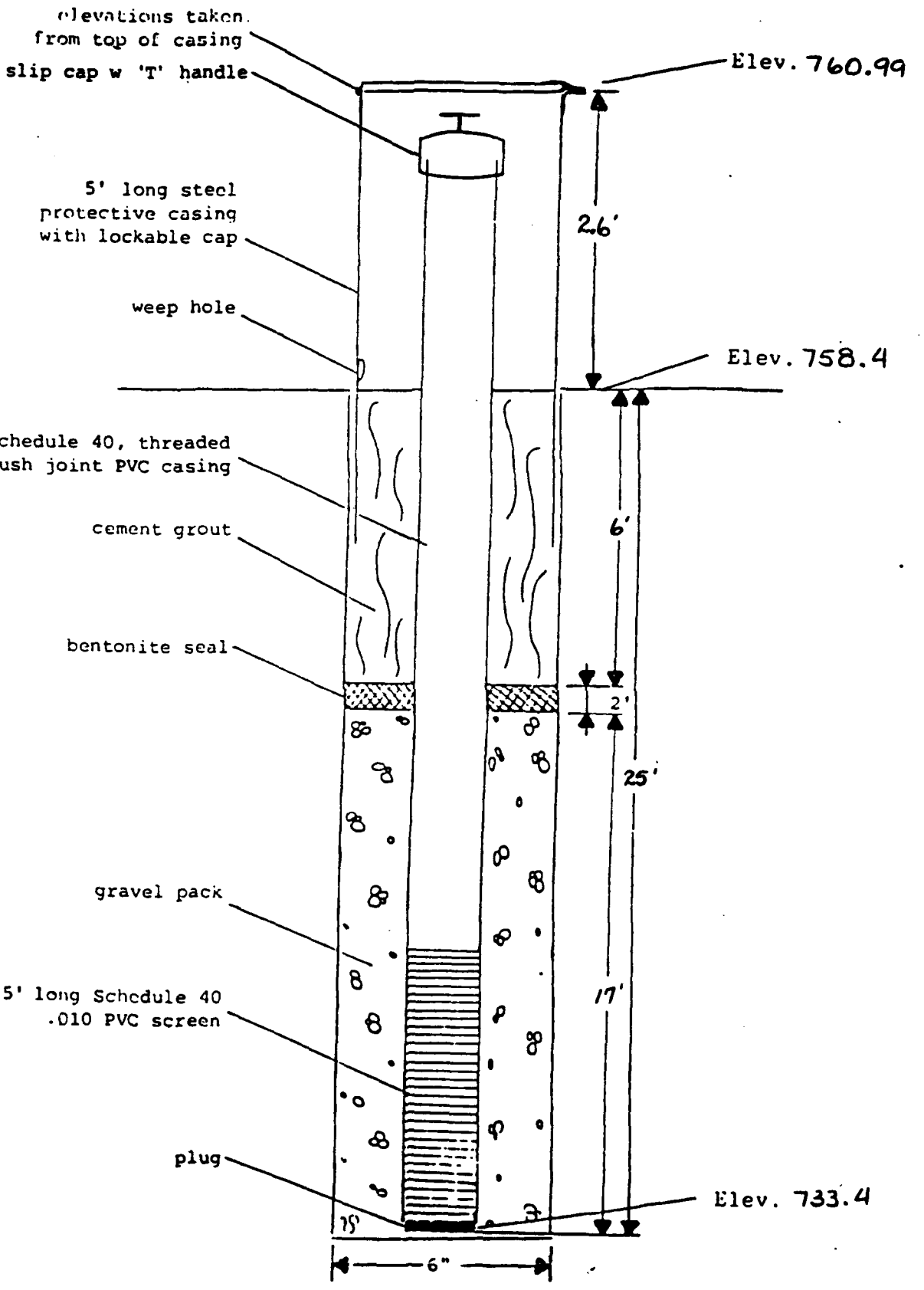
REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| [illegible]t water at approximately 11.0' | | | | (Completion |
| | | | | |

Layne-Western Company, Inc.

C-171

WELL CONSTRUCTION




MW 2-6

# TEST BORING LOG

Project: Lake City Army Ammunition Plant

Boring No.: MW 2-6 Sheet 1 of 1

Surface Elevation: 758.4 Offset:

Address:

Date Started: 12/13/82 Completed: 12/13/82

City & State: Independence, Missouri

Driller: B. Blank Rig: AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | HA | | | | Topsoil |
| 1.0' | 3.0' | HA | | | | Dark brown silty clay, moist, med. |
| 3.0' | 5.0' | HA | | | | Brown silty clay, moist, med. |
| 5.0' | 10.0' | HA | | | | Same |
| 10.0' | 14.5' | HA | | | | Same |
| 14.5' | 16.0' | ST1 | 4.0 | | 1.5' | Brown & gray silty clay w/trace gravel & trace shale, very stiff |
| 16.0' | 18.5' | HA | | | | Same |
| 18.5' | 25.0' | HA | | | | Brown gray silty clay, moist, med. |
| 25.0' | Total depth | | | | | |

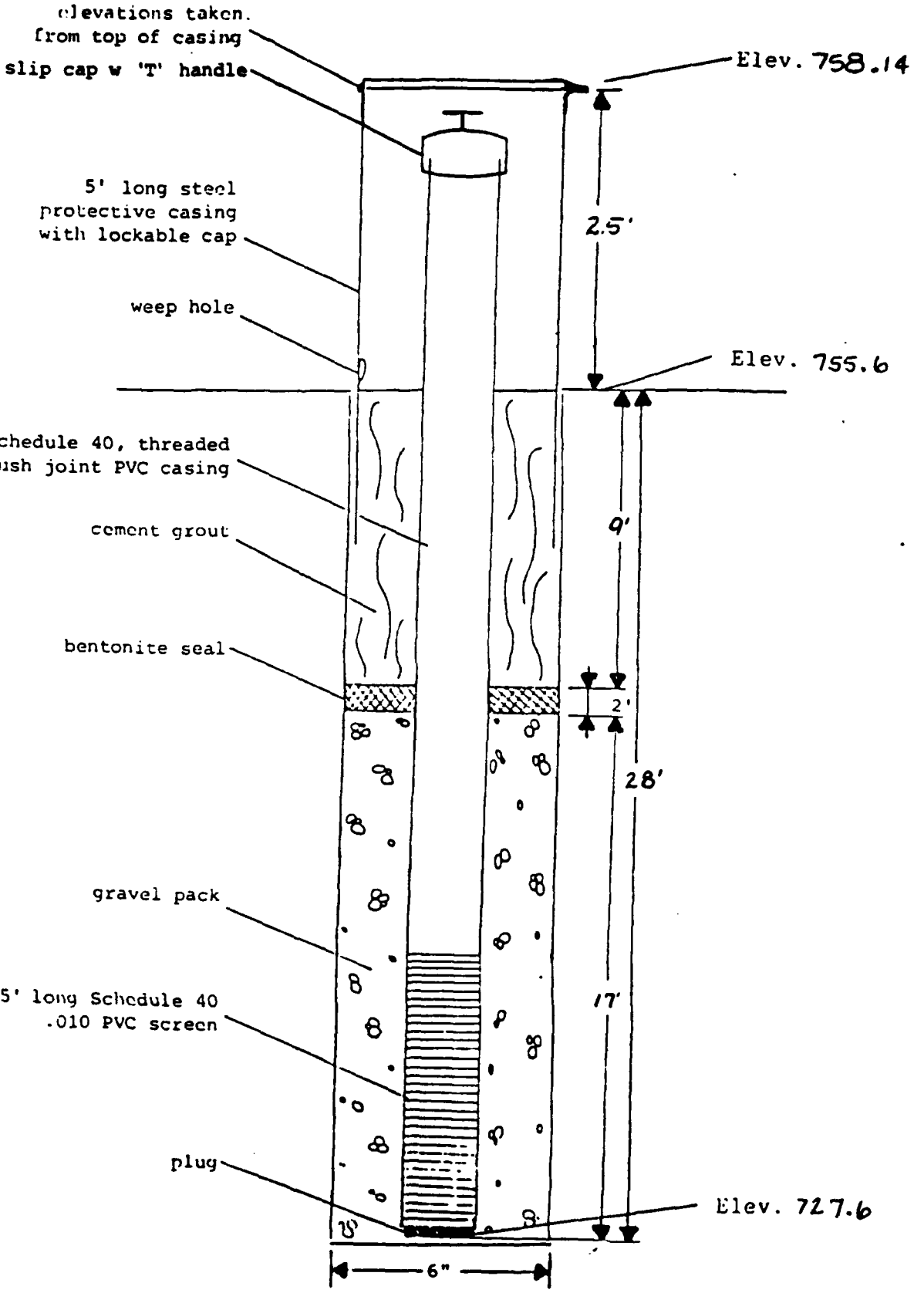
REMARKS. (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 10.0' | | | (Completion) |
| | | | |

Laune-Western Company, Inc.

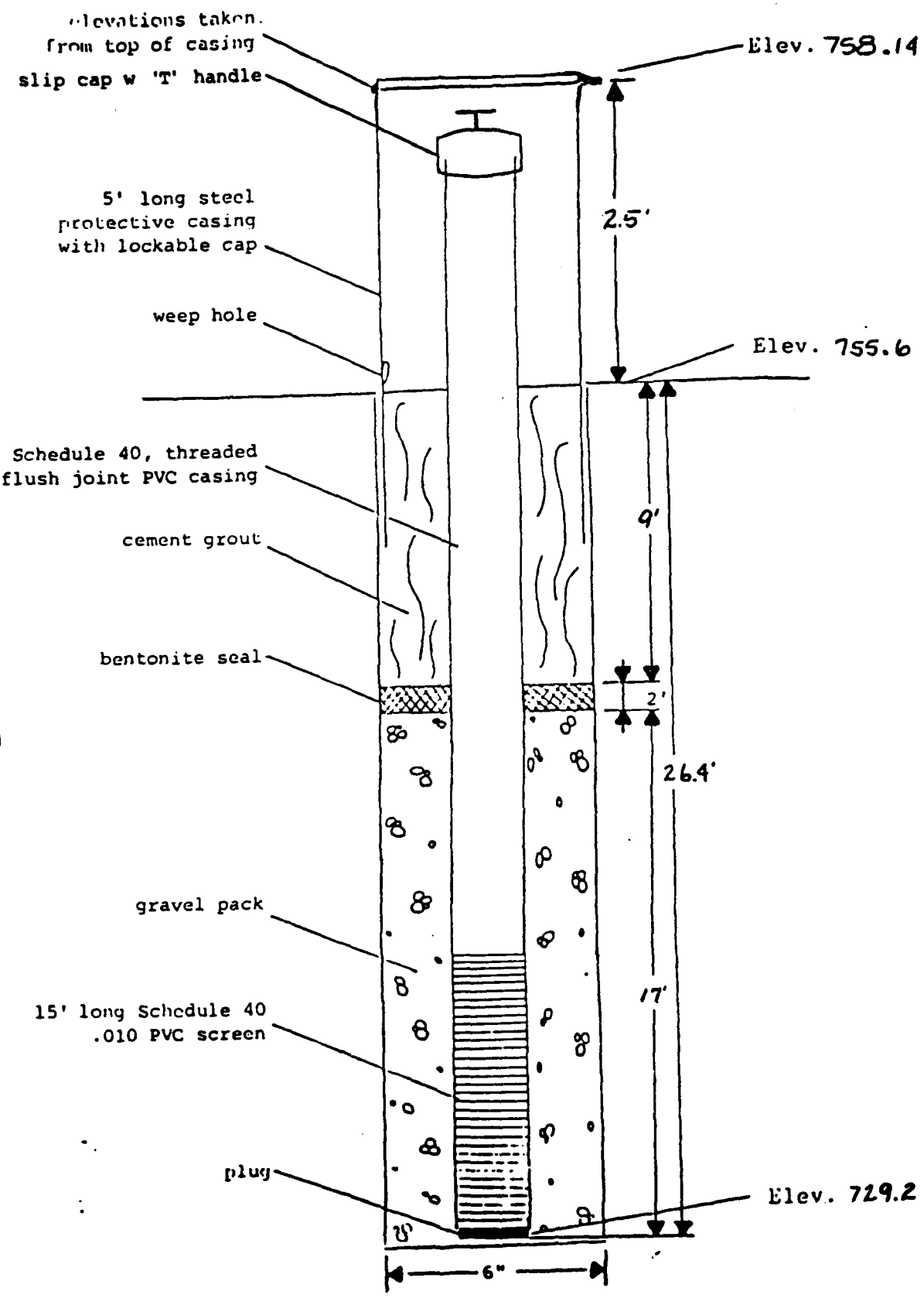
C-173

# WELL CONSTRUCTION




MW 2-7

# WELL CONSTRUCTION




MW 2-7

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 2-7
Sheet: 1 of 1
Surface Elevation: 755.6
Offset:
Address:
Date Started: 1/10/83
Completed: 1/10/83
City & State: Independence, Missouri
Driller: B. Blank
Rig: CME-55

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

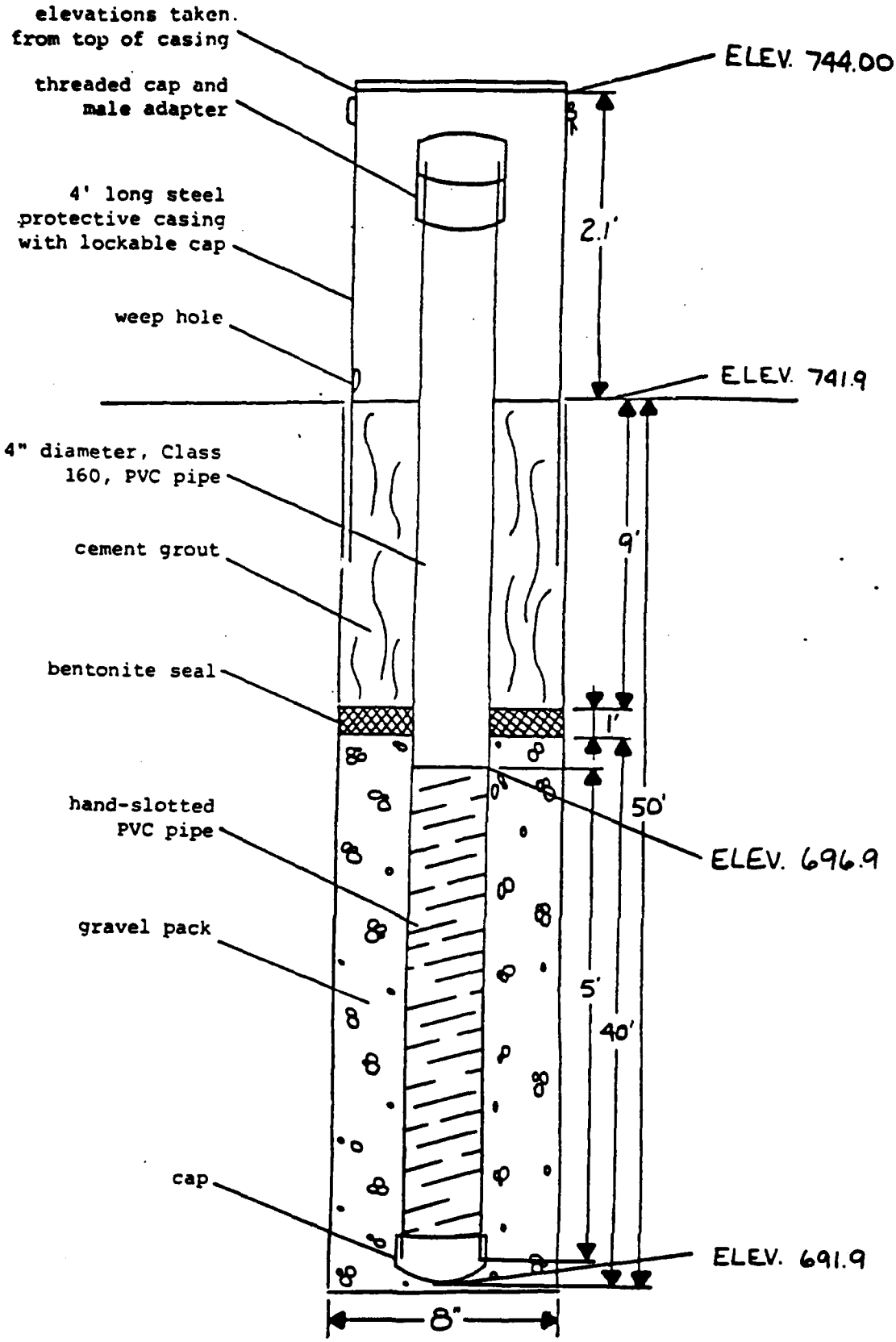
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 10.0' | HA | | | | Dark brown silty clay, moist, stiff |
| 10.0' | 11.5' | ST1 | 1.75 | | 1.2' | Same |
| 11.5' | 13.5' | HA | | | | Dark brown silty clay, very moist, soft |
| 13.5' | 18.0' | HA | | | | Brown silty clay, wet, soft |
| 18.0' | 25.0' | HA | | | | Brown silty clay, wet, very soft |
| 25.0' | 26.5' | ST2 | | | 0.0' | Same |
| 26.5' | 28.0' | HA | | | | Brown silty clay, very soft |
| 28.0' | Total depth | | | | | |

MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 8.7 | 12:15pm | 1/10/83 | (Completion |

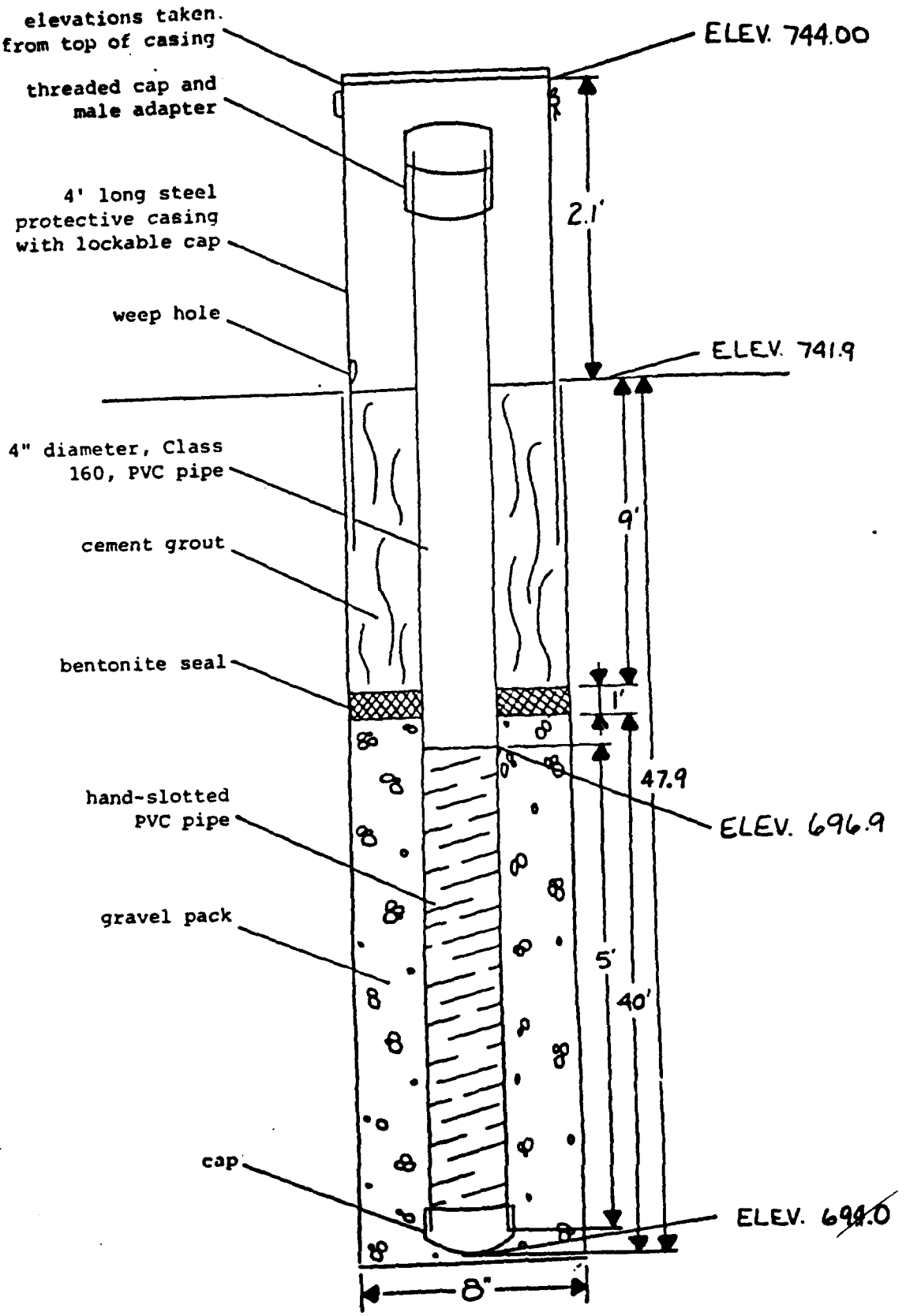
Wayne-Western Company, Inc.

## CONSTRUCTION OF WELL




MW 3-1

CONSTRUCTION OF WELL




MW 3-1

C-178 REDEVELOPMENT 2/85

## TEST BORING LOG

Project: Lake City AAP — Boring No.: MW 3-1 — Sheet 1 of 1

Surface Elevation: 741.9 — Offset:

Date Started: 9/23/81 — Completed: 9/23/81

City & State: Independence, Missouri — Driller: B. Blank — Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Brown silty clay, very stiff |
| 5.0' | 10.0' | WB | | | | Gray and brown fine to medium sand, med. dense |
| 10.0' | 11.0' | WB | | | | Same |
| 11.0' | 15.0' | WB | | | | Brown and gray sandy silt w/trace clay stiff |
| 15.0' | 20.0' | WB | | | | Same |
| [illegible]0' | 22.0' | WB | | | | Same |
| 22.0' | 25.0' | WB | | | | Gray and brown fine sand, loose |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 35.0' | WB | | | | Same |
| 35.0' | 40.0' | WB | | | | Same |
| 40.0' | 45.0' | WB | | | | Gray fine sand w/trace coarse sand, med. dense |
| 45.0' | 50.0' | WB | | | | Same |
| 50.0' | Total | depth | | | | |
| | | | | | | |
| | | | | | | |

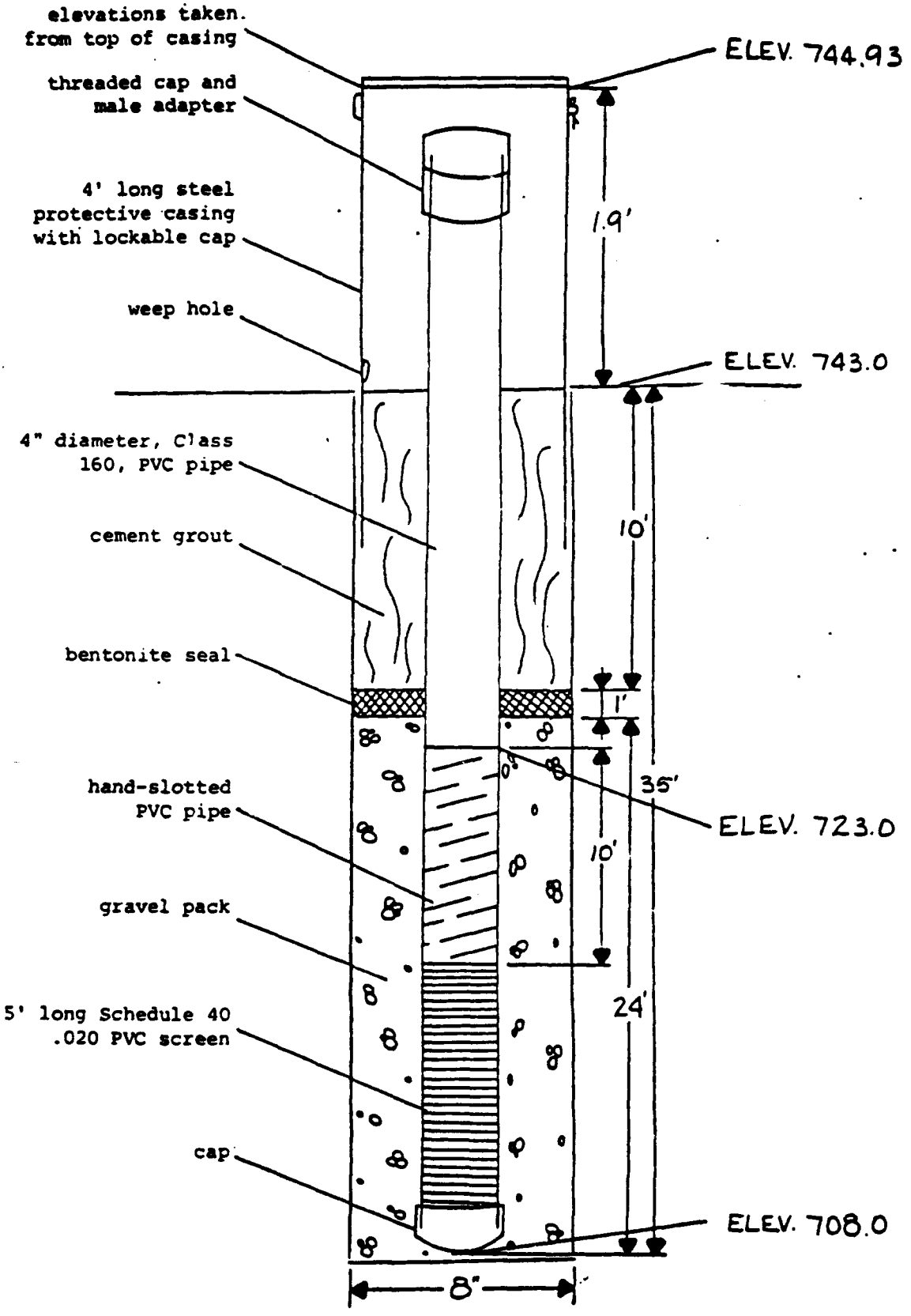
RKS: (Casing, Water Loss, Etc.)

| Static Water Level | Time | Date |
|---|---|---|
| 28.0 | | 9/23/81 (Completic |
| | | |

Pumped 2 hrs. - 6 2/3 GPM

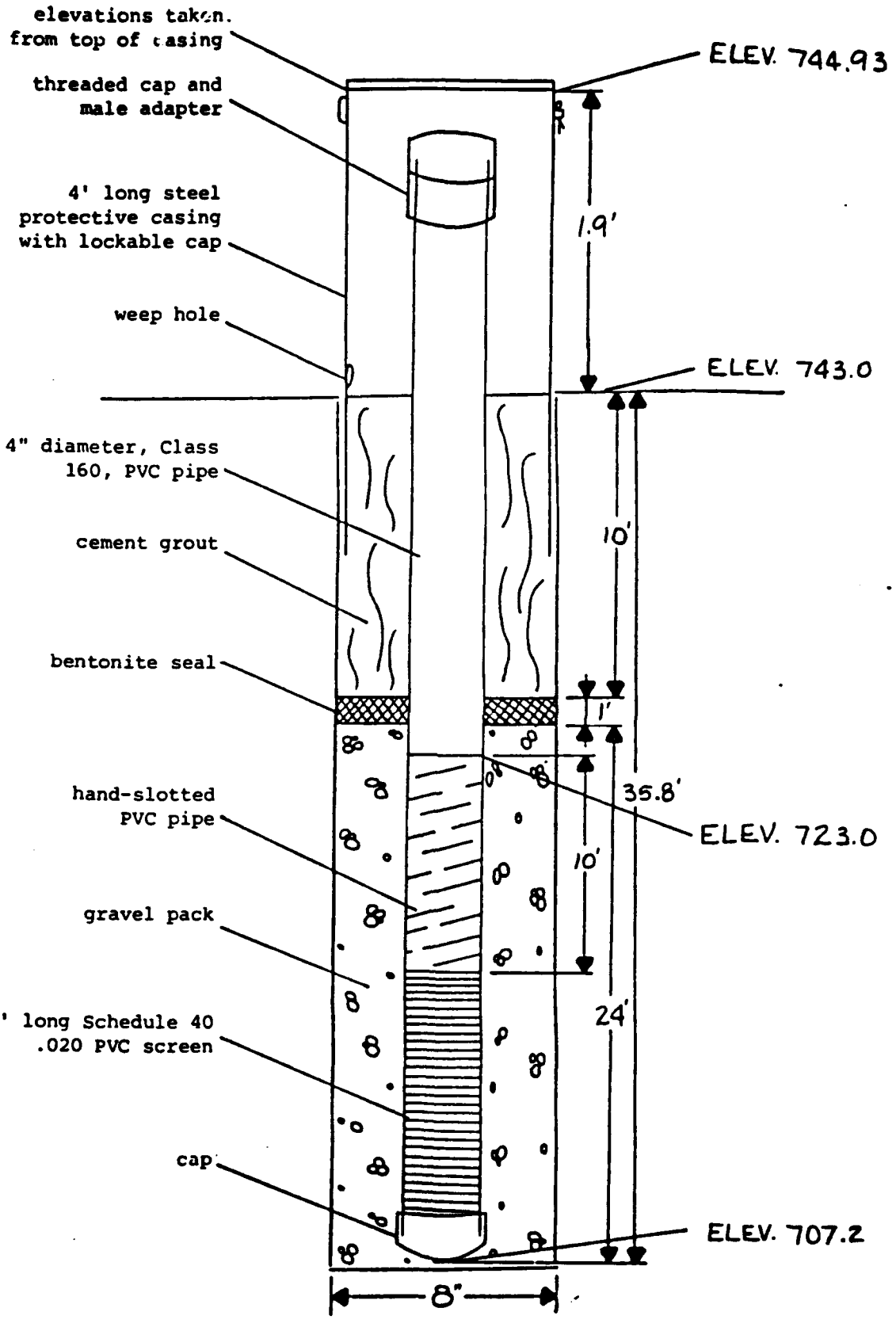
Wayne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 3-2

CONSTRUCTION OF WELL




MW 3-2



REDEVELOPMENT 2/85

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 3-2 Sheet: 1 of 1

Surface Elevation: 743.0 Offset:

Date Started: 8/17/81 Completed: 8/17/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO. METER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Dark brown silty clay, stiff |
| 5.0' | 6.0' | WB | | | | Same |
| 6.0' | 9.0' | WB | | | | Brown & gray silty clay w/trace sand, stiff |
| 9.0' | 10.5' | ST1 | 1.75 | | | Same |
| 10.5' | 15.0' | WB | | | | Same |
| [illegible]' | 19.0' | WB | | | | Same |
| 19.0' | 20.5' | ST2 | | | | Dark brown clayey fine to med. sand, dense |
| 20.5' | 25.0' | WB | | | | Same |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 35.0' | WB | | | | Gray clayey fine sand, dense |
| 35.0' | 40.0' | WB | | | | Same |
| 40.0' | Total depth | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

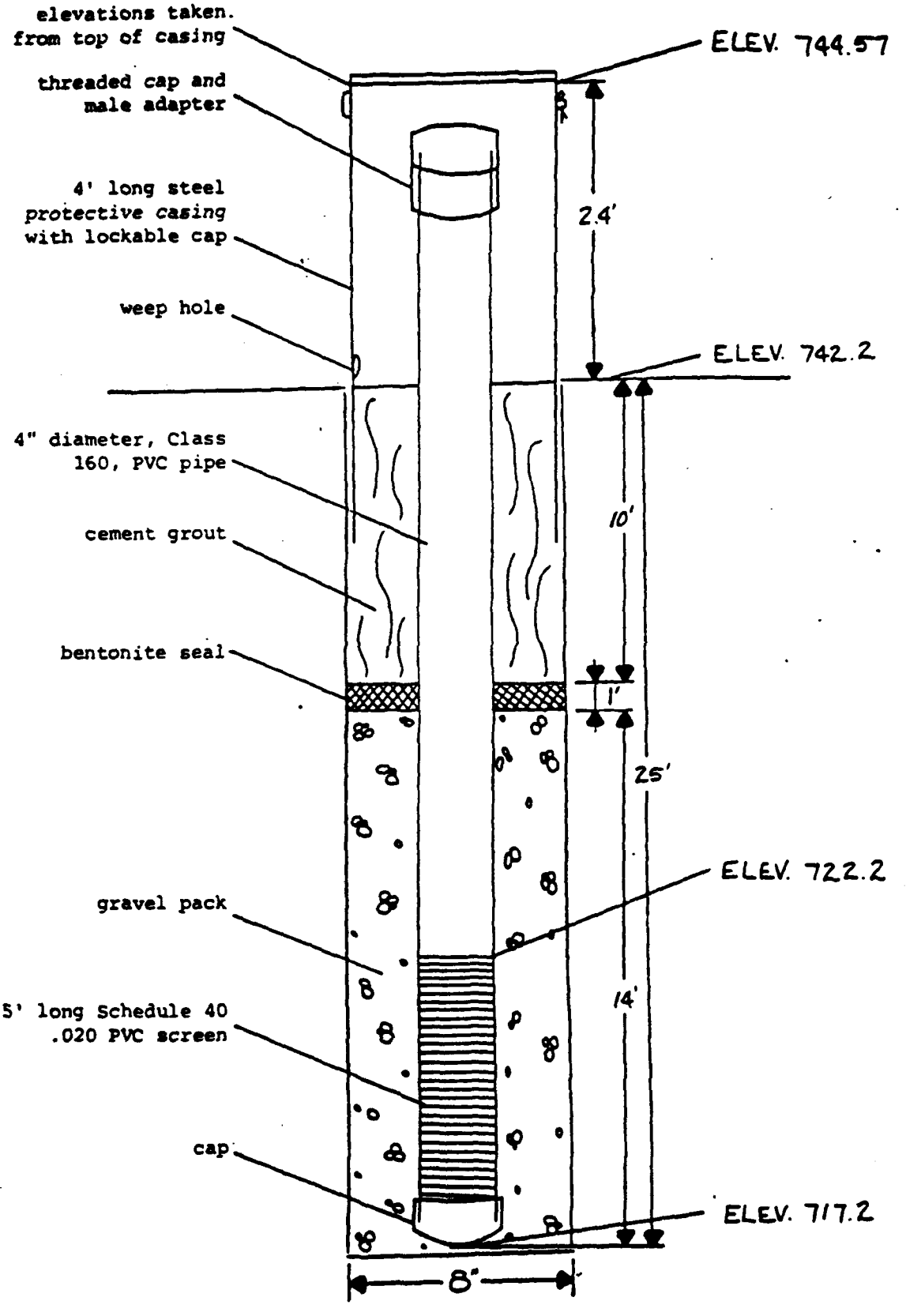
REMARKS: (Casing, Water Loss, Etc.)

Pumped 2 hours - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 28.3 | | 9/10/81 (Completion) |
| | | |

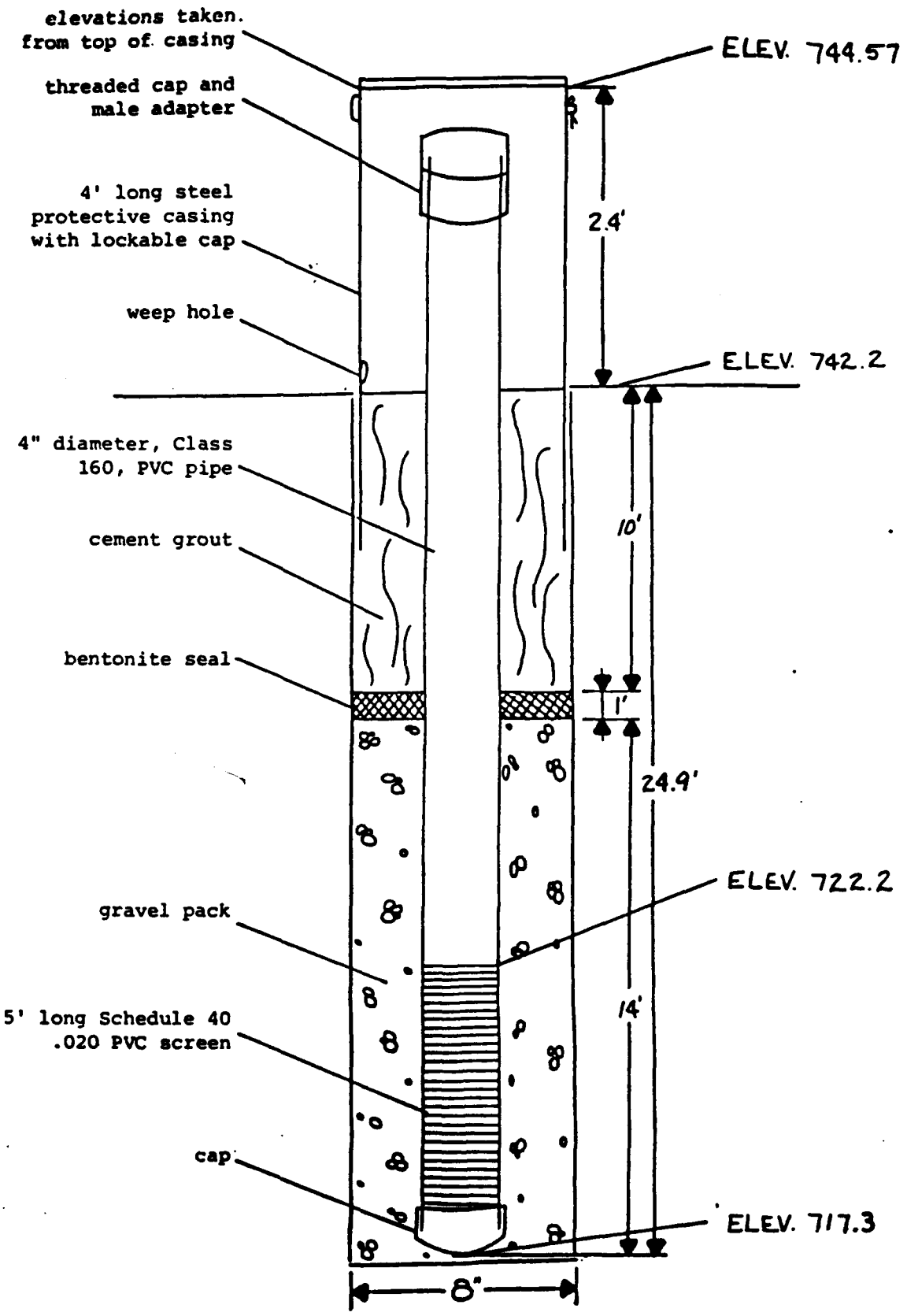
[illegible] Company, Inc.

## CONSTRUCTION OF WELL




MW 3-3

## CONSTRUCTION OF WELL




MW 3-3

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 3-3 Sheet: 1 of 1

Surface Elevation: 742.2 Offset:

Date Started: 8/14/81 Completed: 8/14/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.5' | WB | | | | Orange sandy clay, soft to med. |
| 4.5' | 8.0' | WB | | | | Light brown sandy clay, soft |
| 8.0' | 9.5' | WB | | | | Brown & orange fine to med. sand |
| 9.5' | 11.0' | ST1 | 1.0 | | | Orange & brown fine to med. sand |
| 11.0' | 17.0' | WB | | | | Brown & orange fine sand |
| 17.0' | 18.0' | WB | | | | Gray clay, soft to med. |
| 18.0' | 24.0' | WB | | | | Light brown fine sand |
| 24.0' | 40.0' | WB | | | | Gray fine sand |
| 40.0' | Total | depth | | | | |

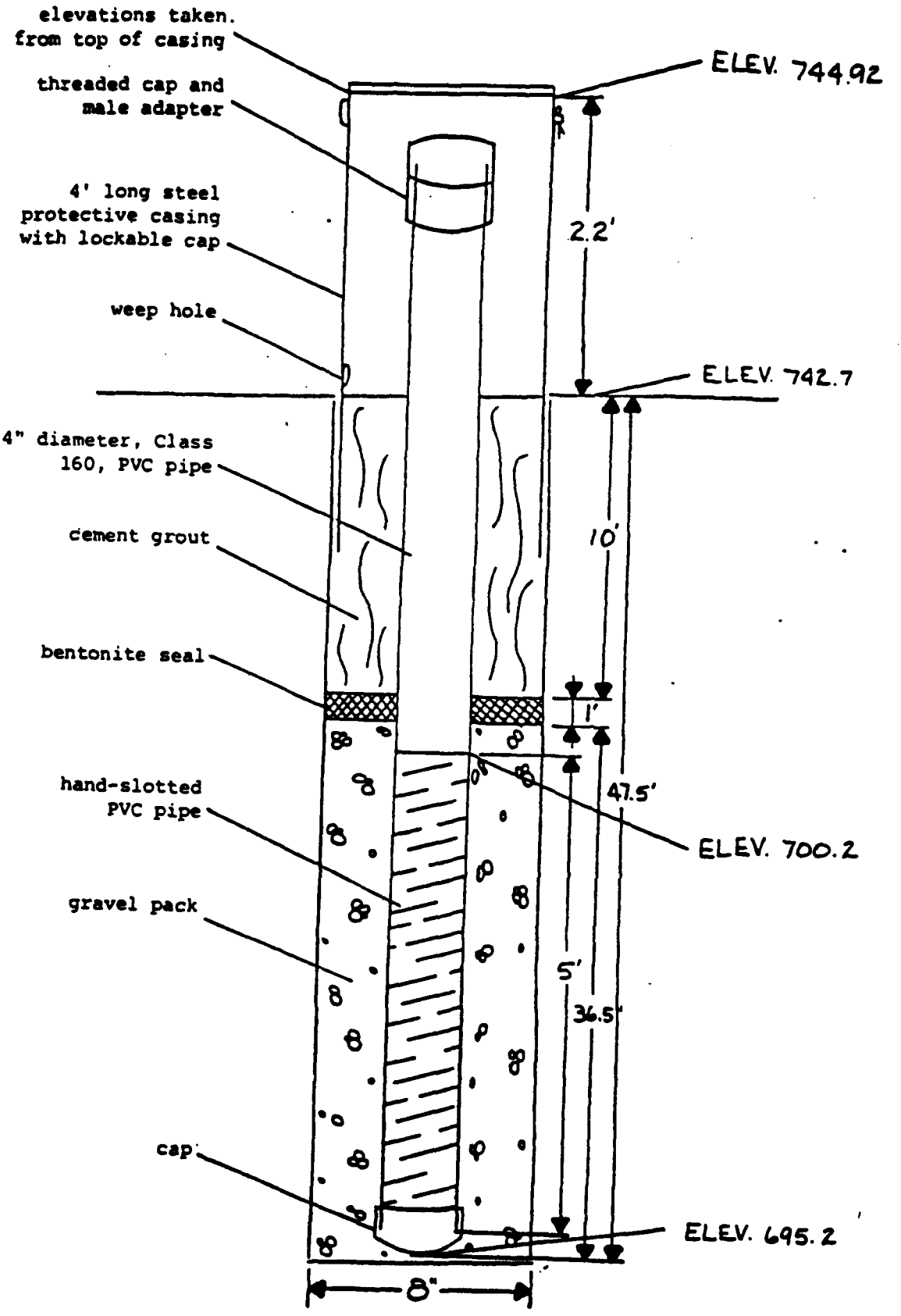
REMARKS: (Casing, Water Loss, Etc.)

mped 1 hour - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 16.1 | | 9/10/81 (Completion) |

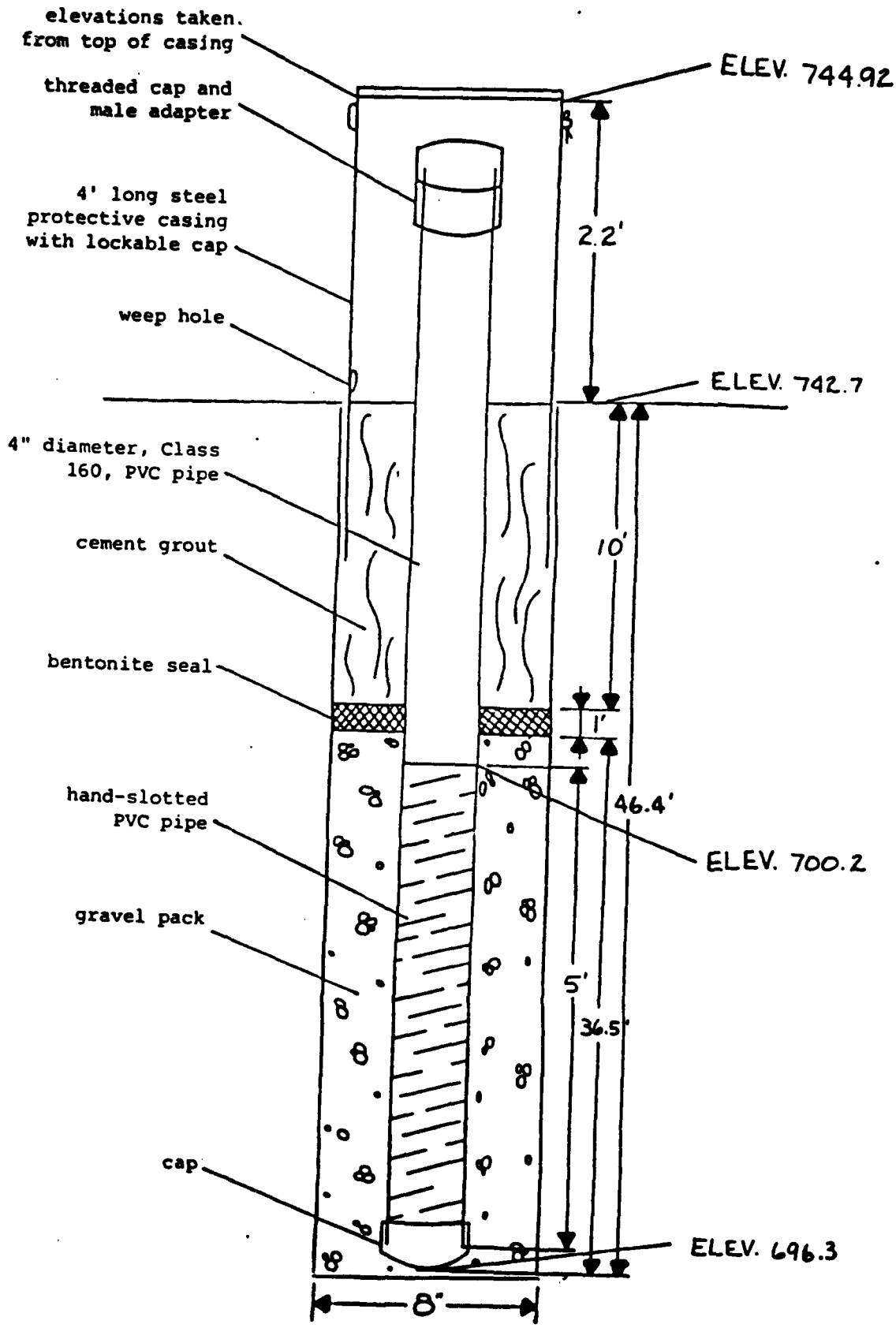
Layne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 3-4

# CONSTRUCTION OF WELL




No. B-4



Redevelopment 2/85

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 3-4 Sheet: 1 of 1

Surface Elevation: 742.7 Offset:

Address:

Date Started: 9/22/81 Completed: 9/22/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

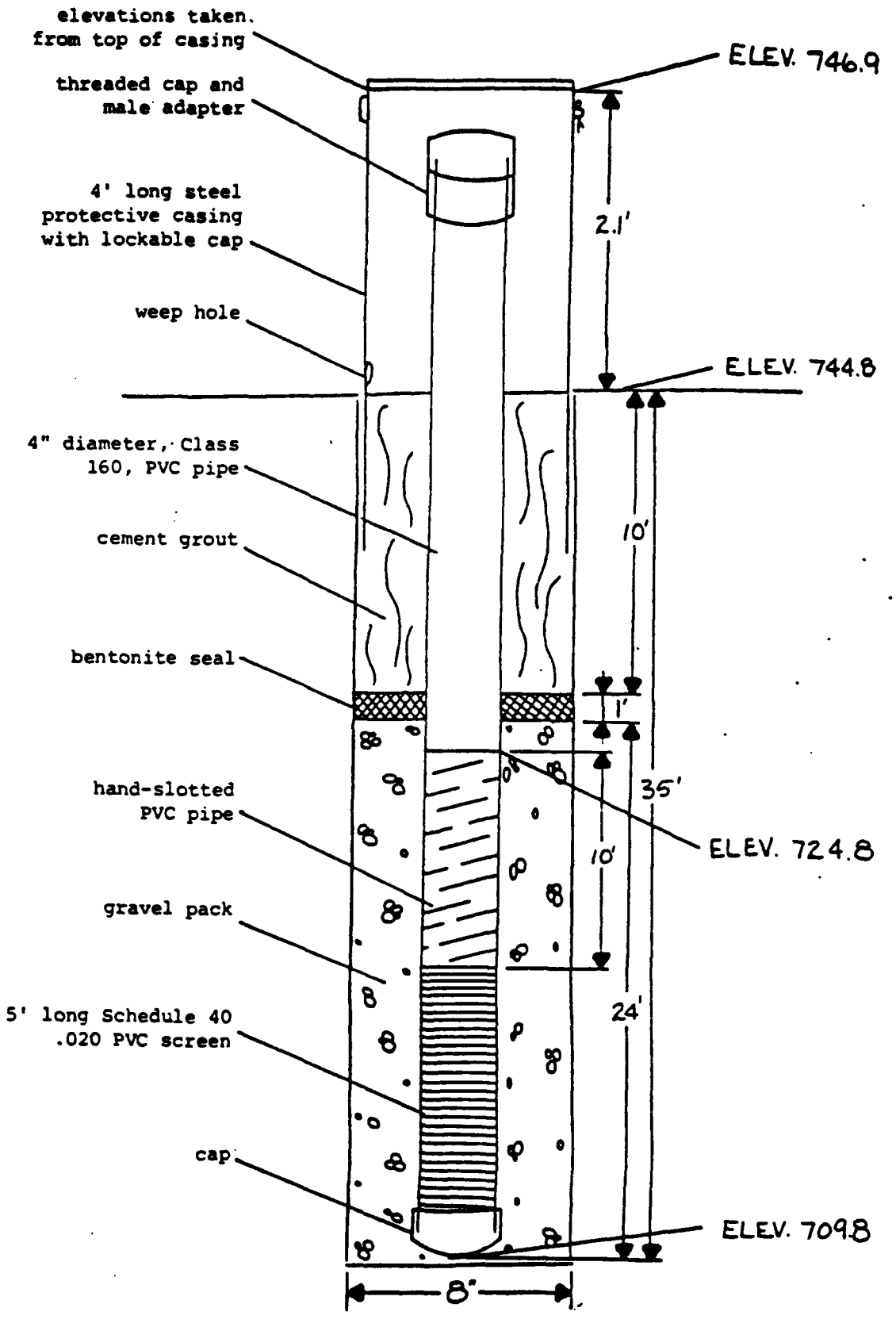
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Brown silty clay, stiff |
| 5.0' | 10.0' | WB | | | | Gray & brown clayey silt, med. |
| 10.0' | 11.6' | WB | | | | Same |
| 11.6' | 15.0' | WB | | | | Brown sandy silt, med. |
| 15.0' | 20.0' | WB | | | | Same |
| 20.0' | 26.4' | WB | | | | Same |
| 26.4' | 30.0' | WB | | | | Brown & gray sandy silt, very stiff |
| 30.0' | 33.0' | WB | | | | Same |
| 33.0' | 35.0' | WB | | | | Gray fine sand, loose |
| 35.0' | 40.0' | WB | | | | Same |
| 40.0' | 45.0' | WB | | | | Gray fine sand w/trace med. sand, loose |
| 45.0' | 50.0' | WB | | | | Same |
| 50.0' | Total | depth | | | | |
| | | | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

Pumped 1.75 hours - 7 GPM

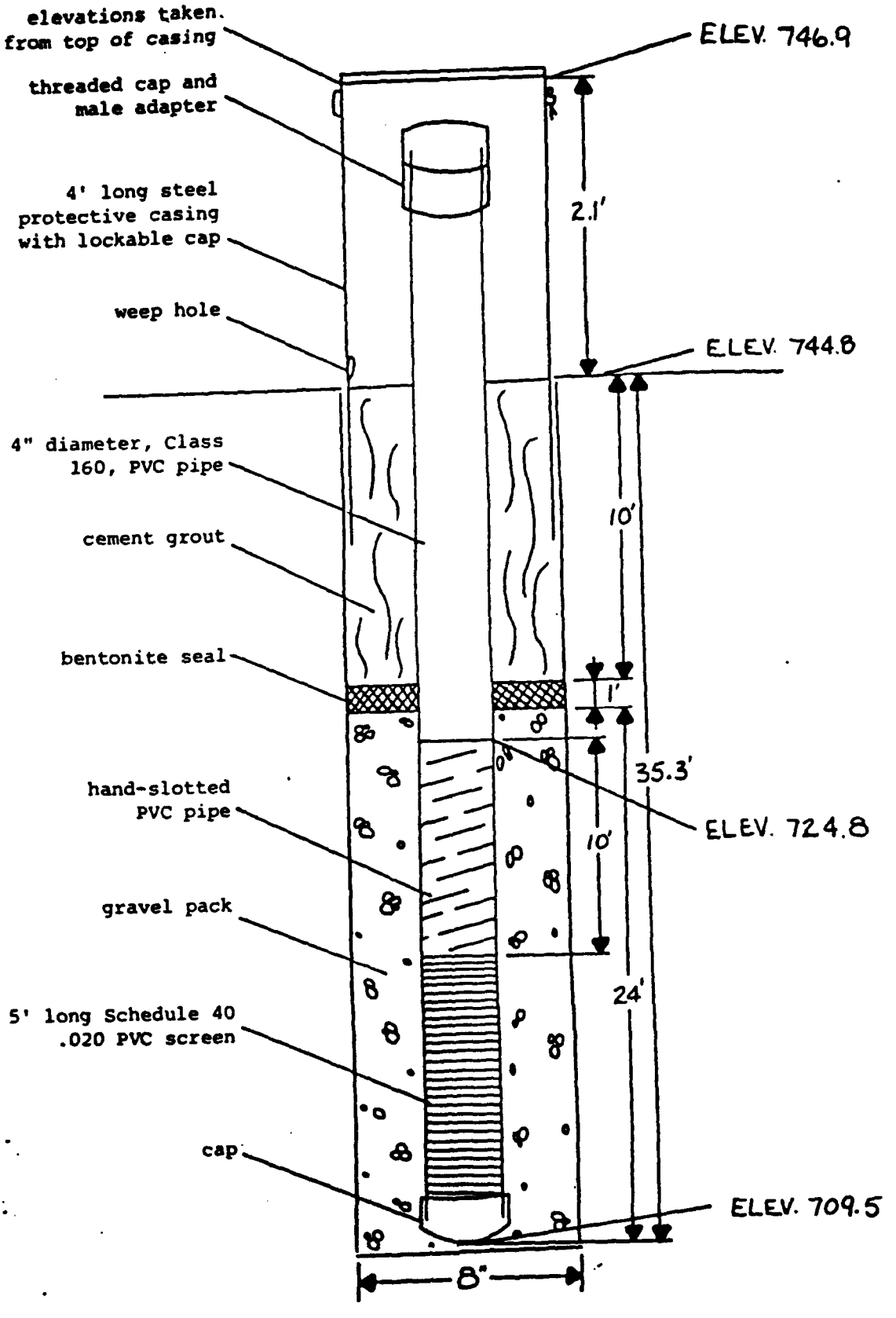
| Static Water Level | Time | Date |
|---|---|---|
| 27.8 | | 9/22/81 (Completion) |
| | | |

Western Company, Inc.


elevations taken from top of casing
threaded cap and male adapter
4' long steel protective casing with lockable cap
weep hole
4" diameter, Class 160, PVC pipe
cement grout
bentonite seal
hand-slotted PVC pipe
gravel pack
5' long Schedule 40 .020 PVC screen
cap
ELEV. 746.9
2.1'
ELEV. 744.8
10'
1'
35'
ELEV. 724.8
10'
24'
ELEV. 709.8
8"

MW 3-5

## CONSTRUCTION OF WELL




MW 3-5

# TEST BORING LOG

oject Lake City AAP

Boring No. MW 3-5 Sheet 1 of 1

Surface Elevation 744.8 Offset

ddress

Date Started 8/13/81 Completed 8/14/81

y & State Independence, Missouri

Driller B. Blank Rig

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Brown silty clay, very stiff |
| 5.0' | 9.5' | WB | | | | Dark brown clayey sand, med. dense |
| 9.5' | 11.0' | SS1 | | 3-5-5 | 1.4' | Same |
| 11.0' | 13.0' | WB | | | | Same |
| 13.0' | 15.0' | WB | | | | Gray & brown silty clay w/trace sand, very stiff |
| 15.0' | 20.0' | WB | | | | Same |
| 20.0' | 25.0' | WB | | | | Same |
| 25.0' | 28.0' | WB | | | | Brown silty sand w/trace clay, med. dens |
| 28.0' | 29.5' | WB | | | | Same |
| 29.5' | 31.0' | SS2 | | 3-5-5 | 1.4' | Same |
| 31.0' | 32.0' | WB | | | | Same |
| 32.0' | 35.0' | WB | | | | Blue gray sandy silt, very stiff |
| 35.0' | 40.0' | WB | | | | Same |
| 40.0' | Total | depth | | | | |

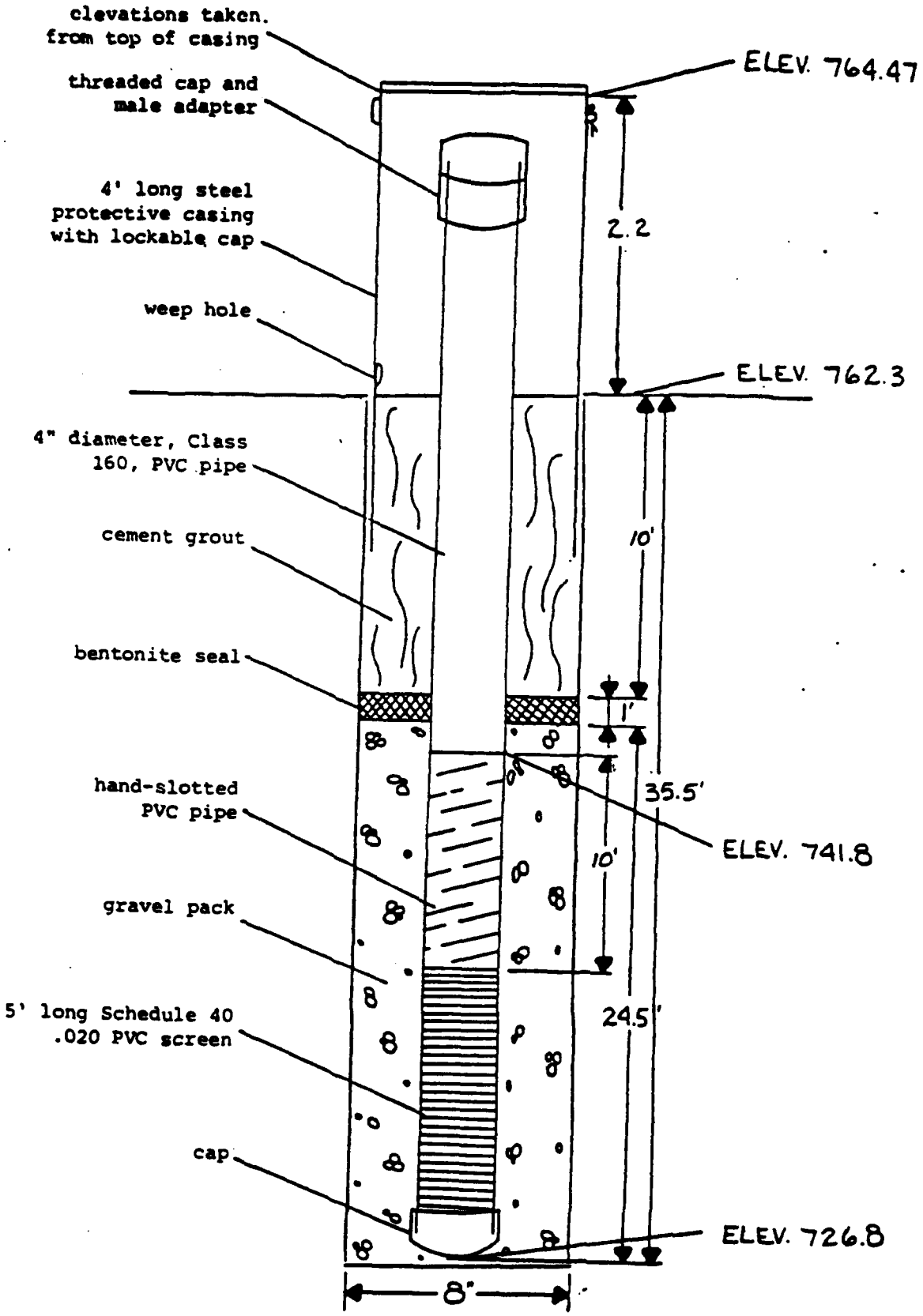
MARKS: (Casing, Water Loss, Etc.)

umped 1-1/2 hour - 2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 30.4 | | 9/10/81 (Completion) |

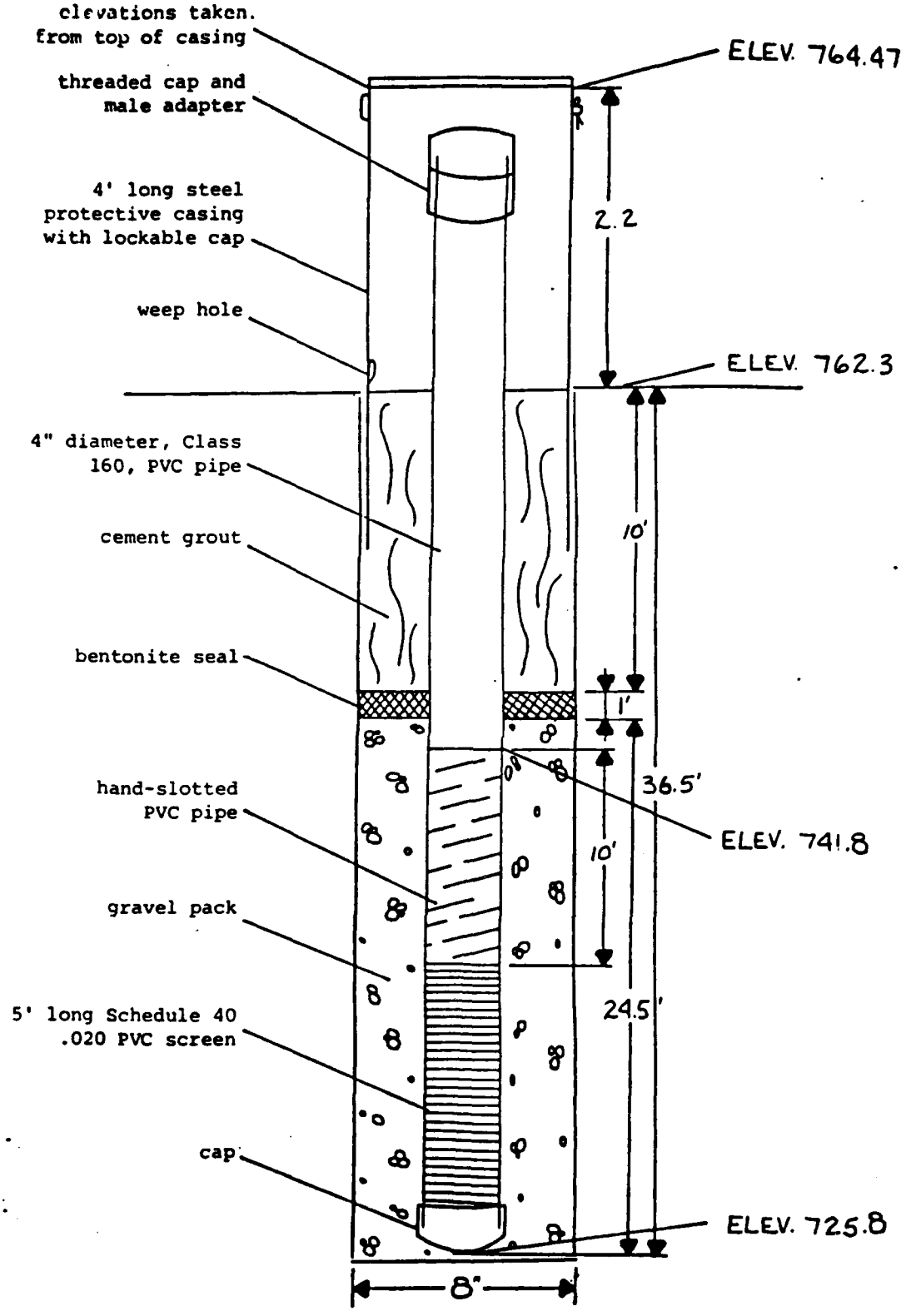
'ayne-Western Company, Inc.

## CONSTRUCTION OF WELL




MW 4-1

## CONSTRUCTION OF WELL




MW 4-1



REDEVELOPMENT 2/85

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 4-1 Sheet: 1 of 1

Surface Elevation: 762.3 Offset:

Address: [redacted]

Date Started: 8/11/81 Completed: 8/12/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

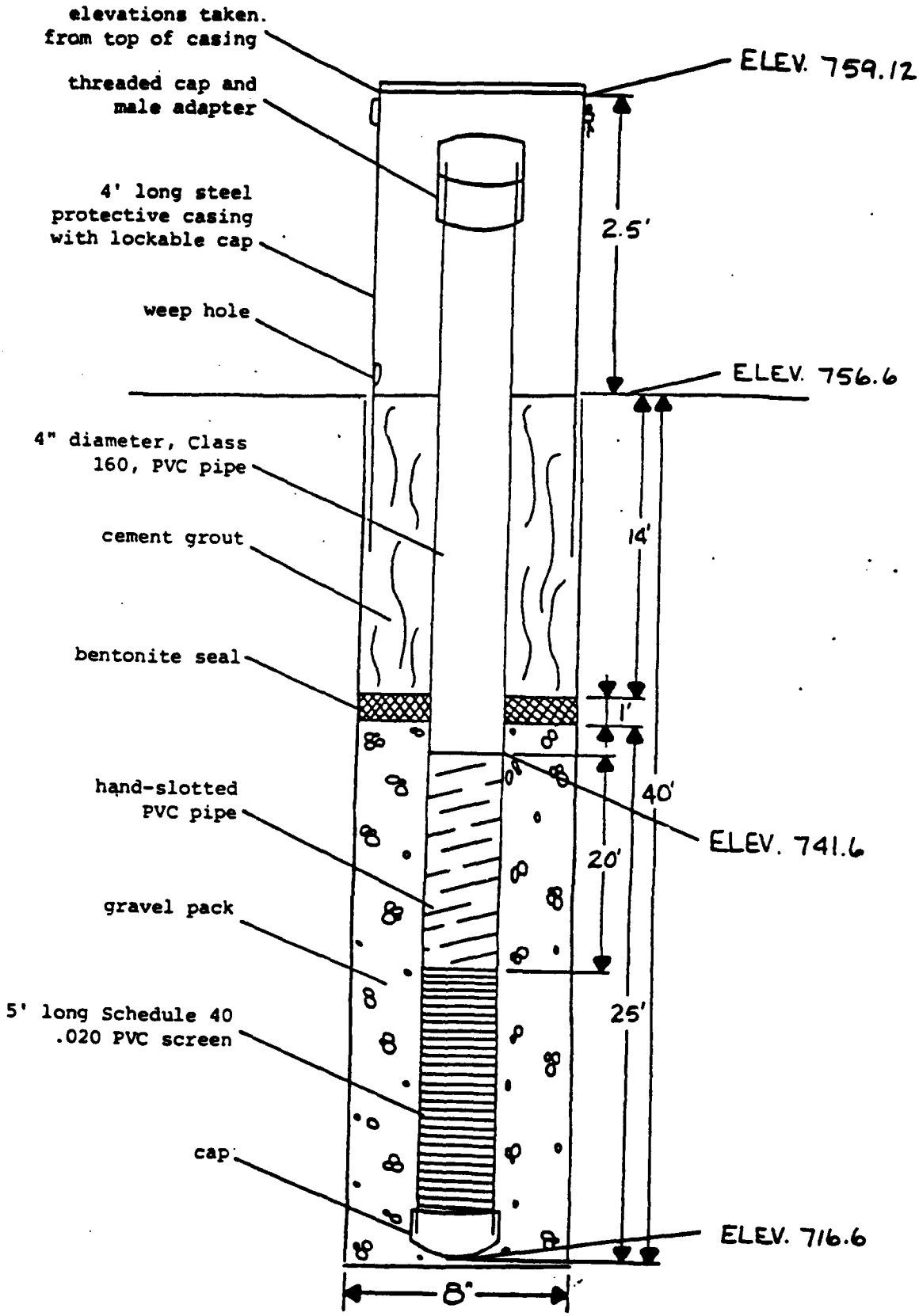
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Gray & brown silty clay, very stiff |
| 5.0' | 9.5' | WB | | | | Same |
| 9.5' | 11.0' | ST1 | 2.5 | | 1.0' | Same |
| 11.0' | 15.0' | WB | | | | Same |
| [illegible]5.0' | 20.0' | WB | | | | Gray & brown silty clay w/trace sand & gravel, very stiff |
| [illegible]0' | 25.0' | WB | | | | Same |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 35.0' | WB | | | | Same |
| 35.0' | 36.0' | WB | | | | Same |
| 36.0' | 40.0' | WB | | | | Yellow brown silty clay w/trace sand, very stiff |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 2 hours - 1/2 GPM | 18.9 | | 9/11/81 (Completion) |
| [redacted] | | | |

Wyne-Western Company, Inc.

## CONSTRUCTION OF WELL




MW 4-2

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 4-2 Sheet: 1 of 1

Surface Elevation: 756.6 Offset:

Date Started: 8/24/81 Completed: 8/25/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

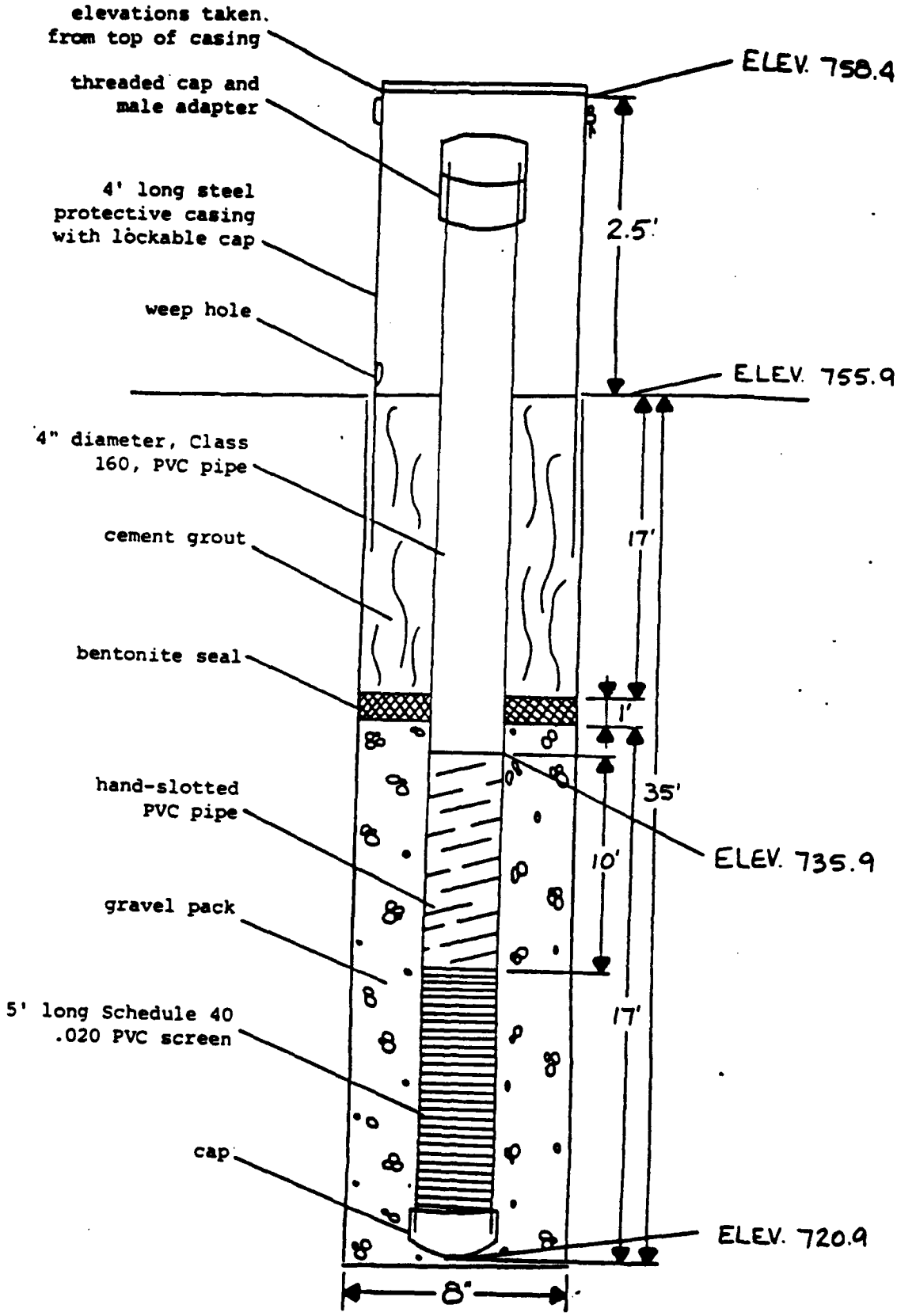
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.5' | WB | | | | Topsoil |
| 0.5' | 7.0' | WB | | | | Dark brown silty clay, soft |
| 7.0' | 9.5' | WB | | | | Gray silty clay, soft |
| 9.5' | 11.0' | ST1 | 1.0 | | | Gray clayey silt, soft |
| 11.0' | 16.0' | WB | | | | Same |
| 16.0' | 19.5' | WB | | | | Light tan silty clay, soft |
| [illegible]5' | 21.0' | ST2 | 2.0 | | | Gray silty clay w/trace sand, soft to m |
| 21.0' | 29.5' | WB | | | | Gray sandy clay, soft to med. |
| 29.5' | 39.5' | WB | | | | Same |
| 39.5' | 41.0' | SS1 | | | | Same |
| 41.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| mped 2 hours - 1/2 GPM | 10.0 | | 9/11/81 (Completion) |
| | | | |

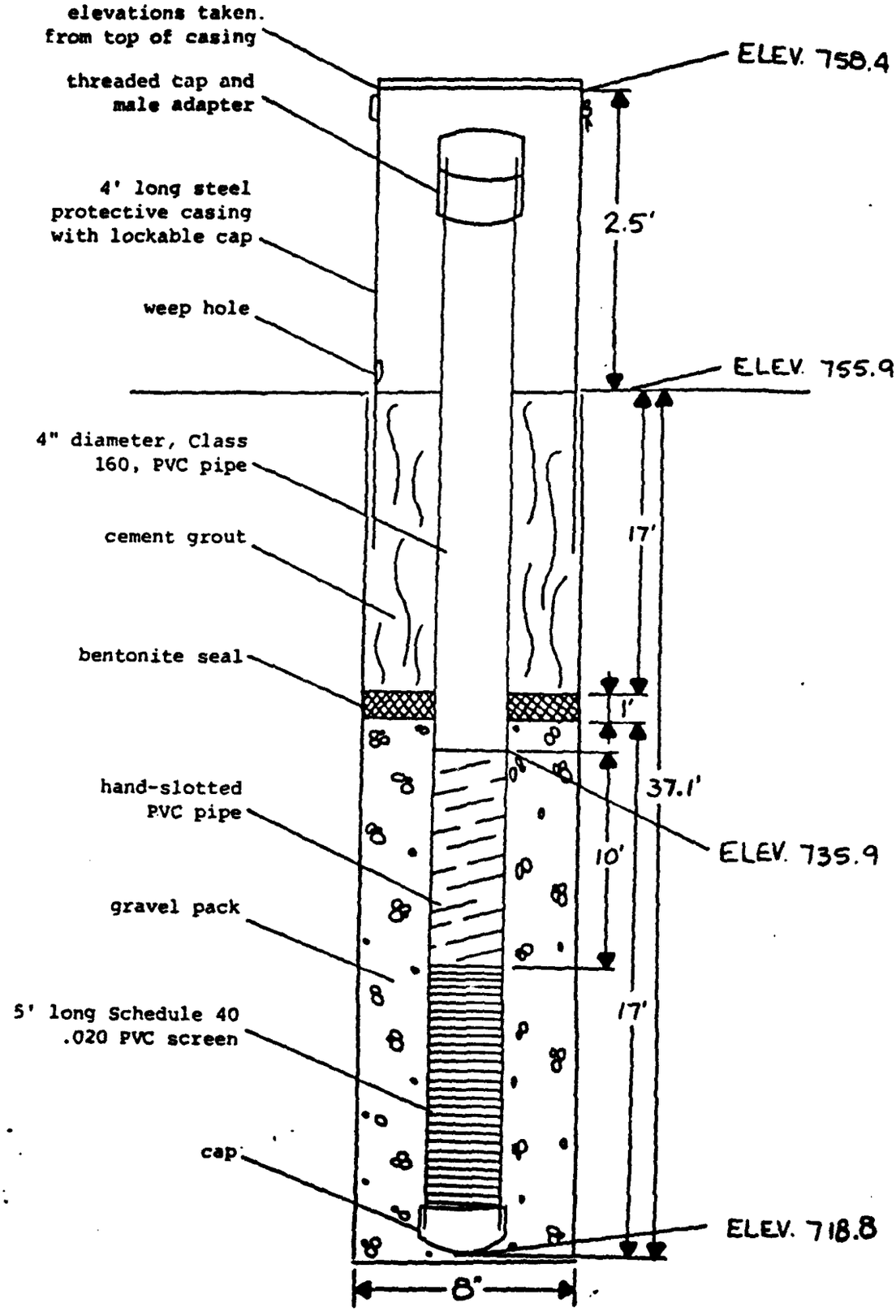
Wayne-Western Company, Inc.

## CONSTRUCTION OF WELL




MW 4-3

CONSTRUCTION OF WELL




MW 4-3



REDEVELOPMENT 2/85

# TEST BORING LOG

Project: Lake City AAP
Boring No.: MW 4-3
Sheet: 1 of 1
Surface Elevation: 755.9
Offset:
Address:
Date Started: 8/12/81
Completed: 8/12/81
City & State: Independence, Missouri
Driller: T. Butler
Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 7.5' | WB | | | | Dark brown silty clay, soft to med. |
| 7.5' | 9.5' | WB | | | | Brown silty clay, med. to stiff |
| 9.5' | 11.0' | ST1 | 4.5 | | | Brown silty clay, very stiff |
| 11.0' | 12.5' | WB | | | | Brown silty clay, stiff |
| 12.5' | 17.0' | WB | | | | Light gray silty clay, soft to med. |
| 17.0' | 19.5' | WB | | | | Light brown silty clay, soft to med. |
| 19.5' | 21.0' | ST2 | 1.0 | | | Light gray silty sandy clay, med. |
| 21.0' | 23.0' | WB | | | | Light gray silty sandy clay, soft to me |
| 23.0' | 28.0' | WB | | | | Light gray silty clay w/trace sand, soft to med. |
| 28.0' | 33.5' | WB | | | | Light gray silty clay w/trace sand, sof |
| 33.5' | 34.5' | WB | | | | Light gray silty clay w/trace sand & weathered shale, soft to med. |
| 34.5' | 40.0' | WB | | | | Light brown sandy clay, soft to med. |
| 40.0' | Total depth | | | | | |

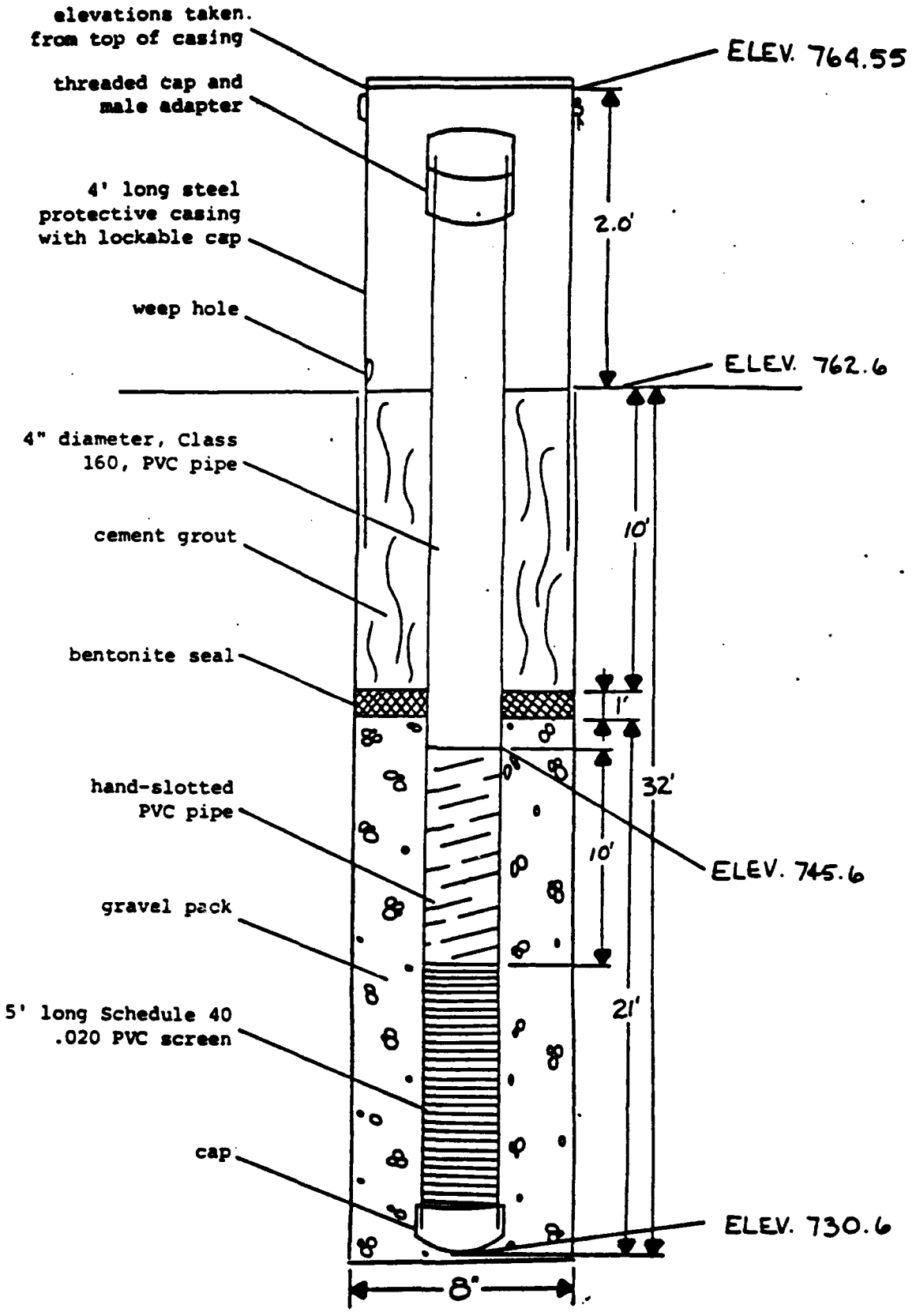
REMARKS: (Casing, Water Loss, Etc.)

Pumped 1-1/2 hour - 1 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 8.0 | | 9/11/81 (Completion) |

Layne-Western Company, Inc.

## CONSTRUCTION OF WELL




MW 4-4

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 4-4 Sheet: 1 of 1

Surface Elevation: 762.6 Offset:

Address:

Date Started: 8/12/81 Completed: 8/13/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Gray & brown silty clay, very stiff |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 15.0' | WB | | | | Same |
| 15.0' | 19.0' | WB | | | | Same |
| 19.0' | 20.5' | ST1 | 1.5 | | 1.3' | Gray & brown silty clay w/trace sand, stiff |
| 20.5' | 25.0' | WB | | | | Same |
| 25.0' | 30.0' | WB | | | | Brown & gray silty clay w/trace sand & gravel, very stiff |
| 30.0' | 35.0' | WB | | | | Same |
| 35.0' | 36.0' | WB | | | | Same |
| 36.0' | 40.0' | WB | | | | Brown silty clay, very stiff |
| 40.0' | Total | depth | | | | |

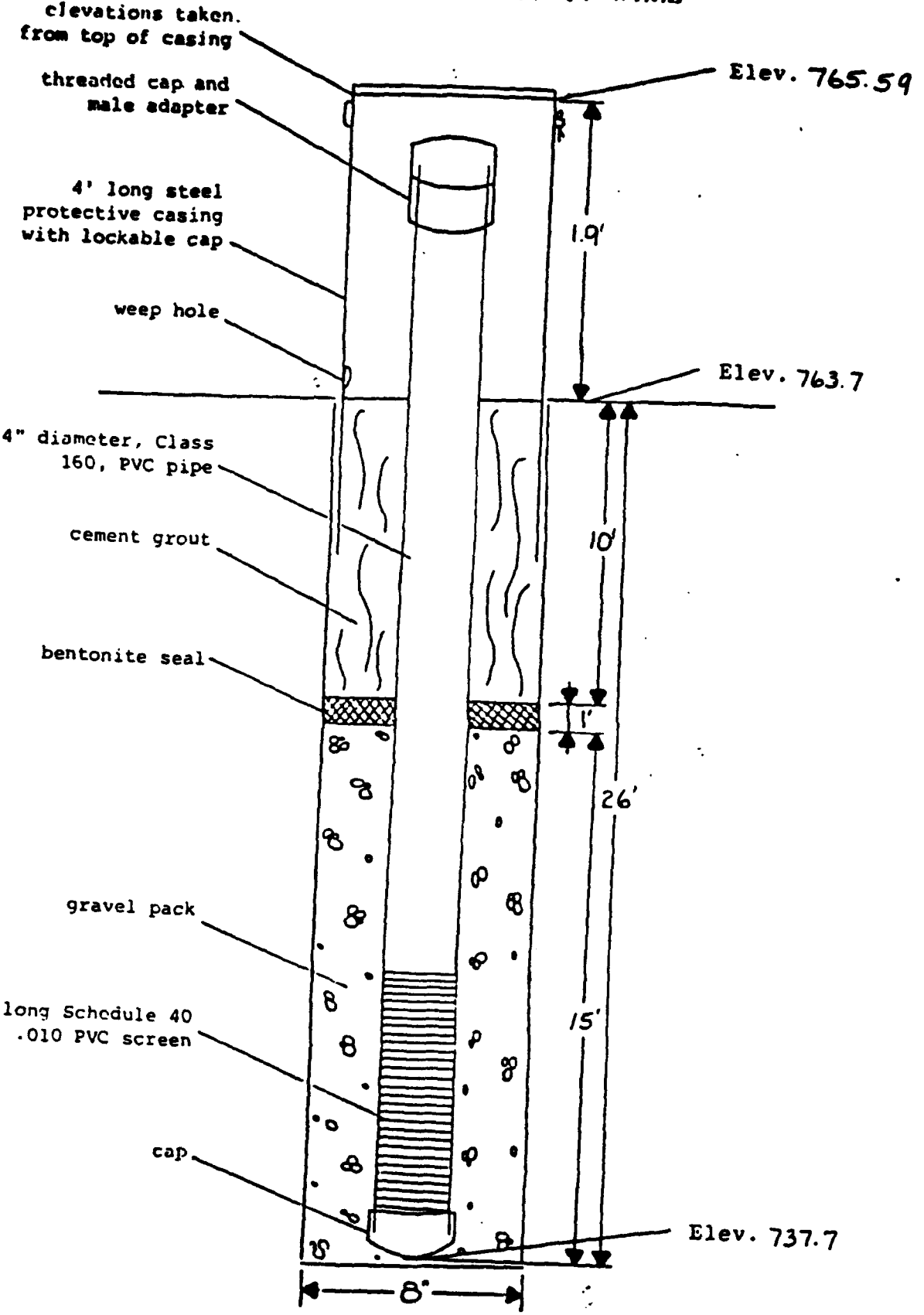
REMARKS: (Casing, Water Loss, Etc.)

Pumped 2 hours - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 13.8 | | 9/11/81 (Completion) |
| | | |

Wayne-Western Company, Inc.

CONSTRUCTION OF WELL




MW 4-5

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. MW 4-5 — Sheet 1 of 1

Surface Elevation _____ Offset _____

Address _____ Date Started 1/21/82 Completed 1/21/82

City & State Independence, Missouri — Driller T. J. Butler Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

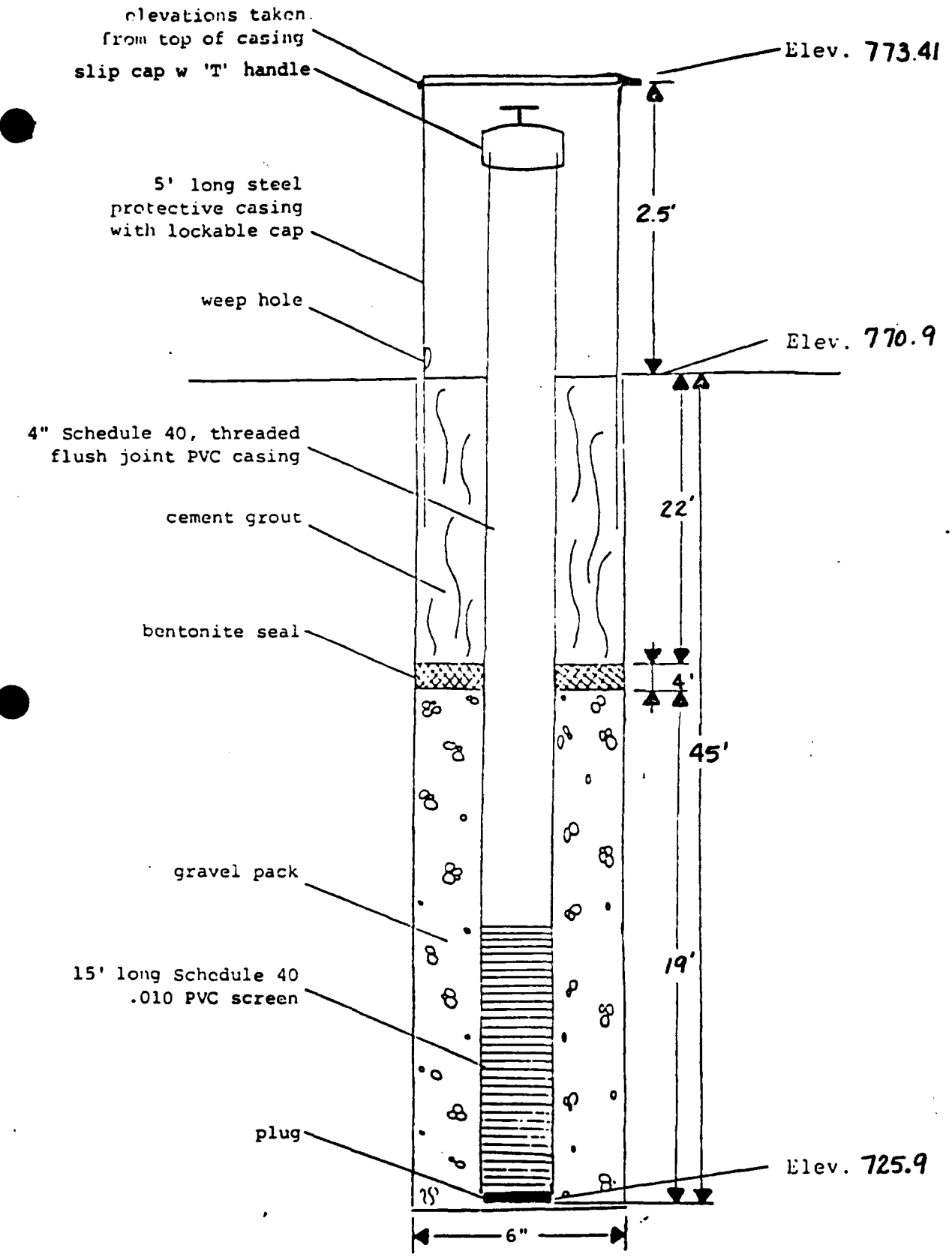
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 7.5' | WB | | | | Light brown & gray silty clay, med. to stiff |
| 7.5' | 10.0' | WB | | | | Same |
| 10.0' | 15.0' | WB | | | | Same |
| 15.0' | 20.0' | WB | | | | Same |
| 20.0' | 29.5' | WB | | | | Gray silty clay, very soft to soft |
| 29.5' | 40.0' | WB | | | | Gray silty clay, stiff to medium |
| 40.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date |
|---|---|---|---|
| Pumped 2½ hours @ 3.5 GPM, not steadily | 4.0' | Before Pumping | 1/25/82 (Completion) |
| | | | |

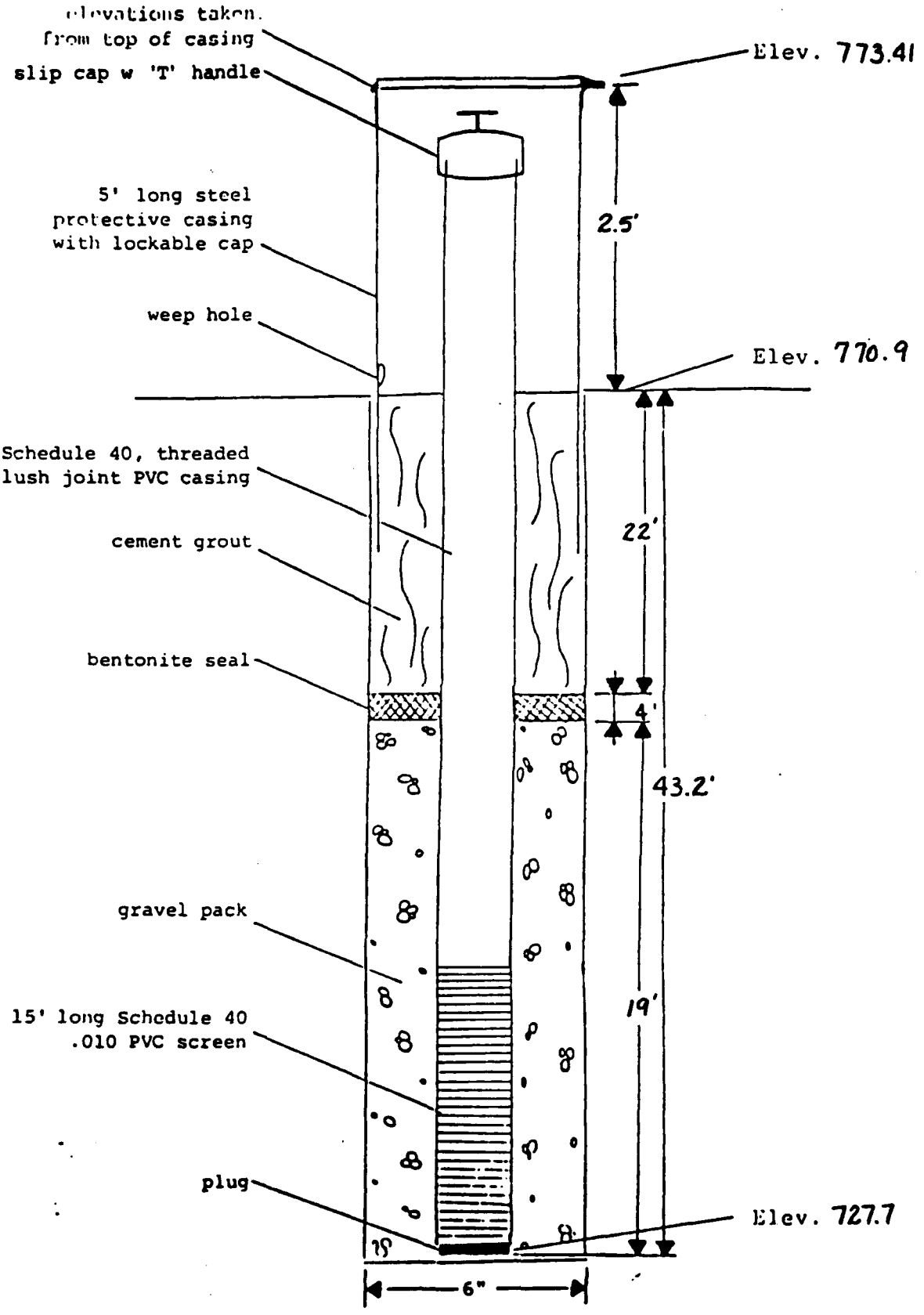
Layne-Western Company, Inc.

# WELL CONSTRUCTION




MW 4-6

# WELL CONSTRUCTION




MW 4-6



Redevelopment 2/85

# TEST BORING LOG

Project: Lake City Army Ammunition Plant — Boring No. TH 1 — Sheet 1 of 2

Surface Elevation 761.5 — Offset

Address: Lake City Plant — Date Started 9/26/83 — Completed 9/26/83

City & State: Independence, Missouri — Driller M. L. Blank — Rig D-12

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | HA | | | | Brown silty clay, moist, very stiff |
| 1.0' | 2.5' | SS1 | | 5-7-10 | 0.3' | Brown & dark brown gray silty clay, fill, iron stains, moist, very stiff |
| 2.5' | 4.0' | SS2 | | 6-6-6 | 1.5' | Gray & brown silty clay w/iron stains, trace of roots & small rock, fill, moist, stiff |
| 4.0' | 5.5' | SS3 | | 6-7-10 | 1.5' | Gray & brown very silty clay, w/iron stains, trace small rock, moist, very stiff |
| 5.5' | 7.0' | SS4 | | 3-6-7 | 1.5' | Gray very silty clay w/iron stains, moist, stiff |
| 7.0' | 8.5' | SS5 | | 4-6-10 | 1.5' | Same |
| 8.5' | 10.0' | SS6 | | 3-6-8 | 1.5' | Same |
| 10.0' | 11.5' | SS7 | | 3-6-9 | 1.5' | Gray w/brown silty clay, w/iron stains, moist, stiff (possible fill) |
| 11.5' | 13.0' | SS8 | | 3-5-5 | 1.5' | Gray very silty clay w/ iron stains, moist, stiff (increasing moisture content) |
| 13.0' | 14.5' | SS9 | | 2-4-6 | 1.5' | Same |
| 14.5' | 16.0' | SS10 | | 2-4-4 | 1.5' | Gray fine sandy silty clay, w/trace iron stain & small rock, moist, medium (possible fill?) |
| 16.0' | 17.5' | SS11 | | 2-4-6 | 1.5' | Gray very silty clay, trace fine sand & small rock, moist, stiff, (possible fill?) |
| 17.5' | 19.0' | SS12 | | 2-5-6 | 1.5' | Gray w/trace brown very silty clay, trace iron stains, moist, stiff (possible fill?) |
| 19.0' | 20.5' | SS13 | | 3-4-6 | 1.5' | Gray w/trace brown very silty clay, becoming sandier w/depth, moist, stiff |
| 20.5' | 22.0' | SS14 | | 2-4-5 | 1.5' | Gray w/trace brown silt, traces of fine sand & clay, moist, stiff |
| 22.0' | 23.5' | SS15 | | 3-3-5 | 1.5' | Gray w/trace brown clayey silt, trace iron stains, moist, medium |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Completion) |
| | | | |

Law Western Company, Inc.

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. TH 1 — Sheet 2 of 2

Surface Elevation _____ Offset _____

Address _____ Date Started _____ Completed _____

City & State _____ Driller _____ Rig _____

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 23.5' | 25.0' | SS16 | | 4-5-7 | 1.5' | Gray w/trace brown silt, w/traces of clay, moist, stiff |
| 25.0' | 26.5' | SS17 | | 3-4-5 | 1.5' | Gray silt, w/traces of clay in upper zone, very moist, (increasing moisture w/depth), stiff |
| 26.5' | 28.0' | SS18 | | 2-3-6 | 1.5' | Gray clayey silt, moist, stiff |
| 28.0' | 29.5' | SS19 | | 3-4-4 | 1.5' | Gray clayey silt, trace fine sand, wet pockets in soil, very moist, medium |
| 29.5' | 31.0' | SS20 | | 4-6-7 | 1.5' | Gray clayey silt, w/rocky zones (chert) limestone, very moist, stiff |
| 31.0' | 32.5' | SS21 | | 2-4-5 | 1.5' | Gray silt, trace of clay & fine sand, moist, stiff |
| 32.5' | 34.0' | SS22 | | 5-6-6 | 1.5' | Brown gray clayey silt, w/traces fine sand, moist, stiff (sampler wet) |
| 34.0' | 35.5' | SS23 | | 4-5-6 | 1.5' | Brown gray clayey silt, trace fine sand, iron nodules & stains, moist, stiff |
| 35.5' | 37.0' | SS24 | | 2-4-6 | 1.5' | Gray clayey silt, w/iron stains & nodules, w/traces of rock, moist, stiff |
| 37.0' | 38.5' | SS25 | | 4-5-7 | 1.5' | Brown clayey silt w/traces of rock, moist, stiff |
| 38.5' | 40.0' | SS26 | | 3-5-6 | 1.5' | Brown w/traces of gray clayey silt, moist, stiff |
| 40.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Completion) |
| | | | |

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: TH 2 & MW-4-6 Sheet: 1 of 3
Surface Elevation: 770.9 Offset:
Address: Lake City Plant
Date Started: 9/27/83 Completed: 9/27/83
City & State: Independence, Missouri
Driller: M. L. Blank Rig: D-12

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | HA | | | | Topsoil |
| 1.0' | 2.5' | SS1 | | 5-5-5 | 0.5' | Gray brown clayey silt, trace of roots, slightly moist, stiff |
| 2.5' | 4.0' | SS2 | | 6-4-3 | 0.5' | Gray brown clayey silt, trace of roots, slightly moist, medium |
| 4.0' | 5.5' | SS3 | | 2-2-4 | 0.8' | Gray & brown very silty clay, trace of dark & iron stains, moist, medium (fill) |
| 5.5' | 7.0' | SS4 | | 6-4-6 | 1.5' | Gray & brown very silty clay, trace of dark & iron stains, moist, stiff (fill) |
| 7.0' | 8.5' | SS5 | | 2-4-5 | 1.5' | Gray w/brown very silty clay w/gray clay pocke trace of roots, moist, stiff (fill) |
| 8.5' | 10.0' | SS6 | | 2-4-6 | 1.5' | Gray w/brown very silty clay w/gray clay pocke w/dark nodules, moist, stiff (fill) |
| 10.0' | 11.5' | SS7 | | 3-4-7 | 1.5' | Same |
| 11.5' | 13.0' | SS8 | | 4-6-8 | 1.5' | Brown w/gray very silty clay, trace of dark nodules, moist, stiff (fill?) |
| 13.0' | 14.5' | SS9 | | 2-5-6 | 1.5' | Brown & gray very silty clay,tr. of dark nodul & iron stains, moist, stiff |
| 14.5' | 16.0' | SS10 | | 2-4-6 | 1.5' | Brown & gray very silty clay,tr.of dark nodule & iron stains, sand & small rock, moist, stiff |
| 16.0' | 17.5' | SS11 | | 3-4-6 | 1.5' | Same |
| 17.5' | 18.5' | SS12 | | 1-7-9 | 1.5' | Gray very silty clay, traces of dark nodules, fine sand & small rock, moist, very stiff |
| 18.5' | 20.0' | SS13 | | 2-10-14 | 1.5' | Gray very silty clay, traces of dark nodules, & iron stains, moist, very stiff |
| 20.0' | 21.5' | SS14 | | 4-7-10 | 1.5' | Same |
| 21.5' | 23.0' | SS15 | | 4-8-12 | 1.5' | Gray & brown very silty clay, dark & iron stains, moist, very stiff |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date | |
|---|---|---|---|---|
| w/augers in | 28.3' | 2:15 pm | 9/27/83 | (Completion) |
| | 20.5' | 10:00 am | 9/28/83 | |

Layne-Western Company, Inc.

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. TH 2 & MW-4-6 — Sheet 2 of 3

Surface Elevation _____ Offset _____

Address _____ Date Started _____ Completed _____

City & State _____ Driller _____ Rig _____

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 23.0' | 24.5' | SS16 | | 5-8-11 | 1.5' | Gray & brown very silty clay, dark & iron stains, moist, very stiff |
| 24.5' | 26.0' | SS17 | | 4-7-8 | 1.5' | Same (sample gets grayer w/depth) |
| 26.0' | 27.5' | SS18 | | 3-6-10 | 1.5' | Brown & gray very silty clay, traces of iron & dark stains, moist, stiff |
| 27.5' | 29.0' | SS19 | | 4-8-12 | 1.5' | Brown & gray very silty clay w/dark stains, traces of iron stains, moist, stiff |
| 29.0' | 30.5' | SS20 | | 5-8-12 | 1.5' | Brown & gray very silty clay, traces of small rock & iron nodules, moist, very stiff |
| 30.5' | 32.0' | SS21 | | 4-8-12 | 1.5' | Brown & blue gray very clayey silt w/dark sta: moist, very stiff |
| 32.0' | 33.0' | HA | | | | Same |
| 33.0' | 34.5' | SS22 | | 4-7-11 | 1.5' | Brown & gray clayey silt w/dark & iron stains, moist, very stiff |
| 34.5' | 36.0' | SS23 | | 4-6-9 | 1.5' | Brown & gray clayey silt w/dark & iron stains w/traces of small rock, moist, very stiff |
| 36.0' | 37.5' | SS24 | | 2-5-8 | 1.5' | Same |
| 37.5' | 39.0' | SS25 | | 5-6-10 | 1.5' | Brown & gray clayey silt w/dark & iron stains w/traces small rock & fine sand, moist, v. st: |
| 39.0' | 40.5' | SS26 | | 5-6-10 | 1.5' | Same |
| 40.5' | 42.0' | SS27 | | 6-8-11 | 1.5' | Same (Note: rock is concentrated in zones in sample & is mostly chert) |
| 42.0' | 43.5' | SS28 | | 3-7-9 | 1.5' | Brown & gray sandy clayey silt, w/dark & iron stains, traces of small rock, moist, ver: |
| | | | | | | stiff (water on sampler) |
| 43.5' | 45.0' | SS29 | | 4-7-8 | 1.5' | Brown & gray sandy clayey silt w/dark & iron stains, w/lots of rock & sandy zones, mo. very stiff |

MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Completion) |
| | | | |

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. TH 2 & MW-4-6 — Sheet 3 of 3

Surface Elevation _____ Offset _____

Address _____ Date Started _____ Completed _____

City & State _____ Driller _____ Rig _____

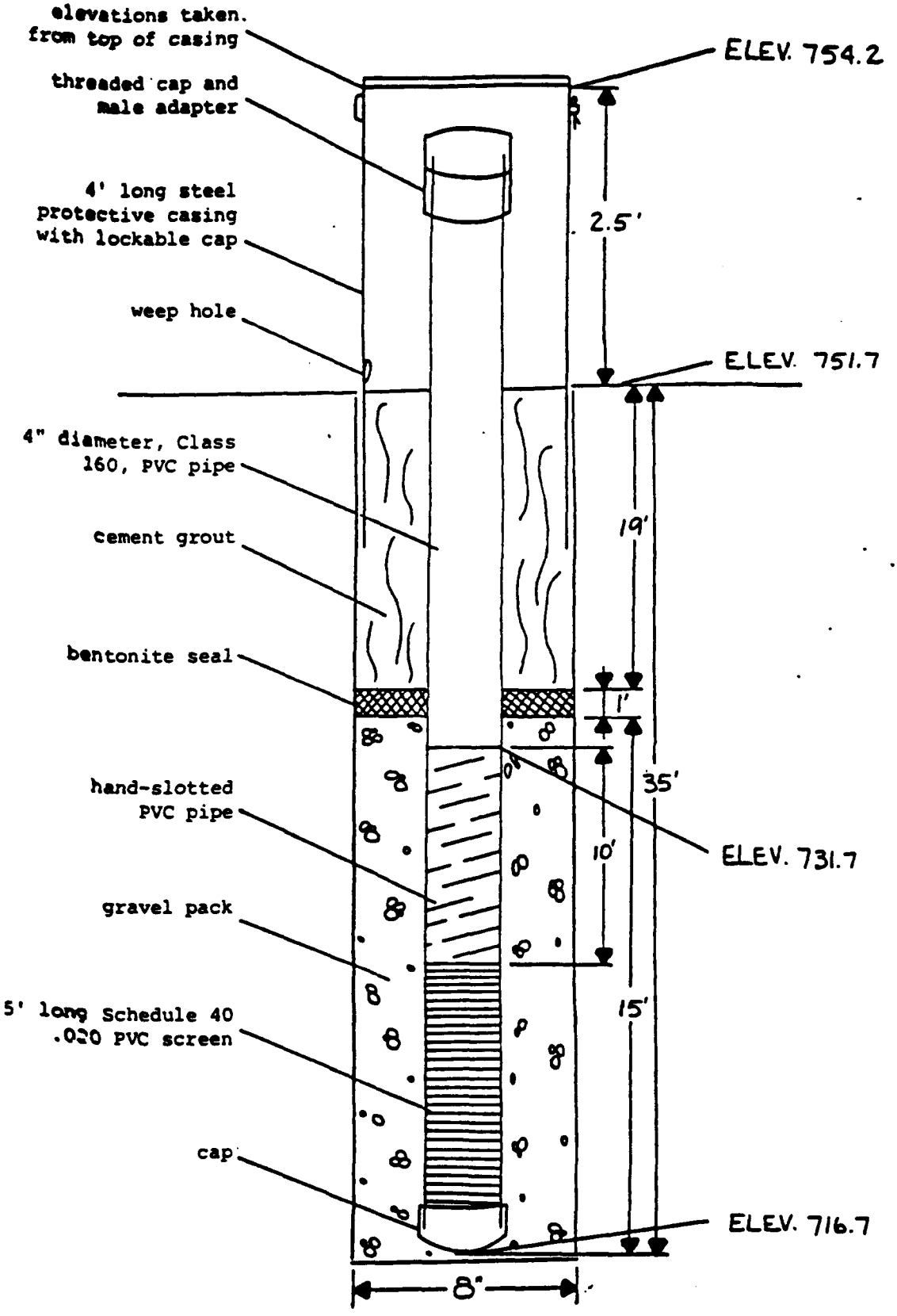
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 45.0' | 46.5' | SS30 | | 5-8-10 | 1.5' | Brown & gray sandy clayey silt w/dark & iron stains, w/lots of rock & sandy zones, mo: very stiff |
| 46.5' | 48.0' | SS31 | | 2-3-5 | 1.5' | Brown & gray sandy clayey silt w/dark & iron stains, w/lots of rock & sandy zones, ve: wet sample, medium |
| 48.0' | 49.5' | SS32 | | 3-4-5 | 1.5' | Brown sandy rocky clay, very moist, medium |
| 49.5' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Completion |
| | | | |

# CONSTRUCTION OF WELL




MW 5-1

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 5-1 Sheet: 1 of 1

Surface Elevation: 751.7 Offset:

Add.

Date Started: 8/10/81 Completed: 8/10/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.5' | WB | | | | Light brown silty clay, med. |
| 5.5' | 9.5' | WB | | | | Gray silty clay, med. |
| 9.5' | 11.0' | ST1 | 2.0 | | | Gray silty clay w/trace sand, stiff |
| 11.0' | 15.0' | WB | | | | Gray silty clay w/trace sand, med. |
| 15.0' | 19.5' | WB | | | | Light brown silty clay w/trace sand |
| 19.5' | 21.0' | ST2 | 2.5 | | | Light brown & gray silty clay, very sti |
| 21.0' | 23.5' | WB | | | | Light gray sandy clay, med. |
| 23.5' | 29.5' | WB | | | | Light gray sandy clay, soft to med. |
| 29.5' | 34.0' | WB | | | | Light gray sandy clay, med. to stiff |
| 34.0' | 40.0' | WB | | | | Light gray sandy clay, soft to med. |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

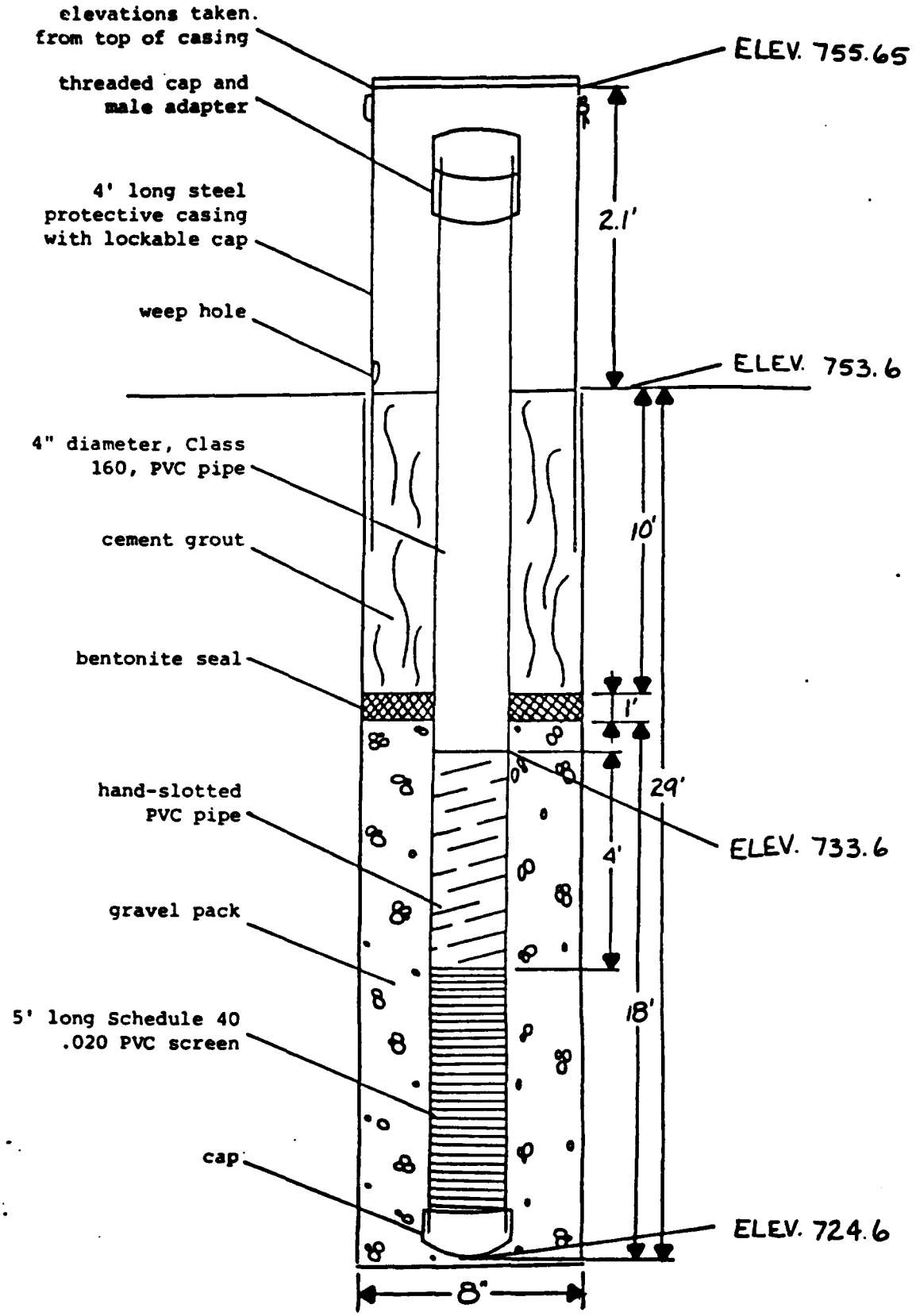
mped 1 hour - 2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 12.8 | | 9/11/81 (Completion) |

Wayne-Western Company, Inc.

C-212

CONSTRUCTION OF WELL




MW 5-2

C-213 Redevelopment 2/85

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 5-2 Sheet: 1 of 1

Surface Elevation: 753.6 Offset:

Date Started: 7/28/81 Completed: 7/28/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.3' | WB | | | | Topsoil |
| 1.3' | 5.0' | WB | | | | Brown & gray silty clay, stiff |
| 5.0' | 6.4' | WB | | | | Dark brown silty clay, soft |
| 6.4' | 10.0' | WB | | | | Brown silty clay, stiff |
| 10.0' | 20.0' | WB | | | | Gray brown silty clay, stiff |
| .0' | 24.5' | WB | | | | Gray brown silty clay, soft |
| 5' | 27.5' | WB | | | | Gray brown silty clay, stiff |
| 27.5' | 29.5' | WB | | | | Tan & green weathered shale, med. |
| 29.5' | 31.0' | WB | | | | Same |
| 31.0' | 34.0' | WB | | | | Same |
| 34.0' | 35.0' | WB | | | | Weathered shale & gray shale, hard |
| 35.0' | 40.0' | WB | | | | Gray shale, hard |
| 40.0' | Total | depth | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

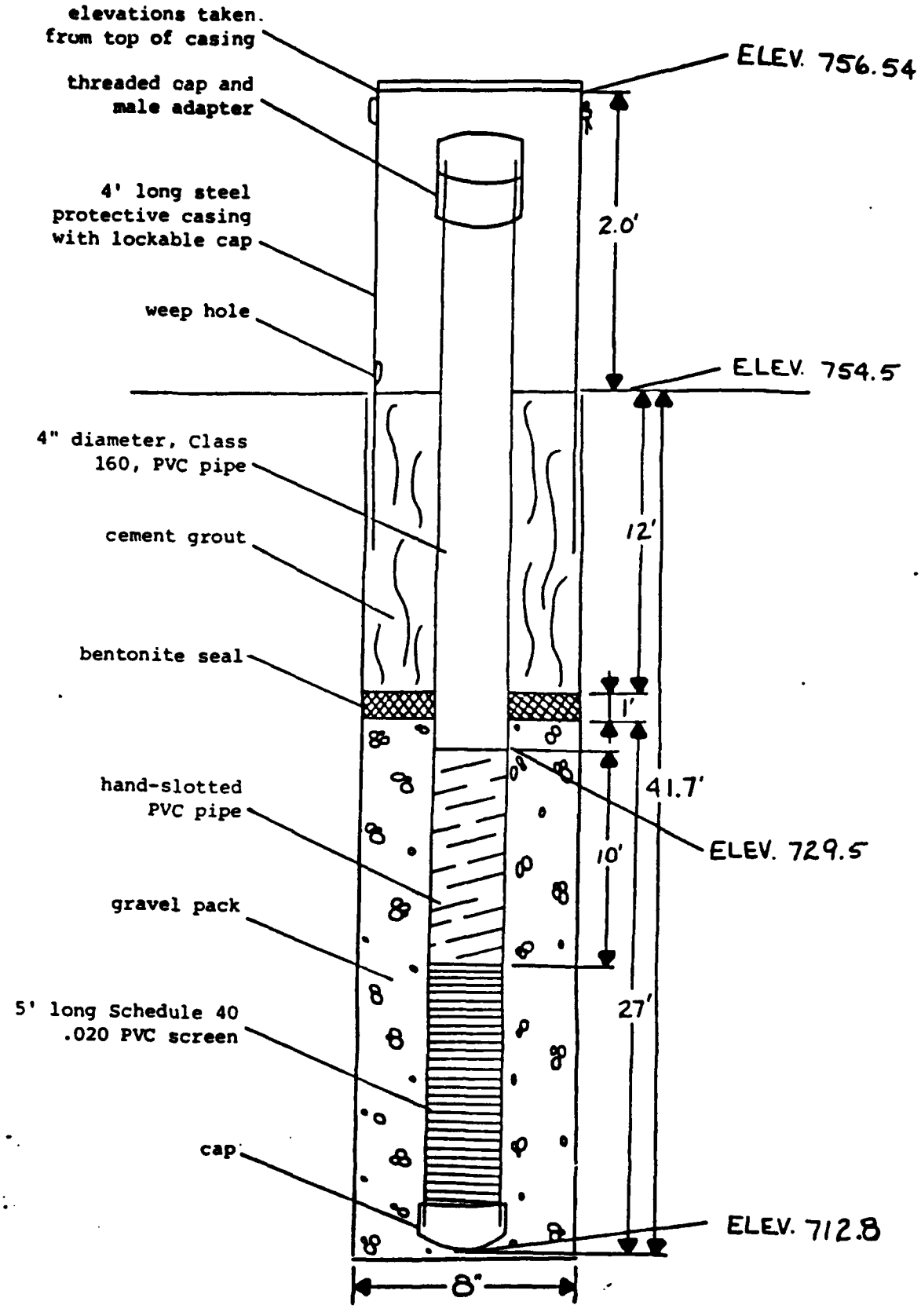
REMARKS: (Casing, Water Loss, Etc.)

Pumped 1-1/2 hour - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 13.6 | | 9/11/81 (Completion) |
| | | |

Wyne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 5-3

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 5-3 Sheet 1 of 1

Surface Elevation: 754.5 Offset:

Address:

Date Started: 8/10/81 Completed: 8/11/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

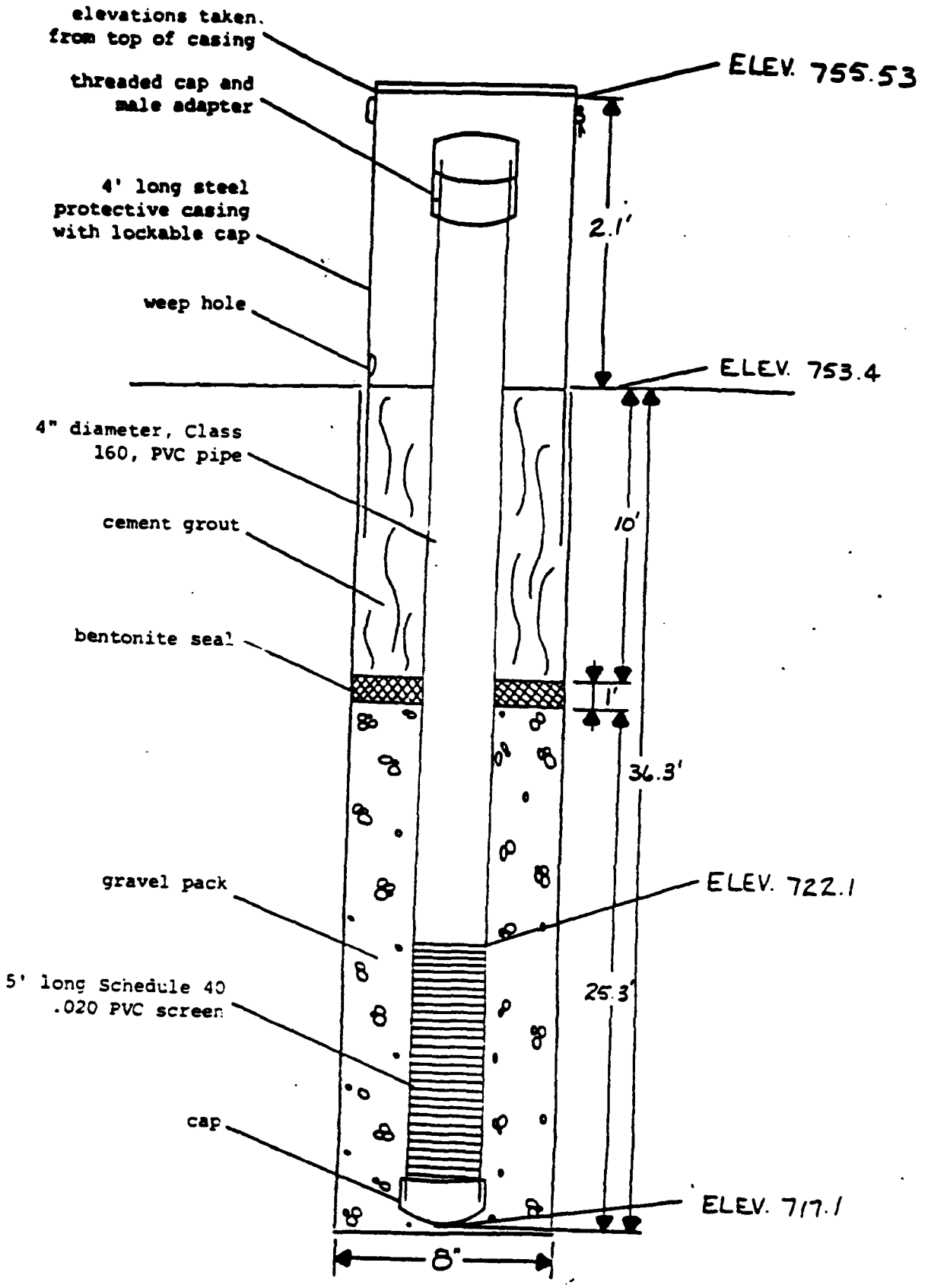
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Gray brown silty clay, stiff |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 15.0' | WB | | | | Same |
| 15.0' | 16.5' | ST1 | 1.75 | | | Same |
| 16.5' | 20.0' | WB | | | | Same |
| 20.0' | 25.0' | WB | | | | Same |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 35.0' | WB | | | | Same |
| 35.0' | 35.5' | WB | | | | Gray brown silty clay w/trace sand, stiff |
| 35.5' | 40.0' | WB | | | | Yellow brown sandy clay w/trace gravel, med. |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

Pumped 2 hours - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 13.9 | | 9/11/81 (Completion) |
| | | |

Dyne-Western Company, Inc.


elevations taken from top of casing
threaded cap and male adapter
4' long steel protective casing with lockable cap
weep hole
4" diameter, Class 160, PVC pipe
cement grout
bentonite seal
gravel pack
5' long Schedule 40 .020 PVC screen
cap
ELEV. 755.53
2.1'
ELEV. 753.4
10'
1'
36.3'
ELEV. 722.1
25.3'
ELEV. 717.1
8"

MW 5-4

# TEST BORING LOG

Project: Lake City AAP — Boring No.: MW 5-4 — Sheet 1 of 1

Surface Elevation: 753.4 — Offset:

Add.: — Date Started: 7/28/81 — Completed: 7/28/81

City & State: Independence, Missouri — Driller: J. Von Holt — Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 6.0' | WB | | | | Brown silty clay, stiff |
| 6.0' | 23.0' | WB | | | | Brown & gray silty clay, stiff |
| 23.0' | 31.0' | WB | | | | Gray w/trace brown silty clay, stiff |
| 31.0' | 38.0' | WB | | | | Yellow brown & gray shaley clay w/trace sand & gravel, stiff |
| 38.0' | 40.5' | WB | | | | Yellow brown shaley clay, stiff |
| 40.5' | 42.0' | SS1 | 1.5 | | | Same |
| 42.0' | Total depth | | | | | |

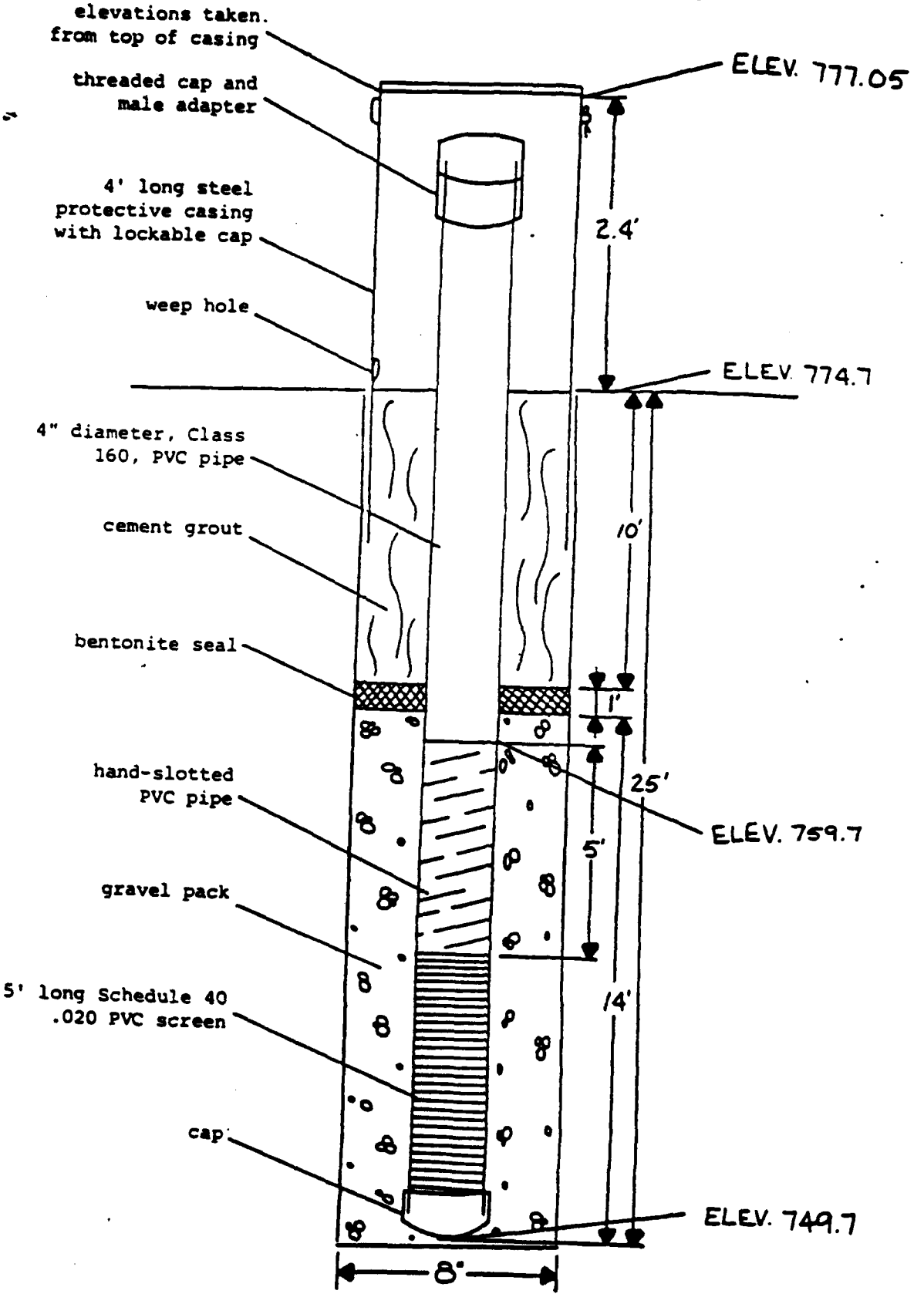
REMARKS: (Casing, Water Loss, Etc.)

| Static Water Level | Time | Date |
|---|---|---|
| 7.4 | | 9/11/81 (Completion) |
| | | |

Layne-Western Company, Inc.

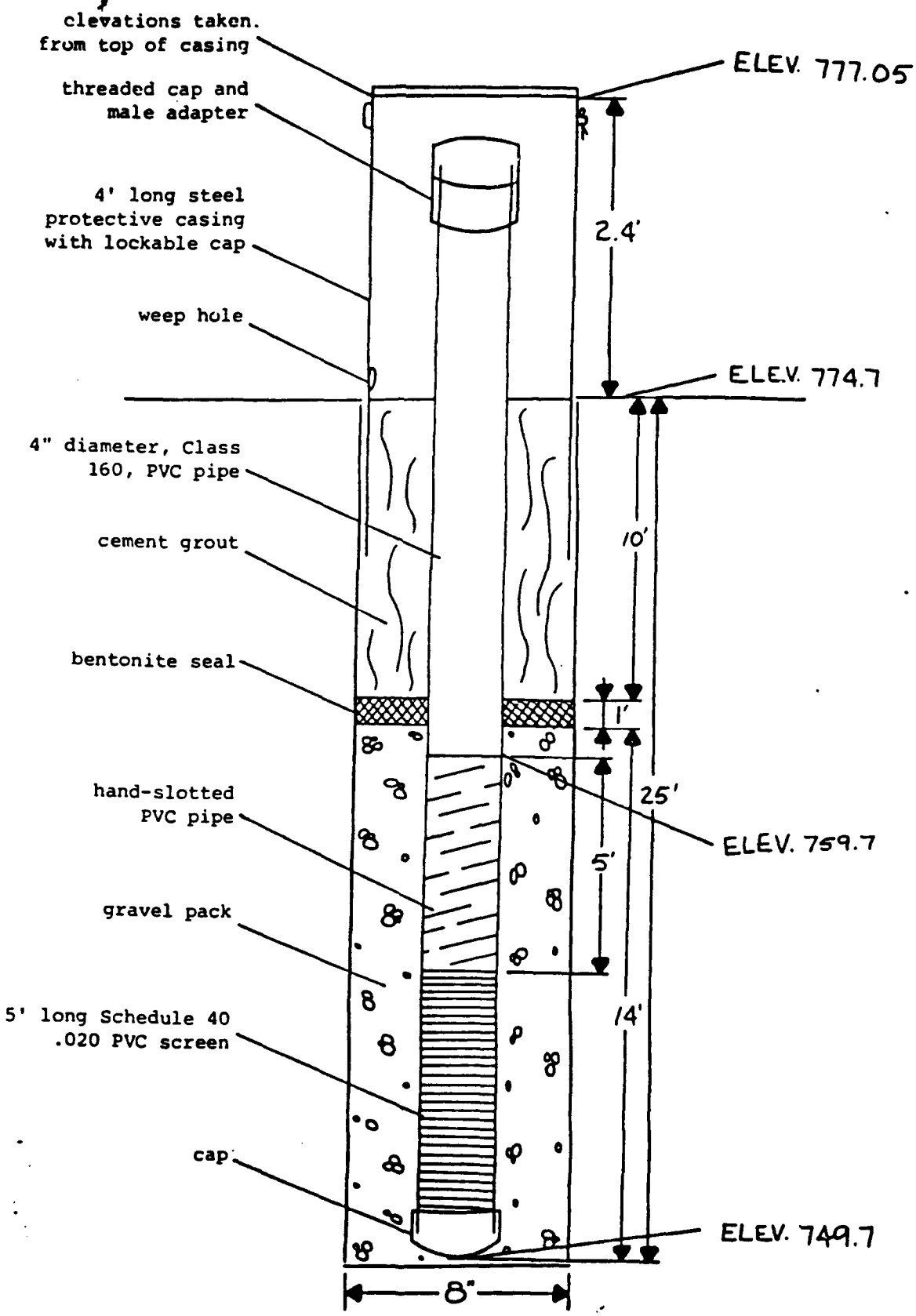
C-218

CONSTRUCTION OF WELL




MW 6-1

CONSTRUCTION OF WELL




MW 6-1

# TEST BORING LOG

ect Lake City AAP

Boring No. MW 6-1 Sheet 1 of 1

Surface Elevation 774.7 Offset

ress

Date Started 8/5/81 Completed 8/5/81

& State Independence, Missouri

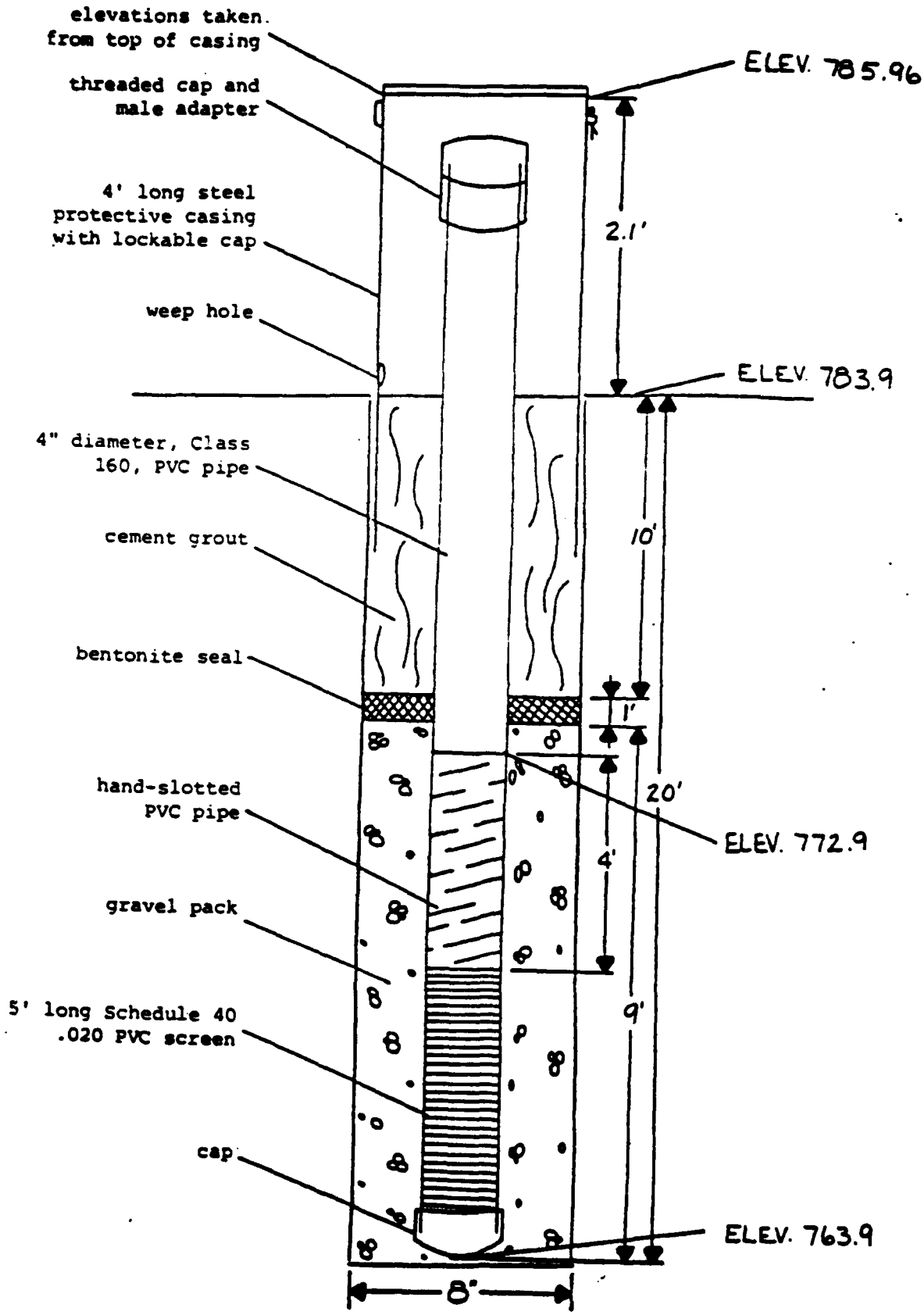
Driller D. Vogt Rig

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; .W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.5' | WB | | | | Topsoil |
| 1.5' | 7.0' | WB | | | | Dark brown silty clay, stiff |
| 7.0' | 10.0' | WB | | | | Gray brown silty clay, stiff |
| 10.0' | 11.5' | WB | | | | Same |
| 11.5' | 20.0' | WB | | | | Same |
| 20 ' | 22.3' | WB | | | | Weathered limestone lenses & gray shale |
| 22.3 | 32.0' | WB | | | | Gray shale, med. |
| 32.0' | 40.0' | WB | | | | Maroon shale, hard |
| 40.0' | Total | depth | | | | |

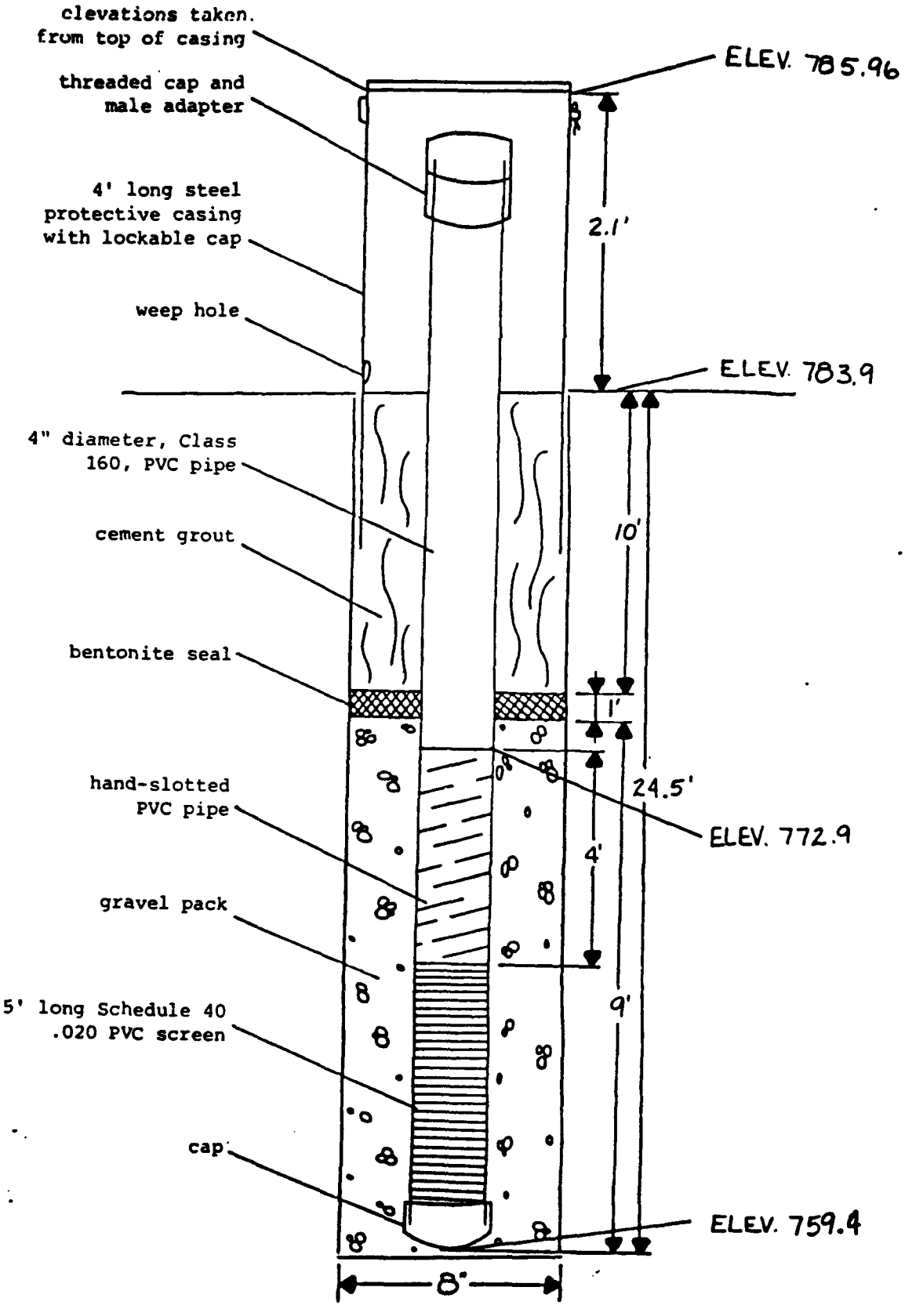
| S: (Casing, Water Loss, Etc.) | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 1-1/2 hour - 1 GPM | 7.5 | | 9/10/81 (Completion) |
| | | | |

## CONSTRUCTION OF WELL




MW 6-2

# CONSTRUCTION OF WELL




MW 6-2



REDEVELOPMENT 2/85

Project: Lake City AAP

Boring No.: MW 6-2 Sheet: 1 of

Surface Elevation: 783.9 Offset:

Address:

Date Started: 8/6/81 Completed: 8/6/81

State: Independence, Missouri

Driller: D. Vogt Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wate; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 6.0' | WB | | | | Dark brown silty clay, soft |
| 6.0' | 11.0' | WB | | | | Brown silty clay, stiff |
| 11.0' | 17.0' | WB | | | | Olive brown weathered shale, soft to |
| 17.0' | 27.0' | WB | | | | Gray shale, med. |
| 27.0' | 28.0' | WB | | | | Weathered limestone lenses & gray sha |
| 28.0' | 40.0' | WB | | | | Gray shale, hard |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

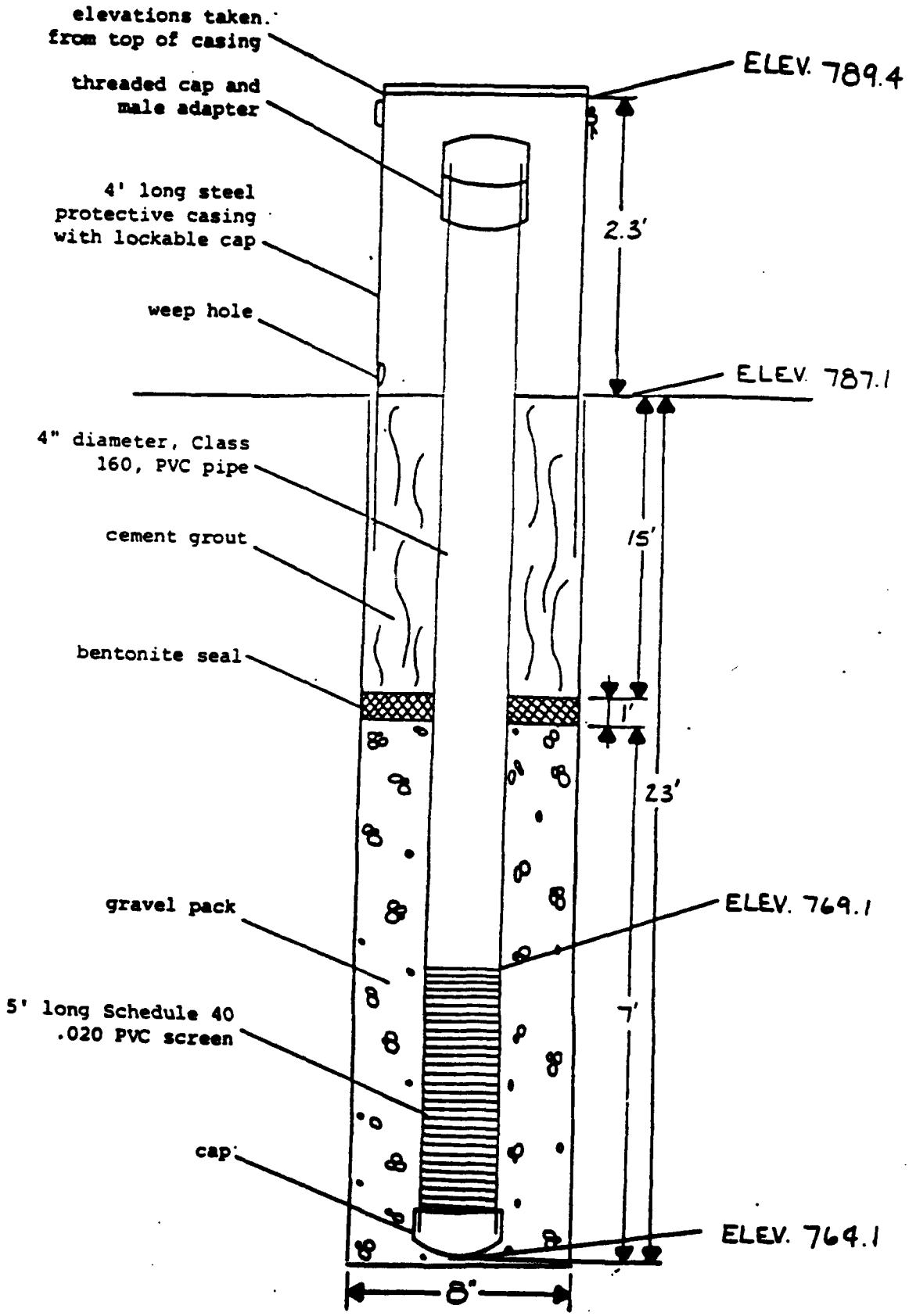
Pumped 1-1/2 hour - 1-1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 4.2 | | 9/10/81 (Completio |

Layne-Western Company, Inc.

C-224

## CONSTRUCTION OF WELL




MW 6-3

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 6-3 Sheet: 1 of 1

Surface Elevation: 787.1 Offset:

Address:

Date Started: 8/6/81 Completed: 8/6/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

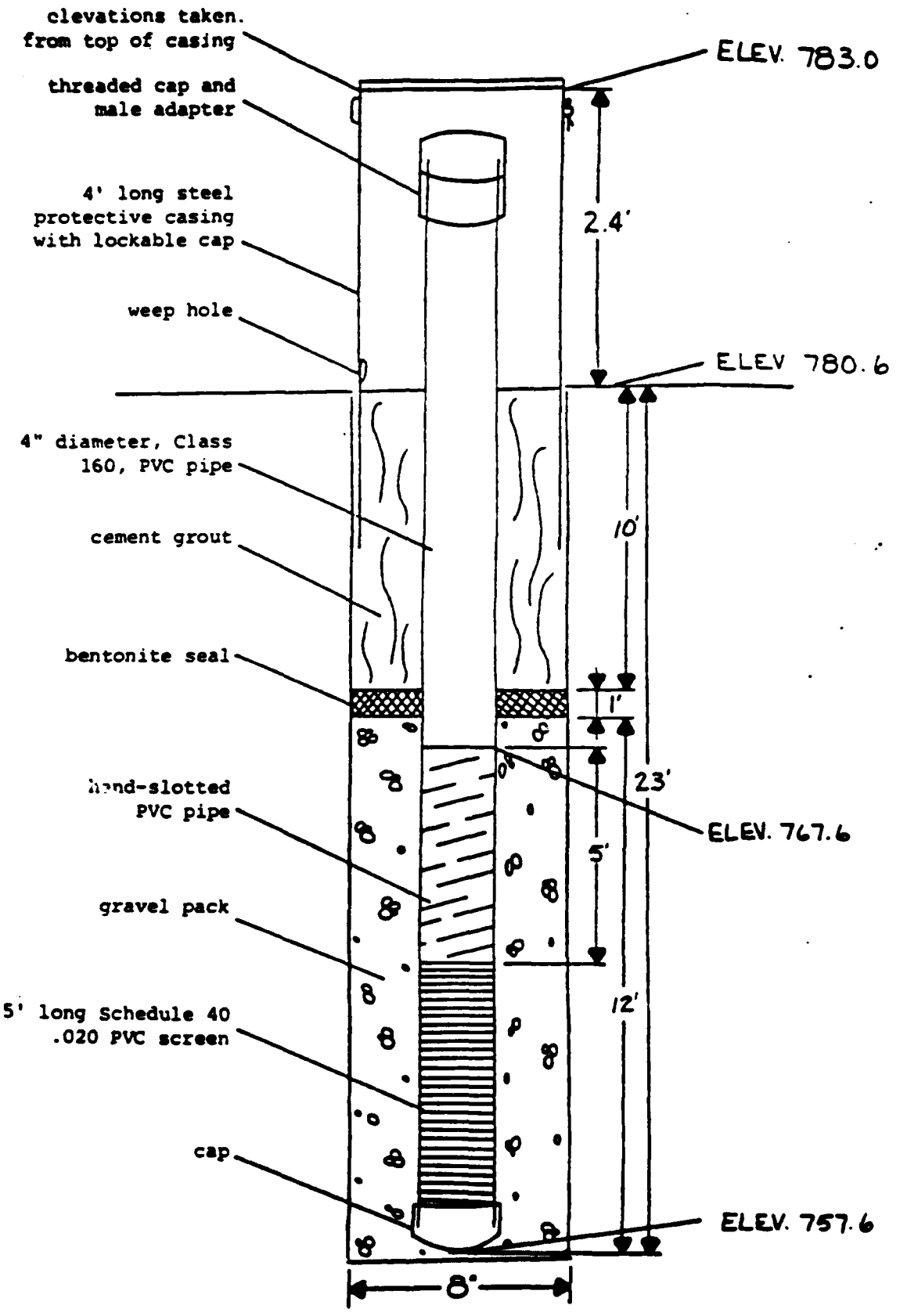
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.5' | WB | | | | Topsoil |
| 0.5' | 4.0' | WB | | | | Dark brown silty clay, med. to stiff |
| 4.0' | 9.0' | WB | | | | Light brown silty clay, med. to stiff |
| 9.0' | 10.5' | ST1 | 3.5 | | | Light brown silty clay, very stiff |
| 10.5' | 13.5' | WB | | | | Tan silty clay w/trace weathered shale stiff |
| .5' | 19.0' | WB | | | | Light tan shaly clay, stiff |
| 19.0' | 20.0' | ST2 | 4.5 | | | Light tan & gray shaly clay, very stif |
| 20.0' | 22.5' | WB | | | | Light gray shale, med. to hard |
| 22.5' | 27.5' | WB | | | | Same |
| 27.5' | 28.0' | WB | | | | Dark gray sandy shale, med. to hard |
| 28.0' | 30.0' | WB | | | | Light gray shale, med. to hard |
| 30.0' | 31.0' | WB | | | | Same |
| 31.0' | 33.5' | WB | | | | Dark gray sandy shale, med. to hard |
| 33.5' | 40.0' | WB | | | | Light gray shale, med. to hard |
| 40.0' | Total | depth | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

Pumped 1 hour - 1-1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 1.5 | | 9/10/81 (Completion) |
| | | |

## CONSTRUCTION OF WELL




MW 6-4

TEST BORING LOG

oject Lake City AAP

Boring No. MW 6-4 Sheet 1 of 1

Surface Elevation 780.6 Offset

dr

Date Started 8/13/81 Completed 8/13/81

y & State Independence, Missouri

Driller T. Butler Rig

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core Water
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Air
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO METER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.9' | WB | | | | Topsoil |
| 0.9' | 3.5' | WB | | | | Brown silty clay, med. |
| 3.5' | 7.0' | WB | | | | Dark gray silty clay, med. |
| 7.0' | 9.5' | WB | | | | Light brown silty clay, med. to stiff |
| 9.5' | 11.0' | ST1 | 4.5 | | | Light brown silty clay, very stiff |
| 11.0' | 12.5' | WB | | | | Same |
| 1[illegible]' | 15.5' | WB | | | | Light tan shaly clay, stiff |
| 15.5' | 16.0' | WB | | | | Weathered shale, hard |
| 16.0' | 21.5' | WB | | | | Light tan shaly clay, med. to stiff |
| 21.5' | 23.0' | WB | | | | Light gray shale, med. to hard |
| 23.0' | 25.0' | WB | | | | Dark gray shale, med. to hard |
| 25.0' | 40.0' | WB | | | | Light gray shale, med. to stiff |
| 0.0' | Total | depth | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

ARKS: (Casing, Water Loss, Etc.)

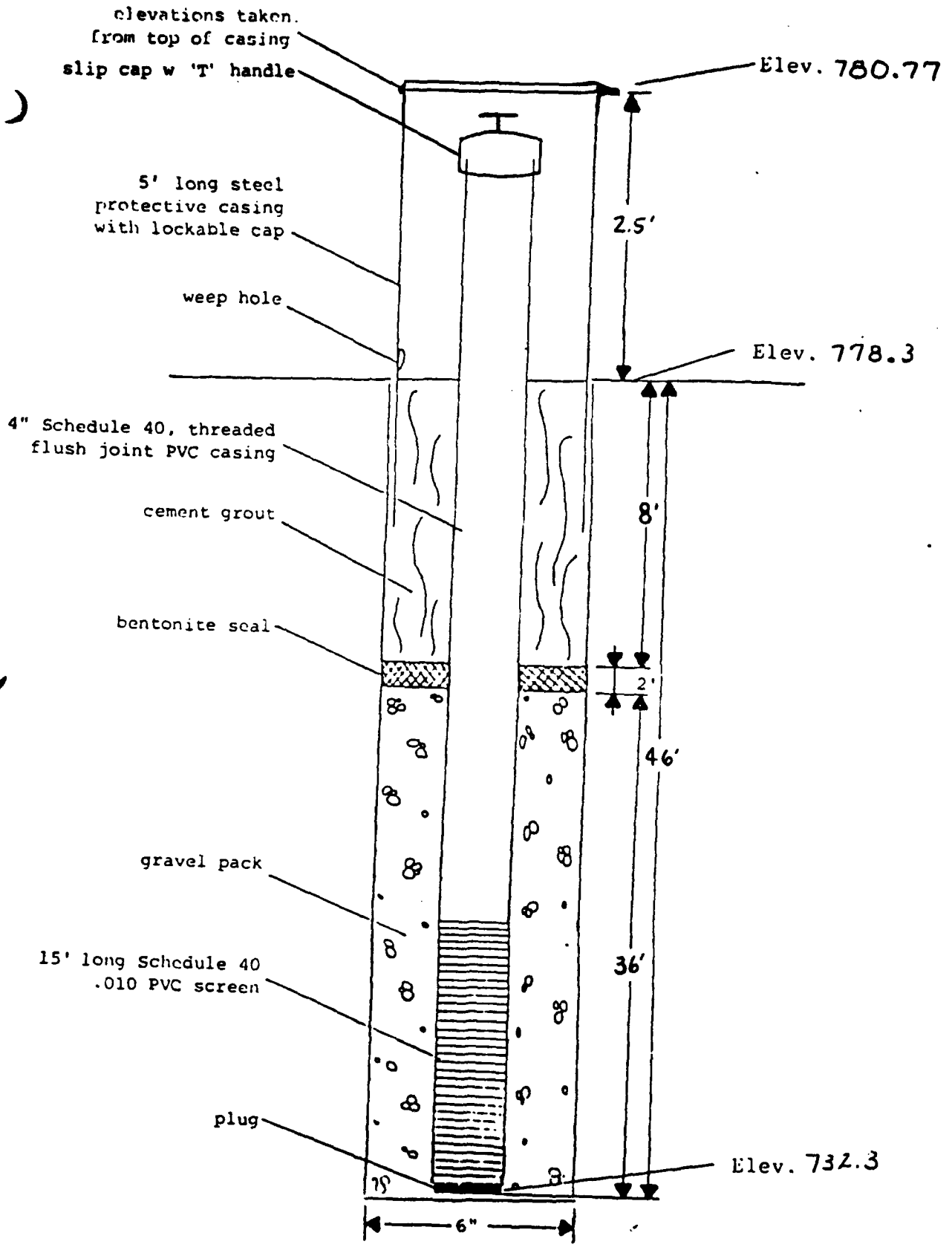
| Static Water Level | Time | Date |
|---|---|---|
| 3.7 | | 9/10/81 (Completion) |

u ed 1-1/2 hour - 1-1/2 GPM

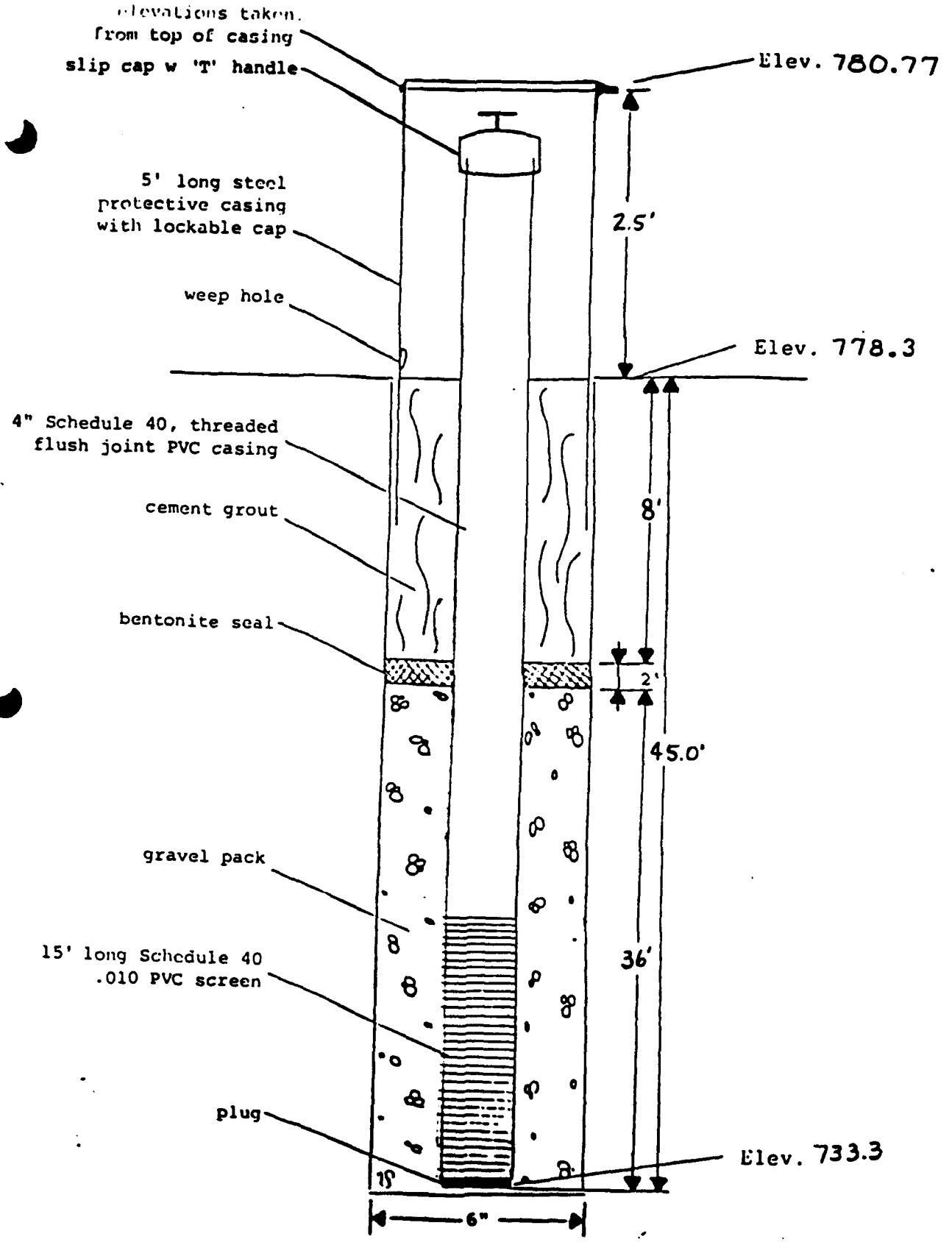
no-Western Company, Inc.

C-228

WELL CONSTRUCTION




MW 6-5


Elevations taken from top of casing
slip cap w 'T' handle
Elev. 780.77
5' long steel protective casing with lockable cap
2.5'
weep hole
Elev. 778.3
4" Schedule 40, threaded flush joint PVC casing
cement grout
8'
bentonite seal
2'
45.0'
gravel pack
15' long Schedule 40 .010 PVC screen
36'
plug
Elev. 733.3
6"

RIW 6-5

# TEST BORING LOG

roject Lake City Army Ammunition Plant

Boring No. MW 6-5 Sheet 1 of 1

Surface Elevation 778.3 Offset

Address

Date Started 1/5/83 Completed 1/5/83

City & State Independence, Missouri

Driller R. Kelly Rig CME-55

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core Water
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Air
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 5.5' | HA | | | | Dark brown silty clay, moist, very stiff |
| 5.5' | 8.7' | HA | | | | Brown silty clay, moist, very stiff |
| 8.7' | 9.2' | HA | | | | Yellow brown shaly clay, moist, very stiff |
| 9.2' | 13.0' | HA | | | | Yellow brown clayey shale, moist, very stiff |
| 0' | 18.0' | HA | | | | Olive brown shale, dry, med. to hard |
| .0' | 23.0' | HA | | | | Yellow weathered shaly sandstone, dry, med. to hard |
| 23.0' | 25.5' | HA | | | | Yellow brown weathered shale, dry, med. to hard |
| 25.5' | 31.0' | HA | | | | Gray shale, dry, med. to hard |
| 31.0' | 40.0' | HA | | | | Gray clayey shale, moist, soft to med. |
| 40.0' | 46.0' | HA | | | | Gray clayey shale, very moist, soft |
| 46.0' | Total depth | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

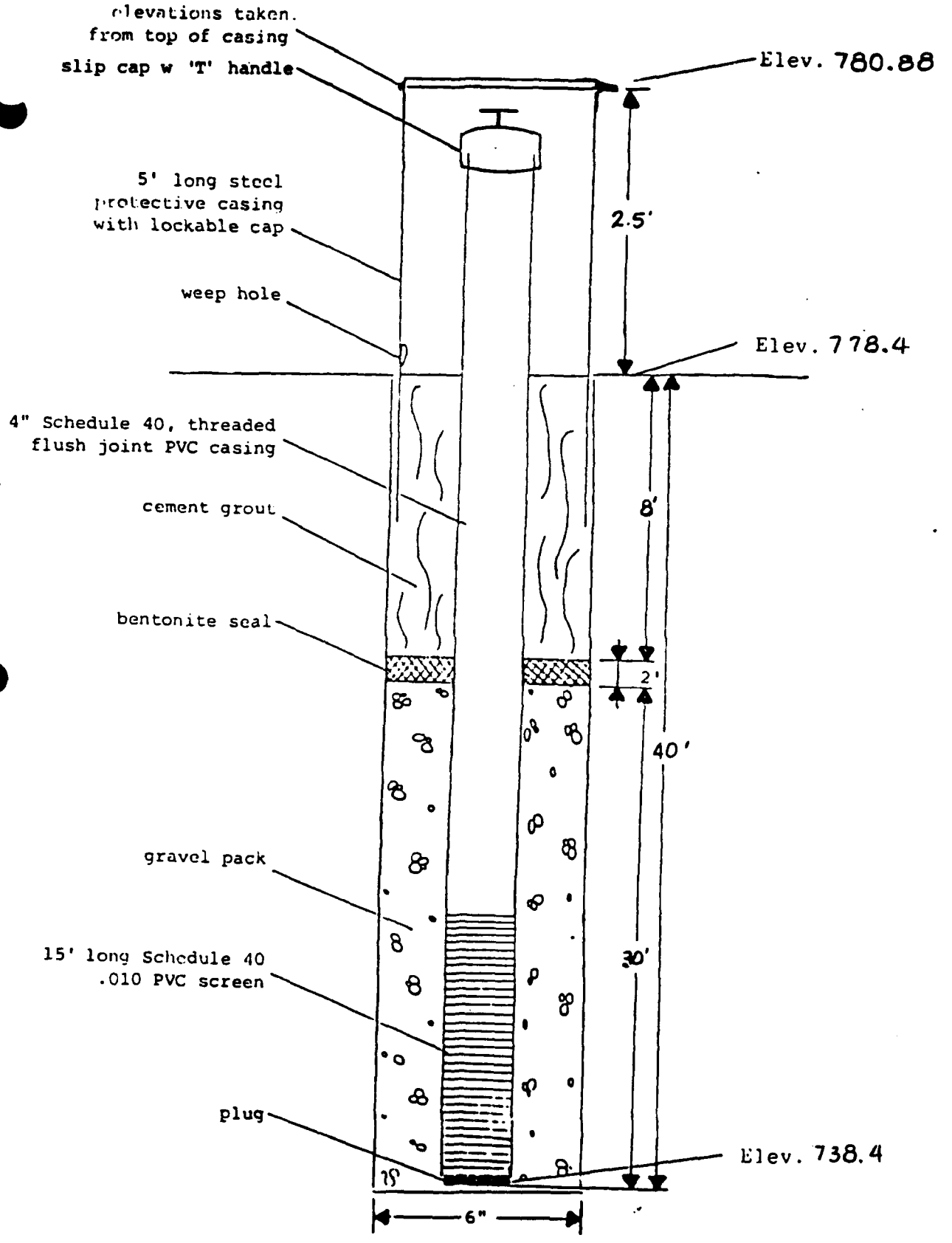
ARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 28.2 | 4:00pm | 1/5/83 | (Completion) |
| 18.2 | 3:30pm | 1/6/83 | |

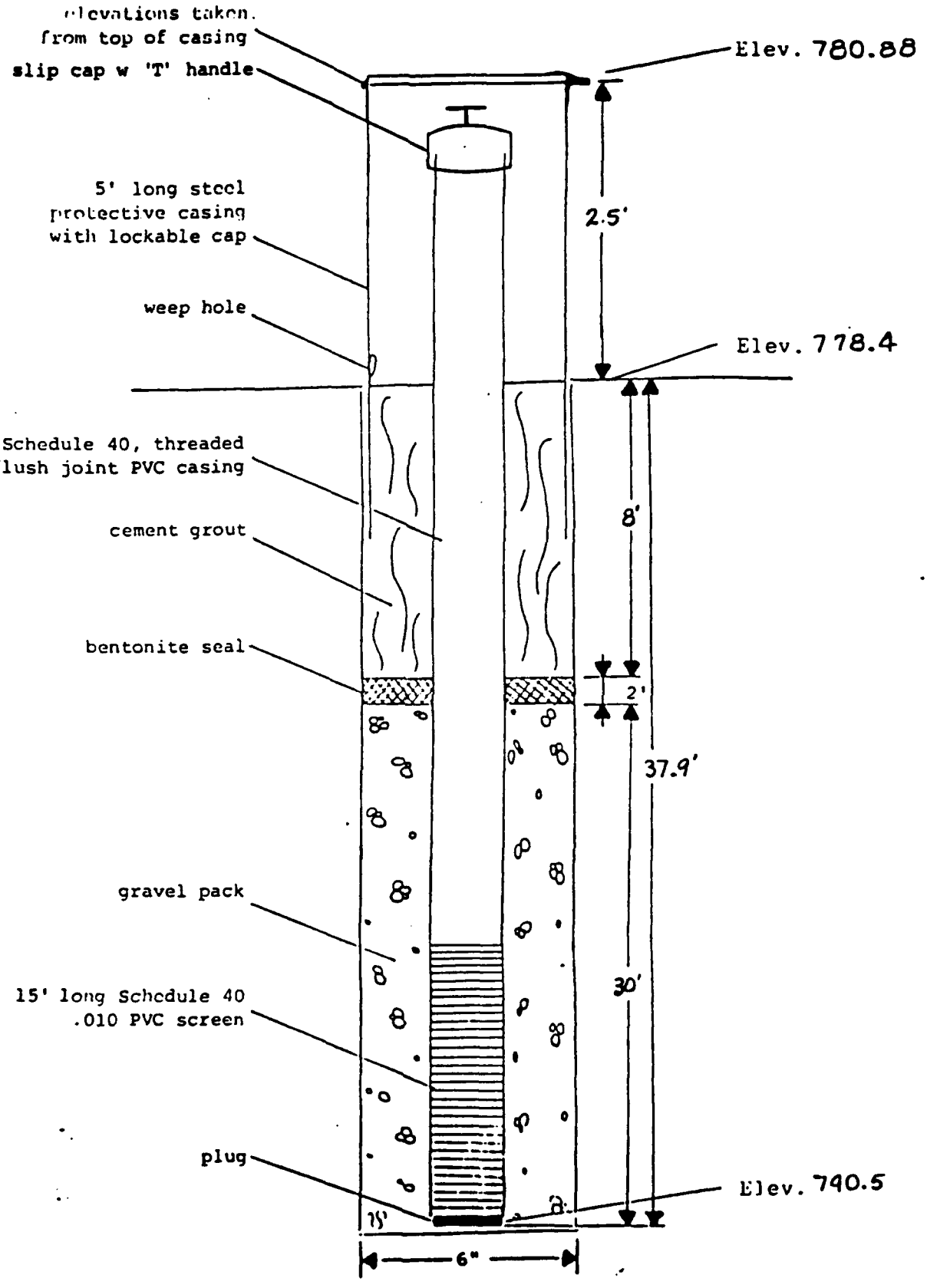
Layne-Western Company, Inc.

C-231

# WELL CONSTRUCTION




MW 6-6




MW 6-6

C-233 REDEVELOPMENT 2/85

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 6-6
Sheet: 1 of 1
Surface Elevation: 778.4
Offset:
Address:
Date Started: 1/7/83
Completed: 1/7/83
City & State: Independence, Missouri
Driller: R. Kelly
Rig: CME-55

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 6.3' | HA | | | | Dark brown silty clay, moist, stiff |
| 6.3' | 13.5' | HA | | | | Light brown silty clay, moist, very stiff |
| 13.5' | 22.5' | HA | | | | Brown gray shaly sandstone, slightly moist, med. to hard |
| 22.5' | 29.0' | HA | | | | Gray shale, slightly moist, med. to hard |
| 29.0' | 30.0' | HA | | | | Gray shale, moist, med. to soft |
| 30.0' | 35.0' | HA | | | | Gray shale, very moist, soft to very soft |
| 35.0' | 36.5' | ST1 | | | 0.0' | Same |
| 36.5' | 40.0' | HA | | | | Gray shale, moist, soft |
| 40.0' | 41.5' | ST1 | 1.75 | | 1.3' | Gray shale, moist, soft to med. |
| 41.5' | Total depth | | | | | |

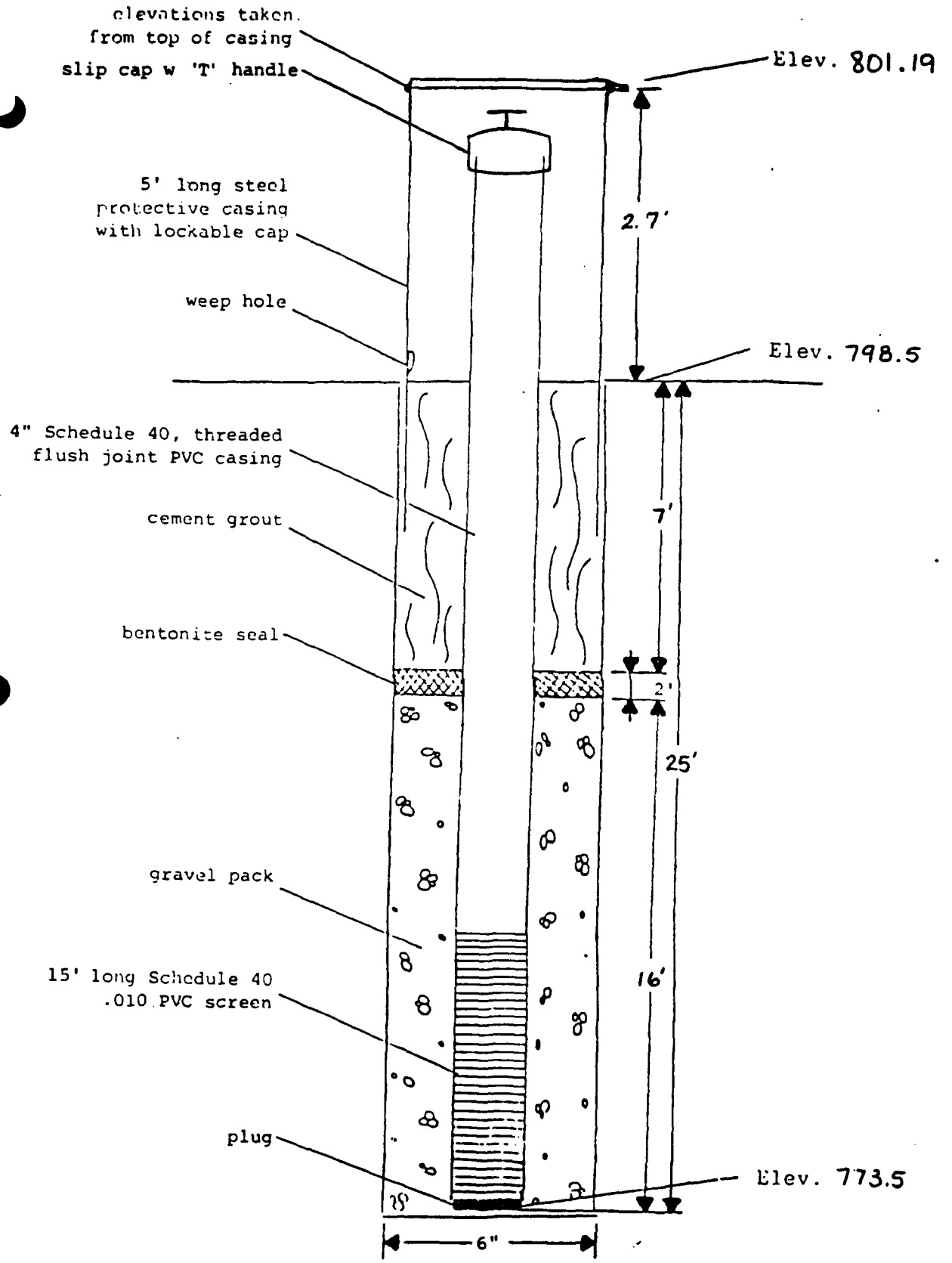
REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 20.0 | 4:00pm | 1/7/83 | (Completion) |

Layne-Western Company, Inc.

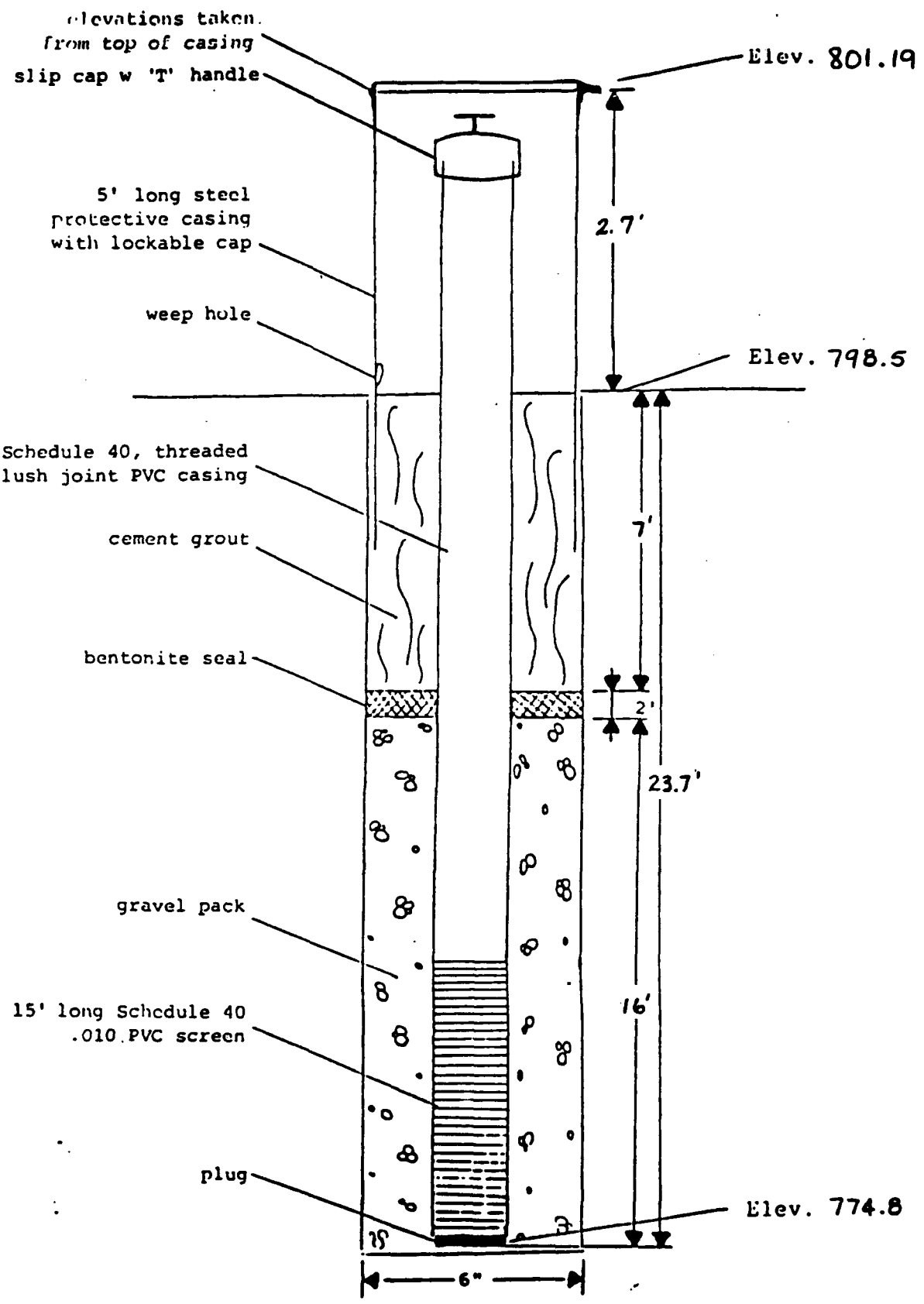
C-234

WELL CONSTRUCTION




MW 6-7

WELL CONSTRUCTION




MW 6-7

C-236 Redevelopment 2/85

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. MW 6-7 Sheet 1 of 1

Surface Elevation 798.5 Offset

Address

Date Started 1/6/83 Completed 1/6/83

City & State Independence, Missouri

Driller R. Kelly Rig CME-55

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

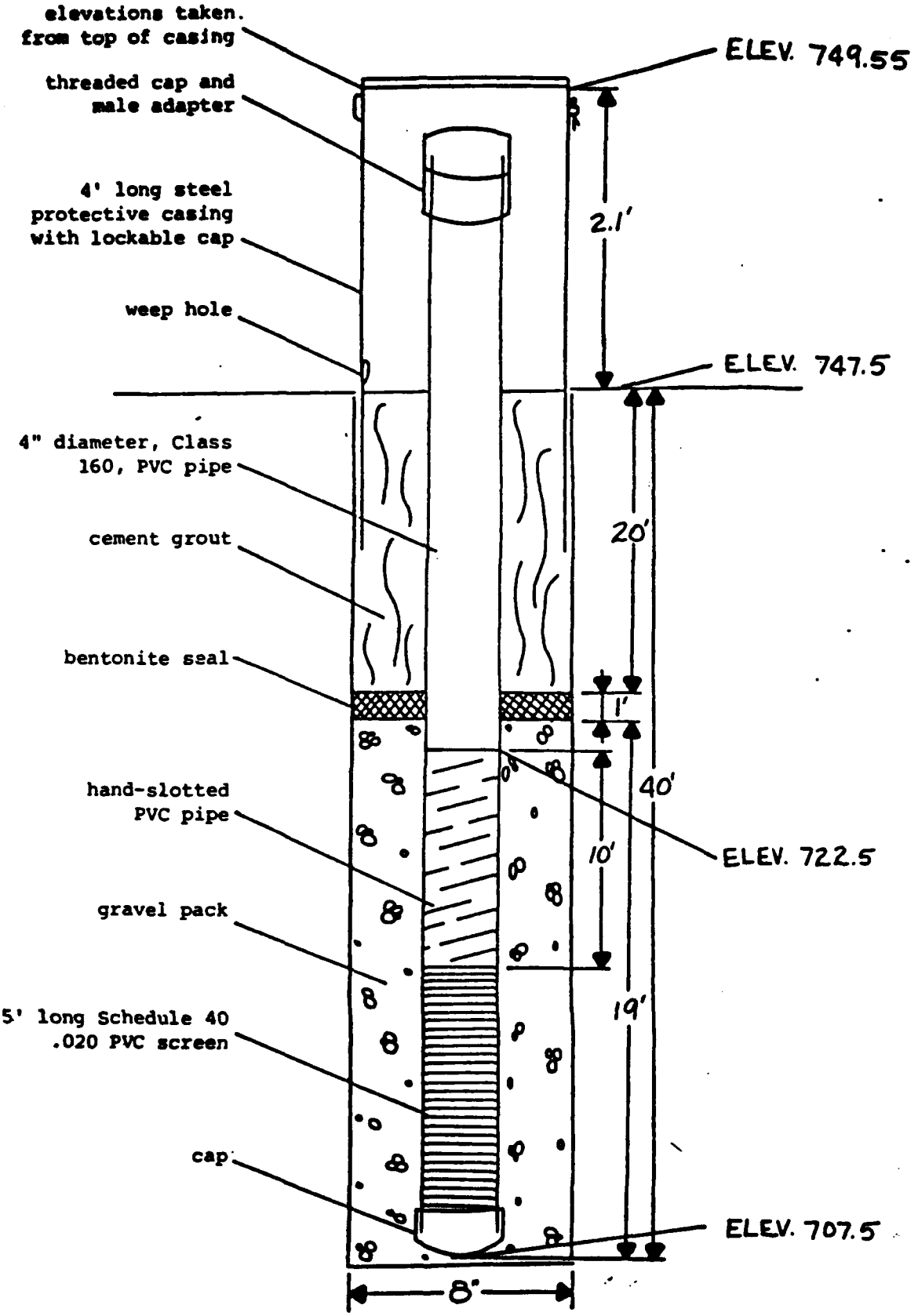
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO-METER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 5.0' | HA | | | | Dark brown silty clay, moist, very stiff |
| 5.0' | 6.5' | ST1 | 2.5 | | 1.5' | Same |
| 6.5' | 11.5' | HA | | | | Brown silty clay, moist, stiff |
| 11.5' | 15.0' | HA | | | | Same |
| 15.0' | 16.5' | ST2 | 1.75 | | 1.5' | Yellow brown silty clay, moist, stiff |
| 16.5' | 25.0' | HA | | | | Same |
| 25.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 5.0 | 12:00pm | 1/6/83 | (Completion) |
| 3.0 | 3:30pm | 1/6/83 | |

Layne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 7-1

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 7-1 Sheet: 1 of 1

Surface Elevation: 747.5 Offset:

Date Started: 8/4/81 Completed: 8/4/81

City & State: Independence, Missouri Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

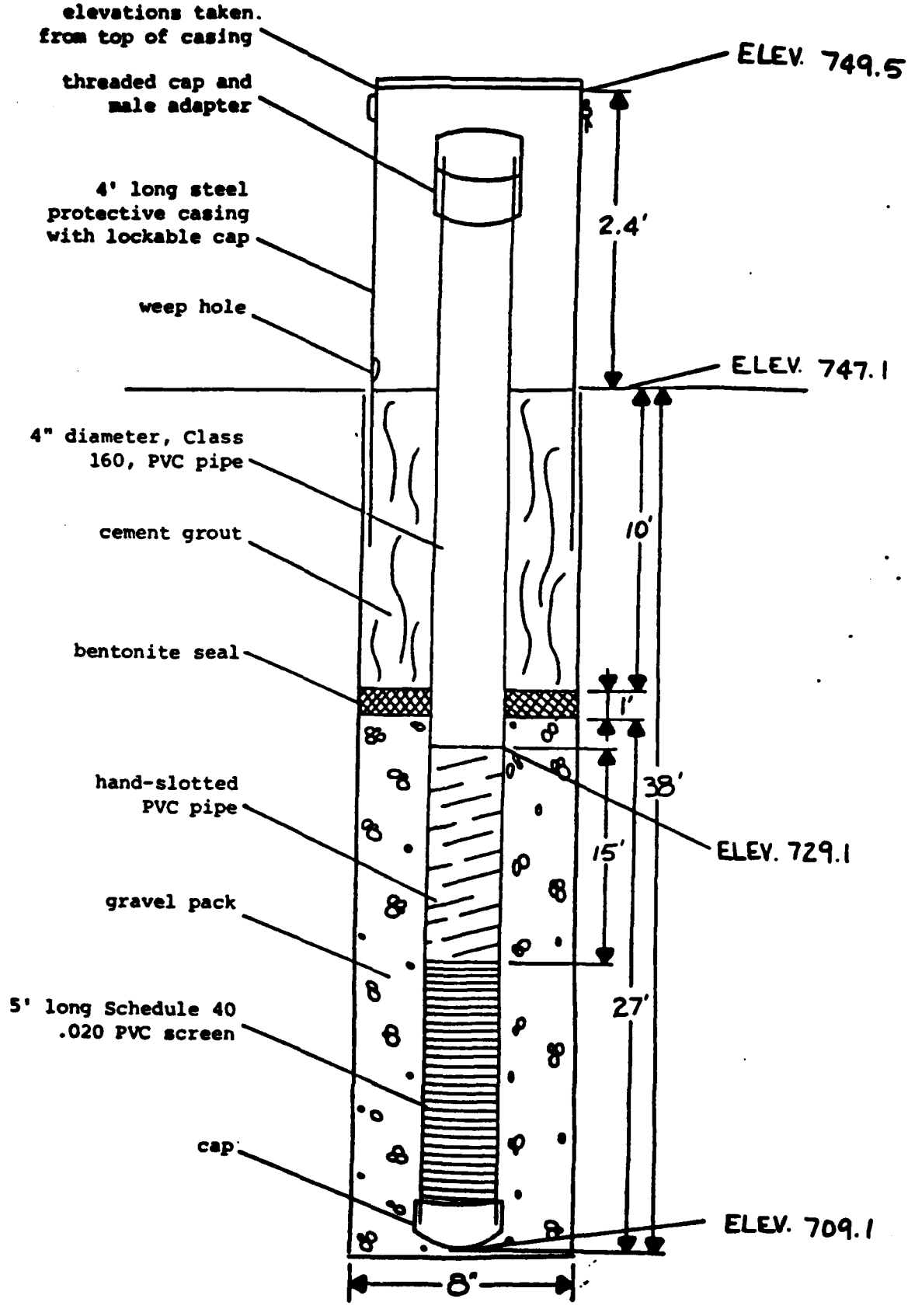
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 2.5' | WB | | | | Topsoil |
| 2.5' | 4.0' | WB | | | | Dark brown silty clay, med. to stiff |
| 4.0' | 9.0' | WB | | | | Dark gray & brown silty clay, med. to stiff |
| 9.0' | 10.5' | ST1 | 2.5 | | | Dark gray silty clay w/trace sand, med. to stiff |
| 10.5' | 15.0' | WB | | | | Dark gray silty clay w/trace sand, soft to med. |
| .0' | 17.5' | WB | | | | Dark gray silty clay, soft to med. |
| 5' | 19.0' | WB | | | | Dark gray silty clay w/trace sand, soft to med. |
| 19.0' | 20.5' | WB | | | | Dark gray silty clay, med. to stiff |
| 20.5' | 24.0' | WB | | | | Gray silty clay, med. to stiff |
| 24.0' | 29.0' | WB | | | | Same |
| 29.0' | 31.5' | ST2 | 4.5 | | | Same |
| 31.5' | 34.5' | WB | | | | Gray silty clay, soft to med. |
| 34.5' | 40.0' | WB | | | | Gray fine sand |
| 40.0' | Total | depth | | | | |
| | | | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 1-1/2 hour - 2 GPM | 26.6 | | 9/11/81 (Completion) |

Layne-Western Company, Inc.

CONSTRUCTION OF WELL




MW 7-2

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 7-2 Sheet: 1 of 1

Surface Elevation: 747.1 Offset:

Address:

Date Started: 7/31/81 Completed: 7/31/81

City & State: Independence, Missouri

Driller: J. Von Holt Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 7.0' | WB | | | | Brown silty clay, stiff |
| 7.0' | 12.0' | WB | | | | Dark gray silty clay, stiff |
| 12.0' | 18.0' | WB | | | | Light gray & light brown silty clay |
| 18.0' | 27.0' | WB | | | | Brown fine sand |
| 27.0' | 35.0' | WB | | | | Brown & gray fine sand |
| 35.0' | 45.0' | WB | | | | Gray fine sand |
| 45.0' | Total depth | | | | | |

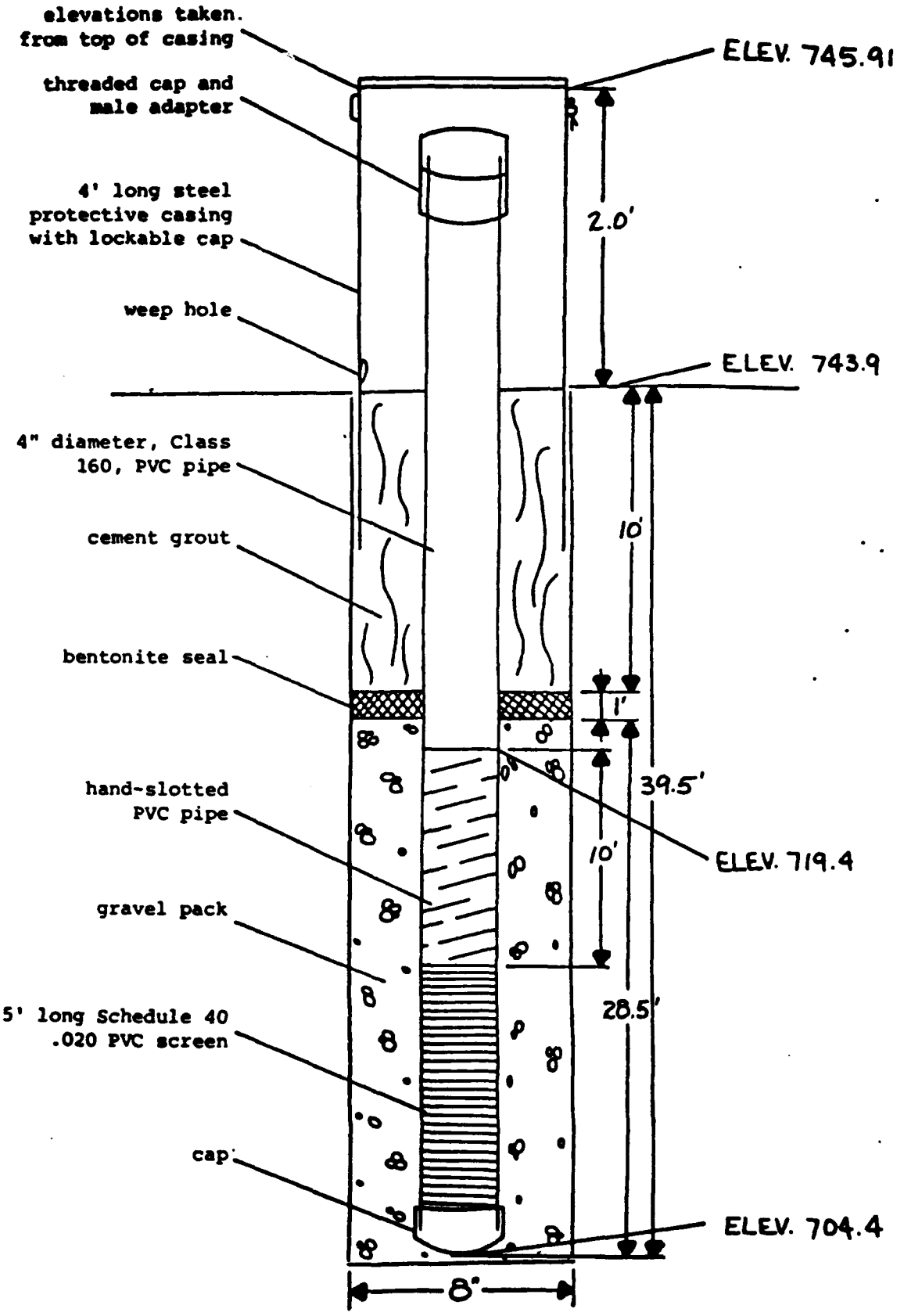
REMARKS: (Casing, Water Loss, Etc.)

| Static Water Level | Time | Date |
|---|---|---|
| 20.9 | | 9/11/81 (Completion) |
| | | |

Layne-Western Company, Inc.

C-241

# CONSTRUCTION OF WELL




MW 7-3

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 7-3 Sheet: 1 of 1

Surface Elevation: 743.9 Offset:

Date Started: 8/21/81 Completed: 8/21/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

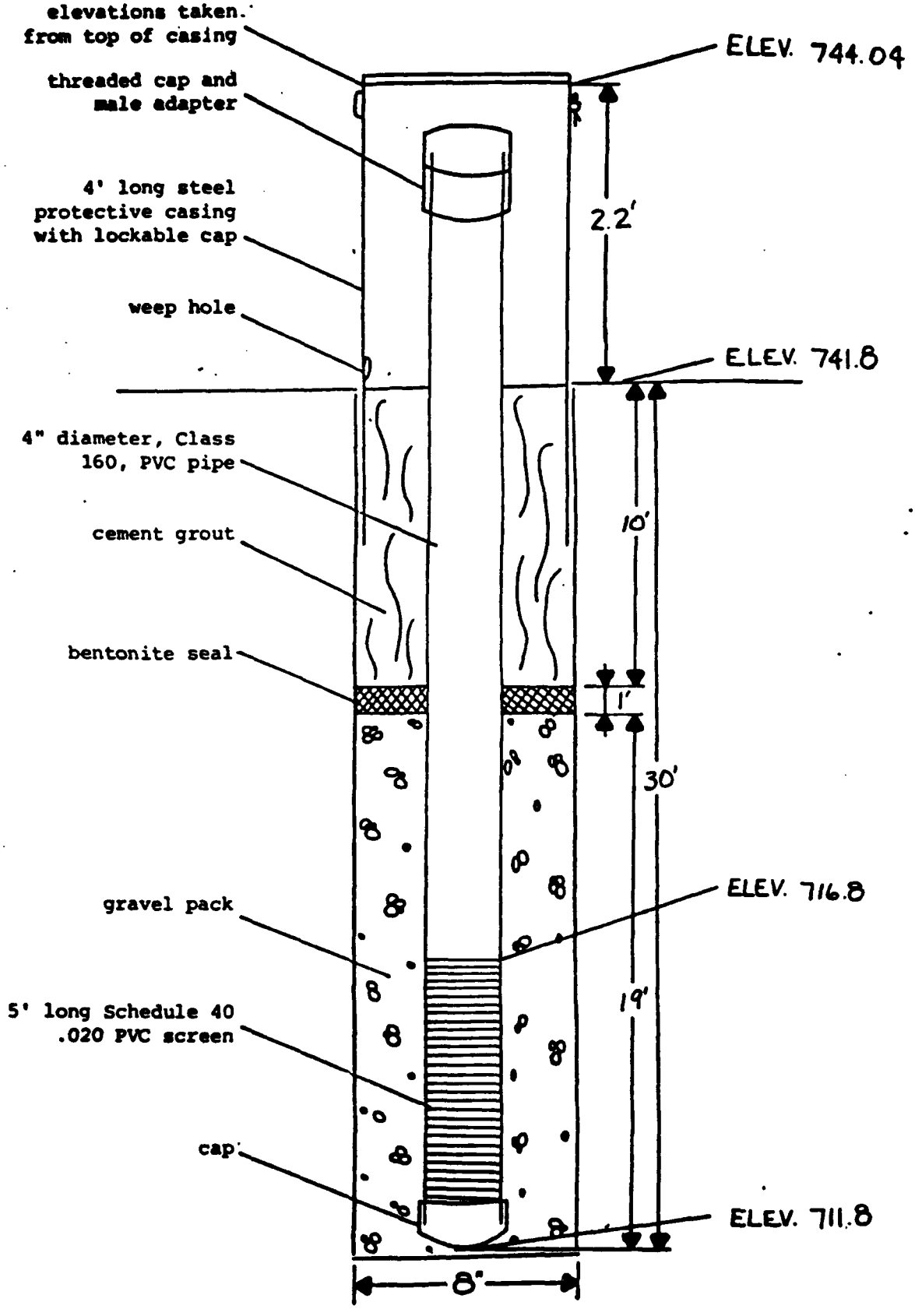
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Dark gray silty clay, stiff |
| 5.0' | 9.0' | WB | | | | Same |
| 9.0' | 10.5' | ST1 | 1.75 | | | Same |
| 10.5' | 12.0' | WB | | | | Same |
| 12.0' | 15.0' | WB | | | | Gray & brown silty clay, stiff |
| [illegible].0' | 19.0' | WB | | | | Same |
| 19.0' | 20.5' | ST2 | 1.25 | | | Same |
| 20.5' | 23.0' | WB | | | | Same |
| 23.0' | 25.0' | WB | | | | Gray silty clay, stiff |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 34.0' | WB | | | | Same |
| 34.0' | 38.0' | WB | | | | Gray very fine sand, dense |
| 38.0' | 40.0' | WB | | | | Gray silty clay w/trace sand, & coal, stiff |
| 40.0' | Total | depth | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| [illegible]mped 2 hours, 1/2 GPM | 5.6 | | 9/11/81 (Completion) |
| | | | |

Layne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 7-4

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 7-4 Sheet: 1 of 1

Surface Elevation: 741.8 Offset:

Date Started: 8/3/81 Completed: 8/3/81

& State: Independence, Missouri Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.5' | WB | | | | Topsoil |
| 1.5' | 9.0' | WB | | | | Dark gray silty clay, med. to stiff |
| 9.0' | 10.5' | SS1 | | | | Same |
| 10.5' | 13.0' | WB | | | | Same |
| 13.0' | 20.0' | WB | | | | Light gray silty clay, soft to med. |
| 20.0' | 22.0' | WB | | | | Same |
| 0' | 25.0' | WB | | | | Light gray silty clay w/trace sand, sof to med. |
| 25.0' | 42.0' | WB | | | | Light gray fine sand |
| 42.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

Pumped 1-1/2 hour - 6 GPM

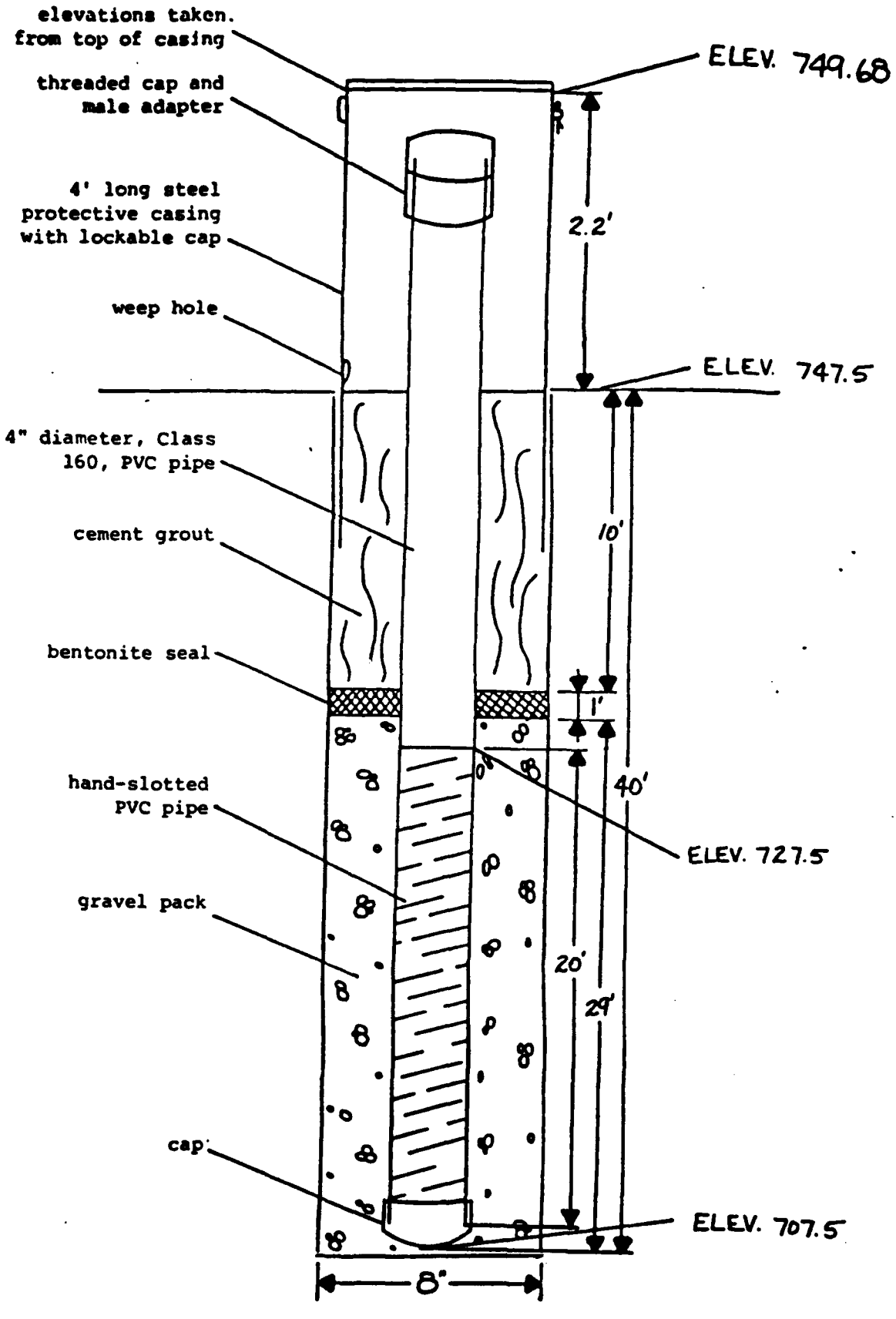
| Static Water Level | Time | Date |
|---|---|---|
| 20.7 | | 9/11/81 (Completion) |
| | | |

Wyne-Western Company, Inc.

C-245

60A

# CONSTRUCTION OF WELL




MW 7-5

# TEST BORING LOG

Project: Lake City AAP — Boring No.: MW 7-5 — Sheet 1 of 1

Surface Elevation: 747.5 — Offset:

Address: — Date Started: 9/2/81 — Completed: 9/3/81

City & State: Independence, Missouri — Driller: T. Butler — Rig:

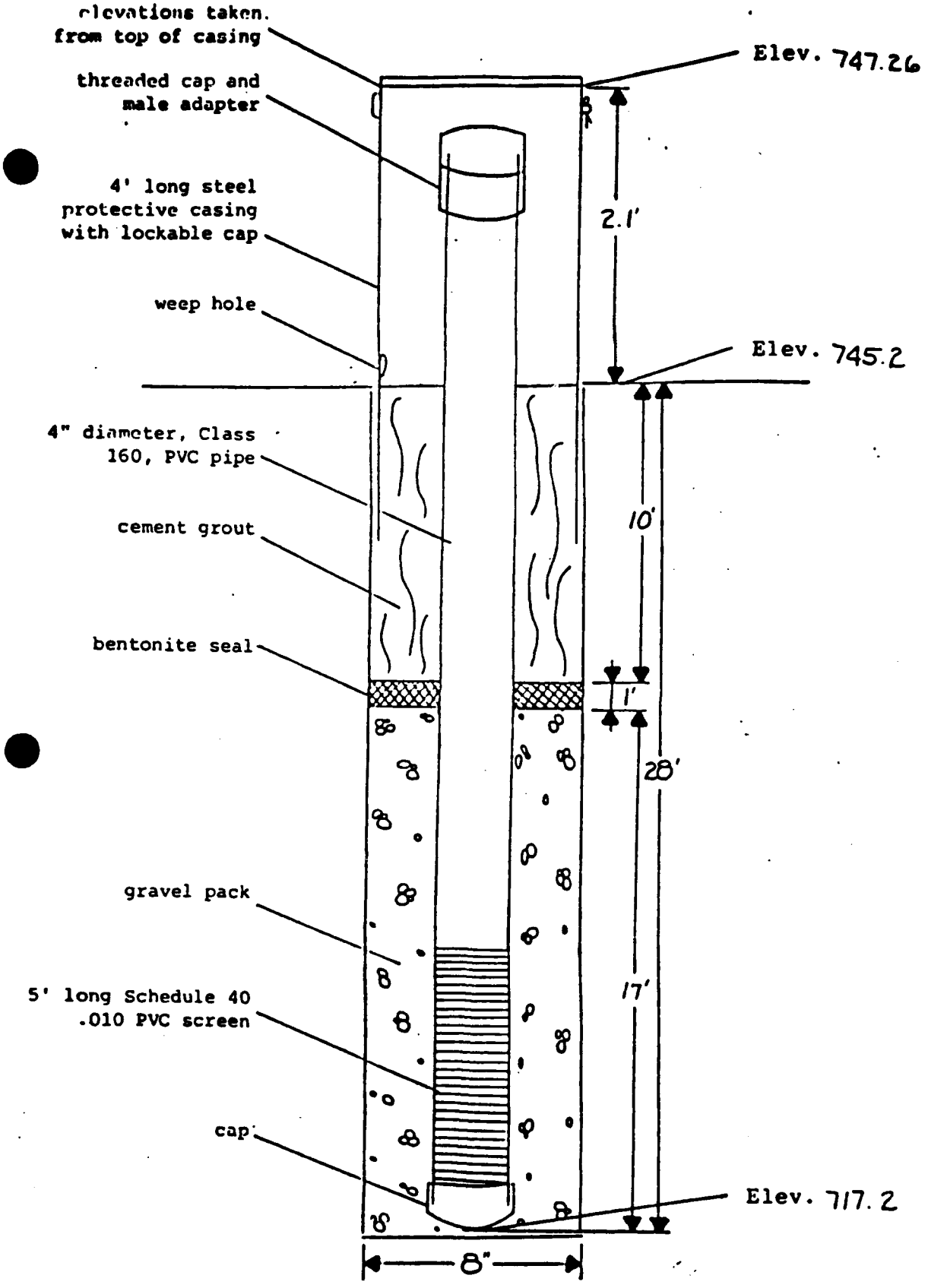
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 5.5' | WB | | | | Dark gray silty clay, med. to stiff |
| 5.5' | 9.5' | WB | | | | Dark gray silty clay, soft to med. |
| 9.5' | 11.0' | ST1 | 3.5 | | | Dark gray silty clay, med. to stiff |
| 11.0' | 14.0' | WB | | | | Same |
| 14.0' | 19.5' | WB | | | | Gray silty clay w/trace sand, soft to med. |
| 5' | 21.0' | ST2 | 1.0 | | | Gray silty clay w/trace sand, soft |
| 0' | 40.0' | WB | | | | Gray fine sand |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 2 hours - 10 GPM | 25.1 | | 9/11/81 (Completion) |
| | | | |

Dyne-Western Company, Inc.


elevations taken from top of casing
threaded cap and male adapter
4' long steel protective casing with lockable cap
weep hole
4" diameter, Class 160, PVC pipe
cement grout
bentonite seal
gravel pack
5' long Schedule 40 .010 PVC screen
cap
Elev. 747.26
2.1'
Elev. 745.2
10'
1'
28'
17'
Elev. 717.2
8"

MW 7-6

# TEST BORING LOG

ject Lake City Army Ammunition Plant

Boring No. MW 7-6 Sheet 1 of 1

Surface Elevation _____ Offset _____

dr[redacted]

Date Started 1/20/82 Completed 1/20/82

y & State Independence, Missouri

Driller T. J. Butler Rig D-2

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core Water
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Air
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger Bit

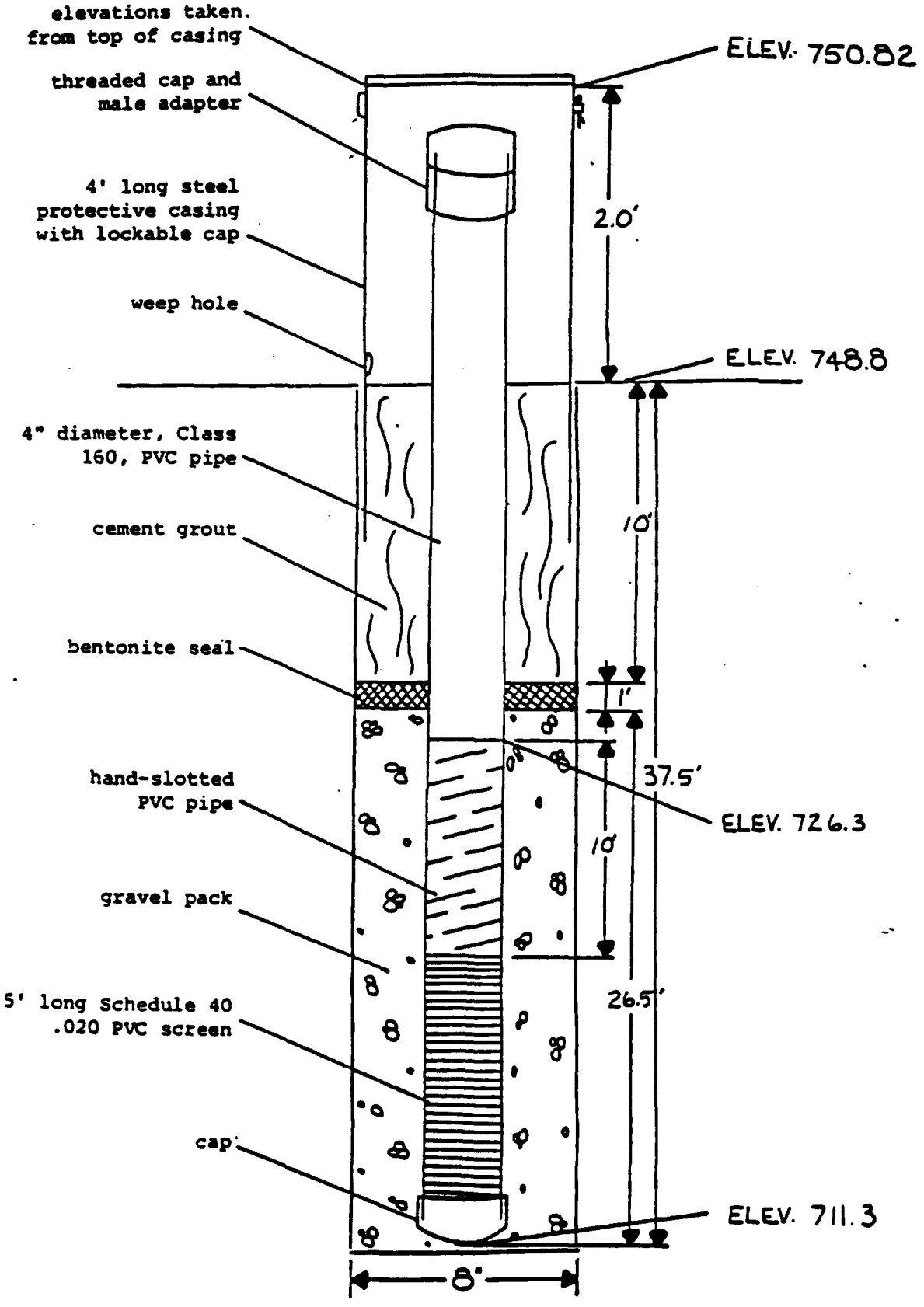
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO METER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.5' | WB | | | | Dark Brown silty clay, medium to soft |
| 4.5' | 10.0' | WB | | | | Dark gray silty clay, medium stiff |
| 10.0' | 17.0' | WB | | | | Same |
| 17.0' | 24.5' | WB | | | | Gray silty clay, medium soft |
| 24.5' | 28.5' | WB | | | | Light gray silty clay, medium soft |
| 5' | 31.0' | WB | | | | Maroon silty clay, w/trace sand, medium to soft |
| 31.0' | 40.0' | WB | | | | Gray fine to medium sand |
| 40.0' | Total Depth | | | | | |

RKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date |
|---|---|---|---|
| [redacted]ped 2 hours @ 4 GPM, not steadily | 22' | Before Pumping | 1/25/82 (Completio |

Layne-Western Company, Inc.

CONSTRUCTION OF WELL




MW 8-1

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 8-1 Sheet: 1 of _

Surface Elevation: 748.8 Offset: _____

Date Started: 8/18/81 Completed: 8/18/81

City & State: Independence, Missouri

Driller: B. Blank Rig: _____

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wa; C.A. – Core Air; F.B. – Finger B

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 3.0' | WB | | | | Dark brown silty clay, very stiff |
| 3.0' | 5.0' | WB | | | | Brown silty clay, very stiff |
| 5.0' | 9.0' | WB | | | | Same |
| 9.0' | 10.5' | ST1 | 2.75 | | | Same |
| 10.5' | 12.5' | WB | | | | Same |
| 12.5' | 15.0' | WB | | | | Red brown silty clay, very stiff |
| 15.0' | 19.0' | WB | | | | Same |
| 19.0' | 20.5' | ST2 | 2.5 | | | Brown silty clay w/shale & trace sandstone, very stiff |
| 20.5' | 22.0' | WB | | | | Same |
| 22.0' | 25.0' | WB | | | | Gray silty clay, very stiff |
| 25.0' | 32.0' | WB | | | | Gray fine sandy clay, very stiff |
| 32.0' | 37.0' | WB | | | | Brown silty fine sand, med. dense |
| 37.0' | 40.0' | WB | | | | Light brown silty clay, very stiff |
| 40.0' | Total | depth | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

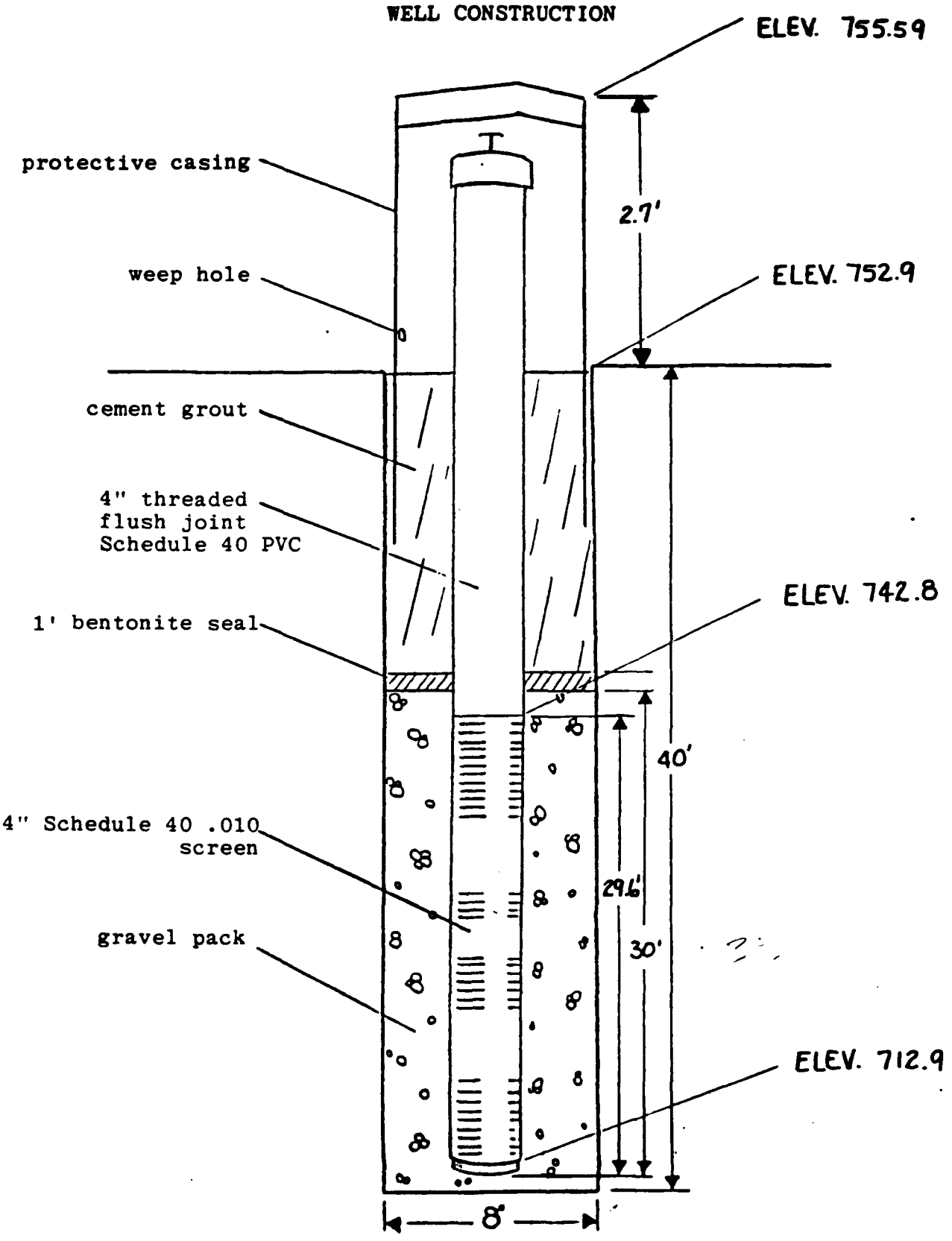
Pumped 1-1/2 hour - 1-1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 9.9 | | 9/14/81 (Comple |
| | | |

Wayne-Western Company, Inc.

C-251

WELL CONSTRUCTION




MW 8-2

# TEST BORING LOG

Project: Lake City A.A.P. — replacement well

Boring No. 8-2 — Sheet 1 of 1

Surface Elevation 752.89 — Offset 5' North of MW 8-2

Date Started 9-25-84 — Completed 9-26-84

City & State: Independence, Missouri

Driller: Buck — Rig: AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wate; C.A. – Core Air; F.B. – Finger Bit

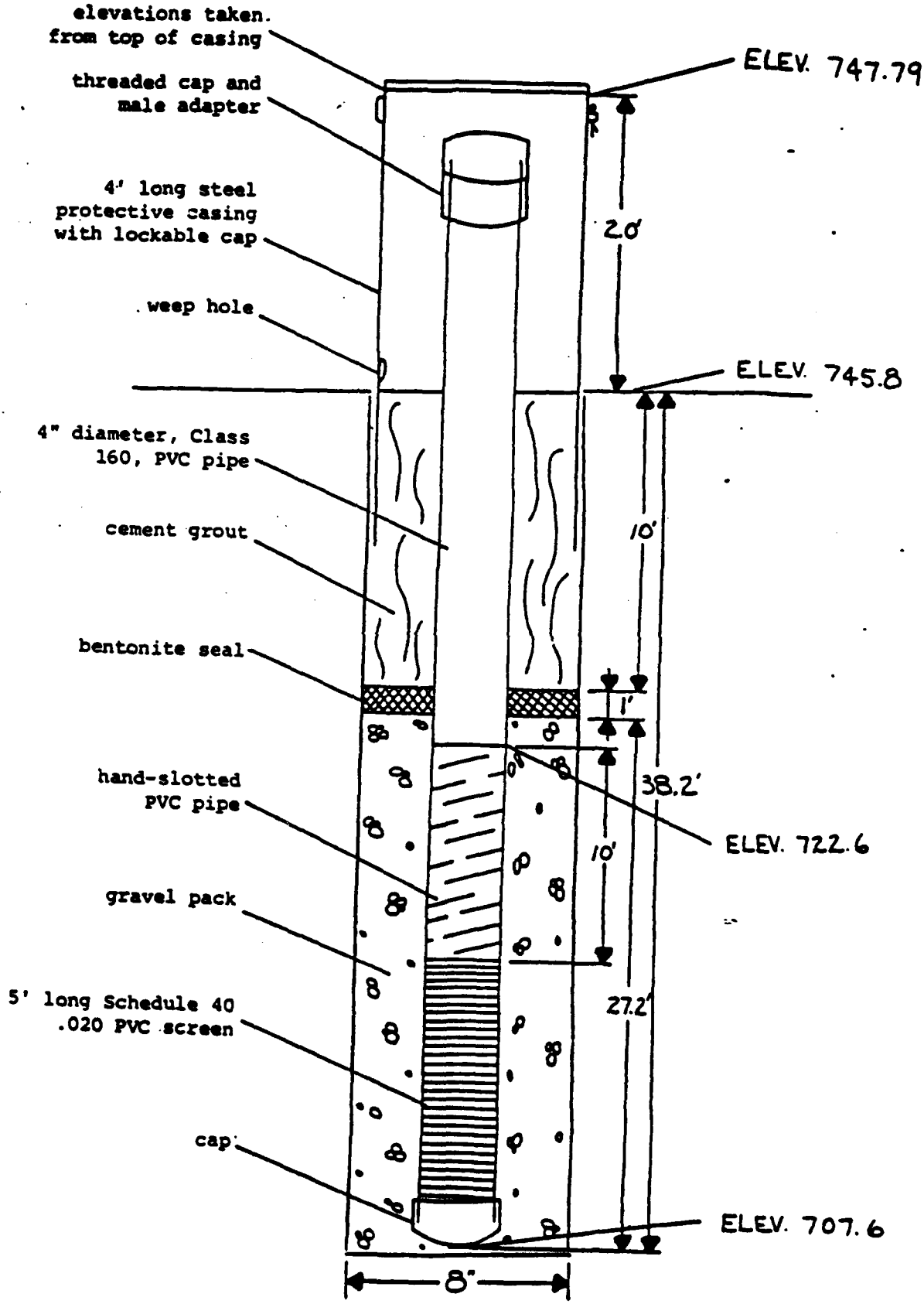
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0 | 1.0 | HA | | | | Brown silty clay, moist, very stiff ( |
| 1.0 | 4.5 | HA | | | | Gray shale, dry, hard (FILL) |
| 4.5 | 6.0 | HA | | | | Gray-brown silty clay, moist, very stiff (FILL) |
| 6.0 | 8.5 | HA | | | | Gray-brown shale & clay, moist, very stiff (FILL) |
| 8.5 | 9.8 | HA | | | | Gray-brown silty clay, moist, very stiff (FILL) |
| 9.8 | 11.0 | HA | | | | Dark brown silty clay, moist, stiff |
| 11.0 | 15.0 | HA | | | | Gray-brown silty clay, moist, stiff |
| 15.0 | 17.0 | ST-1 | 2.25 | | 1.5 | Same |
| 17.0 | 18.0 | HA | | | | Same |
| 18.0 | 28.0 | HA | | | | Dark gray brown silty clay, moist, st |
| 28.0 | 35.0 | HA | | | | Dark gray very silty clay, very moist |
| 35.0 | 37.0 | ST-2 | 0.75 | | 1.0 | Same |
| 37.0 | 40.0 | HA | | | | Same |
| 40.0 | Total | Depth | | | | |
| | | | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| 21.0' | | 9/26/84 (Completic |
| 12.8' | | 1/17/85 |

Wayne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 8-2

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 8-2 Sheet: 1 of 1

Surface Elevation: 745.8 Offset:

Address:

Date Started: 8/19/81 Completed: 8/19/81

City & State: Independence, Missouri

Driller: B. Blank Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

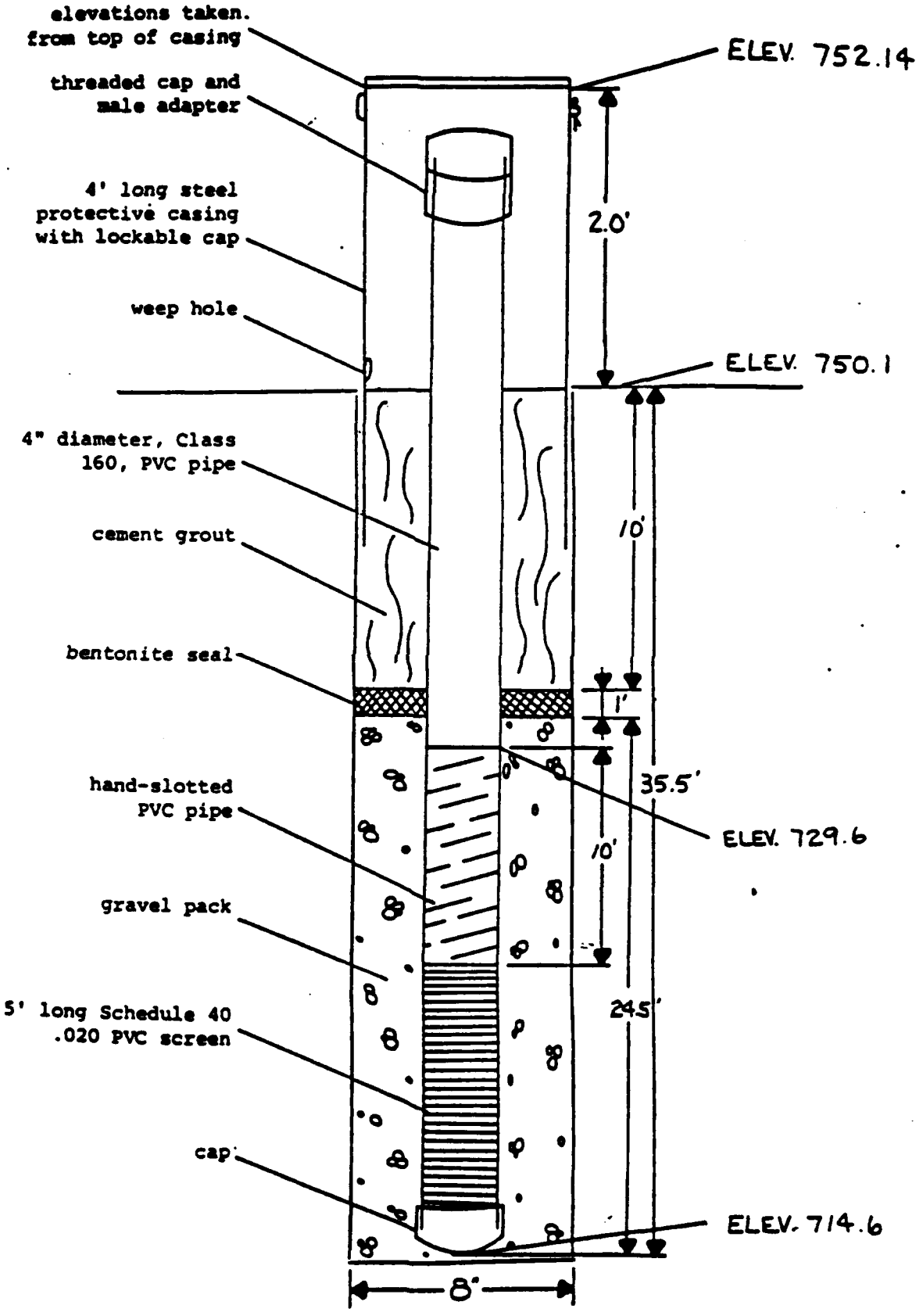
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Dark gray silty clay, very stiff |
| 5.0' | 7.0' | WB | | | | Same |
| 7.0' | 9.0' | WB | | | | Gray & brown silty clay, very stiff |
| 9.0' | 10.5' | ST1 | 2.5 | | | Same |
| 10.5' | 15.0' | WB | | | | Same |
| 15.0' | 19.0' | WB | | | | Same |
| 19.0' | 20.5' | ST2 | 2.25 | | | Same |
| 20.5' | 23.0' | WB | | | | Same |
| 23.0' | 25.0' | WB | | | | Gray silty clay, very stiff |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 32.0' | WB | | | | Gray clayey fine sand, dense |
| 32.0' | 35.0' | WB | | | | Gray silty clay w/trace fine sand, stiff |
| 35.0' | 40.0' | WB | | | | Same |
| 40.0' | Total | depth | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Static Water Level | Time | Date |
|---|---|---|---|
| Pumped 1-1/2 hour - 1-1/2 GPM | 7.4 | | 9/14/81 (Completion) |
| | | | |

Lyne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 8-3

C-256

# TEST BORING LOG

Project: Lake City AAP — Boring No.: MW 8-3 — Sheet: 1 of

Surface Elevation: 750.1 — Offset:

Date Started: 8/20/81 — Completed: 8/20/81

City & State: Independence, Missouri — Driller: B. Blank — Rig:

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core W; C.A. – Core A; F.B. – Finger

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO-METER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY SAND CONSISTENCY DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Dark brown silty clay, very stiff |
| 5.0' | 7.0' | WB | | | | Same |
| 7.0' | 9.0' | WB | | | | Brown & gray silty clay, stiff |
| 9.0' | 10.5' | ST1 | 1.25 | | | Same |
| 10.5' | 15.0' | WB | | | | Same |
| 15.0' | 19.0' | WB | | | | Same |
| 19.0' | 20.5' | ST2 | 1.5 | | | Brown & gray silty clay w/trace sha stiff |
| 20.5' | 22.5' | WB | | | | Same |
| 22.5' | 25.0' | WB | | | | Maroon & olive & gray shale w/trace fine sand, very stiff |
| 25.0' | 30.0' | WB | | | | Gray silty fine sand w/trace clay, very stiff |
| 30.0' | 33.5' | WB | | | | Gray silty fine sand, dense |
| 33.5' | 35.0' | WB | | | | Gray silty clay, very stiff |
| 35.0' | 40.0' | WB | | | | Gray silty clay w/trace lignite, ver stiff |
| 40.0' | Total | depth | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

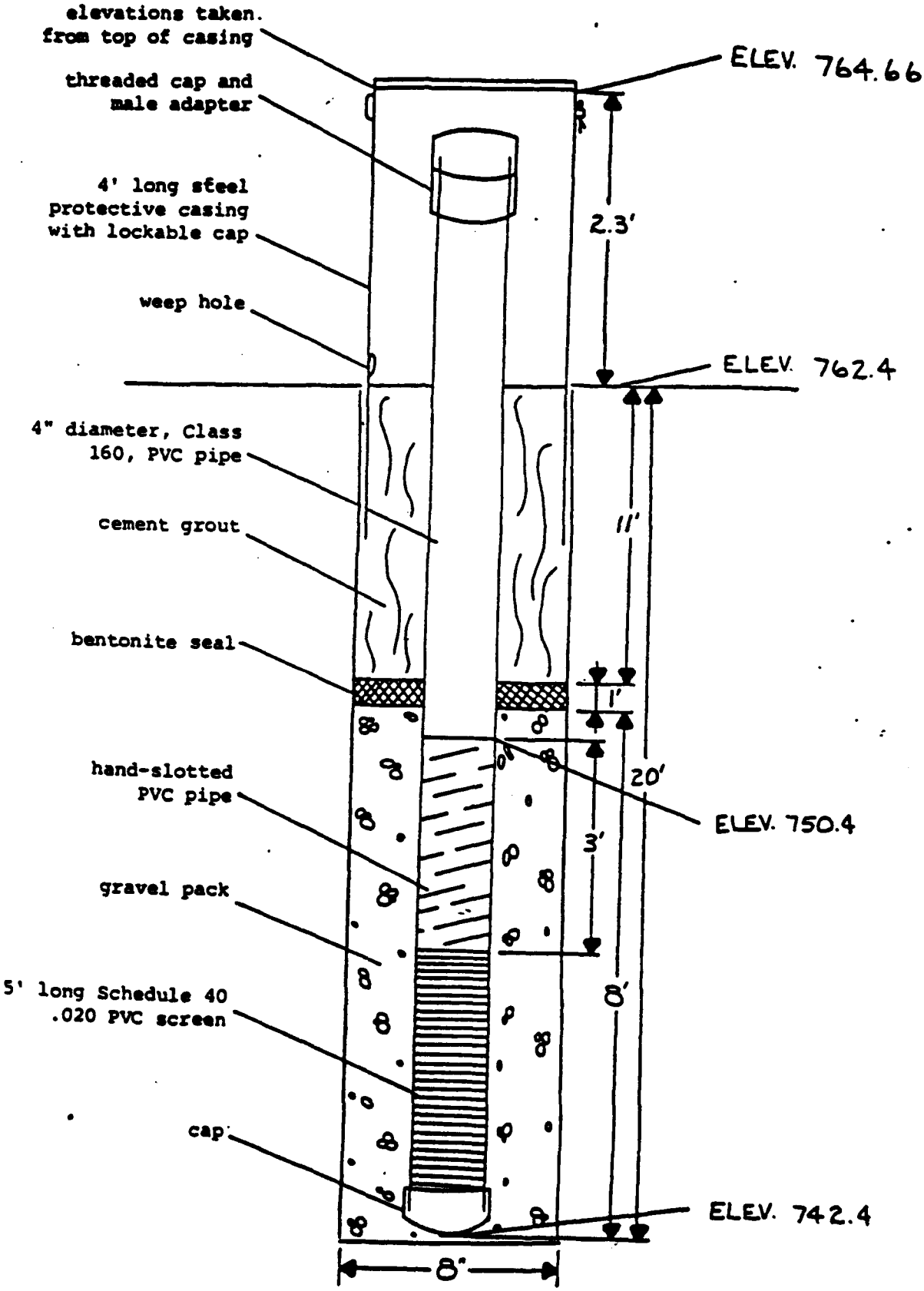
Pumped 2 hours - 1 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 5.9 | | 9/14/81 (Complet |
| | | |

Wayne-Western Company, Inc.

C-257

# CONSTRUCTION OF WELL




MW 8-4

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 8-4 Sheet: 1 of

Surface Elevation: 762.4 Offset:

Date Started: 8/18/81 Completed: 8/18/81

City & State: Independence, Missouri

Driller: T. Butler Rig:

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core W
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core A
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 3.5' | WB | | | | Light brown silty clay, med. to sti |
| 3.5' | 6.0' | WB | | | | Light gray silty clay w/trace sand, to med. |
| 6.0' | 8.5' | WB | | | | Dark brown silty clay w/trace sand, to med. |
| 8.5' | 9.5' | WB | | | | Green gray weathered shale, med. to |
| 9.5' | 11.0' | SS1 | | | | Layered maroon & gray shaly clay, me stiff |
| 11.0' | 13.5' | WB | | | | Same |
| 13.5' | 14.0' | WB | | | | Light gray weathered shale, soft to |
| 14.0' | 16.0' | WB | | | | Maroon and light gray shaly clay, so to med. |
| 16.0' | 19.5' | WB | | | | Green gray weathered shale, med. to hard |
| 19.5' | 40.0' | WB | | | | Light gray shale, hard |
| 40.0' | Total | depth | | | | |

REMARKS: (Casing, Water Loss, Etc.)

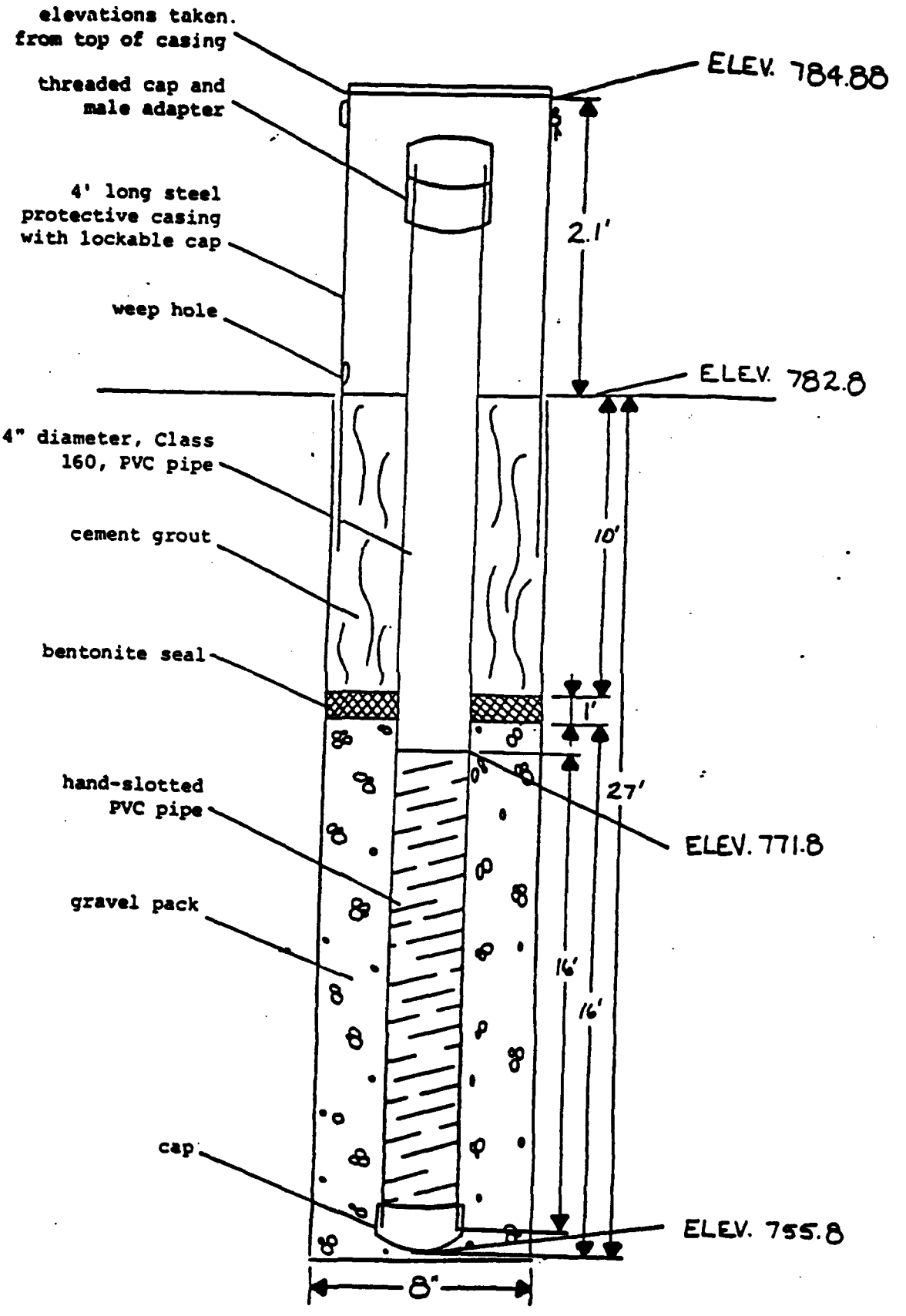
| | Static Water Level | Time | Date |
|---|---|---|---|
| mped 1-1/2 hour - 1/2 GPM | 11.5 | | 9/14/81 (Completio |

Wyne-Western Company, Inc.

C-259

W-99A

# CONSTRUCTION OF WELL




MW 8-5

# TEST BORING LOG

Project: Lake City AAP

Boring No.: MW 8-5 Sheet: 1 of _

Surface Elevation: 782.8 Offset: _____

Date Started: 9/1/81 Completed: 9/2/81

City & State: Independence, Missouri

Driller: T. Butler Rig: _____

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core We; C.A. – Core Air; F.B. – Finger B

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.5' | WB | | | | Light brown silty clay, med. to stif |
| 4.5' | 6.0' | WB | | | | Brown silty clay, med to stiff |
| 6.0' | 9.5' | WB | | | | Gray silty clay, med. to stiff |
| 9.5' | 11.0' | SS1 | | | | Gray sandy clay, med. to stiff |
| 11.0' | 14.0' | WB | | | | Same |
| 14.0' | 16.0' | WB | | | | Light tan silty clay, soft to med. |
| 16.0' | 24.0' | WB | | | | Dark gray sandy shale, med. to hard |
| 24.0' | 27.0' | WB | | | | Light gray shale, soft to med. |
| 27.0' | 29.5' | WB | | | | Gray shale, med. to hard |
| 29.5' | 34.0' | WB | | | | Maroon shale, soft to med. |
| 34.0' | 36.5' | WB | | | | Light gray shale, soft to med. |
| 36.5' | 40.0' | WB | | | | Gray shale, med. to hard |
| 40.0' | Total depth | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

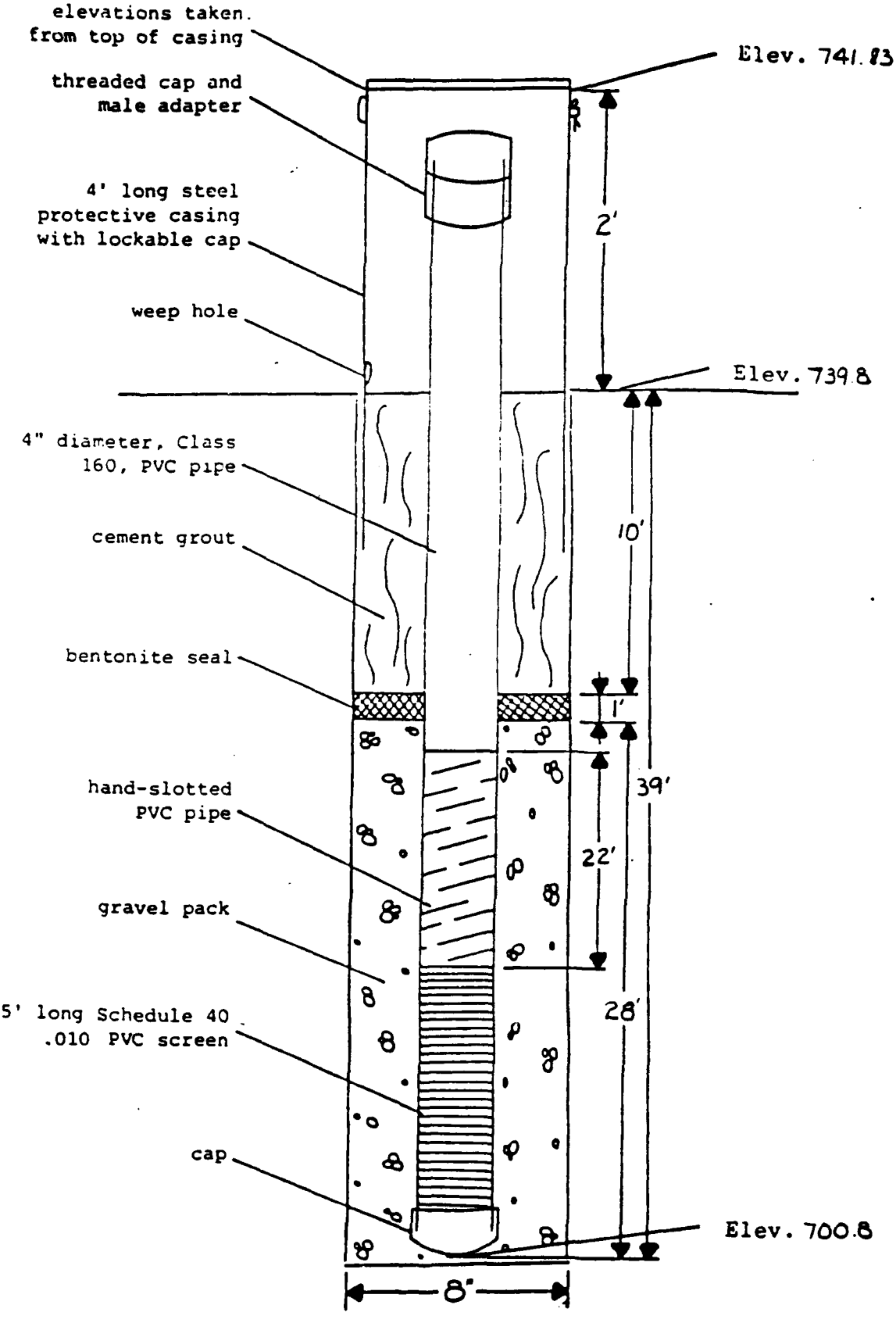
mped 2 hours - 1/2 GPM

| Static Water Level | Time | Date |
|---|---|---|
| 15.9 | | 9/14/81 (Completio |
| | | |

Wyne-Western Company, Inc.

C-261

W-98A


elevations taken from top of casing
threaded cap and male adapter
4' long steel protective casing with lockable cap
weep hole
4" diameter, Class 160, PVC pipe
cement grout
bentonite seal
hand-slotted PVC pipe
gravel pack
5' long Schedule 40 .010 PVC screen
cap
Elev. 741.83
Elev. 739.8
Elev. 700.8
2'
10'
1'
39'
22'
28'
8"

MW 9-1

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 9-1 Sheet: 1 of _
Surface Elevation: 739.83 Offset: _____
Address: Independence, Missouri
Date Started: 12/2/81 Completed: 12/2/81
City & State: Independence, Missouri
Driller: J. Von Holt Rig: D-2

Abbreviations:
A.O. – Auger Only R.B. – Rock Bit C.W. – Core Wa
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Air
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger B

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO METER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.5' | WB | | | | Gravel |
| 0.5' | 5.0' | WB | | | | Dark brown silty clay, stiff |
| 5.0' | 12.0' | WB | | | | Dark gray silty clay, stiff |
| 12.0' | 13.5' | ST1 | 1.0 | | 1.5' | Gray & trace/brown silty clay, medium |
| 13.5' | 19.0' | WB | | | | Same |
| 19.0' | 34.0' | WB | | | | Gray silty clay, medium |
| 34.0' | 40.0' | WB | | | | Gray fine to medium sand, w/trace of silt |
| 40.0' | Total Depth | | | | | |

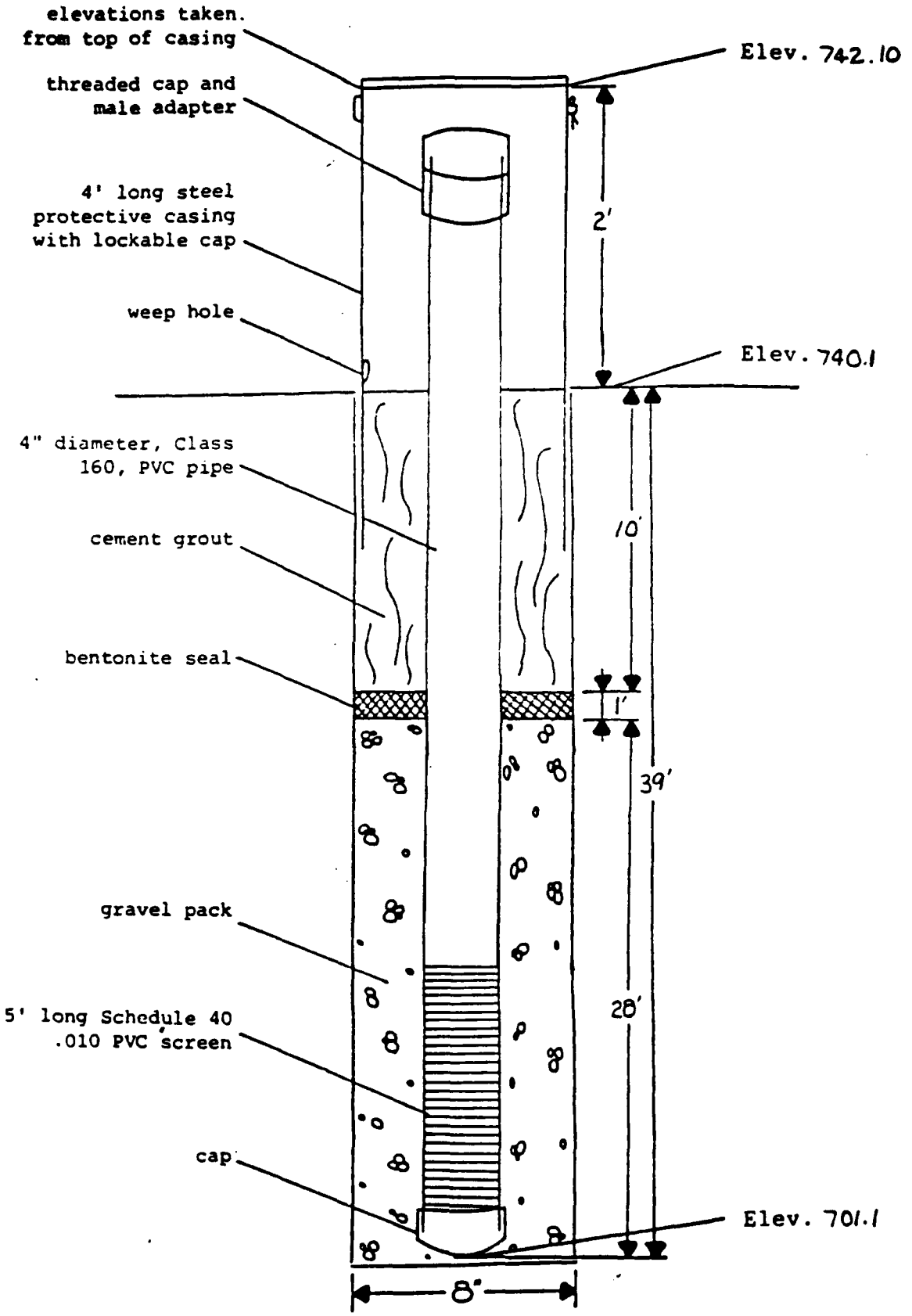
REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date |
|---|---|---|---|
| Sample of Sand @ 34' - 40' | 12.45 | | 1/28/82 (Completion |
| Pumped for 2.5 hours @ 6 GPM | | | |

Wayne-Western Company, Inc.

C-264

# CONSTRUCTION OF WELL




MW 9-2

# TEST BORING LOG

Project: Lake City Army Ammunition Plant

Boring No.: MW 9-2 Sheet: 1 of

Surface Elevation: 740.10 Offset:

Address:

Date Started: 12/9/81 Completed: 12/9/81

City & State: Independence, Missouri

Driller: T. J. Butler Rig: D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wa; C.A. – Core Air; F.B. – Finger B

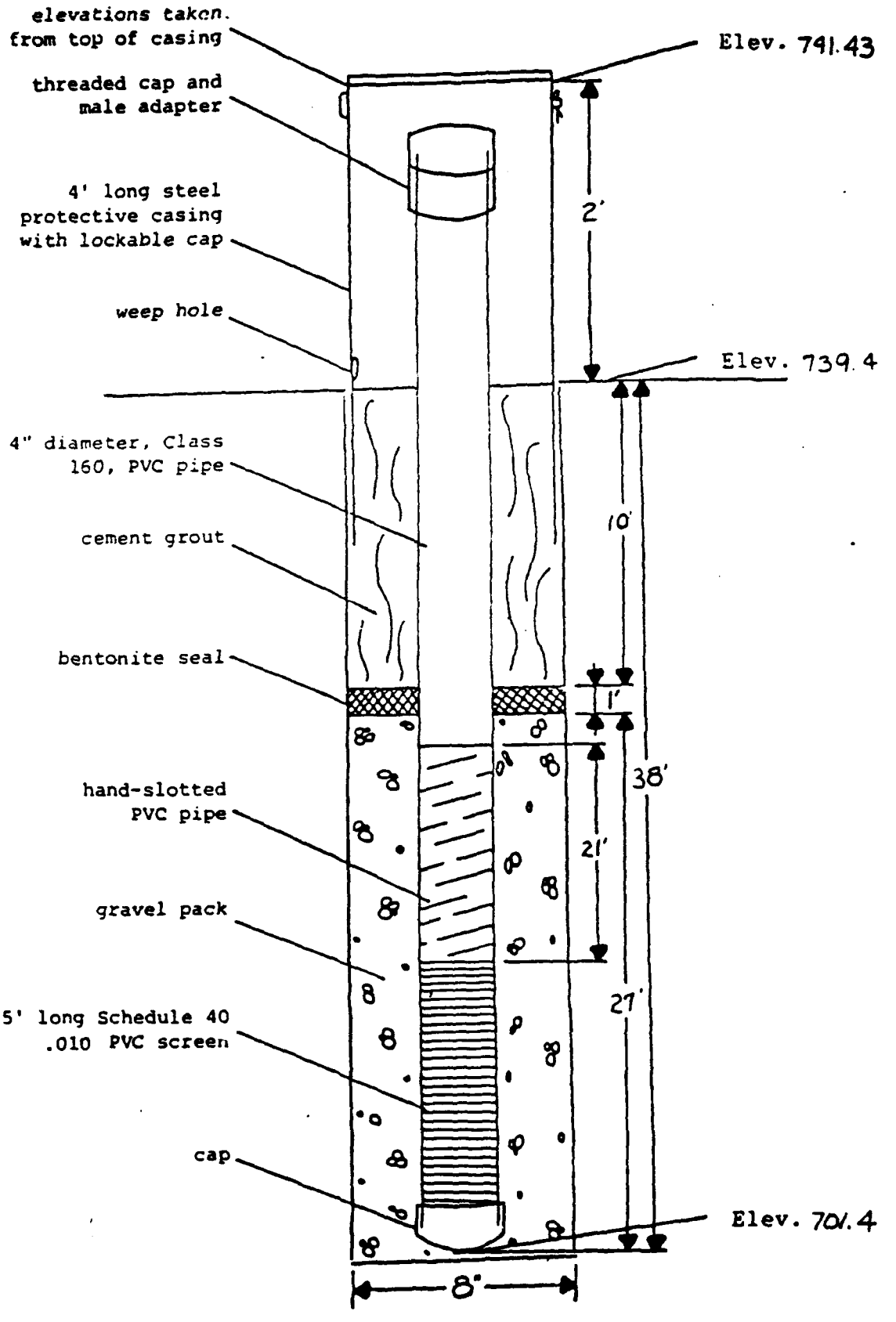
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 2.5' | WB | | | | Brown silty clay, medium to soft |
| 2.5' | 9.0' | WB | | | | Gray silty clay, medium to soft |
| 9.0' | 11.0' | WB | | | | Gray silty clay, medium to stiff |
| 11.0' | 12.5' | WB | | | | Gray silty clay, trace/sand & weathered sha medium to soft |
| 12.5' | 14.0' | ST1 | | | 1.5' | Gray silty clay, trace/sand, stiff |
| 4.0' | 20.0' | WB | | | | Gray silty clay, medium to soft |
| 20.0' | 32.5' | WB | | | | Blue gray clay, medium to stiff |
| 32.5' | 40.0' | WB | | | | Silty fine to medium fine sand |
| 40.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date | |
|---|---|---|---|---|
| ag sample of sand 32.5' - 40.0' | 15.40 | | 1/29/82 | (Compl |
| Pumped for 1 hour @5 GPM | | | | |

Layne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 9-3

# TEST BORING LOG

oje Lake City Army Ammunition Plant — Boring No. MW 9-3 — Sheet 1 of 1

Surface Elevation 739.43 — Offset

ddress — Date Started 12/3/81 — Completed 12/3/81

ity & State Independence, Missouri — Driller J. Von Holt — Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

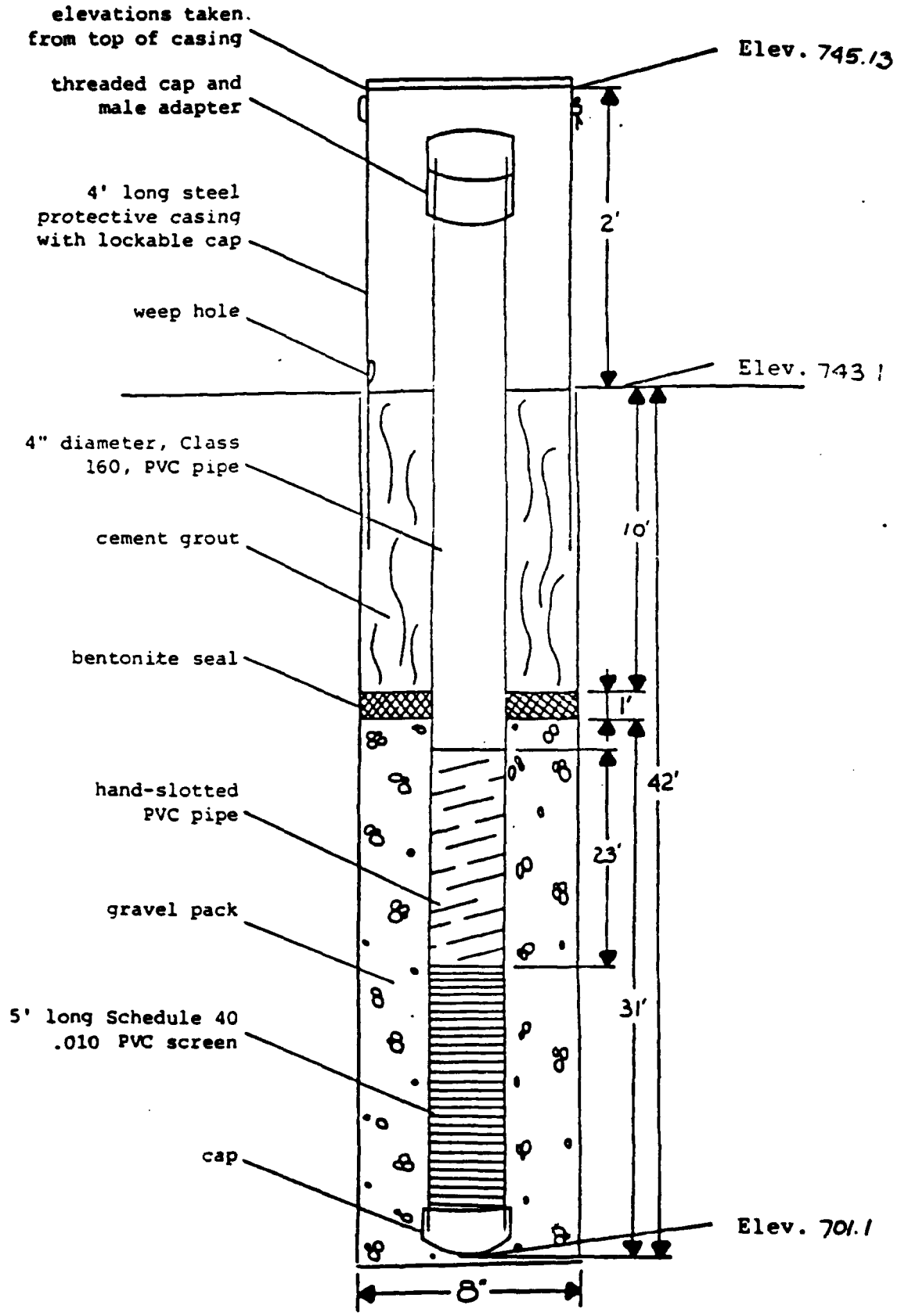
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.5' | WB | | | | Gravel |
| 0.5' | 7.0' | WB | | | | Dark brown silty clay, stiff |
| 7.0' | 12.0' | WB | | | | Dark gray silty clay, stiff |
| 12.0' | 14.0' | WB | | | | Brown & gray silty clay, stiff |
| 14.0' | 15.5' | ST1 | 2.0 | | 1.5' | Same |
| .5' | 27.0' | WB | | | | Same |
| 27.0' | 33.0' | WB | | | | Gray silty clay, medium |
| 33.0' | 40.0' | WB | | | | Gray fine to medium sand w/trace of silt |
| 40.0' | Total Depth | | | | | |

EMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date | |
|---|---|---|---|---|
| Bag Sample of Sand @ 33' - 40' | 11.30 | | 1/28/82 | Comple |
| Pumped for 3 hours @ 6 GPM | | | | |

C-268

# CONSTRUCTION OF WELL




MW 9-4

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. MW 9-4 — Sheet 1 of _

Surface Elevation 743.03 — Offset _____

Address _____ — Date Started 12/4/81 — Completed 12/4/81

City & State Independence, Missouri — Driller J. Von HOlt — Rig D-2

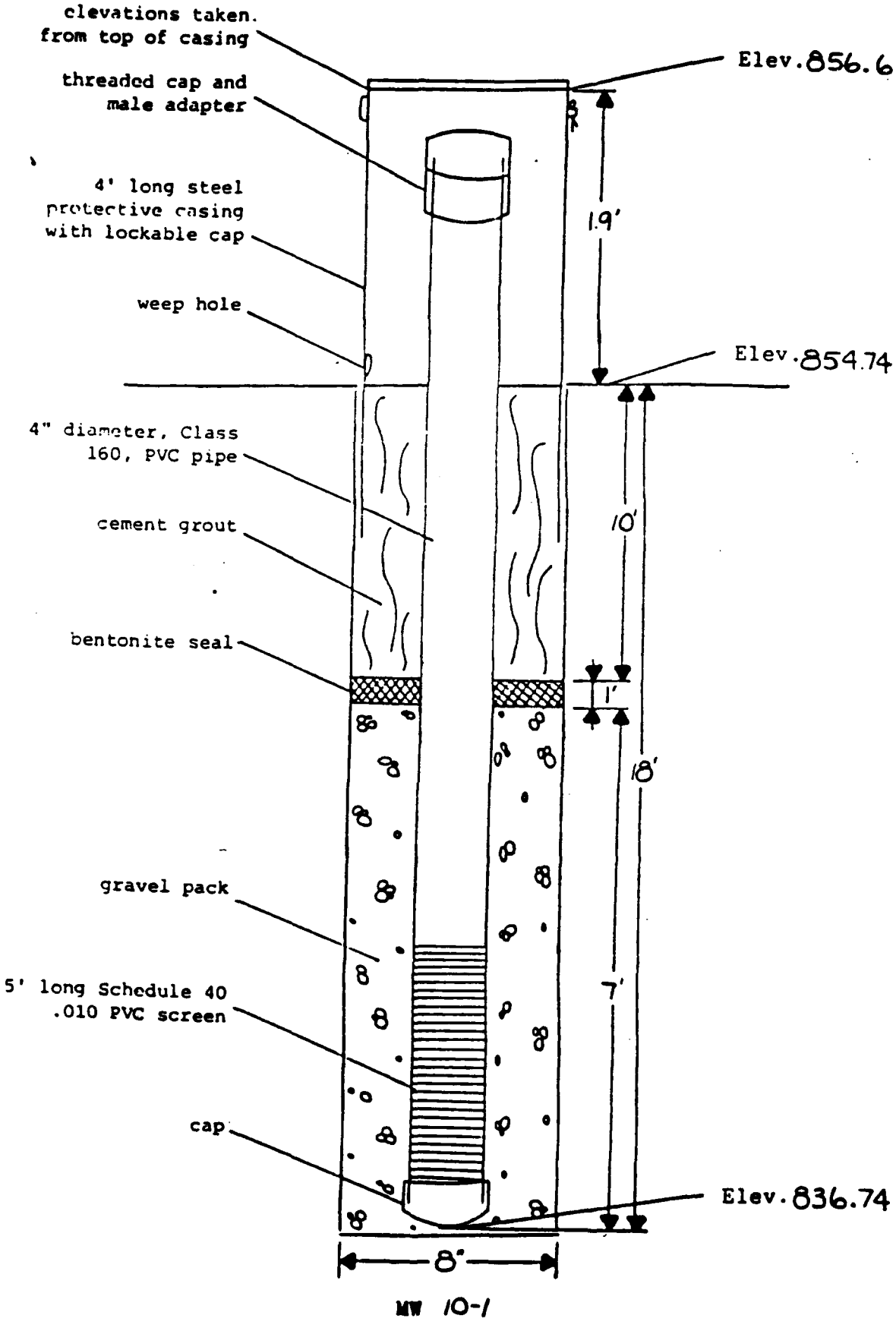
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core W; C.A. – Core A; F.B. – Finger

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Gravel |
| 1.0' | 11.0' | WB | | | | Dark brown silty clay, stiff |
| 11.0' | 18.0' | WB | | | | Brown & gray silty clay, stiff |
| 18.0' | 19.5' | ST1 | 1.5 | | 1.5' | Brown & gray silty clay, stiff |
| 19.5' | 27.0' | WB | | | | Same |
| 27.0' | 36.0' | WB | | | | Gray silty clay, medium |
| 36.0' | 40.0' | WB | | | | Gray fine to medium sand w/trace of silt |
| 40.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date | |
|---|---|---|---|---|
| Grab sample of sand @36' - 40.' | 12.55 | | 1/28/82 | (Compl |
| Pumped for 2.5 hours @ 6 GPM | | | | |

# CONSTRUCTION OF WELL




MW 10-1

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. MW 10-1 Sheet 1 of

Surface Elevation 854.74 Offset 10' E. of 10

Address

Date Started 1/8/82 Completed 1/8/82

City & State Independence, Missouri

Driller T. Butler Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wat; C.A. – Core Air; F.B. – Finger B

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.0' | WB | | | | Dark brown silty clay, slightly moist, med. to soft |
| 4.0' | 9.5' | WB | | | | Dark brown silty clay, slightly moist, soft to med. |
| 9.5' | 13.0' | WB | | | | Same |
| 13.0' | 15.0' | WB | | | | Brown silty clay, very moist, soft to very |
| 15.0' | 16.5' | ST1 | 1.5 | | | Same |
| 16.5' | 17.0' | WB | | | | Same |
| 17.0' | 18.0' | WB | | | | Limestone |
| 18.0' | Refusal | | | | | |

MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| | | (Complet |
| 4.25 | | 2/15/82 |

Layne-Western Company, Inc.

C-272

# TEST BORING LOG

oject Lake City Army Ammunition Plant — Boring No. 10-1 — Sheet 1 of 1

Surface Elevation _____ Offset _____

ddress _____ Date Started 1/4/82 Completed 1/4/82

ty & State Independence, Missouri — Driller T. Butler — Rig D-2

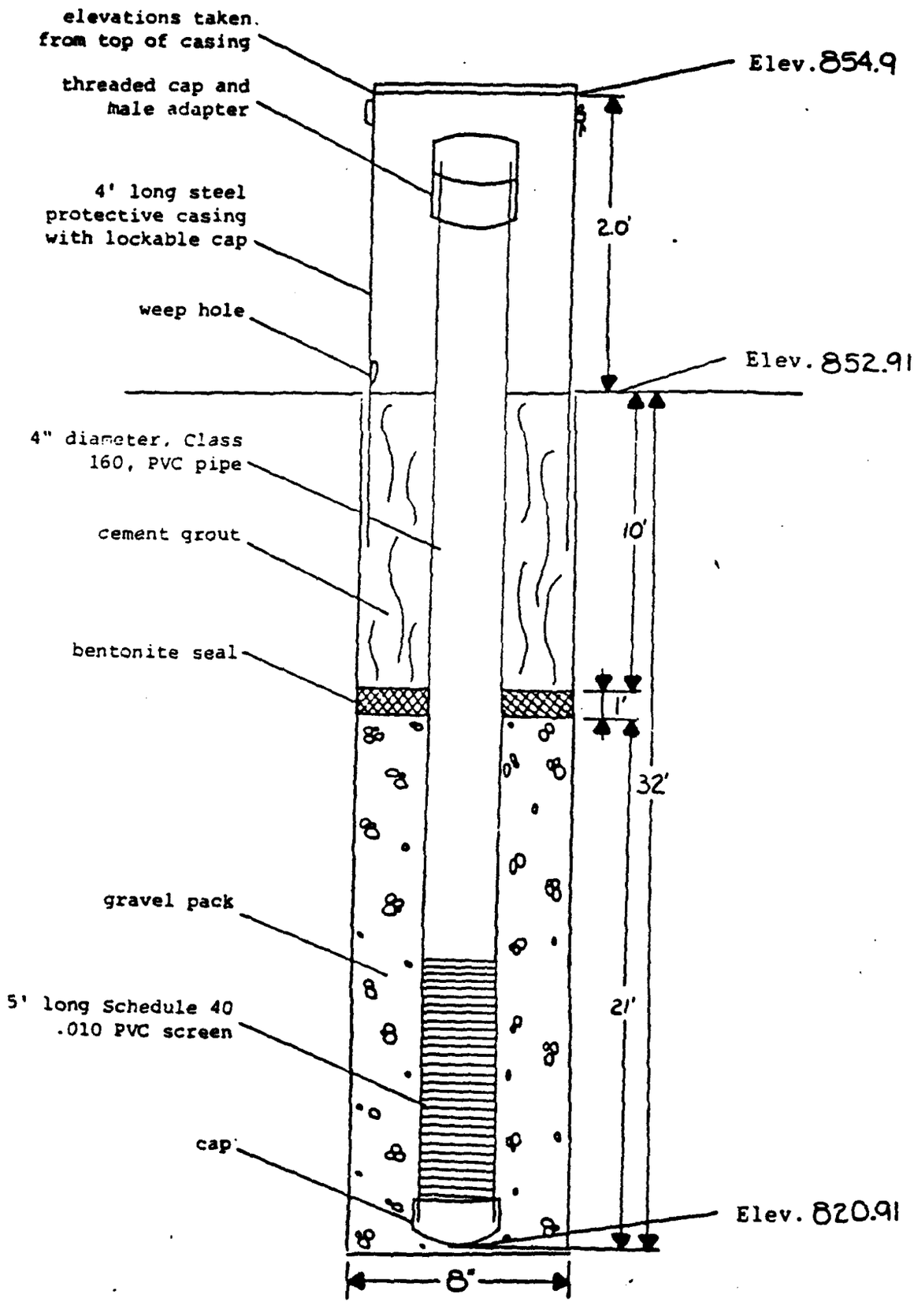
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 4.5' | AO | | | | Dark brown silty clay, slightly moist, med. t |
| 4.5' | 10.0' | AO | | | | Dark brown silty clay, slightly moist, soft t med. |
| 10.0' | 14.0' | AO | | | | Same |
| 14.0' | 20.0' | AO | | | | Brown silty clay, very moist, soft to very so |
| 20.0' | 22.0' | AO | | | | Same |
| .0' | Refusal | | | | | |

E ARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 16.0 | 1:30 pm | 1/4/82 | (Completion |

Layne-Western Company, Inc.


elevations taken from top of casing
threaded cap and male adapter
4' long steel protective casing with lockable cap
weep hole
4" diameter, Class 160, PVC pipe
cement grout
bentonite seal
gravel pack
5' long Schedule 40 .010 PVC screen
cap
Elev. 854.9
Elev. 852.91
Elev. 820.91
2.0'
10'
1'
32'
21'
8"

MW 10-2

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. 10-2 — Sheet 1 of

Surface Elevation _____ Offset _____

Address _____ Date Started 1/4/82 Completed 1/4/82

City & State Independence, Missouri — Driller T. Butler — Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wat; C.A. – Core Air; F.B. – Finger Bi

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 5.0' | AO | | | | Dark brown silty clay, slightly moist, med. to soft |
| 5.0' | 10.0' | AO | | | | Same |
| 10.0' | 15.0' | AO | | | | Same |
| 15.0' | 21.0' | AO | | | | Same |
| 21.0' | 25.0' | AO | | | | Light brown shaly clay, slightly moist, med. to hard |
| 25.0' | 30.0' | AO | | | | Same |
| 30.0' | 32.0' | AO | | | | Same |
| 32.0' | 40.0' | AO | | | | Gray shale, dry, med. to hard |
| 40.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| Dry | 12:15 pm | 1/4/82 | (Con |

Layne Western Company, Inc.

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. MW 10-2 Sheet 1 of

Surface Elevation 852.91 Offset 5' E. of 10-

Date Started 1/9/82 Completed 1/9/82

City & State Independence, Missouri

Driller T. Butler Rig D-2

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core Wa
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Ai
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger E

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR--MATERIAL--MOISTURE--CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 5.0' | WB | | | | Dark brown silty clay, slightly moist, med. to soft |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 15.0' | WB | | | | Same |
| 15.0' | 21.0' | WB | | | | Same |
| 21.0' | 25.0' | WB | | | | Light brown shaly clay, slightly moist, med. to hard |
| 25.0' | 30.0' | WB | | | | Same |
| 30.0' | 32.0' | WB | | | | Gray shale, dry, med. to hard |
| 32.0' | Total depth | | | | | |

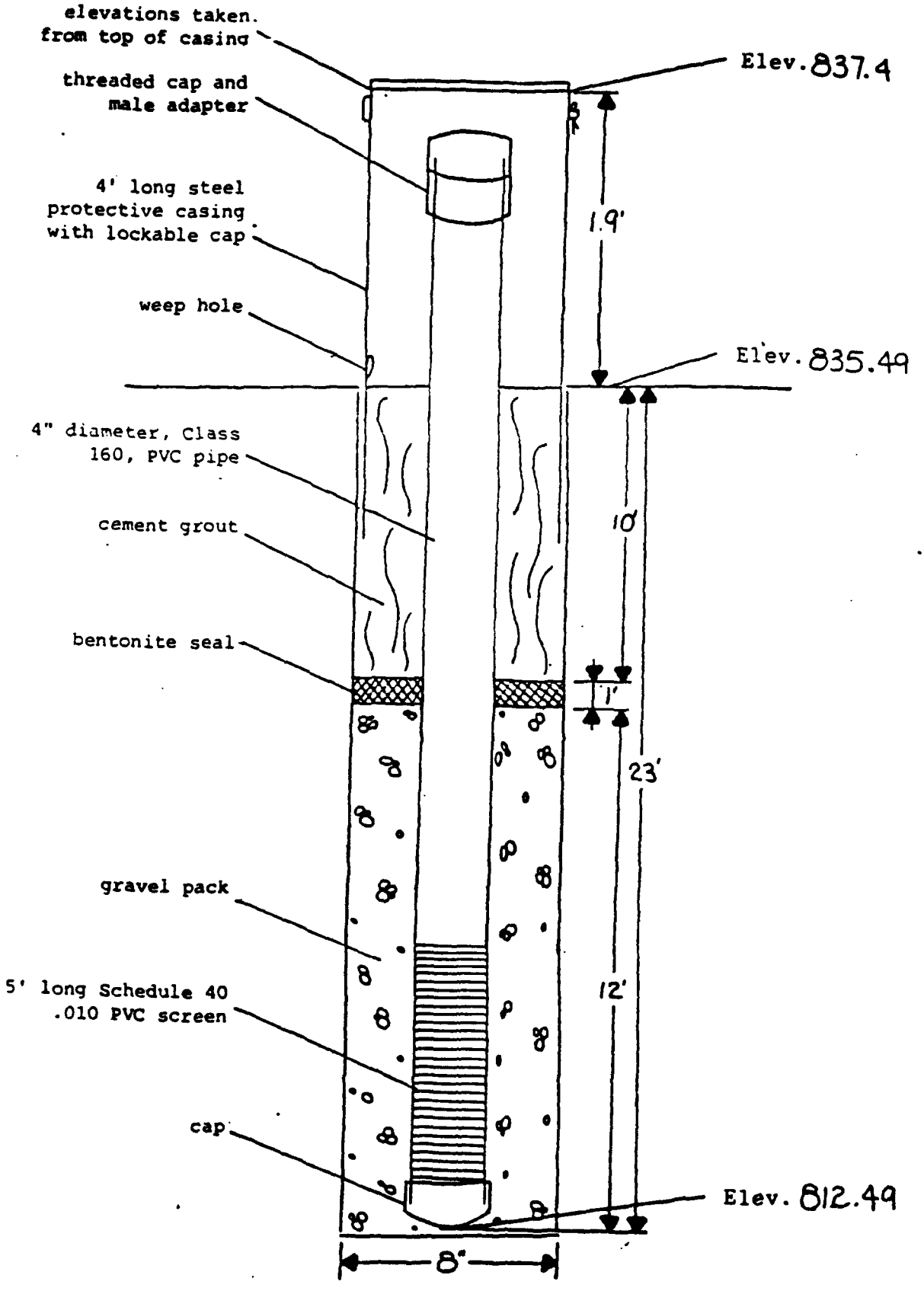
MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| 18.85 | | 2/15/82 (Comple |

Wayne-Western Company, Inc.

C-276

## CONSTRUCTION OF WELL




MW 10-3

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. MW 10-3 Sheet 1 of __

Surface Elevation 835.49 Offset _____

[redacted]ess _____

Date Started 1/4/82 Completed 1/4/82

City & State Independence, Missouri

Driller T. Butler Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wate; C.A. – Core Air; F.B. – Finger Bit

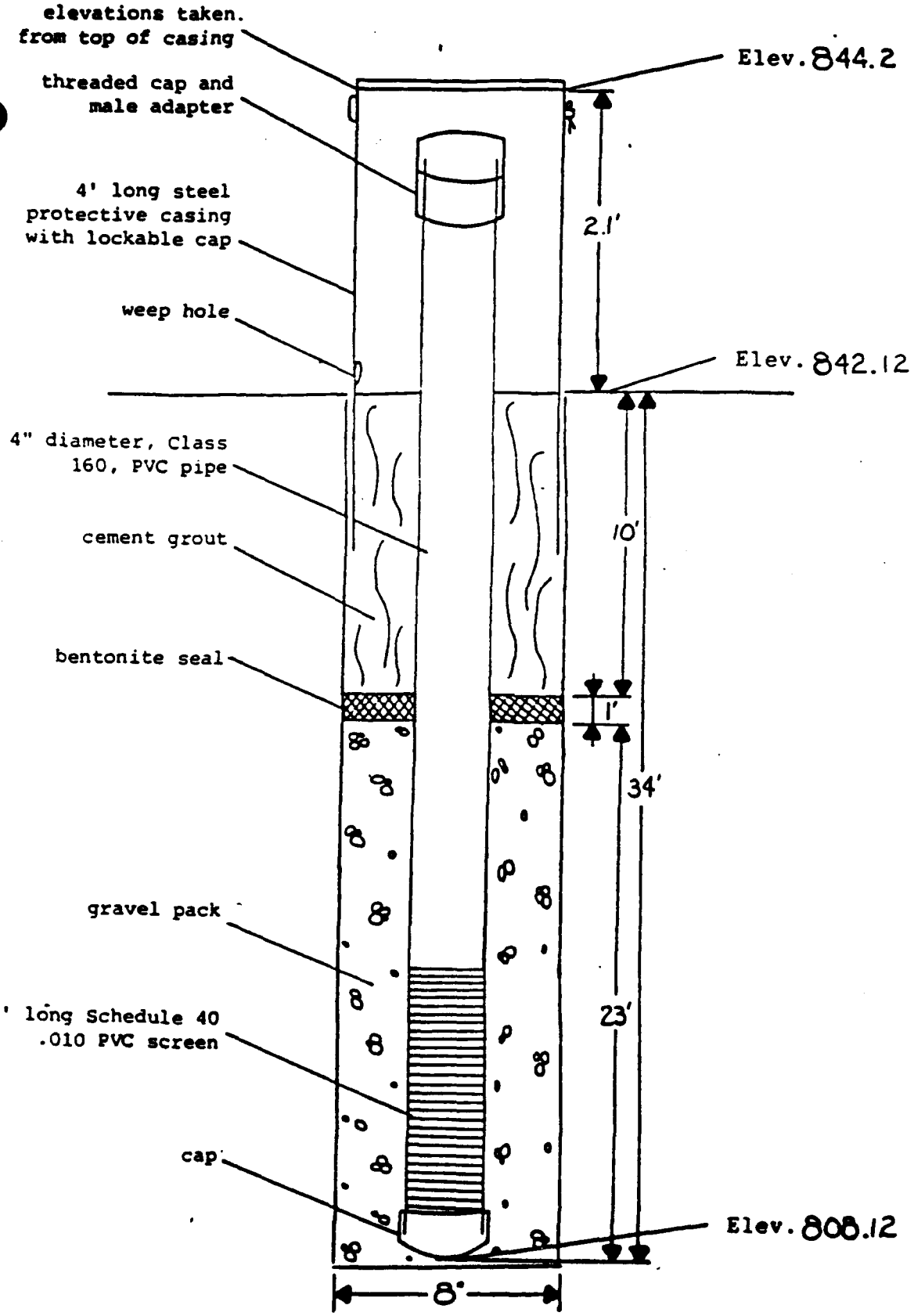
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO METER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 5.0' | AO | | | | Dark brown silty clay, slightly moist, med. to soft |
| 5.0' | 7.0' | AO | | | | Same |
| 7.0' | 12.0' | AO | | | | Dark gray silty clay, slightly moist, soft to med. |
| 12.0' | 15.0' | AO | | | | Dark brown silty clay, slightly moist, med. to soft |
| 15.0' | 21.0' | AO | | | | Same |
| 21.0' | 25.0' | AO | | | | Light brown shaly clay, slightly moist, mec to hard |
| 25.0' | 30.0' | AO | | | | Same |
| 30.0' | 35.0' | AO | | | | Same |
| 35.0' | 40.0' | AO | | | | Same |
| 40.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)
Used auger hole as pilot hole for well.
On 1/7/82 WB hole for monitoring well with a TD of 23'

| Water Level | Time | Date | |
|---|---|---|---|
| Dry | 3:00 pm | 1/4/82 | (Comp |
| 20.35 | | 2/15/82 | |

[redacted]

# CONSTRUCTION OF WELL




MW 10-4

# TEST BORING LOG

Project: Lake City Army Ammunition Plant — Boring No.: MW 10-4 — Sheet 1 of 1

Surface Elevation: 842.12 — Offset:

Address:

Date Started: 1/4/82 — Completed: 1/4/82

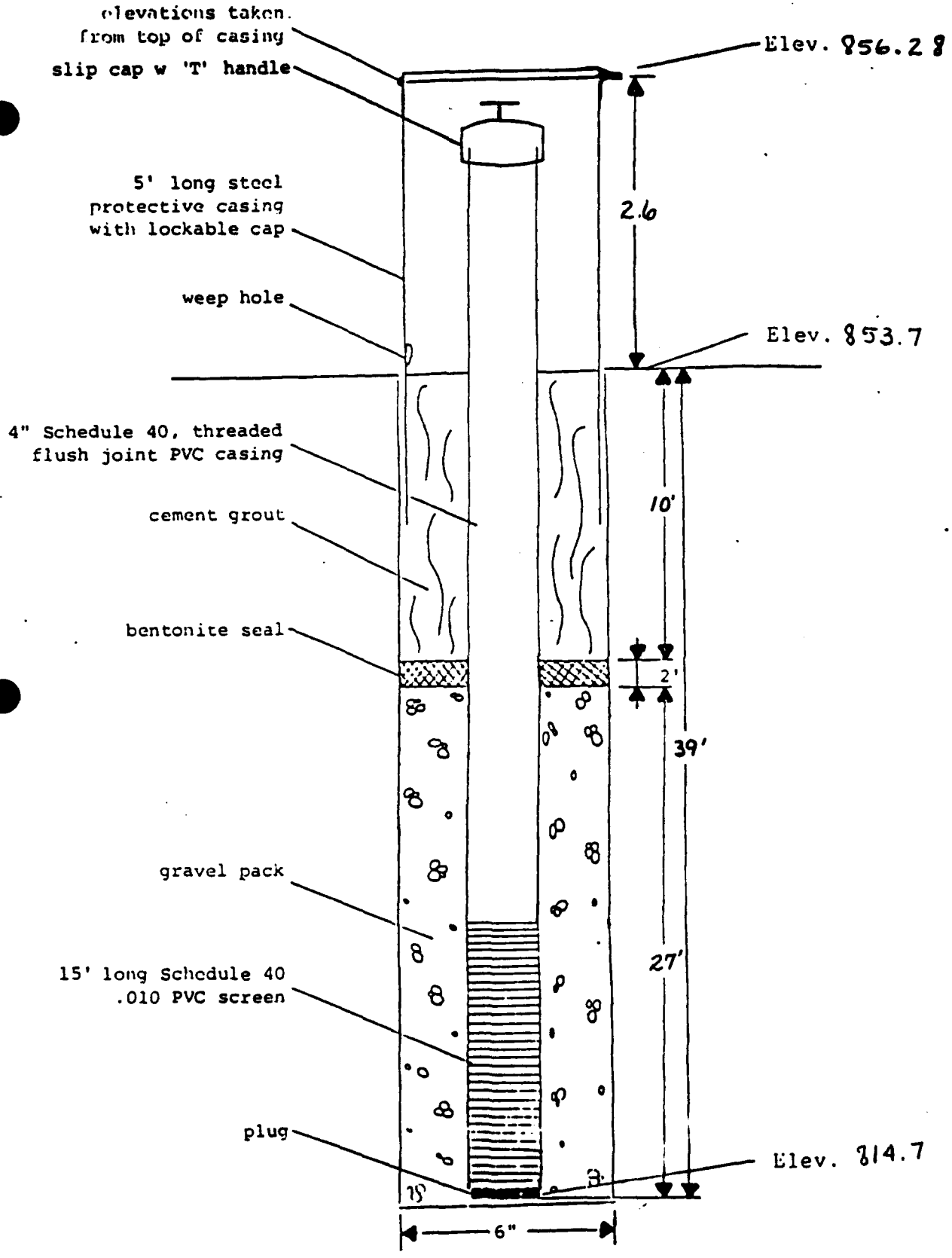
City & State: Independence, Missouri — Driller: T. Butler — Rig: D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 5.0' | AO | | | | Dark brown silty clay, slightly moist, med. to soft |
| 5.0' | 10.0' | AO | | | | Same |
| 10.0' | 15.0' | AO | | | | Dark brown silty clay, moist, soft to med. |
| 15.0' | 20.0' | AO | | | | Same |
| 20.0' | 25.0' | AO | | | | Same |
| .0' | 31.0' | AO | | | | Dark brown silty clay, very moist, soft to med. |
| .0' | 31.5' | AO | | | | Gray shale, dry, hard |
| 31.5' | 40.0' | AO | | | | Gray shale, dry, med. to hard |
| 40.0' | Total depth | | | | | |

| | Water Level | Time | Date | |
|---|---|---|---|---|
| ll. | | | | |
| i with a | 24.0 | 2:00 pm | 1/4/82 | (Completic |
| | 8.1 | | 2/15/82 | |

# WELL CONSTRUCTION




MW 10-5

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 10-5 Sheet: 1 of
Surface Elevation: 829.4 Offset:
Date Started: 1/5/83 Completed: 1/6/83
City & State: Independence, Missouri
Driller: B. Blank Rig: AD-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wate; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO-METER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 3.0' | HA | | | | Brown sandy clay (fill) moist, very stiff |
| 3.0' | 13.5' | HA | | | | Brown silty clay, moist, very stiff |
| 13.5' | 24.5' | HA | | | | Brown silty clay w/trace sand, moist, very |
| 24.5' | 26.0' | ST1 | 2.25 | | 1.5' | Same |
| 26.0' | 33.5' | HA | | | | Same |
| 33.5' | 39.0' | HA | | | | Dark gray shale, dry, med. to hard |
| 0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

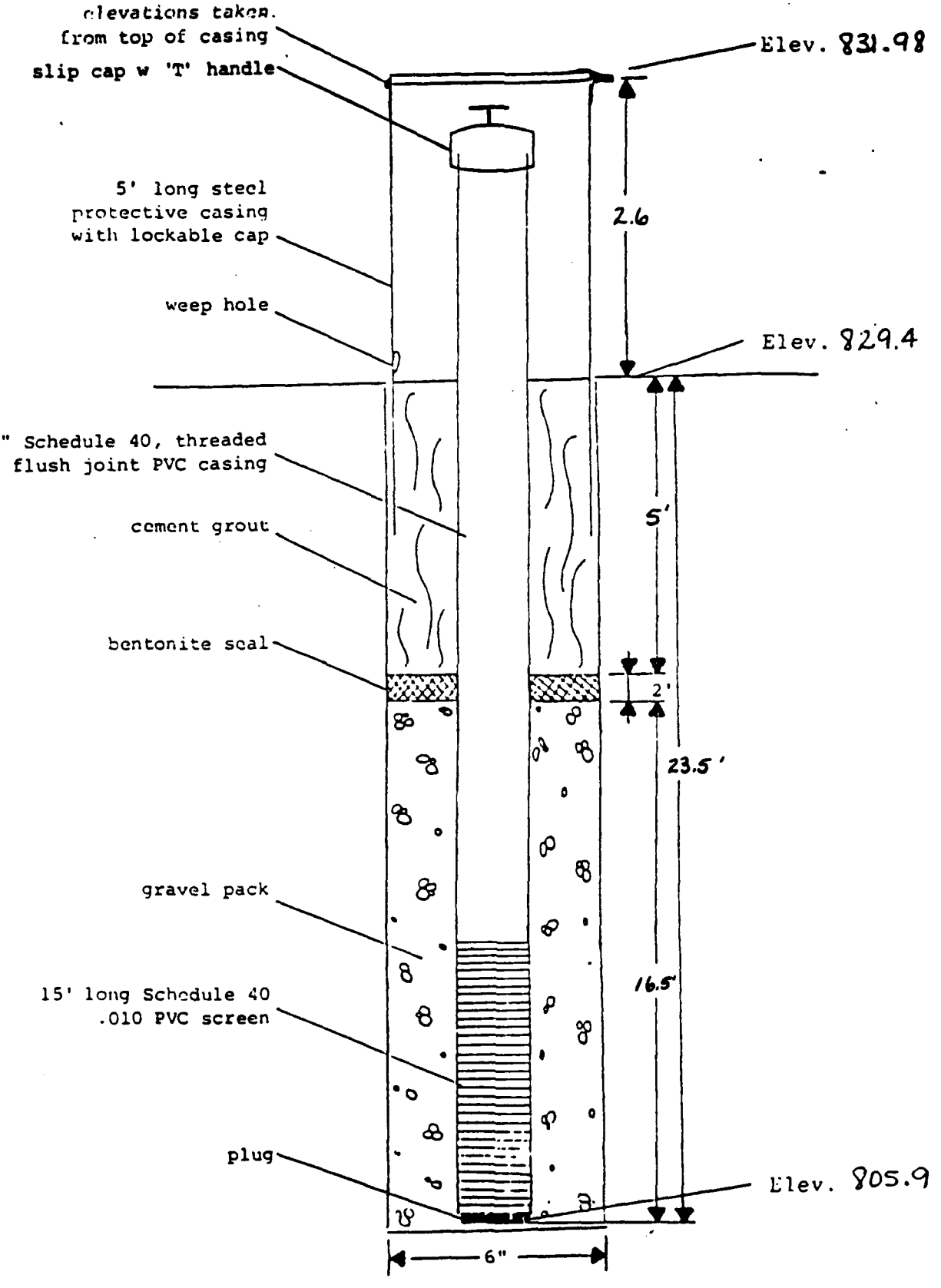
| Water Level | Time | Date | |
|---|---|---|---|
| Dry | 3:00pm | 1/5/83 | (Completior |

Wayne-Western Company, Inc.

C-282

CW-59A

# WELL CONSTRUCTION




MW 10-6

C-283

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: MW 10-6
Sheet: 1 of 1
Surface Elevation: 853.7
Offset:
Date Started: 1/5/83
Completed: 1/5/83
City & State: Independence, Missouri
Driller: B. Blank
Rig: AD-2

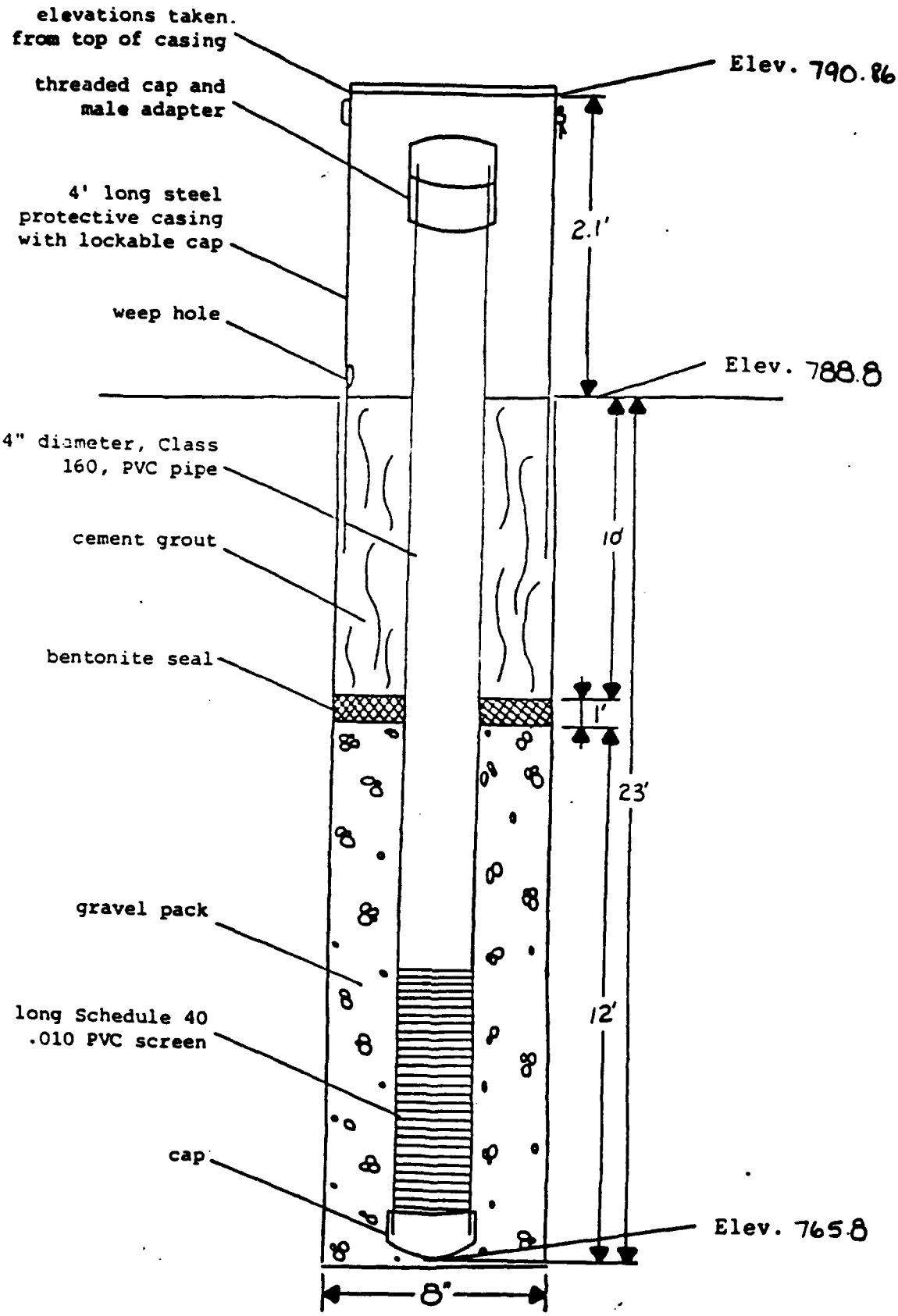
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.6' | HA | | | | Topsoil |
| 0.6' | 2.0' | HA | | | | Brown silty clay, moist, very stiff |
| 2.0' | 5.5' | HA | | | | med. to Olive brown weathered shale, slightly moist, |
| 5.5' | 11.0' | HA | | | | Brown weathered shale, slightly moist, med. to hard |
| 11.0' | 13.0' | HA | | | | Brown & gray weathered shale, slightly moist med. to hard |
| .0' | 13.9' | HA | | | | Brown broken weathered sandstone, slightly m med. to hard |
| .9' | 14.8' | HA | | | | Brown weathered sandstone, slightly moist, med. to hard |
| 14.8' | 23.5' | HA | | | | Gray shale, very moist, med. to hard |
| 23.5' | Refusal | | | | | |

ARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| 10.0 | 12:10pm | 1/5/83 | (Completion |

Layne-Western Company, Inc.


elevations taken from top of casing
threaded cap and male adapter
4' long steel protective casing with lockable cap
weep hole
4" diameter, Class 160, PVC pipe
cement grout
bentonite seal
gravel pack
5' long Schedule 40 .010 PVC screen
cap
Elev. 790.86
Elev. 788.8
Elev. 765.8
2.1'
10'
1'
23'
12'
8"

MW 11-1

# TEST BORING LOG

oject Lake City Army Ammunition Plant — Boring No. MW 11-1 — Sheet 1 of 1

Surface Elevation 788.76 — Offset

ddr[redacted] — Date Started 12/14/81 — Completed 12/14/81

ty & State Independence, Missouri — Driller T. J. Butler — Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Dark brown silty clay, medium to soft |
| 1.0' | 5.0' | WB | | | | Brown silty clay, medium to soft |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 13.0' | WB | | | | Same |
| 13.0' | 22.0' | WB | | | | Light brown silty clay, moist, soft to medium |
| [illegible]' | 23.0' | WB | | | | Gray shale |
| 23.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date |
|---|---|---|---|
| P[redacted]ed for 2 hours. Pumped 1/2 GPM.not steadily | 9.7 | | 1/28/82 (Completion) |

# TEST BORING LOG

:t Lake City Army Ammunition Plant — Boring No. 11-1 — Sheet 1 of 1

— — Surface Elevation _____ Offset _____

Date Started 12/9/81 Completed 12/9/81

& State Independence, Missouri — Driller T. J. Butler — Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | AO | | | | Dark brown silty clay, moist, medium to soft |
| 1,0' | 13.0' | AO | | | | Brown silty clay, moist, medium to soft |
| 13.0' | 23.0' | AO | | | | Light brown silty clay, moist, soft to medium |
| 23.0' | 25.0' | AO | | | | Gray shale, dry, hard |
| 25.0' | Total Depth | | | | | |

RE .RKS: (Casing, Water Loss, Etc.)

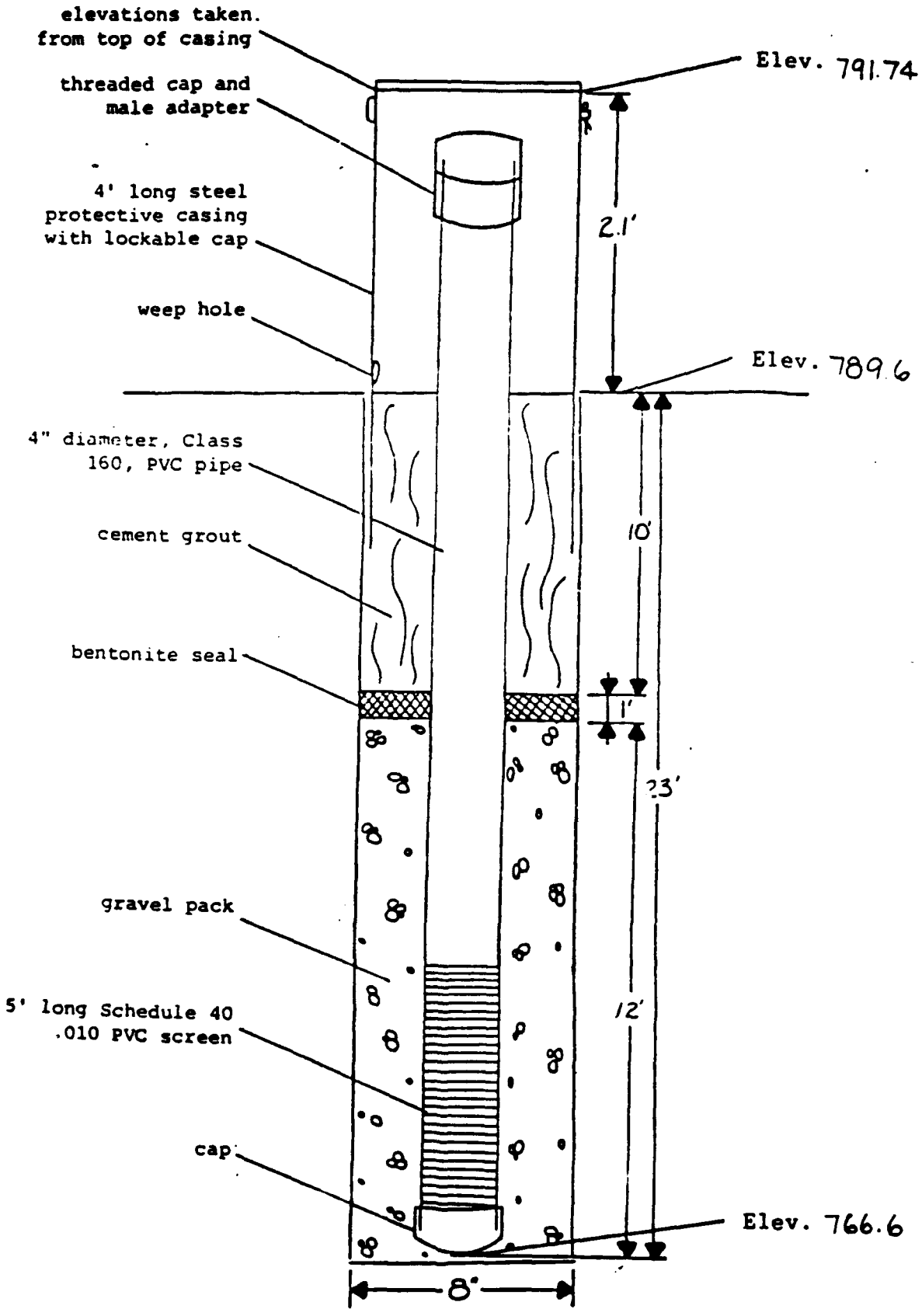
| Water Level | Time | Date | |
|---|---|---|---|
| 22' | 8:30 am | 12/9/81 | (Completic |

r pulling augers, heard water bubbling in hole, probably a pocket of methane gas. Checked after 30 minutes, it had stopped.

Layne-Western Company, Inc.

C-287

# CONSTRUCTION OF WELL




MW 11-2

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. MW 11-2 Sheet 1 of 1

Surface Elevation 789.64 Offset 10' W of 11-2

Address

Date Started 12/15/81 Completed 12/15/8?

City & State Independence, Missouri

Driller T. J. Butler Rig D-2

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core Water
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Air
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Dark brown silty clay, medium to soft |
| 1.0' | 5.0' | WB | | | | Brown silty clay, medium to soft |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 12.0' | WB | | | | Same |
| ?.0' | 13.0' | WB | | | | Light brown silty clay, soft to medium |
| 13.0' | 14.5' | ST1 | 0.5 | | | Light brown silty clay, soft |
| 14.5' | 21.0' | WB | | | | Light brown silty clay, soft |
| 21.0' | 23.0' | WB | | | | Gray shale, medium to hard |
| 23.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date |
|---|---|---|---|
| Pumped for 1.5 hours, Pumped 3 GPM steadily | 6.2 | | 1/28/82 (Comple |

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. 11-2 Sheet 1 of 1

Surface Elevation _____ Offset _____

Address _____

Date Started 12/9/81 Completed 12/9/81

City & State Independence, Missouri

Driller T. J. Butler Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

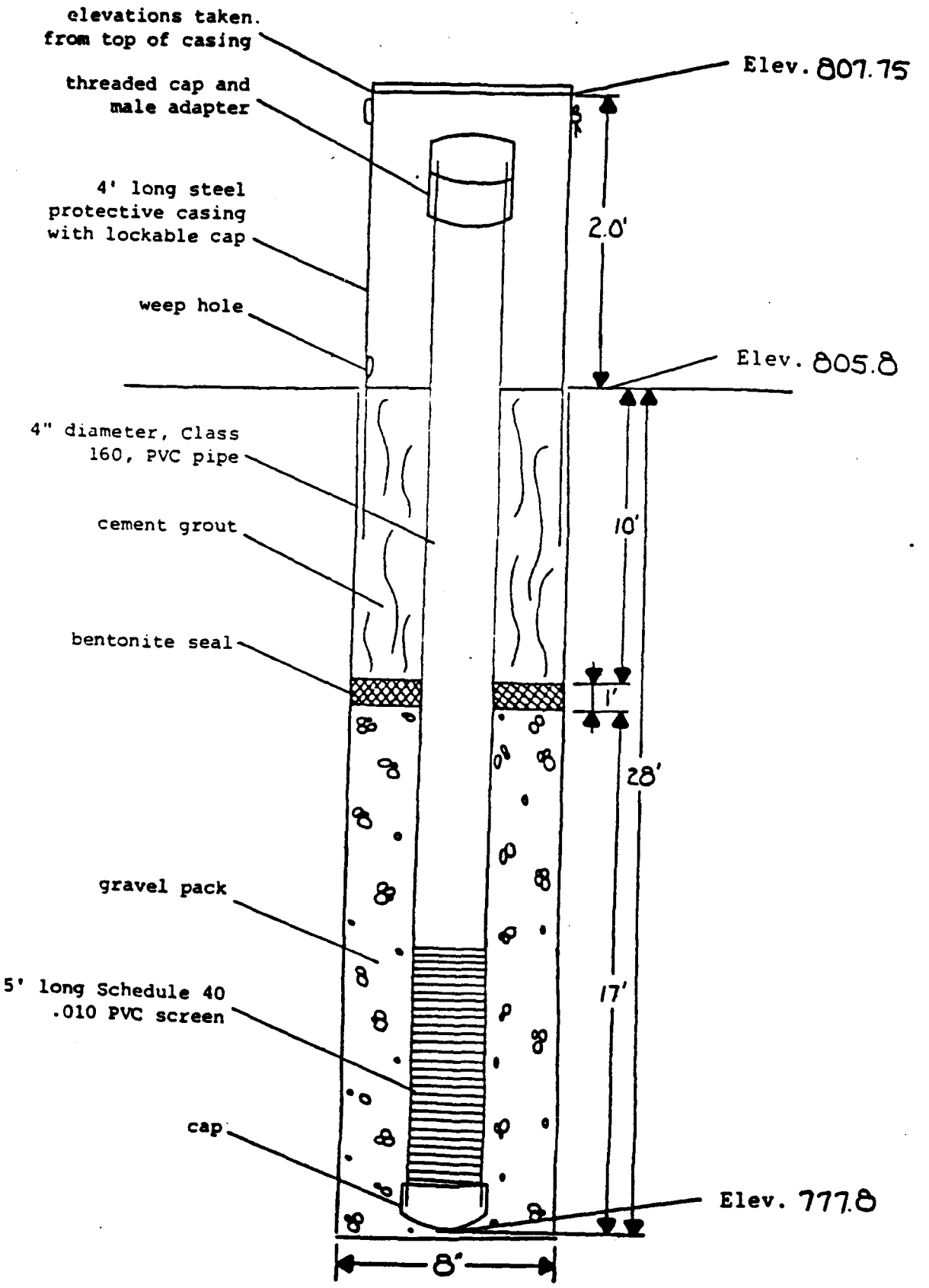
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | AO | | | | Dark brown silty clay, moist, medium to soft |
| 1.0' | 12.0' | AO | | | | Brown silty clay, moist, medium to soft |
| 12.0' | 21.0' | AO | | | | Light brown silty clay, moist, soft to medium |
| 21.0' | 23.0' | AO | | | | Gray shale, dry, hard |
| 23.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Completion) |
| | | | |

Terra-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 11-3

# TEST BORING LOG

P ct Lake City Army Ammunition Plant

Boring No. MW 11-3 Sheet 1 of 1

Surface Elevation 805.74 Offset

Address

Date Started 1/13/82 Completed 1/14/82

City & State Independence, Missouri

Driller T. Butler Rig D-2

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core Wa
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core Air
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Finger S

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 0.5' | WB | | | | Topsoil |
| 0.5' | 5.0' | WB | | | | Dark brown silty clay, med. to soft |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 15.0' | WB | | | | Same |
| 15.0' | 17.5' | WB | | | | Same |
| 17.5' | 20.0' | WB | | | | Light brown silty clay, soft to med. |
| 20.0' | 25.0' | WB | | | | Same |
| 25.0' | 26.5' | WB | | | | Same |
| 26.5' | 27.5' | WB | | | | Brown shaly clay, med. to stiff |
| 27.5' | 35.0' | WB | | | | Gray shale, stiff to med. |
| 35.0' | 36.5' | WB | | | | Gray shale, very stiff to hard |
| 36.5' | 40.0' | WB | | | | Light gray shale, hard to very stiff |
| 40.0' | Total depth | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

EMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| 10.6 | | 1/28/82 (Compl |

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. 11-3 Sheet 1 o

Surface Elevation _____ Offset _____

Address _____

Date Started 12/9/81 Completed 12/9/81

City & State Independence, Missouri

Driller T. J. Butler Rig D-2

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. – Core
H.A. – Hollow Auger S.S. – Split Spoon C.A. – Core
W.B. – Wash Bore S.T. – Shelby Tube F.B. – Fing

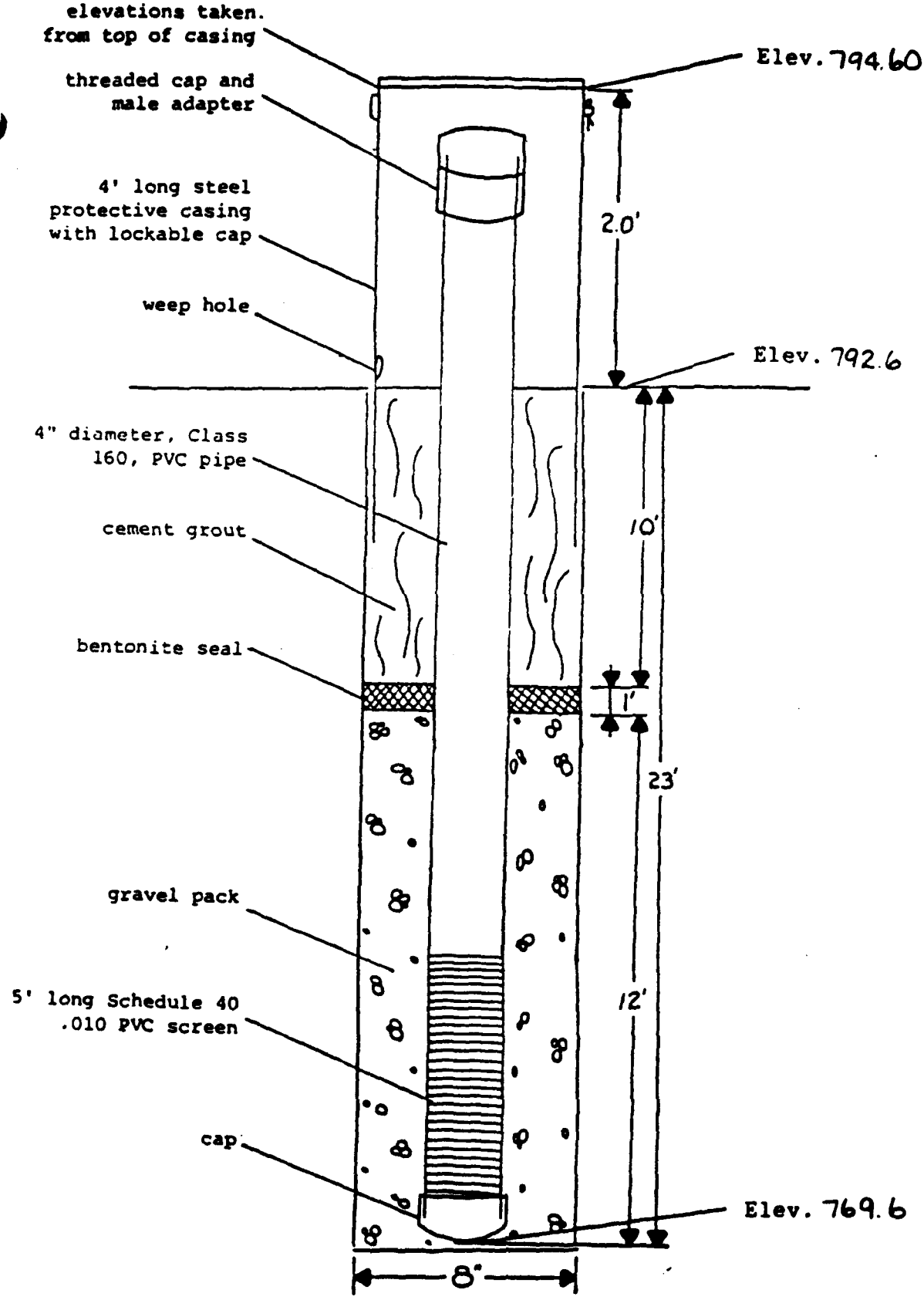
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO METER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENC SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 8.0' | AO | | | | Light tan shaley clay, slightly moist, m to stiff |
| 8.0' | 9.0' | AO | | | | Brown shaley clay, slightly moist, soft |
| 9.0' | 13.0' | AO | | | | Light tan shaley clay, slightly moist, m to stiff |
| 13.0' | 16.0' | AO | | | | Light tan shaley clay, slightly moist, s to medium |
| 16.0' | 18.0' | AO | | | | Light tan shaley clay, slightly moist, m to stiff |
| 18.0' | 19.0' | AO | | | | Red brown shaley clay, slightly moist, m to soft |
| 19.0' | 23.0' | AO | | | | Light tan shaley clay, slightly moist, m to soft |
| 23.0' | 24.0' | AO | | | | Light gray shale, dry, hard |
| 24.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| | Water Level | Time | Date |
|---|---|---|---|
| Location abandoned as no water present | Dry | 12:00pm | 12/9/81 (Cor |

Layne-Western Company, Inc.

# CONSTRUCTION OF WELL




MW 11-4

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. MW 11-4 — Sheet 1 of 1

Surface Elevation 792.60 — Offset 5' W of 11-4

Date Started 1/12/82 — Completed 1/12/82

City & State Independence, Missouri — Driller T. Butler — Rig D-2

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wate; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | WB | | | | Topsoil |
| 1.0' | 5.0' | WB | | | | Dark brown silty clay, med. to soft |
| 5.0' | 10.0' | WB | | | | Same |
| 10.0' | 13.0' | WB | | | | Same |
| 13.0' | 15.0' | WB | | | | Light brown silty clay, soft to med. |
| 5.0' | 20.0' | WB | | | | Same |
| 0.0' | 23.0' | WB | | | | Same |
| 23.0' | 24.0' | WB | | | | Gray shale, stiff to med. |
| 24.0' | Total depth | | | | | |

MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| 4.2 | | 1/28/82 (Compl |

Wayne-Western Company, Inc.

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: 11-4
Sheet: 1 of _
Surface Elevation: _____ Offset: _____
Address: _____
Date Started: 12/9/81 Completed: 12/9/81
City & State: Independence, Missouri
Driller: T. J. Butler Rig: D-2

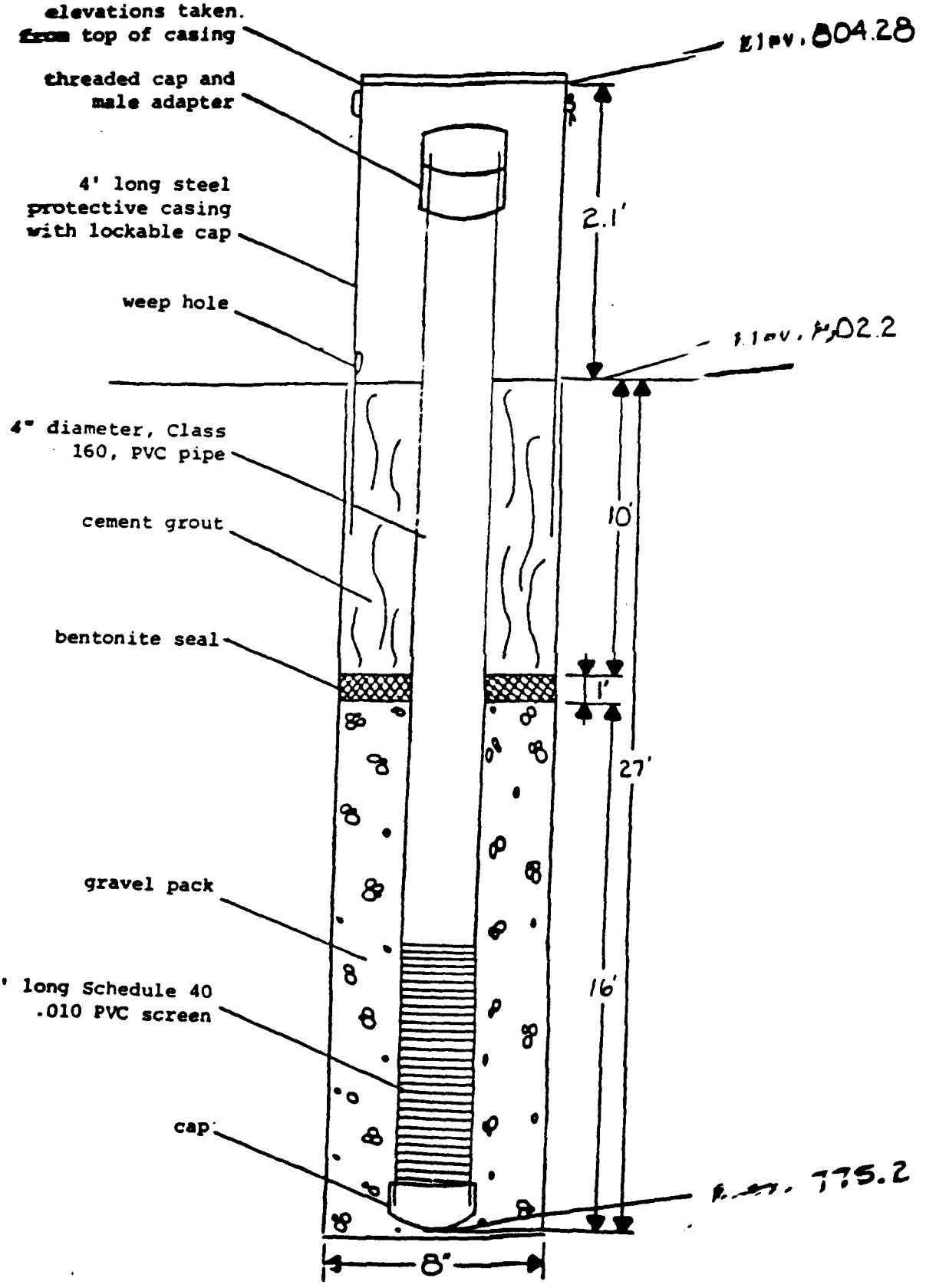
Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Wa; C.A. – Core Air; F.B. – Finger B

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 1.0' | AO | | | | Top soil |
| 1.0' | 13.0' | AO | | | | Brown silty clay, moist, medium to soft |
| 13.0' | 23.0' | AO | | | | Light brown silty clay, moist, soft to medi |
| 23.0' | 24.0' | AO | | | | Light gray shale, dry, hard |
| 24.0' | Total depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Complet |

# CONSTRUCTION OF WELL




B-1

# TEST BORING LOG

Project: Lake City Army Ammunition Plant
Boring No.: B-1
Sheet: 1 of
Surface Elevation: 802.2
Offset:
Date Started: 1/18/82
Completed: 1/18/82
City & State: Independence, Missouri
Driller: T. J. Butler
Rig: D-2

Abbreviations:
A.O. – Auger Only
H.A. – Hollow Auger
W.B. – Wash Bore
R.B. – Rock Bit
S.S. – Split Spoon
S.T. – Shelby Tube
C.W. – Core
C.A. – Core
F.B. – Frngs

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0' | 3.0' | WB | | | | Dark brown silty clay, medium to soft |
| 3.0' | 5.5' | WB | | | | Dark gray silty clay, medium to soft |
| 5.5' | 10.0' | WB | | | | Brown silty clay, w/trace weathered shale, medium to soft |
| 10.0' | 14.0' | WB | | | | Same |
| 14.0' | 20.0' | WB | | | | Light brown silty clay, soft to very soft |
| 20.0' | 22.5' | WB | | | | Same |
| 22.5' | 27.0' | WB | | | | Light gray shaley clay, medium to stiff |
| 27.0' | 34.0' | WB | | | | Gray shale medium to stiff |
| 34.0' | 40.0' | WB | | | | Light gray shale, stiff to medium |
| 40.0' | Total Depth | | | | | |

REMARKS: (Casing, Water Loss, Etc.)

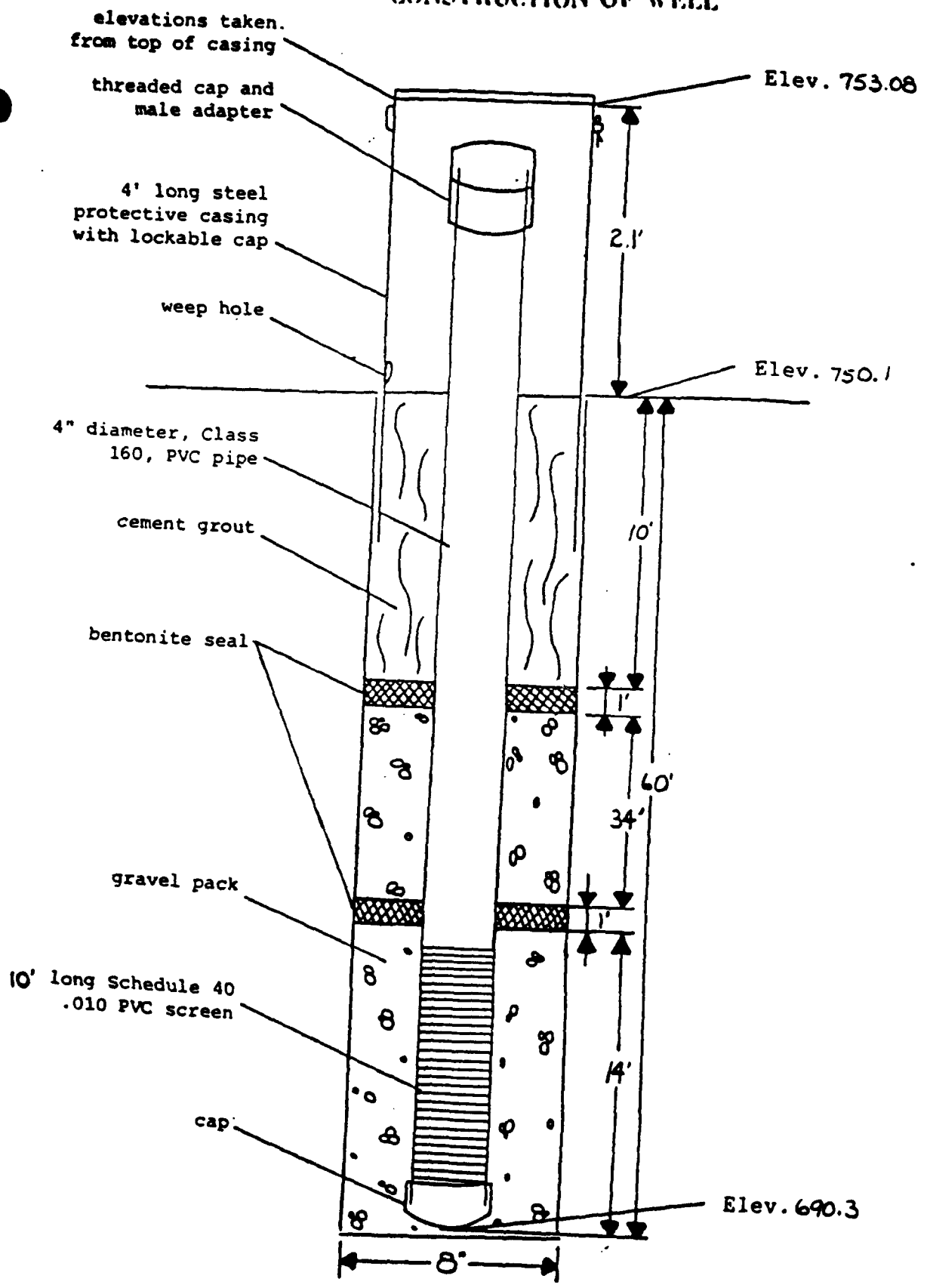
| Water Level | Time | Date |
|---|---|---|
| | | (Completio |
| 7.3 | 1:30P.M. | 2/15/82 |

...ed for 2 hrs.. Pumped 3 GPM, not steadily

...yne-Western Company, Inc.

C-298

# CONSTRUCTION OF WELL




B-2

# TEST BORING LOG

ect Lake City Army Ammunition Plant — Boring No. B-2 — Sheet 2 of 2

Surface Elevation _____ Offset _____

Ire[redacted] — Date Started 2/2/82 Completed 2/3/82

& State Independence, Missouri — Driller T. Butler Rig D-1

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 69.0 | 70.0 | WB | | | | Limestone |
| 70.0 | 74.5 | WB | | | | Dark gray shale, hard |
| 74.5 | 75.5 | WB | | | | Light gray limy shale, medium to stiff |
| 75.5 | 78.0 | WB | | | | Light gray limy shale, stiff to hard |
| 78.0 | Total Depth | | | | | |

[redacted]

[redacted] WKS: (Casing, Water Loss, Etc.) — Water Level — Time — Date

[redacted] for 1.5 hours — (Completion)

0 GPM steady & clear (Total Depth of Well = 60') — 26.25 — 11:30 — 2/17/82

[redacted]yne-Western Company, Inc.

C-300

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. B-2 Sheet 1 of 2

Surface Elevation 751.0 Offset

Addr

Date Started 2/2/82 Completed 2/3/82

City & State Independence, Missouri

Driller T. Butler Rig D-1

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core Water; C.A. – Core Air; F.B. – Finger Bit

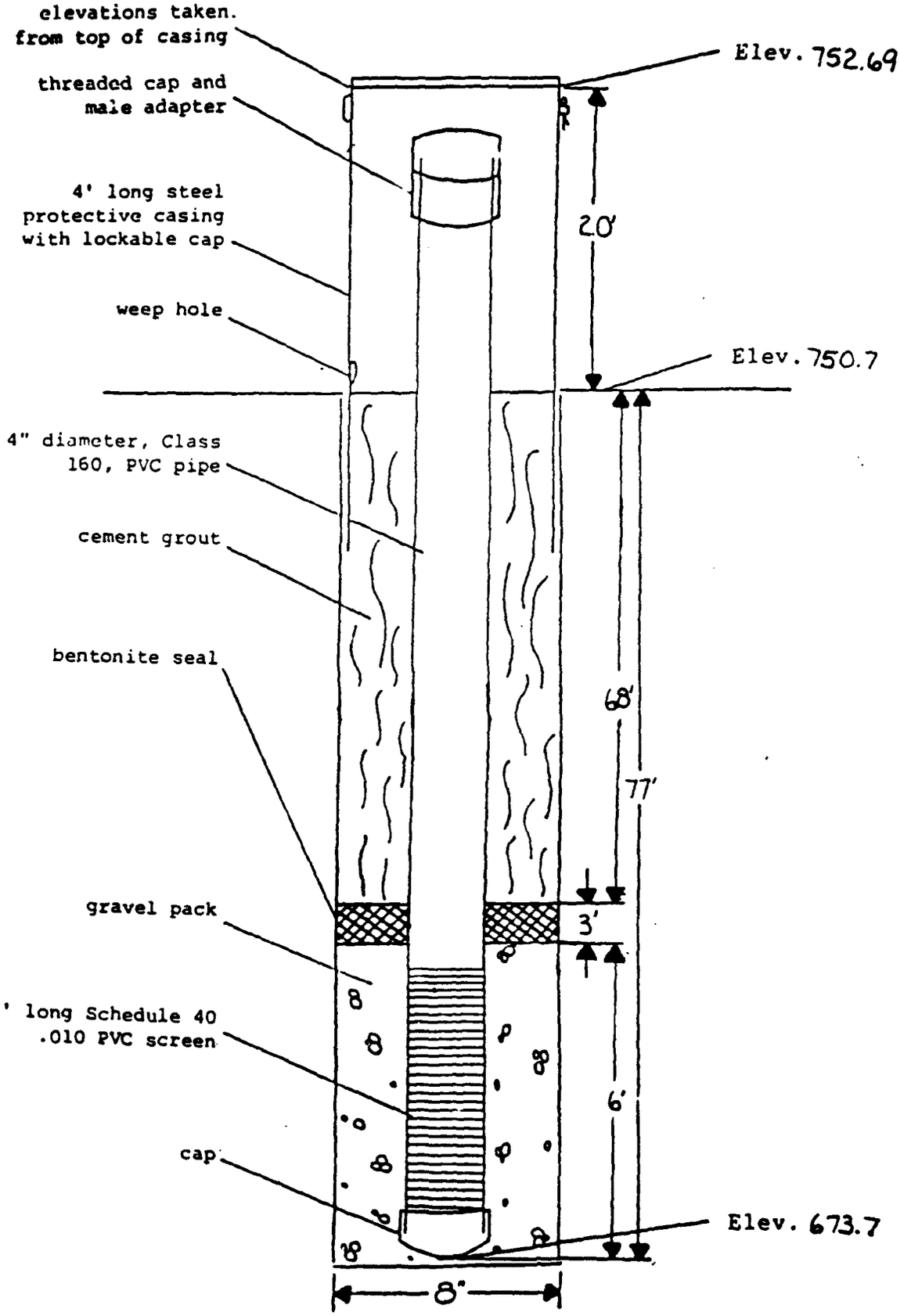
| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 0.0 | 1.0 | WB | | | | Top soil |
| 1.0 | 7.5 | WB | | | | Dark brown silty clay, medium to stiff |
| 7.5 | 12.5 | WB | | | | Brown silty clay, medium to soft |
| 12.5 | 15.0 | WB | | | | Gray clay w/trace very fine sand, & weathered shale |
| 15.0 | 20.0 | WB | | | | Shale, medium to soft |
| 20.0 | 27.0 | WB | | | | Same |
| 27.0 | 30.0 | WB | | | | Gray silty clay, medium to stiff |
| 30.0 | 35.0 | WB | | | | Same |
| 35.0 | 40.0 | WB | | | | Same |
| 40.0 | 43.5 | WB | | | | Same |
| 43.5 | 45.5 | WB | | | | Gray silty clay, medium to soft |
| 45.5 | 50.0 | WB | | | | Gray fine sand, trace medium sand |
| 50.0 | 55.0 | WB | | | | Same |
| 55.0 | 60.0 | WB | | | | Same |
| 60.0 | 63.0 | WB | | | | Gray fine sand, trace very fine sand |
| 63.0 | 69.0 | WB | | | | Gray fine sand, trace medium sand |

MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| | | | (Completio |
| | | | |

Layne-Western Company, Inc.

# CONSTRUCTION OF WELL




B-3

# TEST BORING LOG

Project Lake City Army Ammunition Plant — Boring No. B-3 — Sheet 2 of _

Surface Elevation 750.7 — Offset _____

Address _____ — Date Started 2/16/82 — Completed 2/18/82

City & State Independence, Missouri — Driller T. Butler — Rig D-1

Abbreviations: A.O. – Auger Only; H.A. – Hollow Auger; W.B. – Wash Bore; R.B. – Rock Bit; S.S. – Split Spoon; S.T. – Shelby Tube; C.W. – Core We; C.A. – Core Ai; F.B. – Finger E

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETROMETER | PENETRATION RECORD: NO. OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSISTENCY SAND DENSITY |
|---|---|---|---|---|---|---|
| 74.5 | 75.5 | WB | | | | Light gray limy shale, hard |
| 75.5 | 77.0 | WB | | | | Limestone |
| 77.0 | Total Depth | | | | | |

MARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date | |
|---|---|---|---|
| Dry | 10:00 AM | 2/18/82 | (Comple |

Wayne-Western Company, Inc.

# TEST BORING LOG

Project Lake City Army Ammunition Plant

Boring No. B-3 Sheet

Surface Elevation 750.7 Offset

Address

Date Started 2/16/82 Completed 2/17

City & State Independence, Missouri

Driller T. Butler Rig D-1

Abbreviations: A.O. – Auger Only R.B. – Rock Bit C.W. –
H.A. – Hollow Auger S.S. – Split Spoon C.A. –
W.B. – Wash Bore S.T. – Shelby Tube F.B. –

| DEPTH FROM | DEPTH TO | METHOD | PENETRATION RECORD: POCKET PENETRO METER | PENETRATION RECORD: NO OF BLOWS | CORE RECOVERY | SAMPLE DESCRIPTION: COLOR–MATERIAL–MOISTURE–CLAY CONSIS SAND DENSIT |
|---|---|---|---|---|---|---|
| 0.0 | 0.5 | WB | | | | Topsoil |
| 0.5 | 8.0 | WB | | | | Dark brown silty clay, medium to soft |
| 8.0 | 13.0 | WB | | | | Brown silty clay, soft to medium |
| 13.0 | 26.5 | WB | | | | Gray silty clay, w/trace of weathered & trace fine sand, soft to medium |
| 26.5 | 28.0 | WB | | | | Gray clay, trace of fine sand, medium |
| 28.0 | 34.0 | WB | | | | Gray clay, medium to soft |
| 34.0 | 42.0 | WB | | | | Gray clay, medium to stiff |
| 42.0 | 45.5 | WB | | | | Gray fine sand, trace of medium sand |
| 45.5 | 50.0 | WB | | | | Same |
| 50.0 | 55.0 | WB | | | | Same |
| 55.0 | 60.0 | WB | | | | Same |
| 60.0 | 65.0 | WB | | | | Same |
| 65.0 | 69.0 | WB | | | | Same |
| 69.0 | 69.5 | WB | | | | Limestone |
| 69.5 | 71.5 | WB | | | | Gray shale, medium to hard |
| 71.5 | 74.5 | WB | | | | Light gray limy shale, medium to hard |

REMARKS: (Casing, Water Loss, Etc.)

| Water Level | Time | Date |
|---|---|---|
| | | |
| | | |

Wayne-Western Company Inc

# DRILLING LOG

PROJECT WATER SUPPLY WELL DATE 2/20/41

LOCATION _____ DRILLERS LAYNE-WESTERN

DRILL RIG _____ BORE HOLE #1 (17A)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | BLACK SOIL (SLIGHTLY SILTY CLAY) | ELEV. 741.6' STATIC WATER LEVEL: 16.5' PRODUCTION: 438 gpm WITH 6.5' DRAWDOWN |
| | | YELLOW SANDY CLAY | |
| 10 | | | |
| 20 | | | |
| | | SAND, MEDIUM TO COARSE ARKOSIC | |
| 30 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 2/20/41

LOCATION _____ DRILLERS Layne-Western

_____ _____

DRILL RIG _____ BORE HOLE #1 (17A)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 40 | | | |
| 50 | | | |
| 62 | | SAND, MEDIUM TO COARSE, ARKOSIC SOME LIGNITE | |

# DRILLING LOG

PROJECT Water Supply Wells DATE 2/20/41

LOCATION _____ DRILLERS _____

DRILL RIG _____ BORE HOLE 1 (17A)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| | | COARSE SAND AND GRAVEL; FEW BOULDERS | |
| 70 | | | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN |
| | | | 6" PLUG IN BOTTOM: TOP OF PLUG = 84.5' |
| 80 | | | |
| TD 85.0 | | ? | Top of Pleasanton Fm? |

# DRILLING LOG

PROJECT Water Supply Well — DATE 4/23/41

LOCATION — DRILLERS Layne-Western

DRILL RIG — BORE HOLE #2 (178)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | Glacial Soil (Slightly Silty Clay) | Elev. 739.1' |
| | | Yellow Clay | Static Water Level: 11.0' |
| | | | Production: 330 gpm |
| 10 | | | 8' Drawdown |
| | | Fine Sand | |
| | | Blue Sandy Clay | |
| 20 | | | |
| | | Fine Sand | |
| 30 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 4/23/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #2 (17B)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | Fine to medium sand | |
| 40 | | | |
| | | Coarse sand and gravel | |
| 50 | | | |
| 60 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 4/23/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #2 (178)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| 70 | | | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN<br>12" PLUG IN BOTTOM:<br>TOP OF PLUG: 79.9' |
| 80 | | | |
| TD 80.8 | | TOP OF PLEASANTON SH | |

# DRILLING LOG

PROJECT Water Supply Well DATE 4/30/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #3 (17C)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | Black Soil (slightly silty clay) | Elev. 744.7 |
| | | Brown Clay | Static Water Level: 17.4' |
| 10 | | Sandy Clay | Production: 421 gpm 6' drawdown |
| 20 | | Fine Sand | |
| | | Soft Yellow Clay | |
| 32 | | Fine Sand | |

# DRILLING LOG

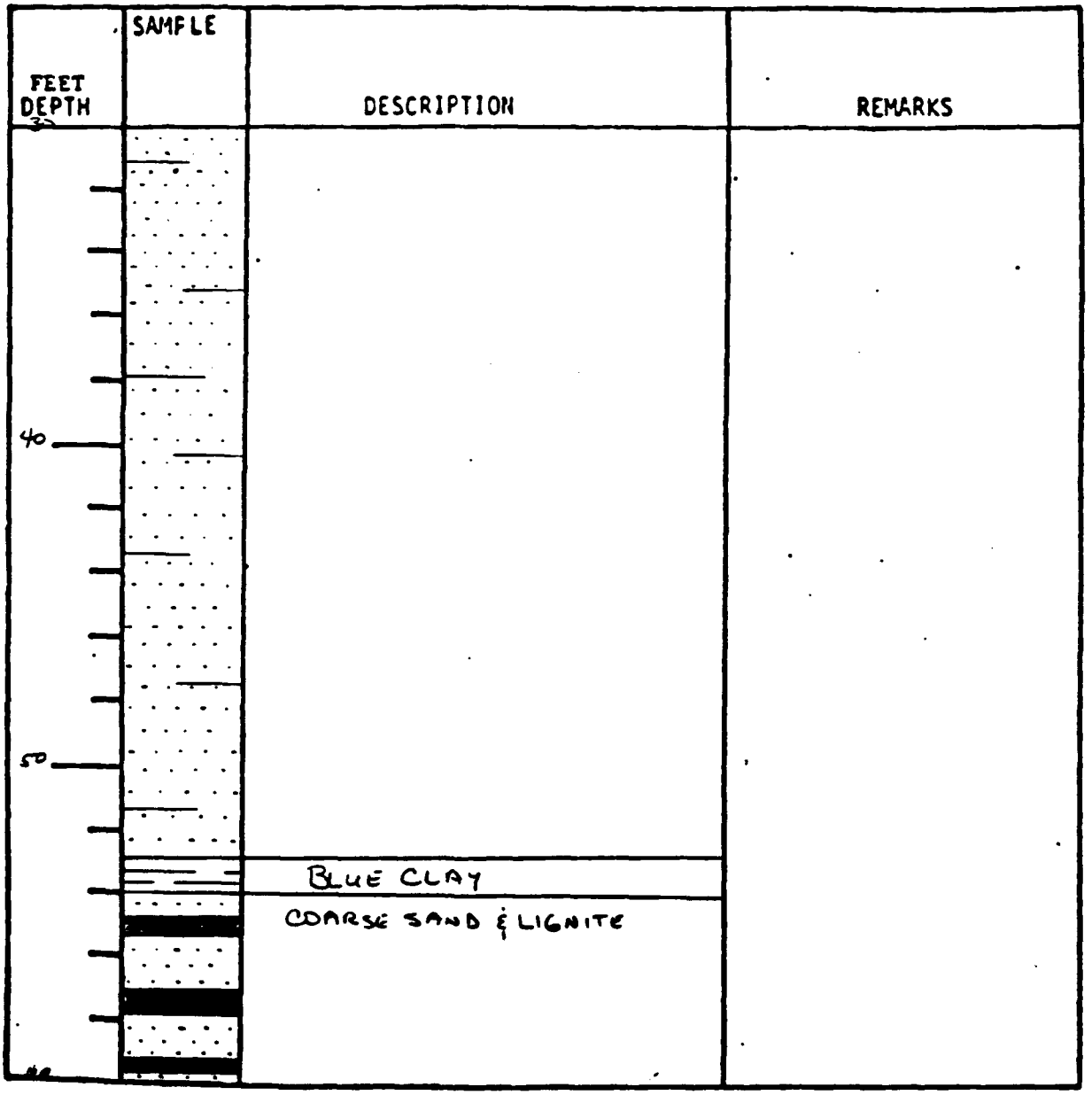
PROJECT Water Supply Well DATE 4/30/41

LOCATION _____ DRILLERS Layne-Western

_____ _____

DRILL RIG _____ BORE HOLE #3 (17C)





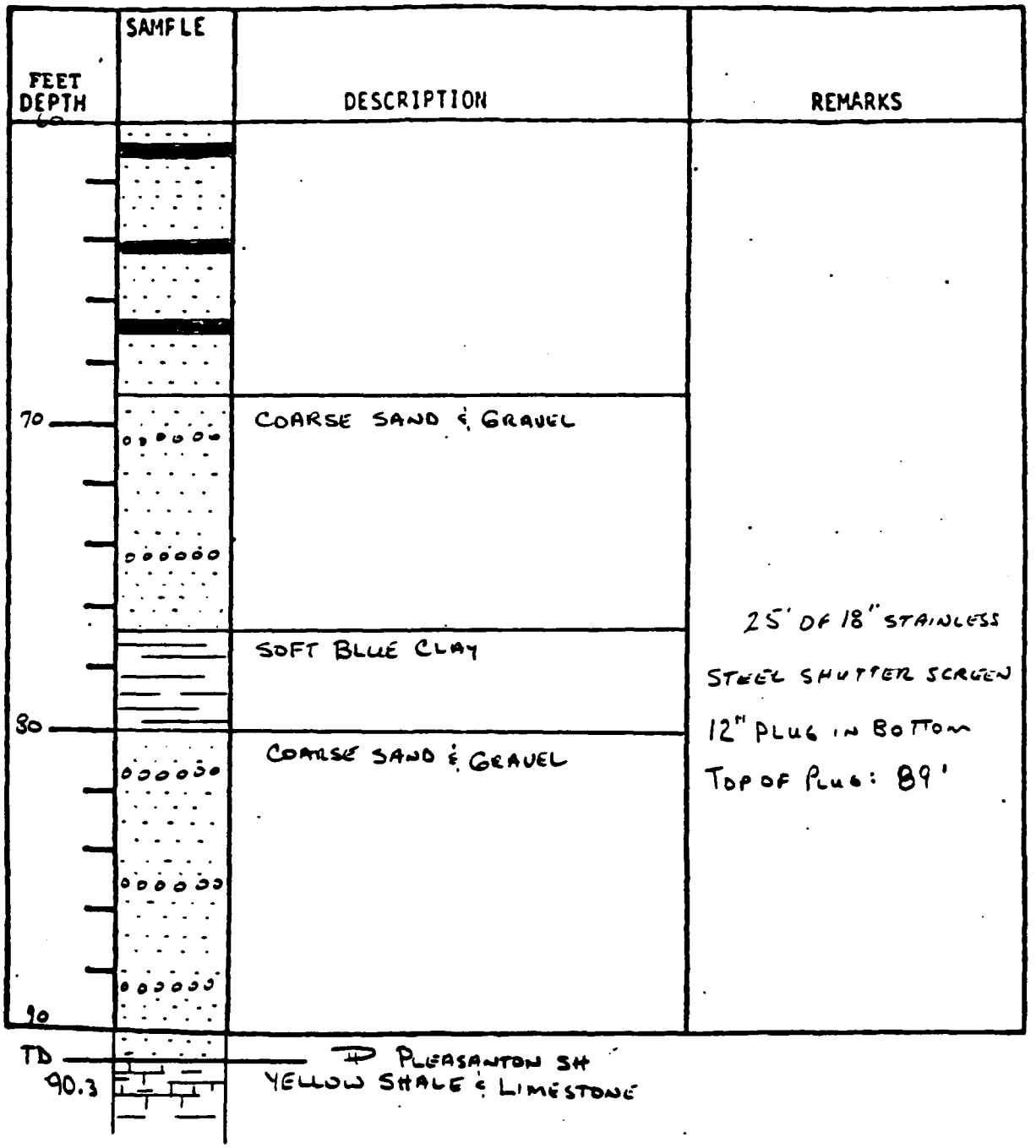
# DRILLING LOG

PROJECT Water Supply Well — DATE 4/30/41

LOCATION — DRILLERS Layne-Western

DRILL RIG — BORE HOLE #3 (17C)





# DRILLING LOG

PROJECT Water Supply Well DATE 5/17/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #4 (17D)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | SOIL (SLIGHTLY SILTY CLAY) | ELEV. 745.3' |
| | | SANDY CLAY | STATIC WATER LEVEL: 16.3' |
| 10 | | DRY SAND | PRODUCTION: 368 gpm 8' DRAWDOWN |
| 20 | | FINE SAND | |
| 32 | | BLUE CLAY | |

# DRILLING LOG

PROJECT Water Supply Well — DATE 5/17/41

LOCATION — DRILLERS Layne-Western

DRILL RIG — BORE HOLE #4 (170)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | | |
| | | Fine, silty sand | |
| 40 | | | |
| | | Coarse to medium sand | |
| | | Fine sand | |
| 50 | | | |
| | | Coarse sand & gravel | |
| 60 | | | |

# DRILLING LOG

PROJECT Water Supply Well — DATE 5/17/41

LOCATION — DRILLERS Layne-Western

DRILL RIG — BORE HOLE #4 (17D)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | | | |
| | | Fine Sand | |
| | | Coarse Sand | |
| 70 | | | |
| 80 | | | |
| | | Fine Sand | |
| 90 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 5/17/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #4 (170)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 90 | | COARSE SAND & GRAVEL | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN<br>10" PLUG IN BOTTOM<br>TOP OF PLUG: 97.3' |
| TD 98.5 | | TOP OF PLEASANTON SH | |

# DRILLING LOG

PROJECT Water Supply Well
LOCATION
DRILL RIG
DATE 5/23/41
DRILLERS Layne-Western
BORE HOLE #5 (17E)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | SOIL | Elev. 741.6' |
| | | Blue Clay | Static Water Level: 12.9' |
| | | | Production: 427 gpm 6' Drawdown |
| 10 | | | |
| 20 | | | |
| 30 | | Fine Sand | |

# DRILLING LOG

PROJECT Water Supply Well DATE 5/23/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #5 (17E)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | | |
| | | CLAY | |
| | | FINE SAND | |
| 40 | | | |
| 50 | | | |
| 60 | | | |

# DRILLING LOG

PROJECT Water Supply Well — DATE 5/23/41

LOCATION — DRILLERS Layne-Western

DRILL RIG — BORE HOLE #5 (1"E)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| | | COARSE SAND | |
| 70 | | | |
| 80 | | COARSE SAND, GRAVEL, BOULDERS | 25' OF 18" [illegible] STEEL SHUTTER SCREEN<br>12" PLUG IN [illegible] FROM TOP OF PLUG [illegible].8 |
| TD 87.8' (?) | | Top of Pleistocene Sh | |

# DRILLING LOG

PROJECT Water Supply Well — DATE 5/6/41

LOCATION — DRILLERS Layne-Western

DRILL RIG — BORE HOLE #7 (17G)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | Black Soil (Slightly Silty Clay) | Elev. 737.0' |
| | | Brown Clay | Static Water Level: 9.0' |
| 10 | | | Production: 348 gpm 10.5' drawdown |
| | | Fine Sand | |
| 20 | | | |
| 30 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 5/6/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #7 (176)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 35 | | | |
| 40 | | | |
| | | MEDIUM TO COARSE SAND | |
| 57 | | | |
| 60 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 5/6/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #7 (176)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| | | COARSE SAND AND GRAVEL | |
| 70 | | | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN<br>14" PLUG IN BOTTOM<br>TOP OF PLUG: 78.2' |
| TD 79.3' | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/15/42

LOCATION _____ DRILLERS _____

DRILL RIG _____ BORE HOLE #8 (17M)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | (SLIGHTLY SANDY CLAY) SOIL | ELEV. 741.5' |
| | | HARD BLUE CLAY | STATIC WATER LEVEL: 16.0' |
| | | | PRODUCTION: 350 GPM 22' DRAWDOWN |
| 10 | | | |
| | | | |
| 20 | | | |
| | | SANDY CLAY | |
| 30 | | VERY FINE SAND, STREAKS OF CLAY | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/15/42

LOCATION _____ DRILLERS _____

_____ _____

DRILL RIG _____ BORE HOLE #8 (17M)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | | |
| 40 | | FINE SAND | |
| | | MEDIUM TO FINE SAND | |
| 50 | | | |
| 60 | | MEDIUM TO COARSE SAND | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/15/42

LOCATION _____ DRILLERS _____

DRILL RIG _____ BORE HOLE #8 (17M)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| 70 | | SAND WITH SOME GRAVEL | |
| 80 | | COARSE SAND | 25' OF 18' STAINLESS STEEL SHUTTER SCREEN<br>10' PLUG IN BOTTOM<br>TOP OF PLUG: 85.5' |
| TD 86.5 | | VERY FINE SAND<br>TOP OF PLEASANTON SH | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/30/42

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #10 (171K)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| | | SOIL (Slightly Sandy Clay) | Elev. 740.0' |
| | | Black Clay | Static Water Level: 20.0' |
| | | Sandy Clay | Production: 350 gpm 20' drawdown |
| 10 | | | |
| 20 | | Fine Sand | |
| | | Fine to Medium Sand | |
| 30 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/30/42

LOCATION _____ DRILLERS Layne-Western

_____ _____

DRILL RIG _____ BORE HOLE #10 (17K)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | | |
| 40 | | | |
| | | COARSE SAND WITH SOME GRAVEL | |
| 50 | | | |
| | | FINE TO MEDIUM COARSE SAND | |
| 60 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/30/42

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #10 (171K)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | FINE SAND | |
| 70 | | COARSE SAND, GRAVEL, FEW SMALL BOULDERS | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN<br>10" PLUG IN BOTTOM<br>TOP OF PLUG: 86' |
| 80 | | | |
| TD 87' | | TOP OF PLEASANTON SH | |

# DRILLING LOG

PROJECT WATER SUPPLY WELL DATE 5/11/41

LOCATION _____ DRILLERS LAYNE-WESTERN

DRILL RIG _____ BORE HOLE #6 (17F)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | | BLACK SOIL (SLIGHTLY SILTY CLAY) | ELEV. 734.6' |
| | | GRAY CLAY | STATIC WATER LEVEL: 9.0' |
| 10 | | | PRODUCTION: 348 gpm |
| | | SOFT BLUE CLAY | 18' DRAWDOWN |
| 20 | | FINE SAND | |
| 30 | | | |

# DRILLING LOG

PROJECT Water Supply Well
LOCATION
DRILL RIG
DATE 5/11/41
DRILLERS Layne-Western
BORE HOLE #6 (17F)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | | |
| 40 | | MEDIUM TO COARSE SAND | |
| 50 | | SOFT BLUE CLAY | |
| | | FINE BLUE SAND | |
| | | COARSE SAND | |
| 60 | | SOFT BLUE CLAY | |

# DRILLING LOG

PROJECT Water Supply Well DATE 5/11/41

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #6 (17F)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| | | FINE SAND | |
| | | COARSE SAND | |
| 70 | | | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN |
| | | | 10" PLUG IN BOTTOM |
| | | | TOP OF PLUG: 82.2' |
| | | COARSE SAND, GRAVEL, BOULDERS | |
| 80 | | | |
| TD 83.5 | | TOP OF PLEASANTON SH | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/18/42

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #9 (17J)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 10 | | Black Clay | Elev. 744.0'<br>Static Water Level:<br>16.0'<br>Production:<br>350 gpm<br>18' Drawdown |
| 20 | | Brown Clay | |
| 30 | | | |

# DRILLING LOG

PROJECT Water Supply Well DATE 10/13/42

LOCATION _____ DRILLERS Layne-Western

DRILL RIG _____ BORE HOLE #9 (17J)



| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 30 | | | |
| | | FINE SAND WITH STREAKS OF CLAY | |
| 40 | | | |
| | | FINE SAND | |
| 50 | | | |
| 60 | | COARSE TO MEDIUM SAND GRAVEL & LIGNITE | |

# DRILLING LOG

PROJECT Water Supply Well — DATE 12/18/82

LOCATION — DRILLERS Layne-Western

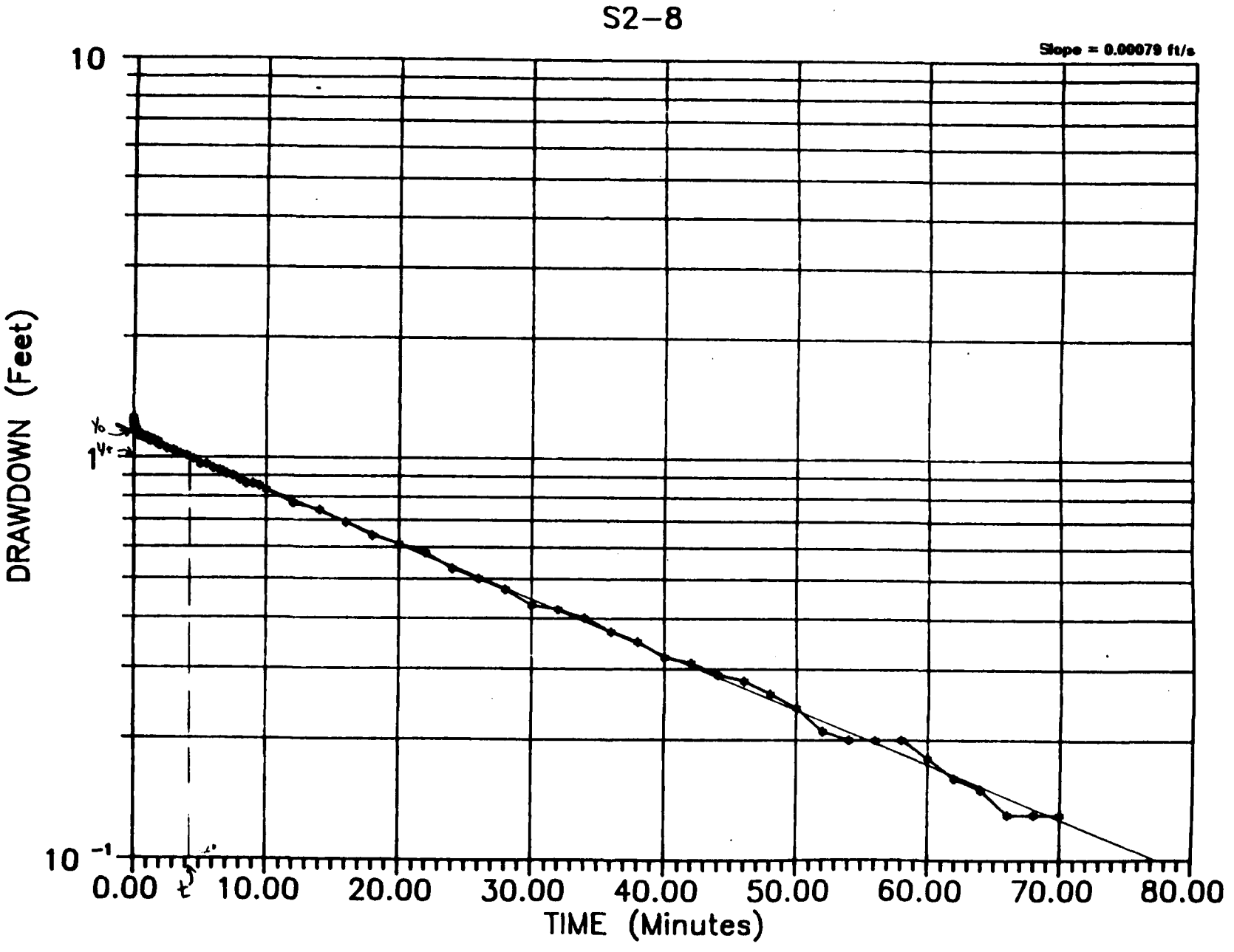
DRILL RIG — BORE HOLE #9 (17J)



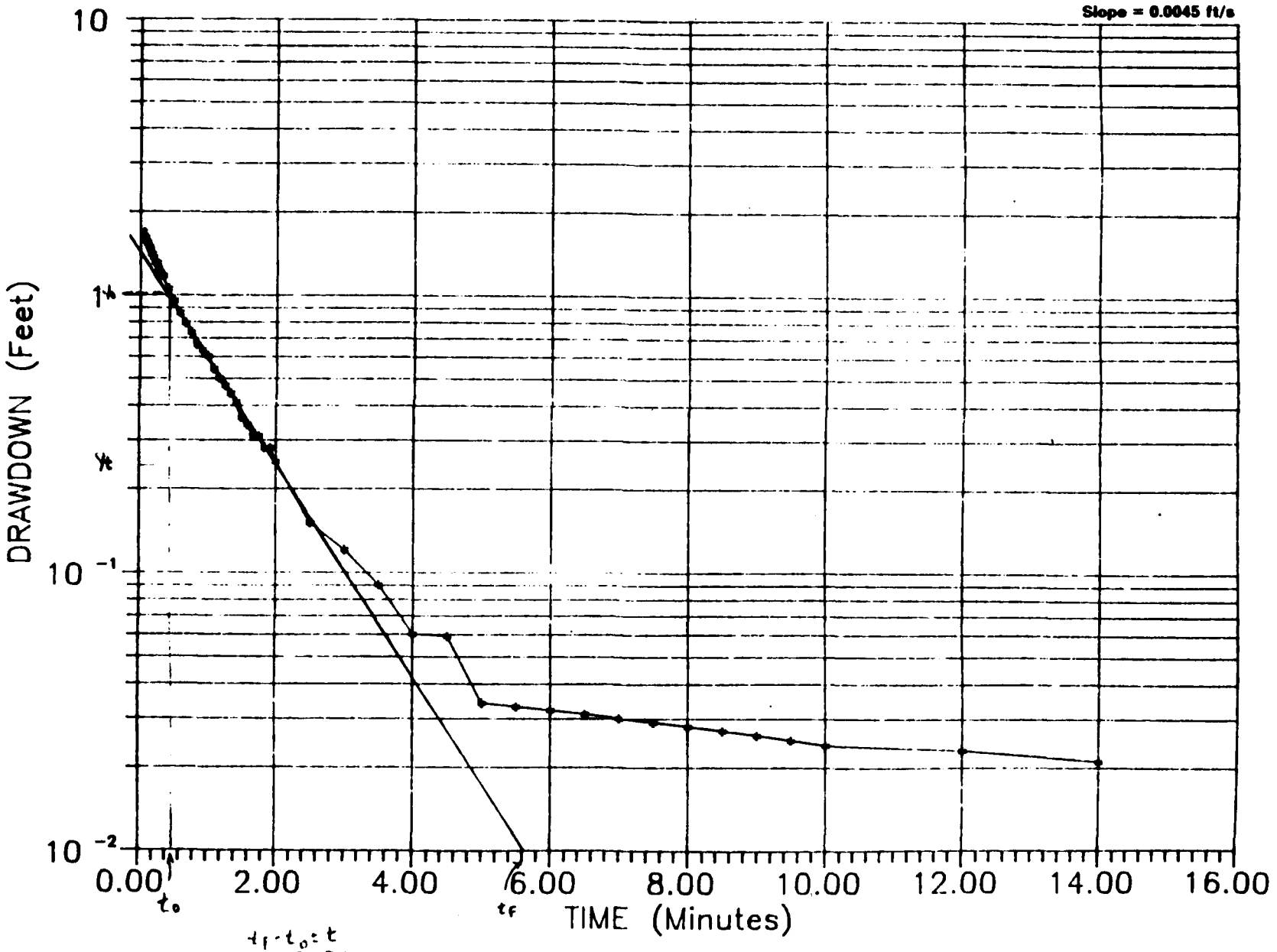
| FEET DEPTH | SAMPLE | DESCRIPTION | REMARKS |
|---|---|---|---|
| 60 | | | |
| 70 | | | |
| 80 | | | 25' OF 18" STAINLESS STEEL SHUTTER SCREEN |
| TD 84.0 | | TOP OF PLEASANTON FM | 10" PLUG IN BOTTOM<br>TOP OF PLUG: 83.2' |

# APPENDIX D

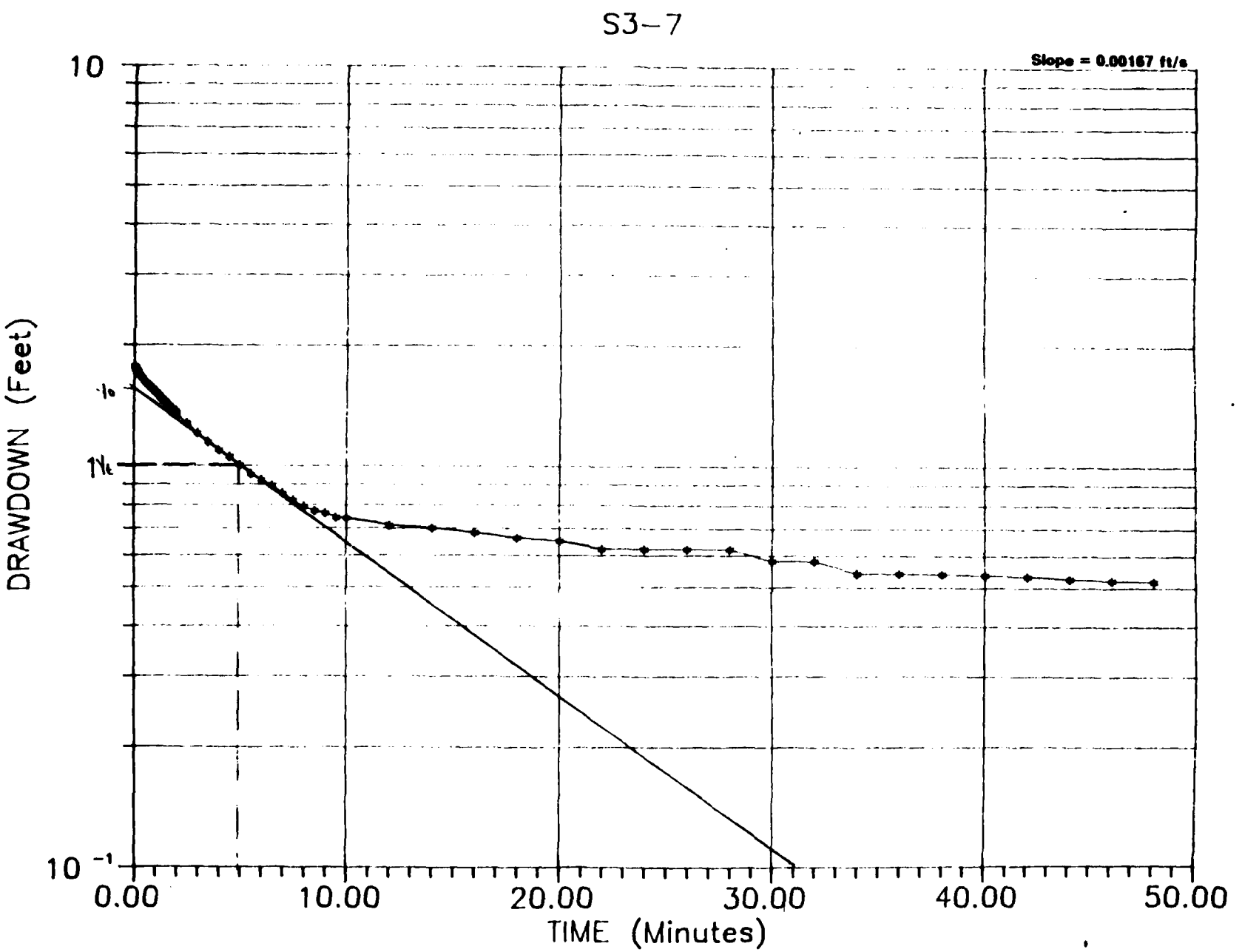
# GEOTECHNICAL DATA

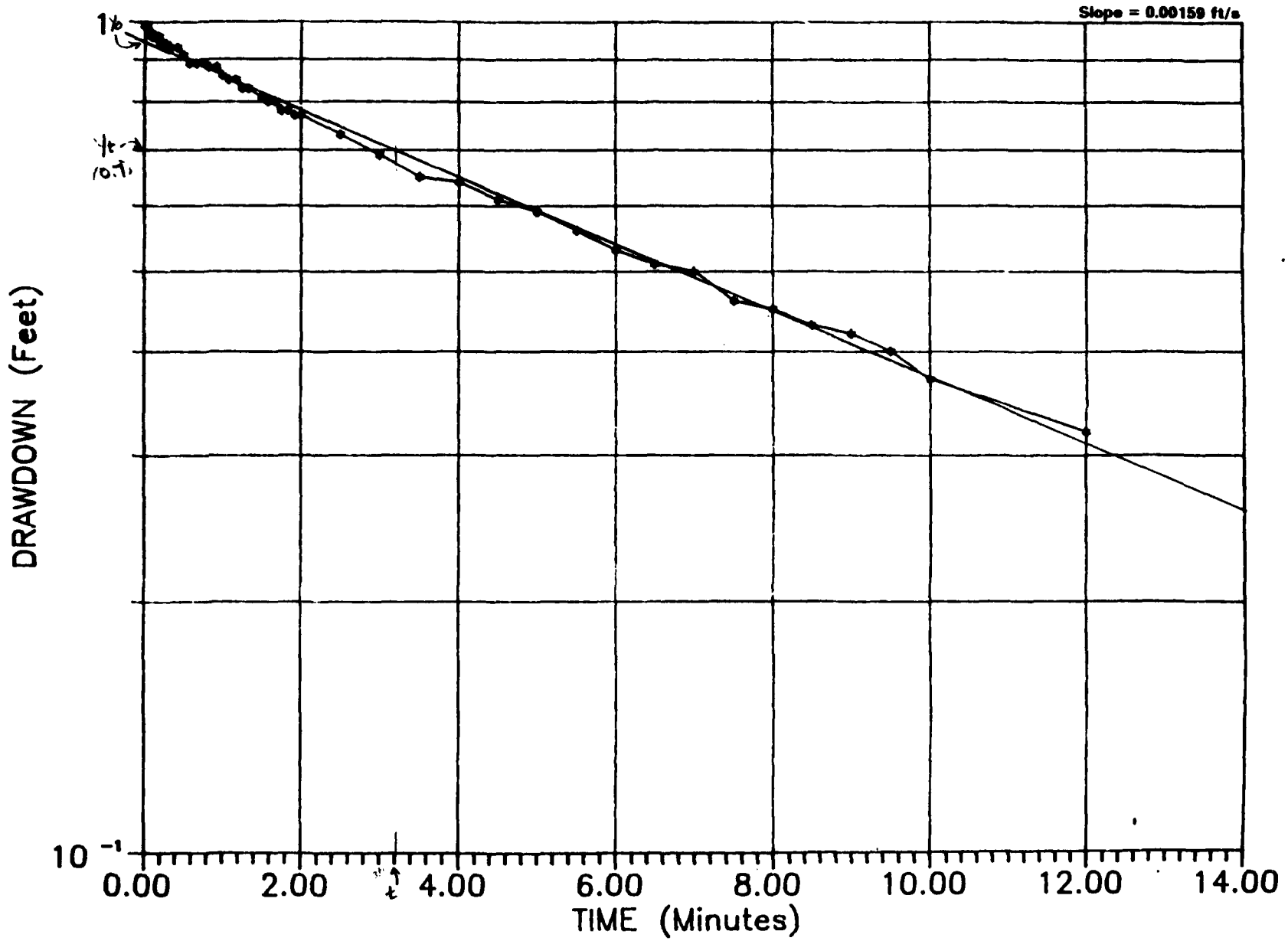

S2-8
Slope = 0.00079 ft/s
10
DRAWDOWN (Feet)
$y_0$
$1^{y_2}$
$10^{-1}$
0.00
$t$
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
TIME (Minutes)

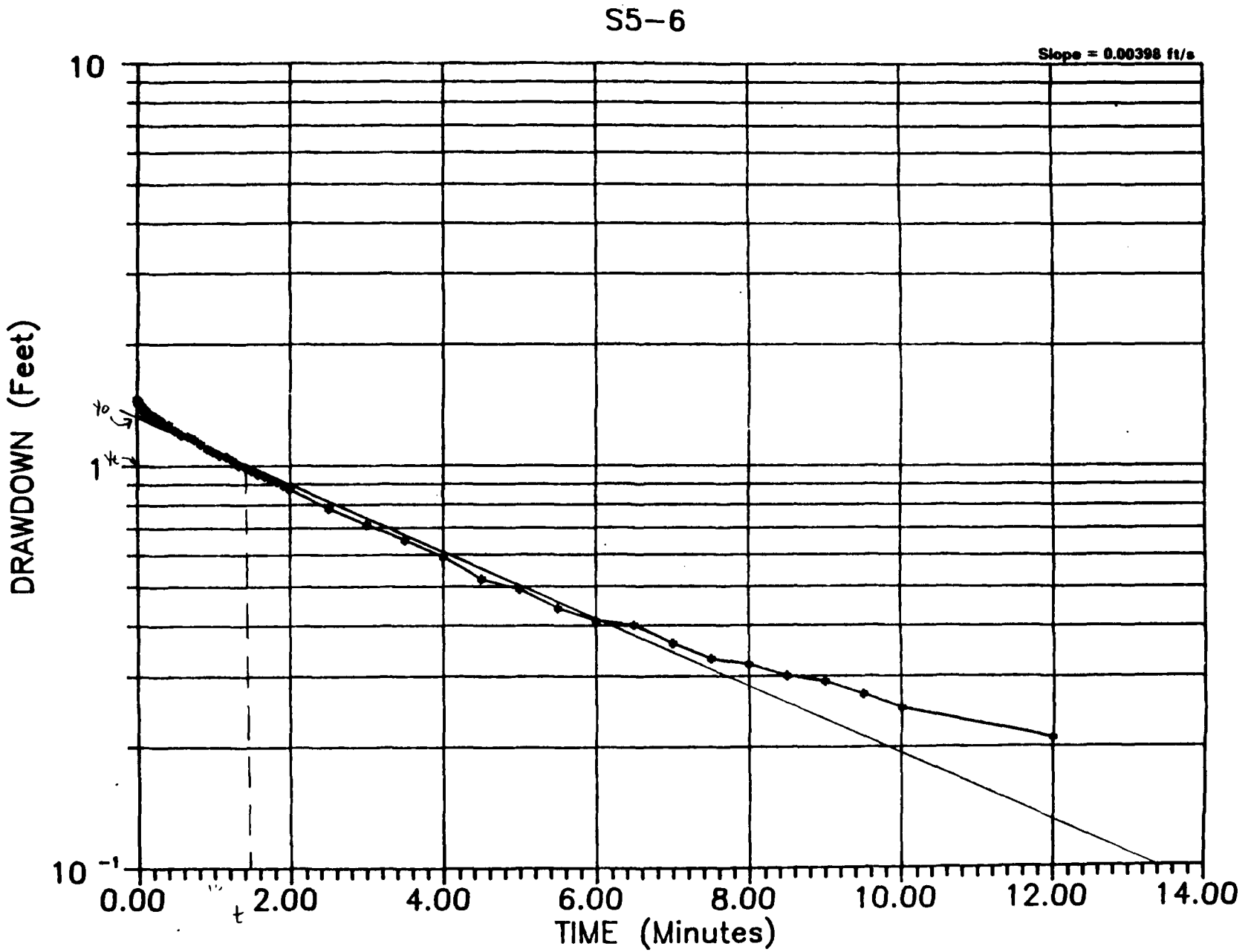
S3-6

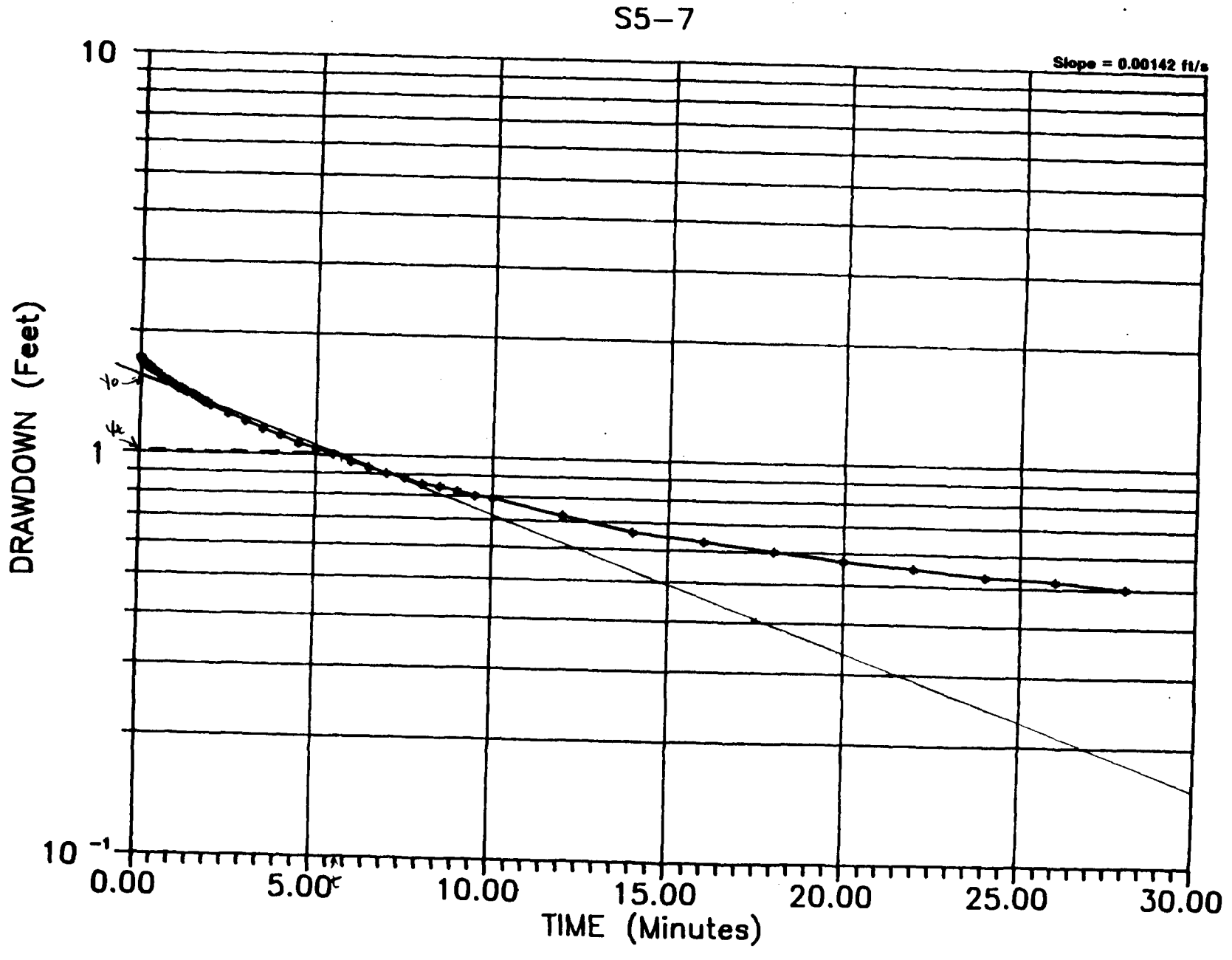

Slope = 0.0045 ft/s
10
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)
$t_0$
$t_f$

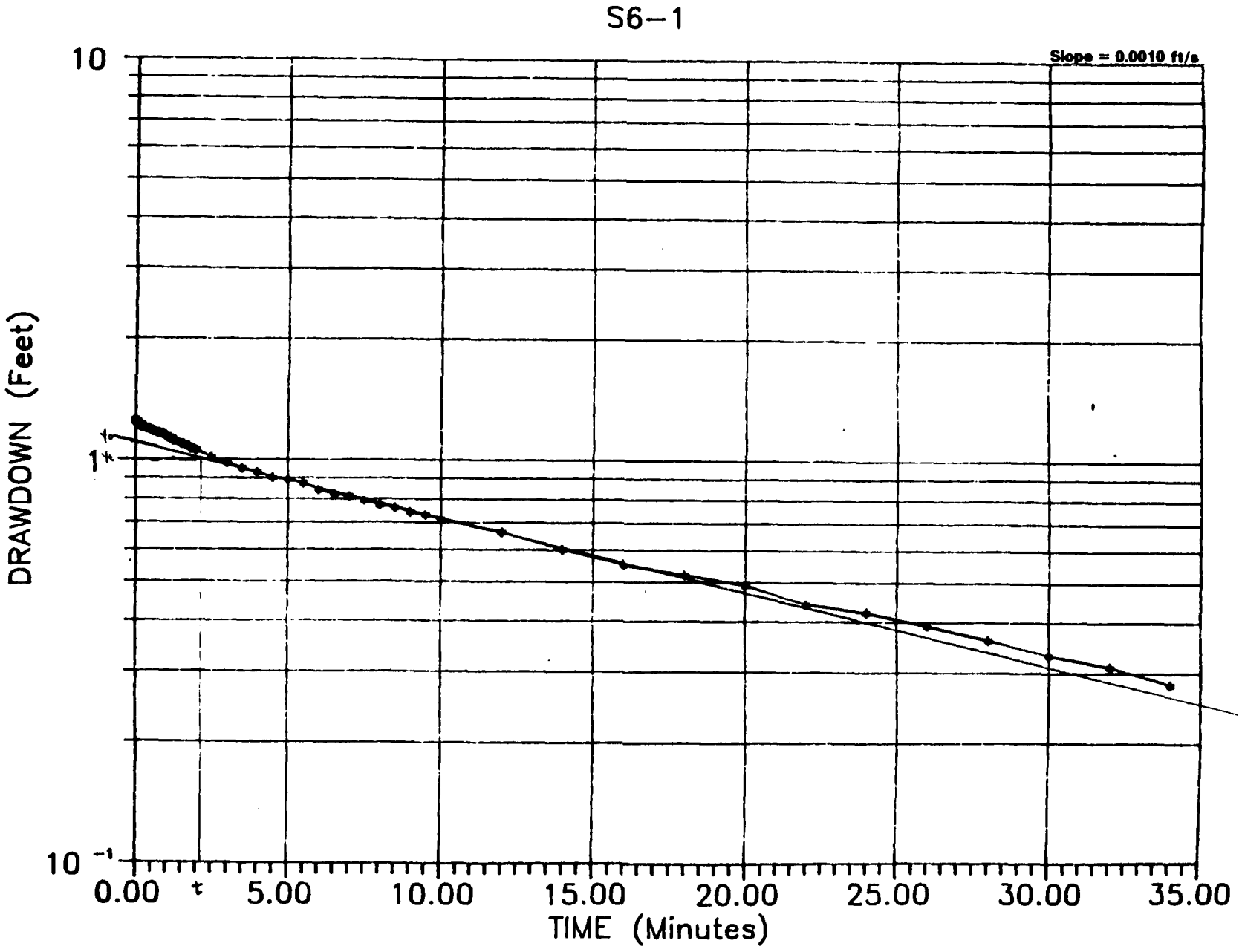
$t_f - t_0 = t$


S3-7
Slope = 0.00167 ft/s
10
1/2
1/4
10 -1
DRAWDOWN (Feet)
0.00
10.00
20.00
30.00
40.00
50.00
TIME (Minutes)

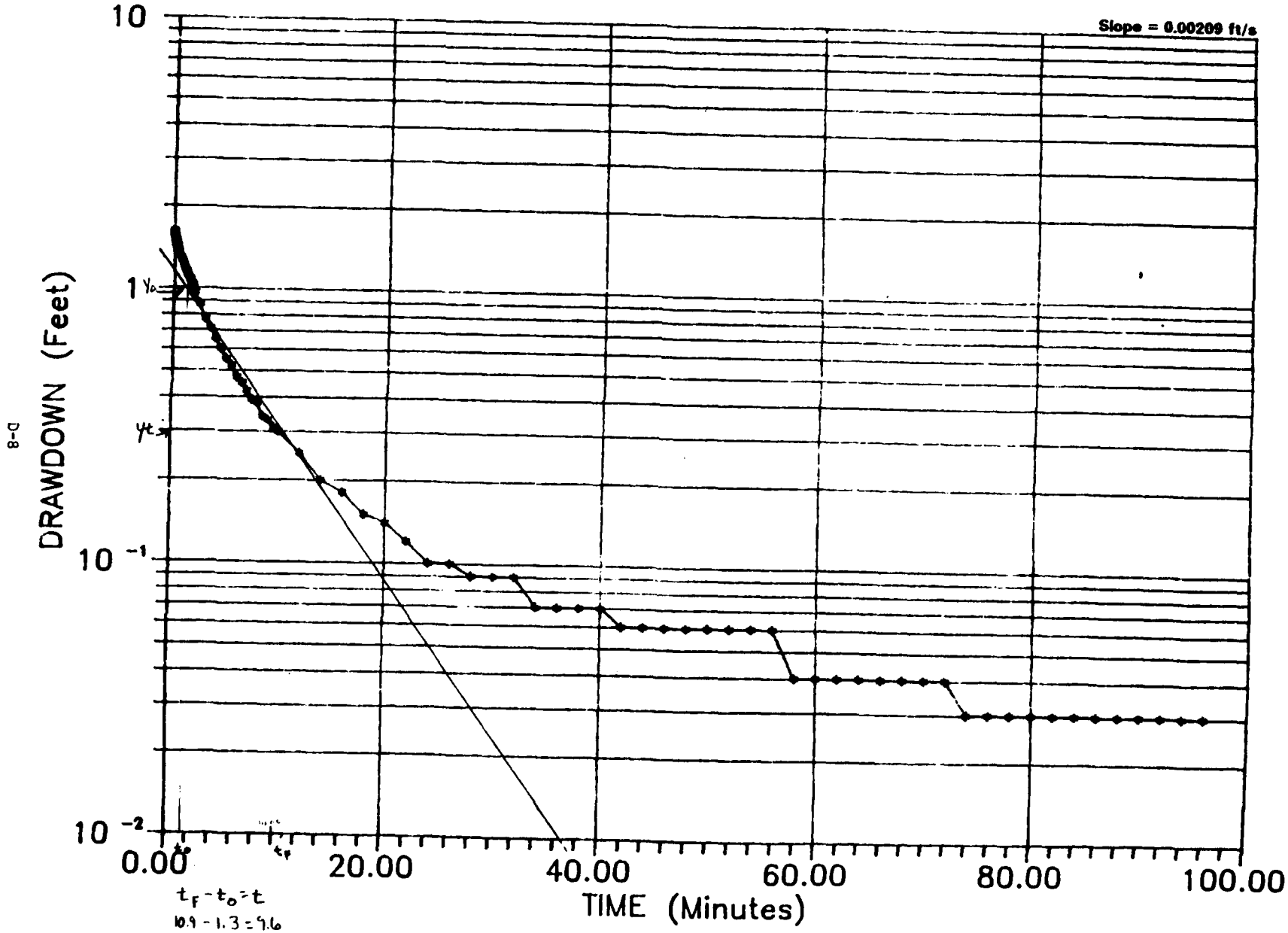

S5-5
Slope = 0.00159 ft/s
1
1/t
(0.1)
DRAWDOWN (Feet)
10 -1
0.00
2.00
t
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)


S5-6
Slope = 0.00398 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)

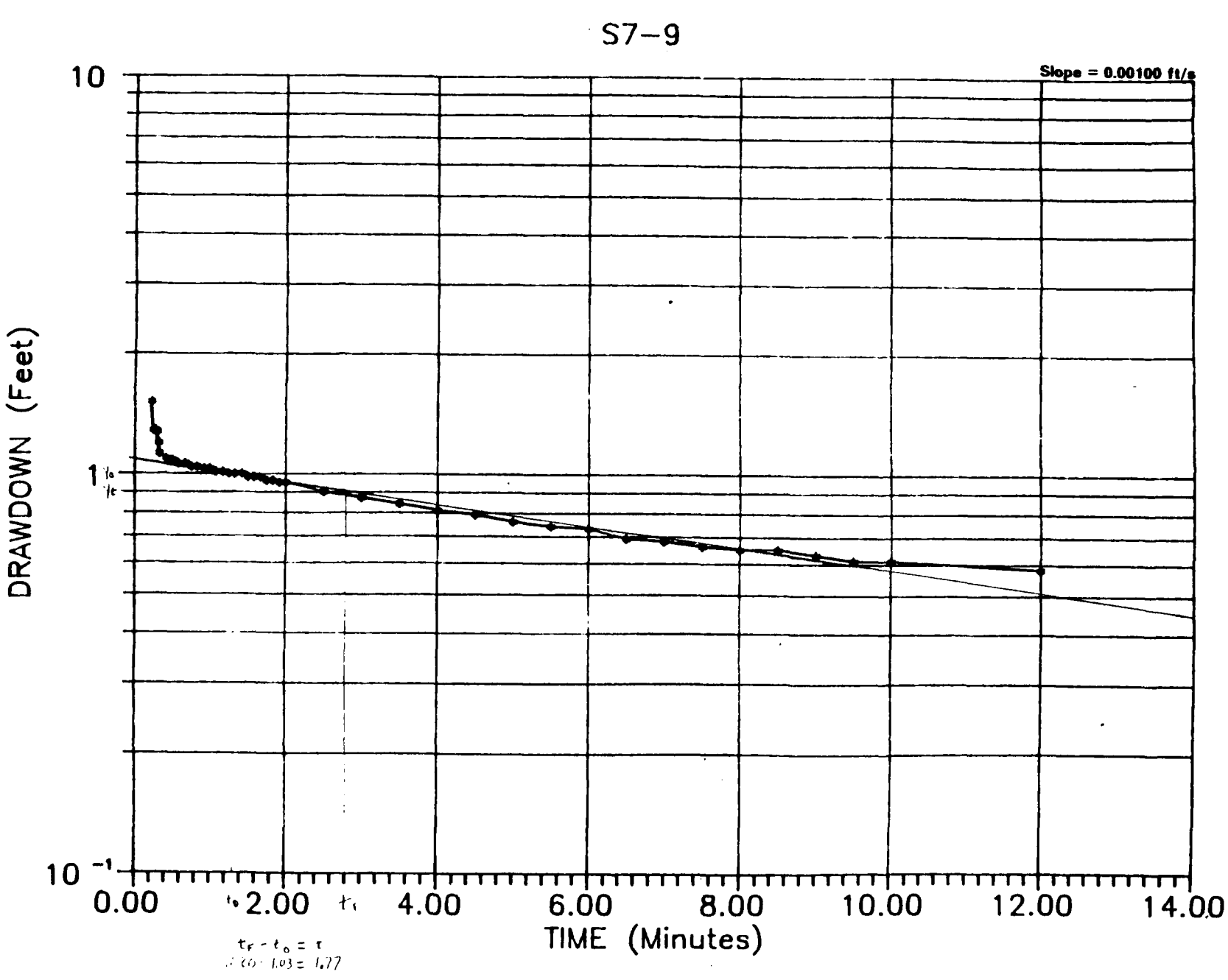

S5-7
Slope = 0.00142 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
TIME (Minutes)


S6-1
Slope = 0.0010 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
t
5.00
10.00
15.00
20.00
25.00
30.00
35.00
TIME (Minutes)

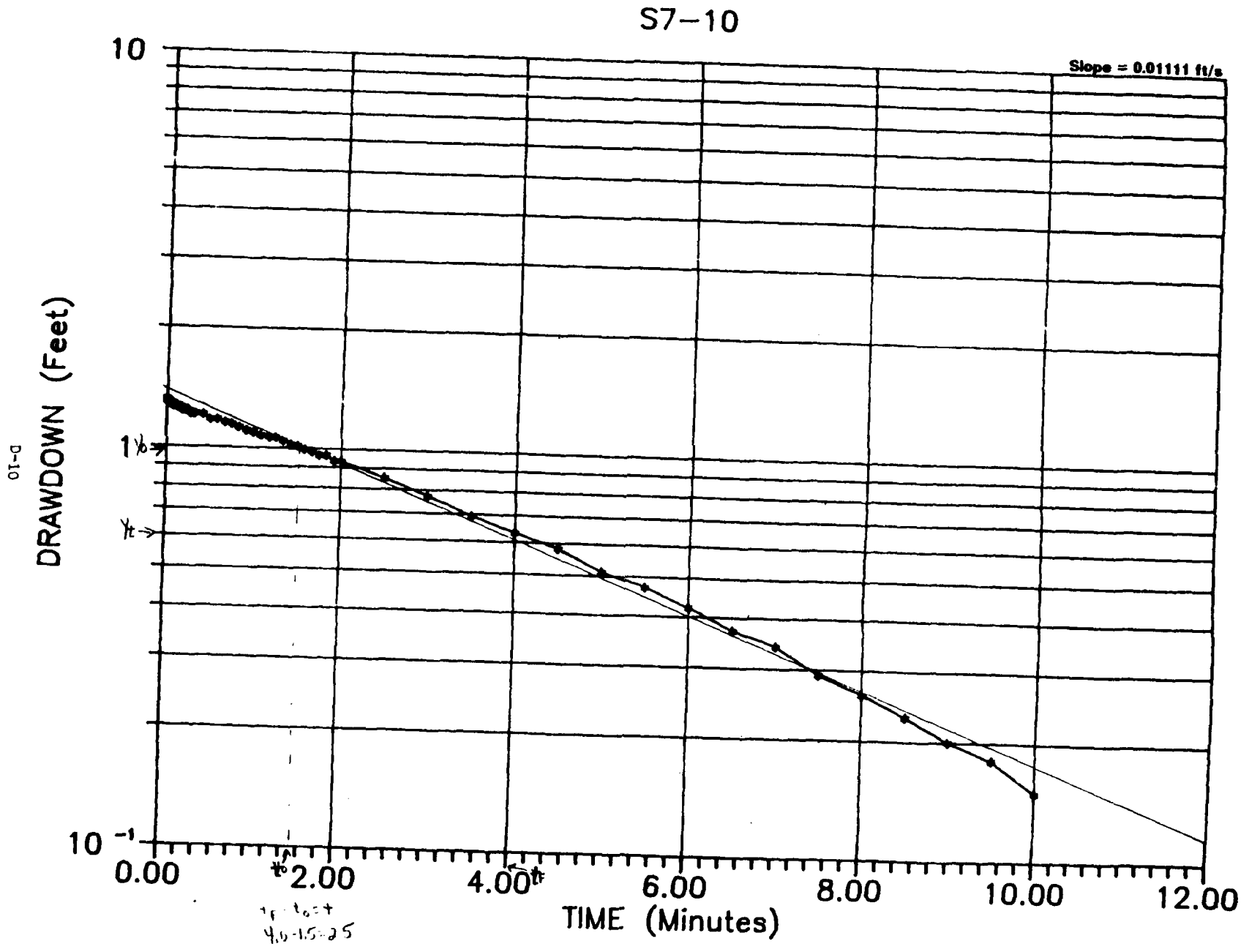
S7-8

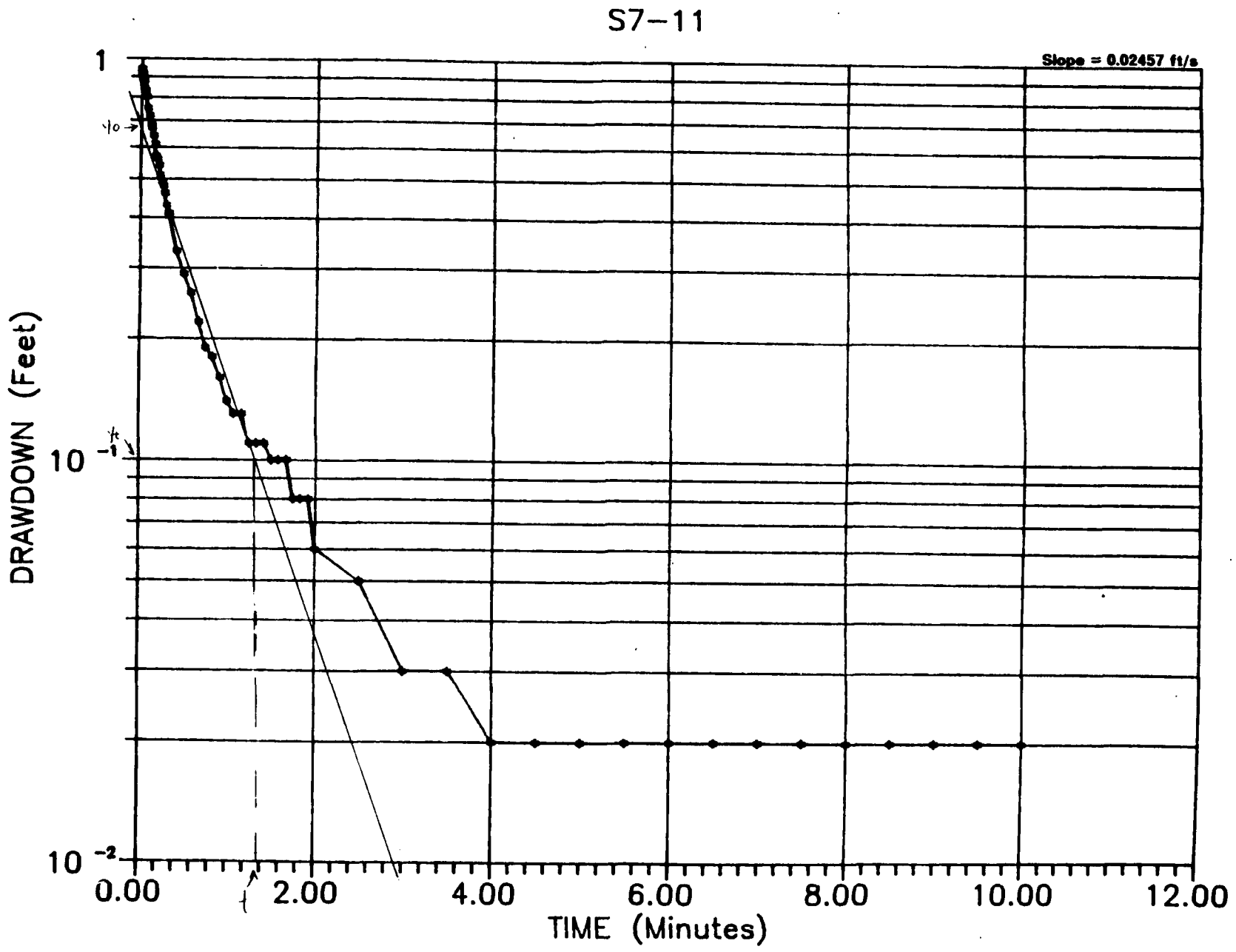

Slope = 0.00209 ft/s
10
1
$y_o$
$y_t$
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
0.00
20.00
40.00
60.00
80.00
100.00
TIME (Minutes)
$t_o$
$t_F$
$t_F - t_o = t$
10.9 - 1.3 = 9.6

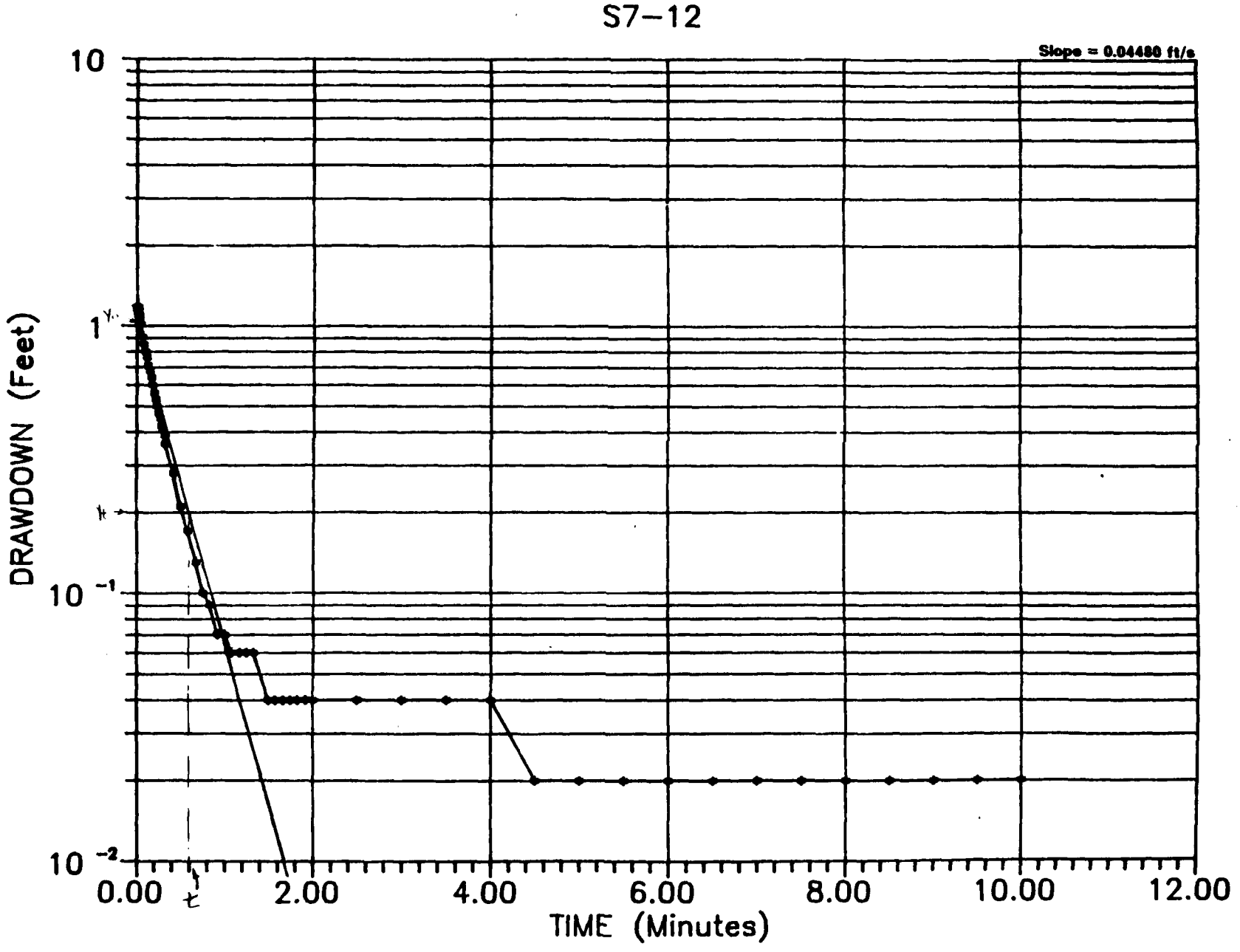
S7-9

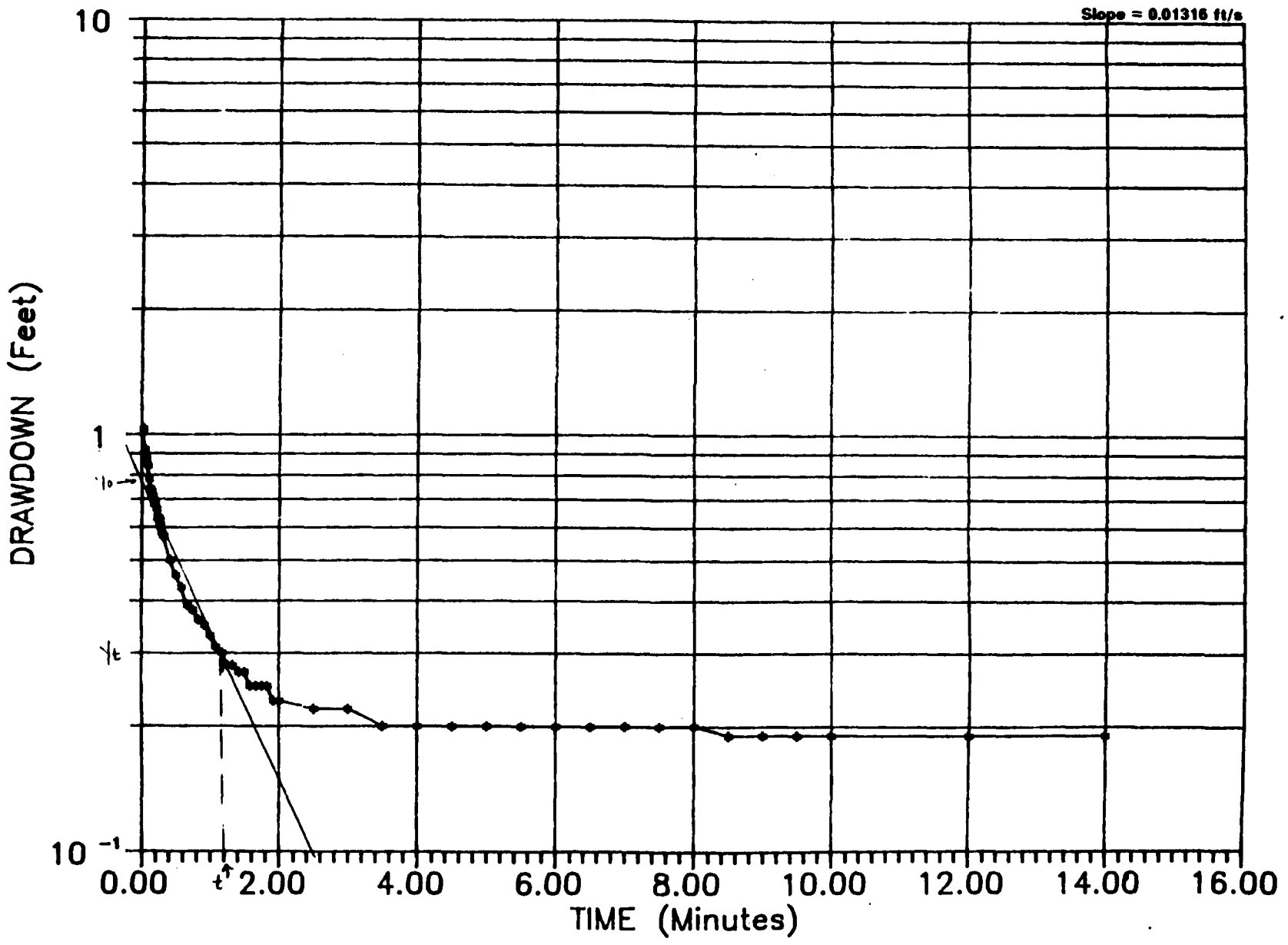

Slope = 0.00100 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)

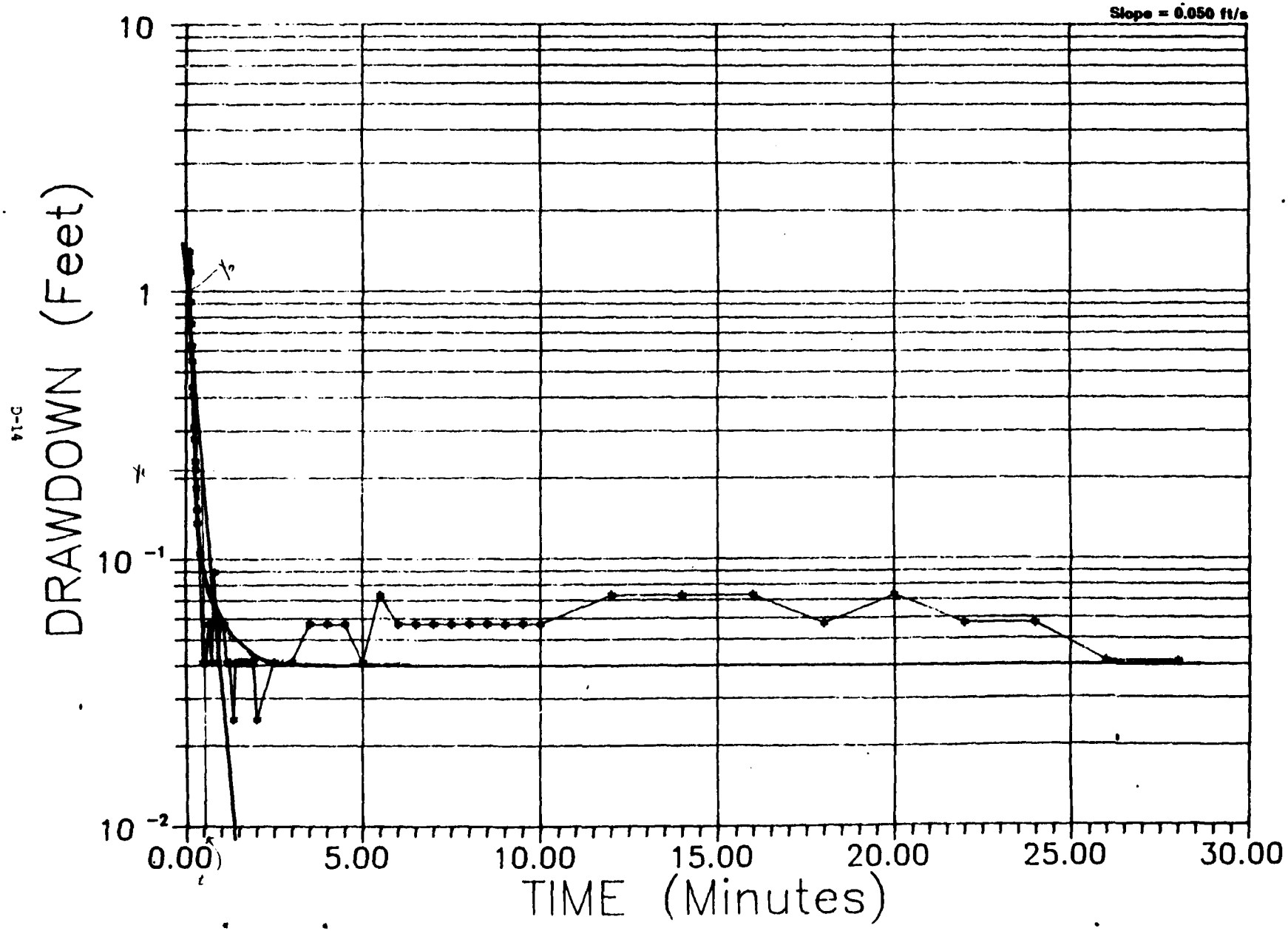
D-9

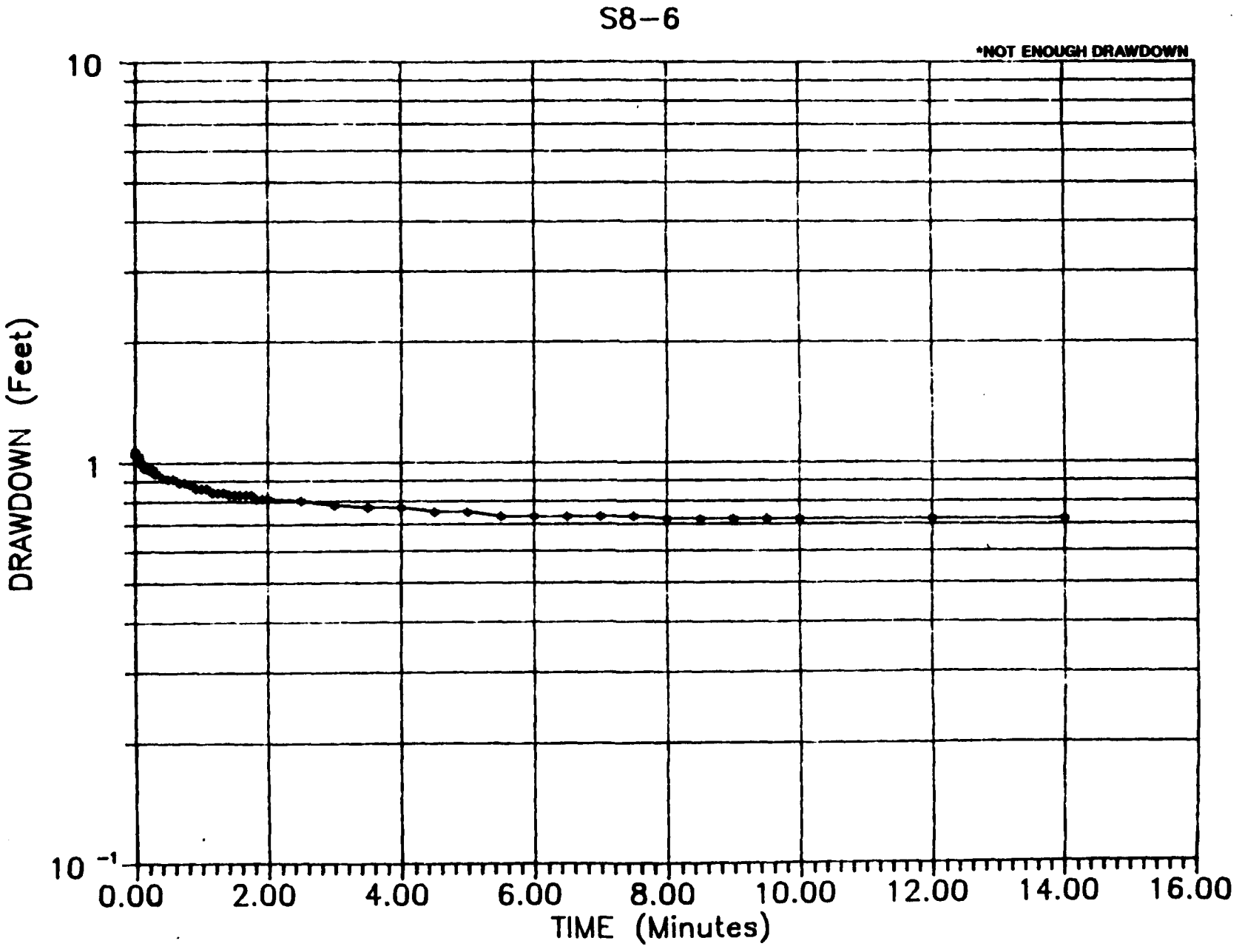

S7-10
Slope = 0.01111 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)

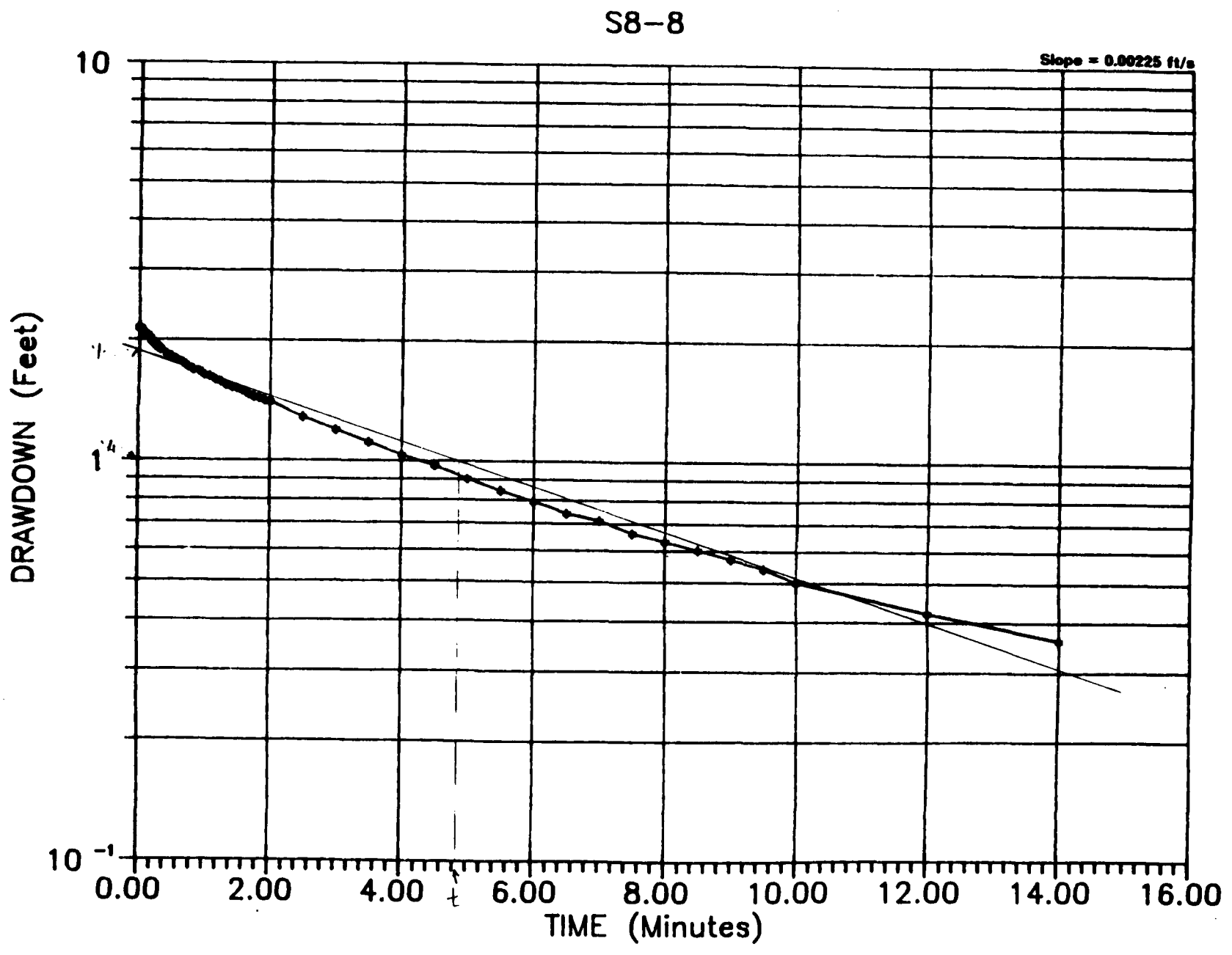

S7-11
Slope = 0.02457 ft/s
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)

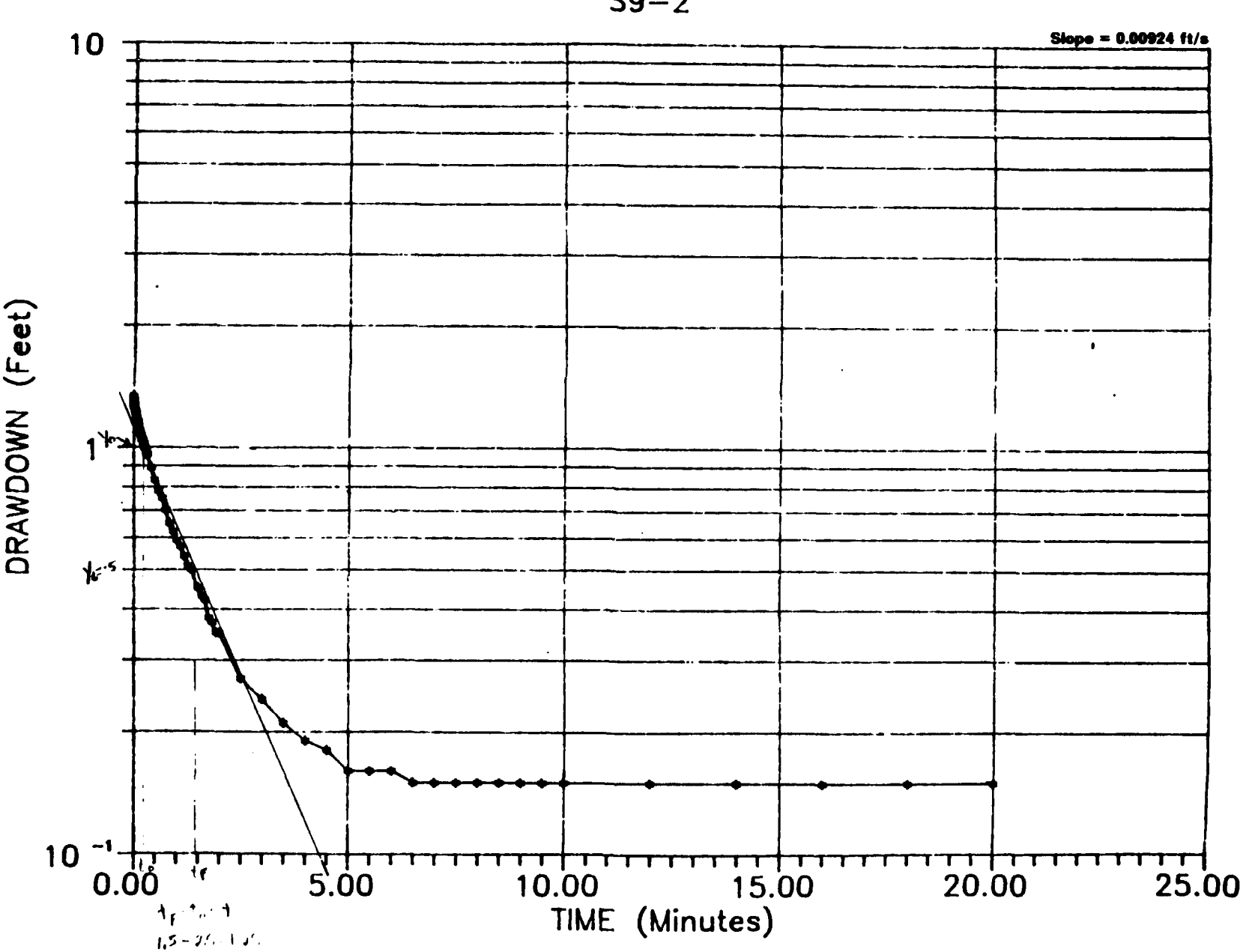

S7-12
Slope = 0.04480 ft/s
10
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)

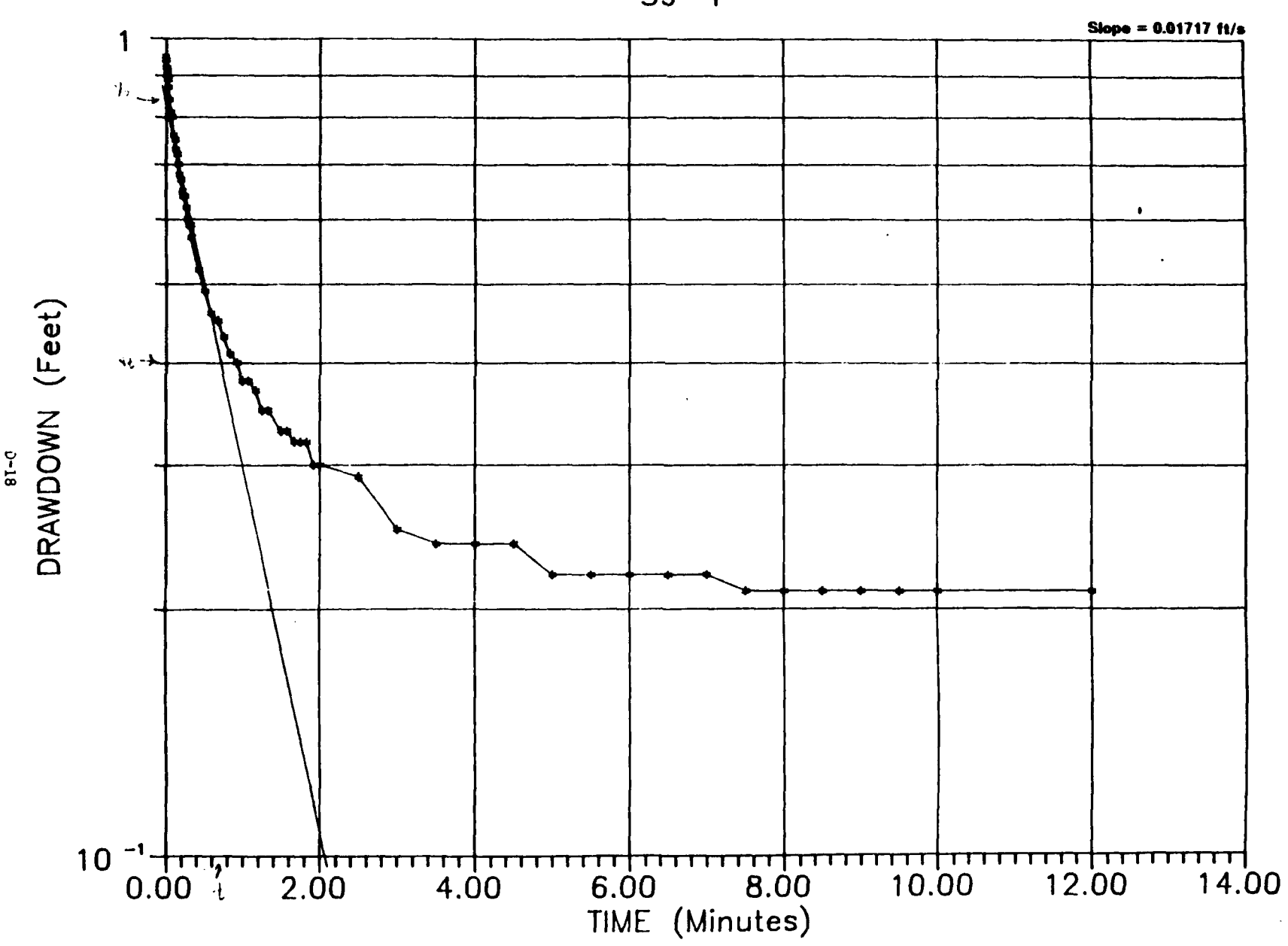

S7-13
Slope = 0.01316 ft/s
10
1
10 -1
DRAWDOWN (Feet)
1/t
0.00
t*
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)

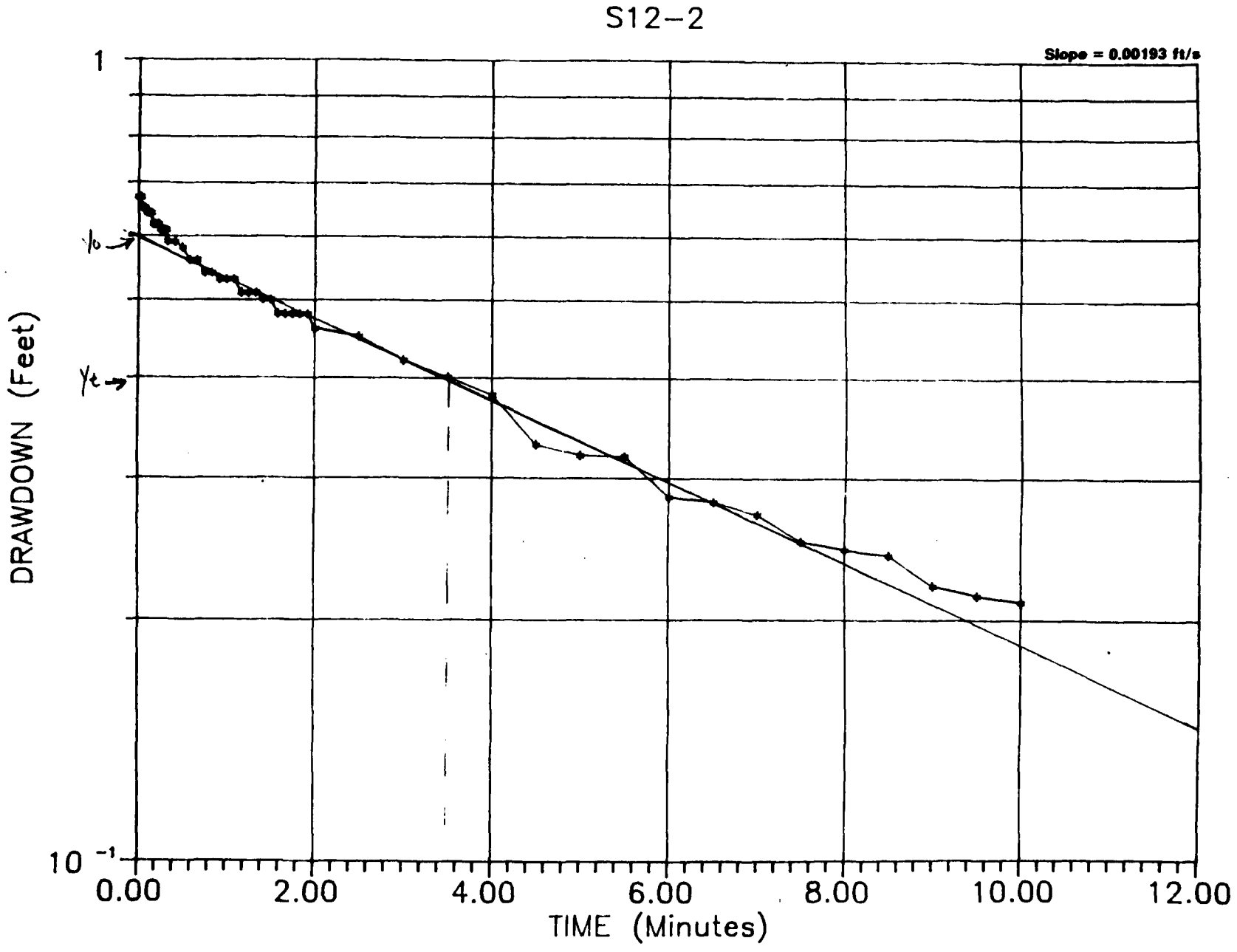

S3-8-2
Slope = 0.050 ft/s
10
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
TIME (Minutes)

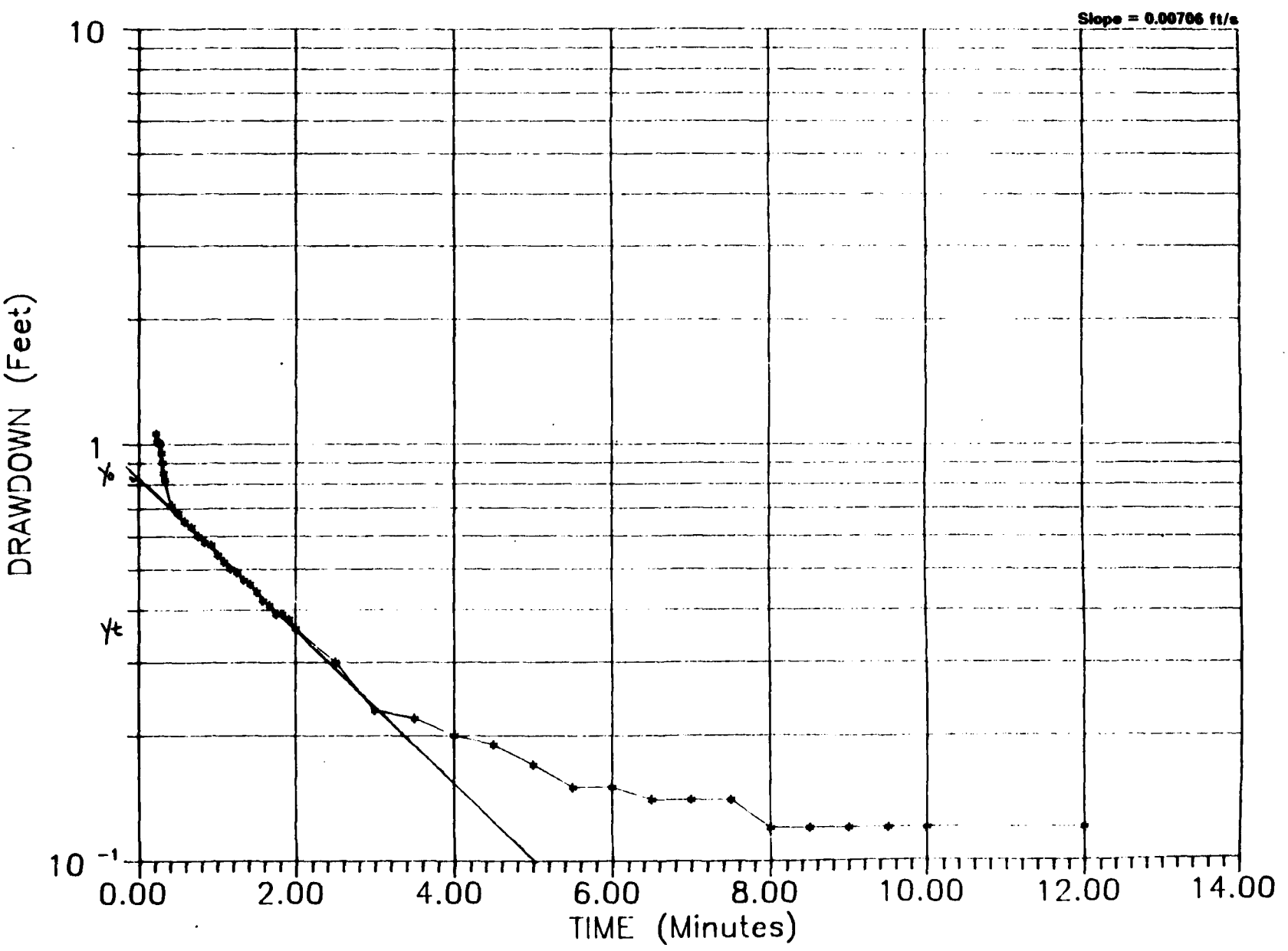

S8-6
*NOT ENOUGH DRAWDOWN
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)

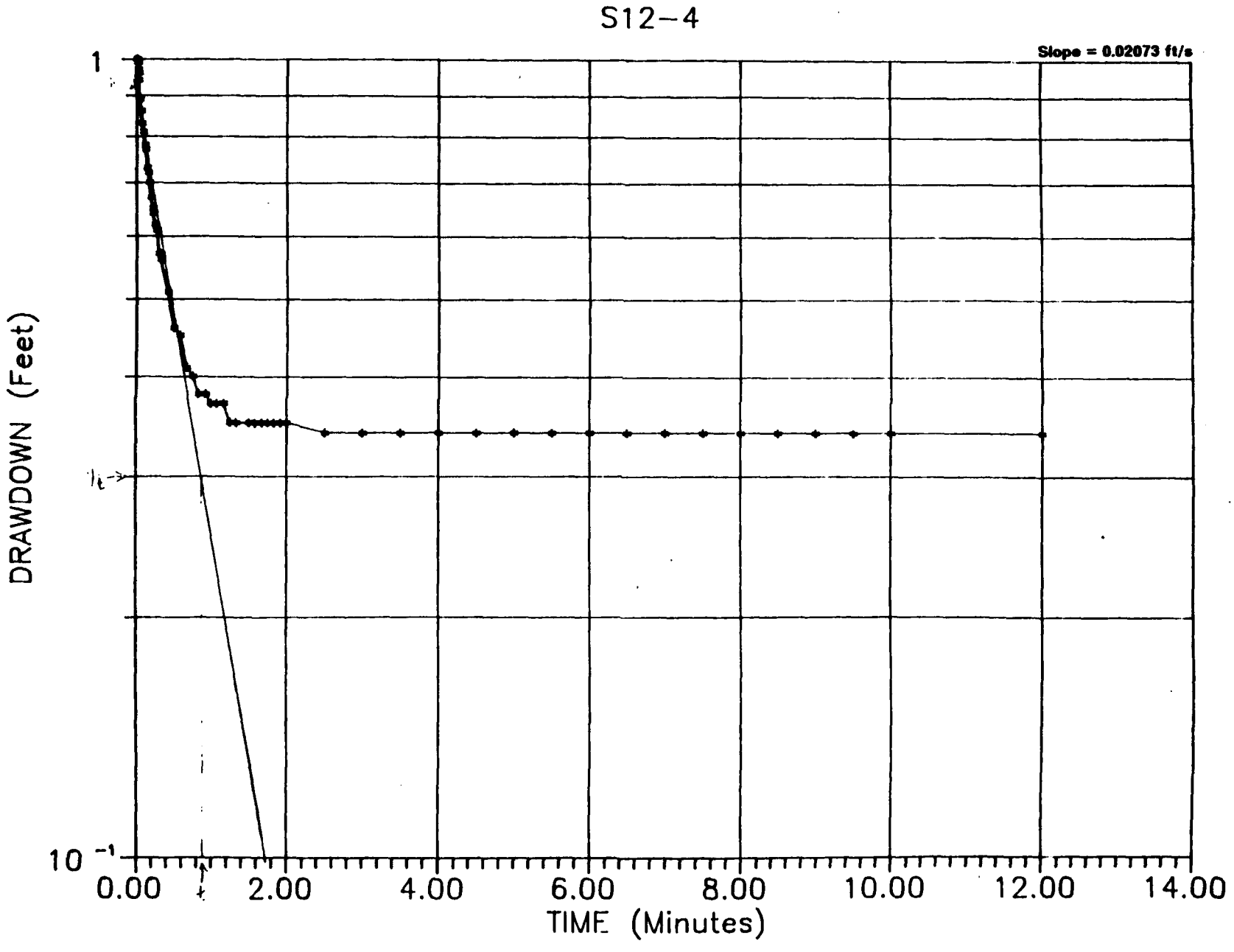

S8-8
Slope = 0.00225 ft/s
10
1
$10^{-1}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)

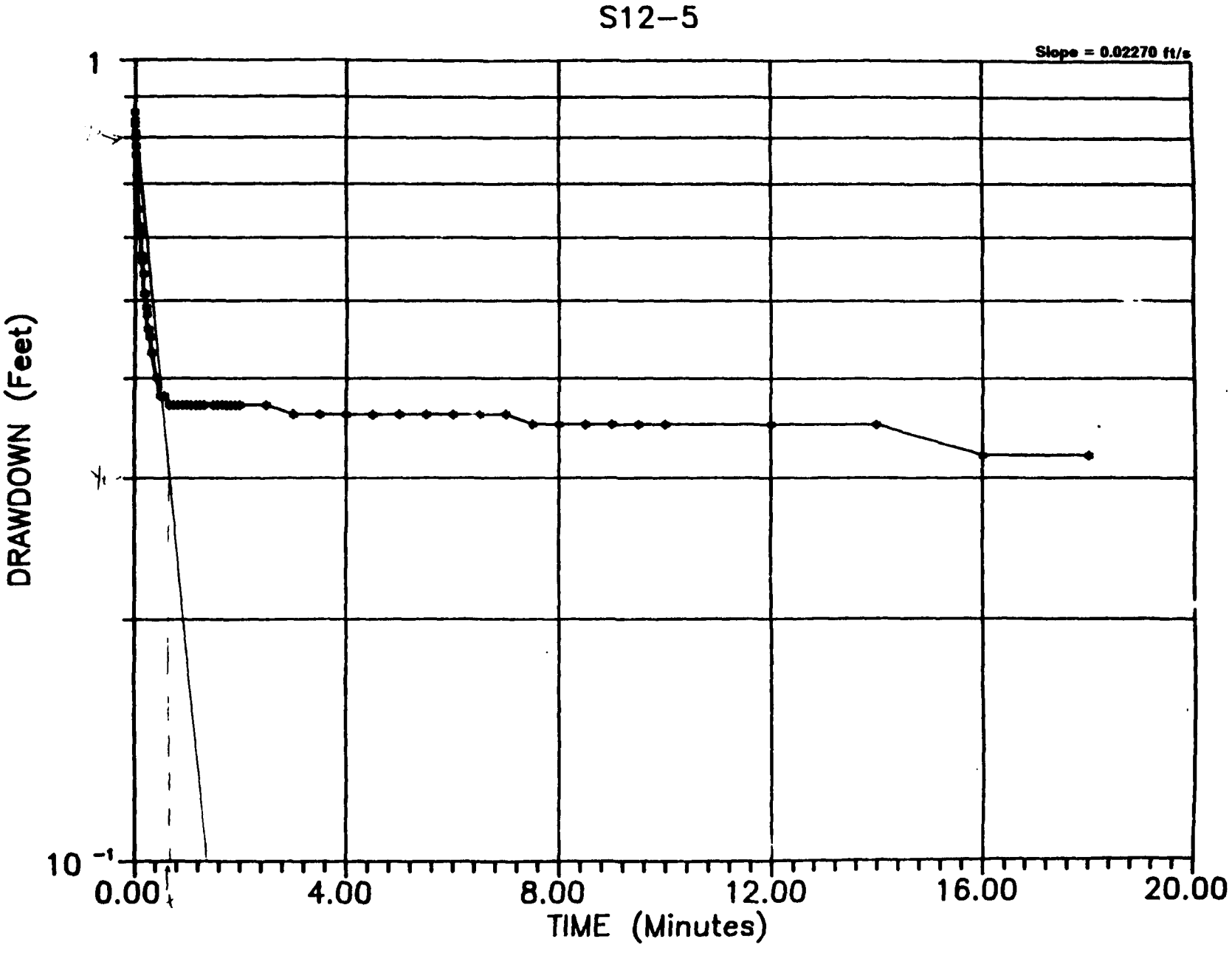

S9-2
Slope = 0.00924 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
TIME (Minutes)

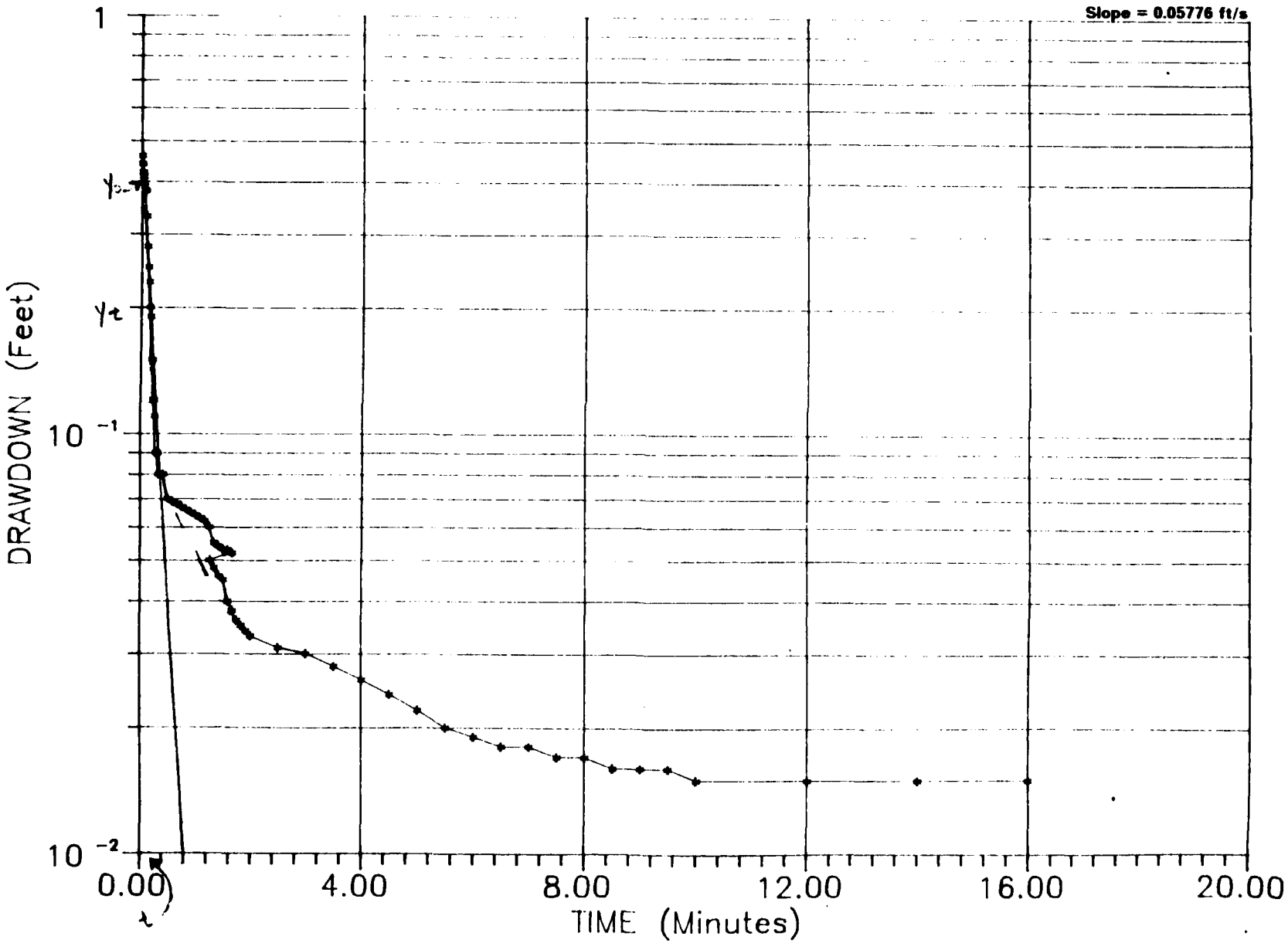

S9-4
Slope = 0.01717 ft/s
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)


S12-2
Slope = 0.00193 ft/s
1
$y_0$
$y_t$
$10^{-1}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)

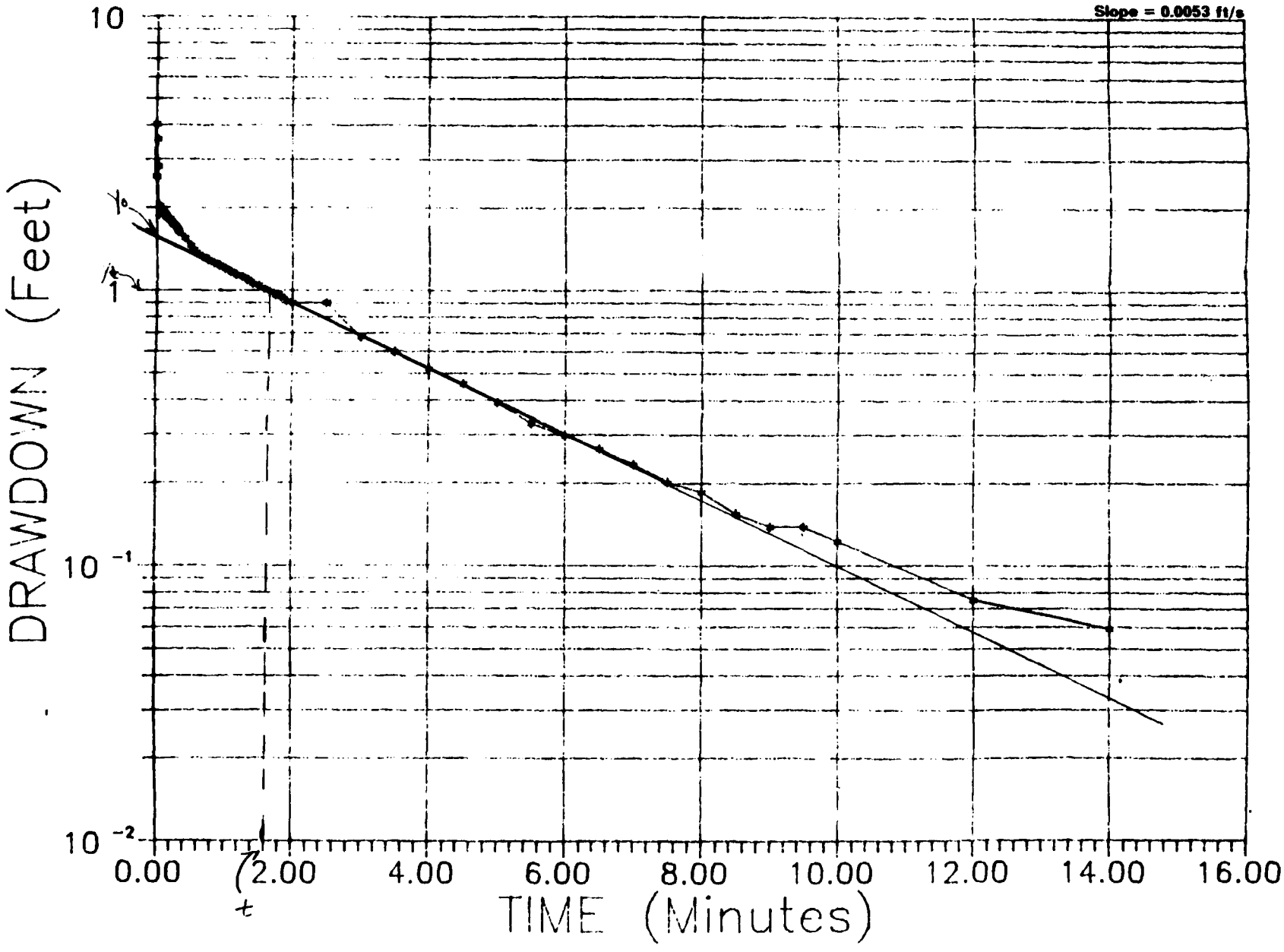

S12-3
Slope = 0.00706 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)

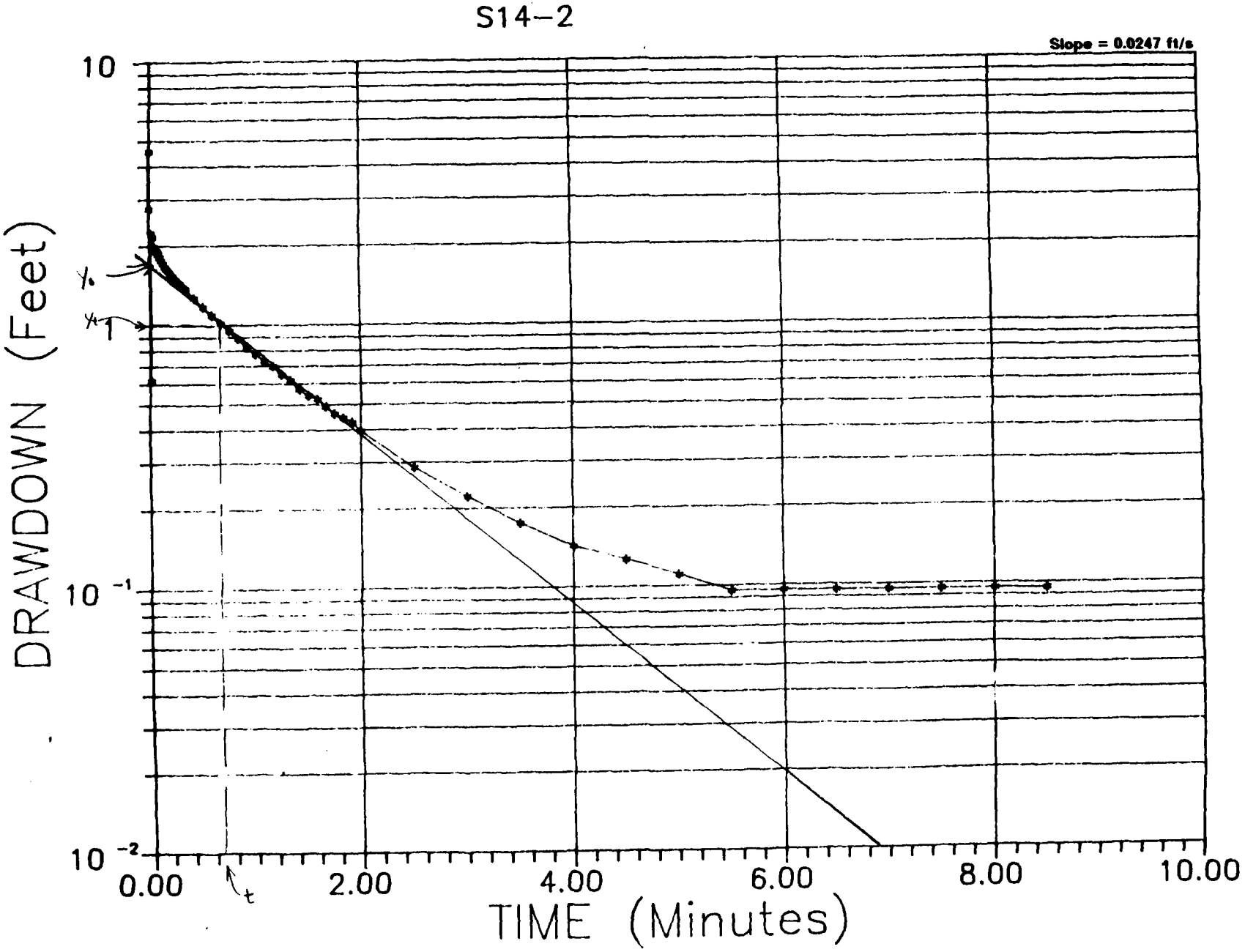

S12-4
Slope = 0.02073 ft/s
1
$10^{-1}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)

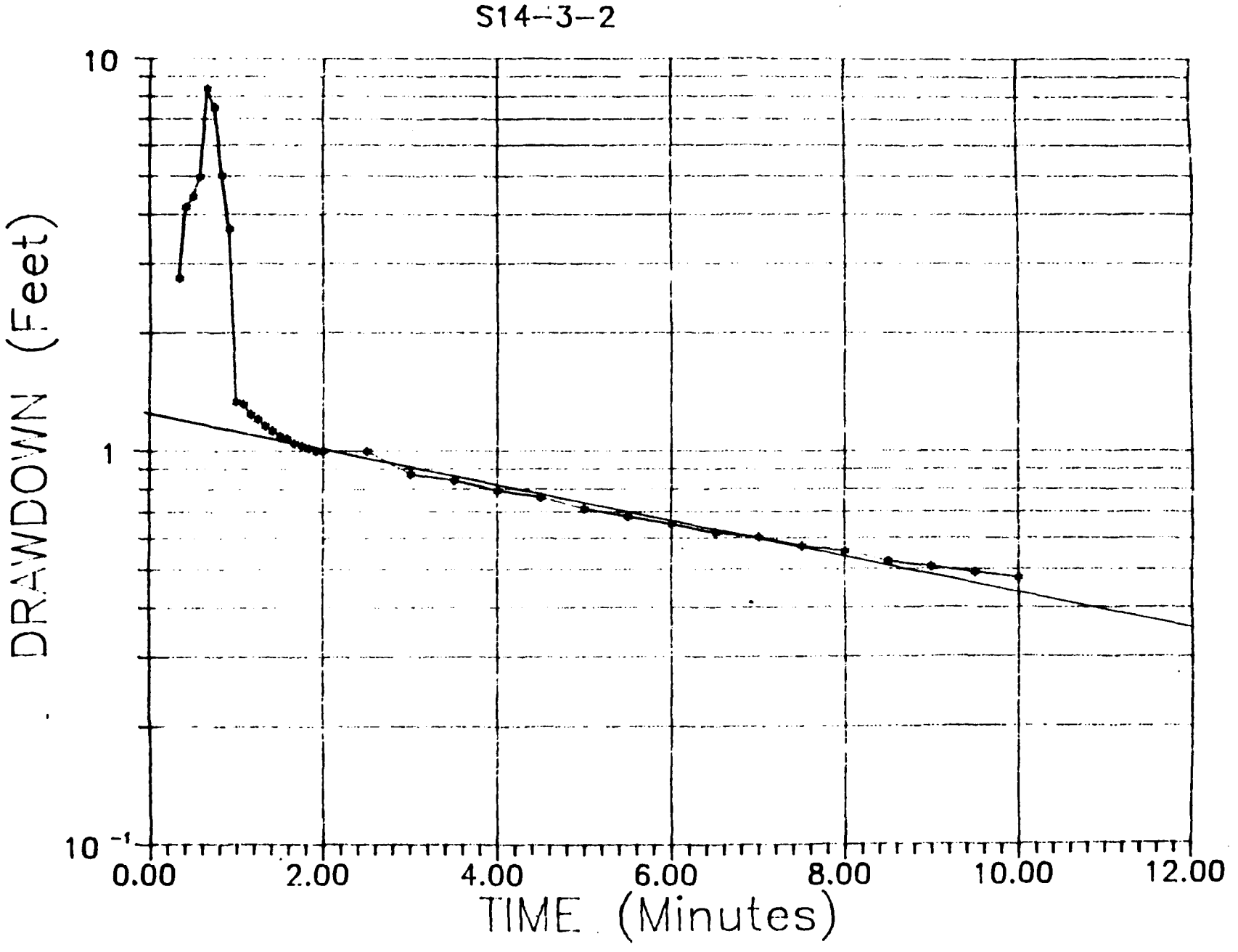

S12-5
Slope = 0.02270 ft/s
1
10 -1
DRAWDOWN (Feet)
0.00
4.00
8.00
12.00
16.00
20.00
TIME (Minutes)

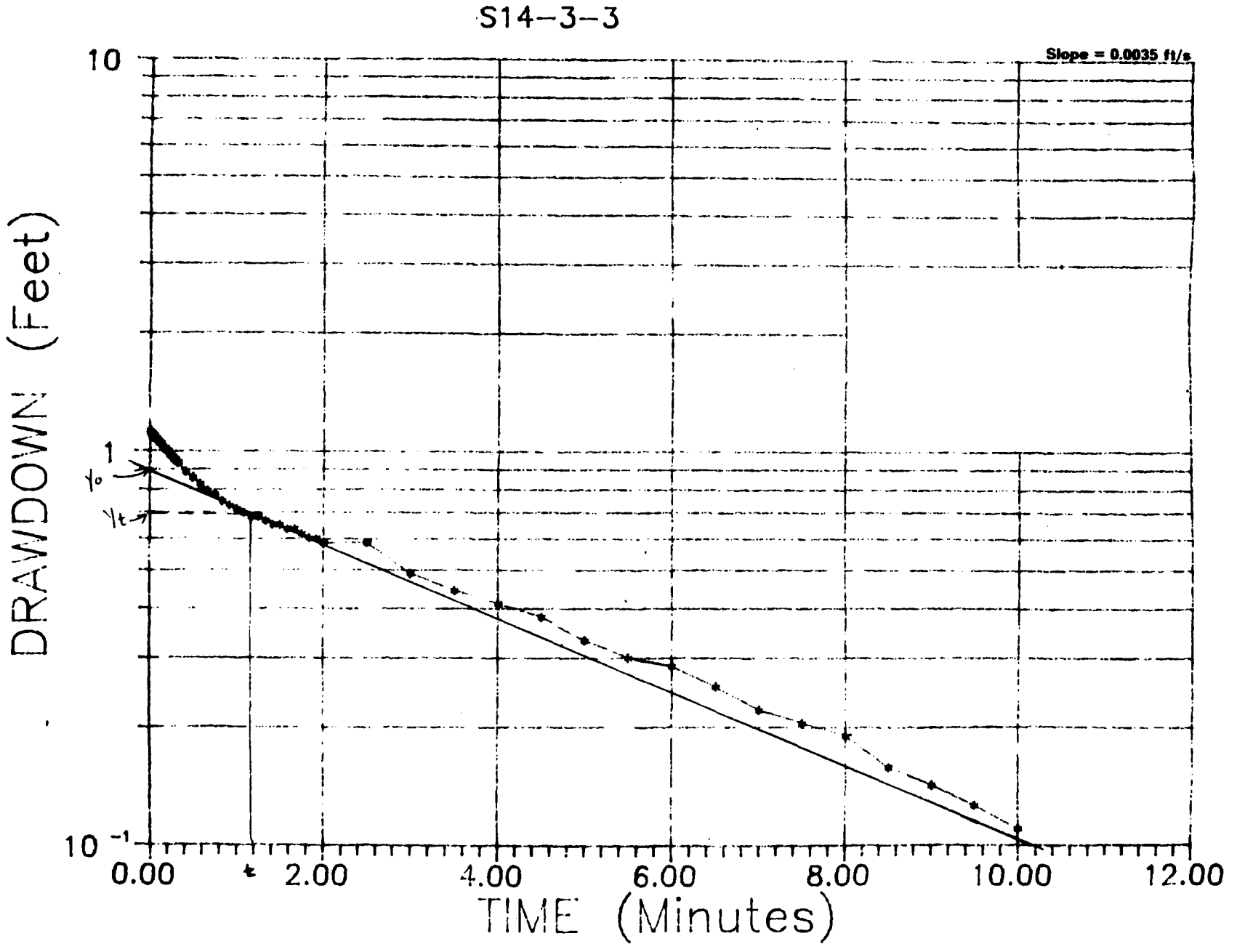

S12-6
Slope = 0.05776 ft/s
DRAWDOWN (Feet)
1
10 -1
10 -2
0.00
4.00
8.00
12.00
16.00
20.00
TIME (Minutes)

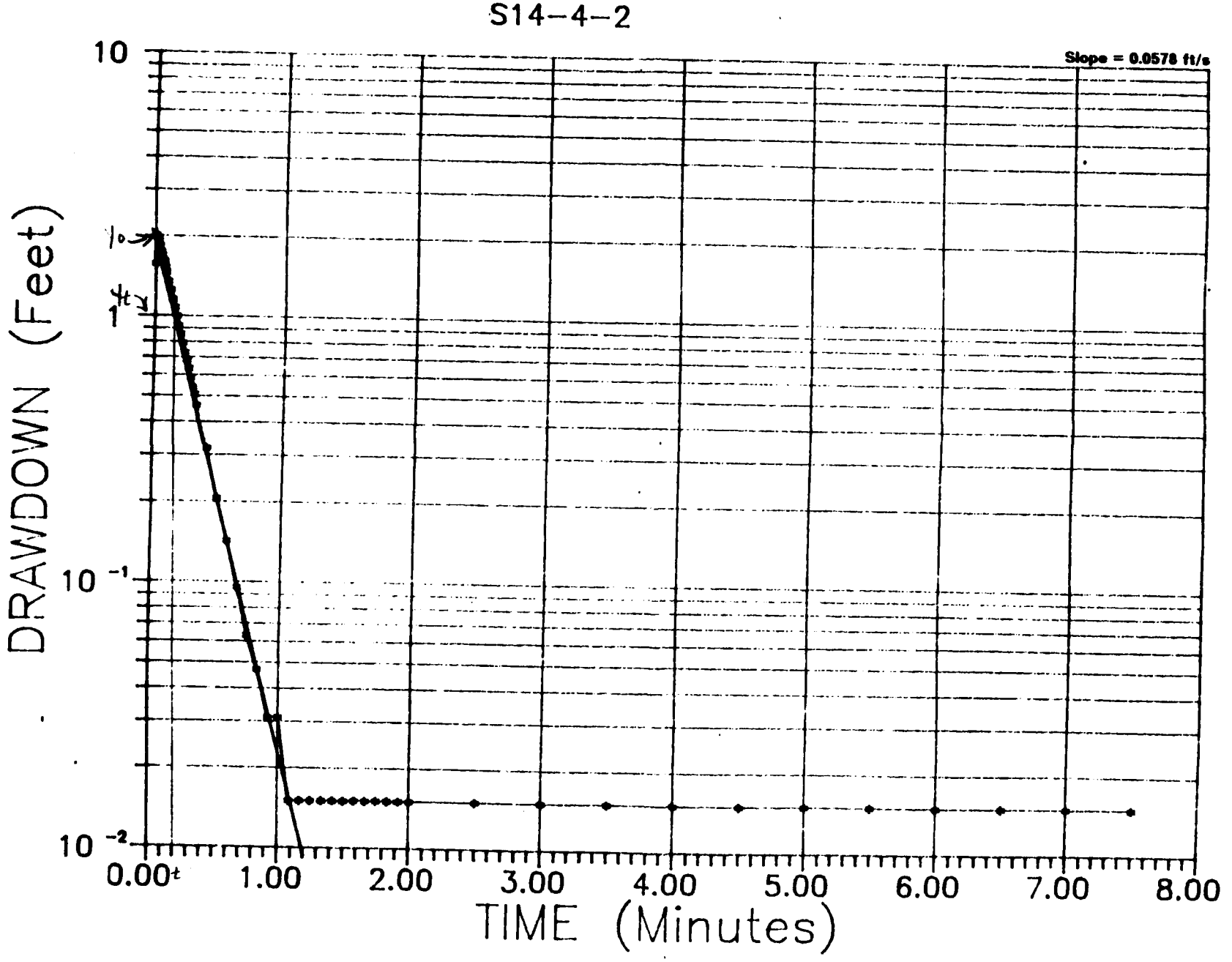
S14--1

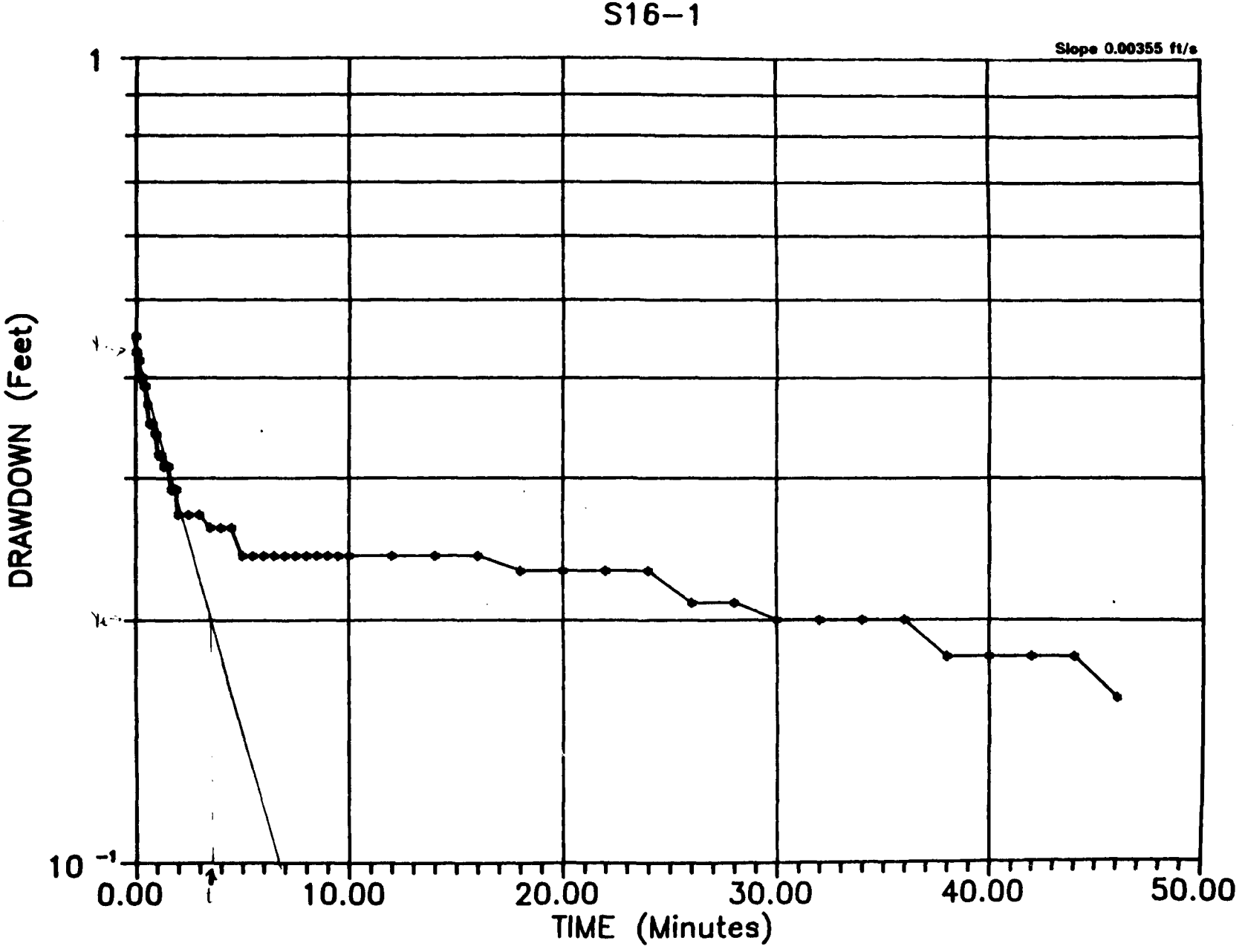

Slope = 0.0053 ft/s
10
$y_0$
1
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
$t$
TIME (Minutes)

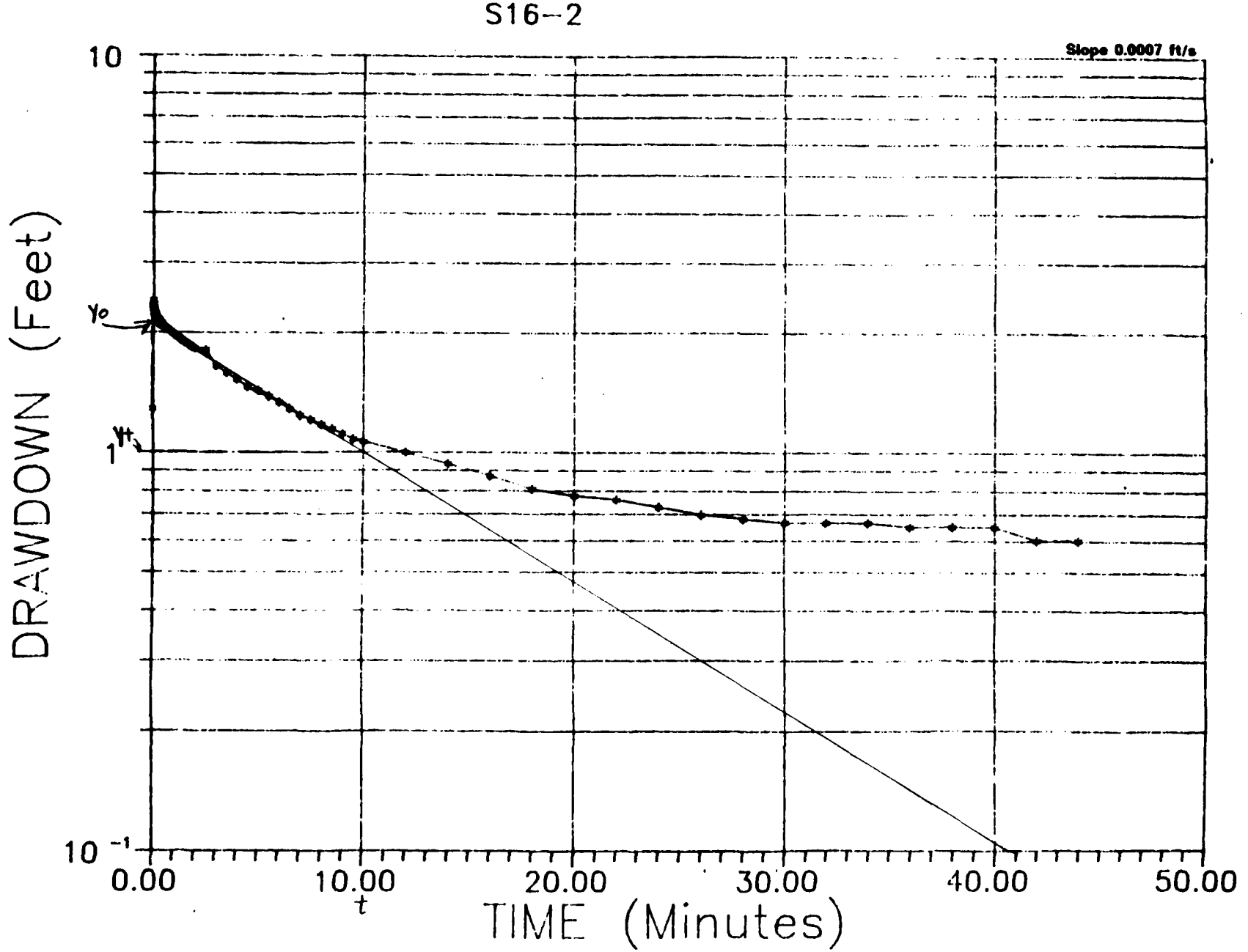

S14-2
Slope = 0.0247 ft/s
10
$y_0$
$y_1$
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
0.00
$t_1$
2.00
4.00
6.00
8.00
10.00
TIME (Minutes)

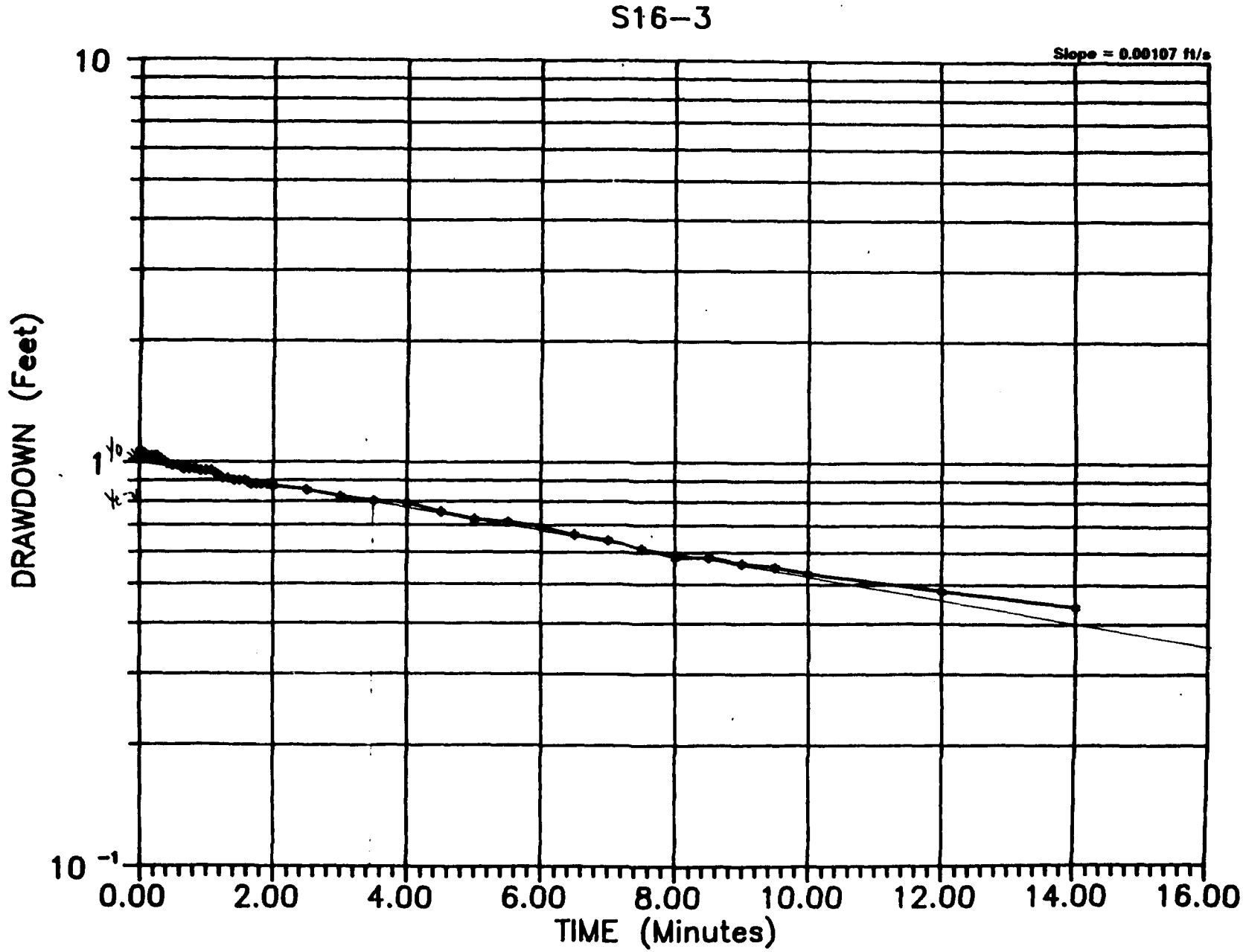

S14-3-2
10
1
$10^{-1}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)

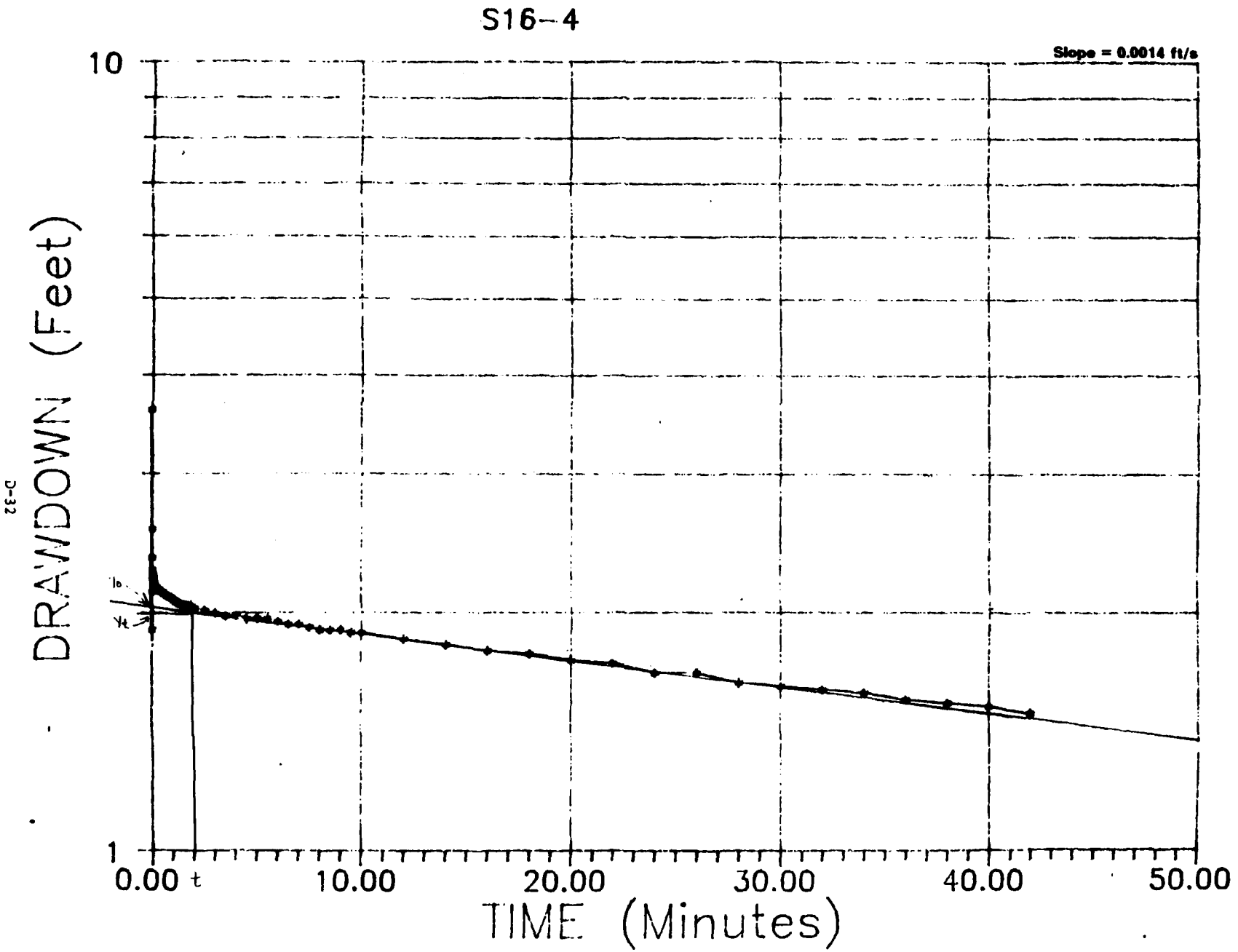

S14-3-3
Slope = 0.0035 ft/s
10
1
$10^{-1}$
$y_o$
$y_t$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
t
TIME (Minutes)

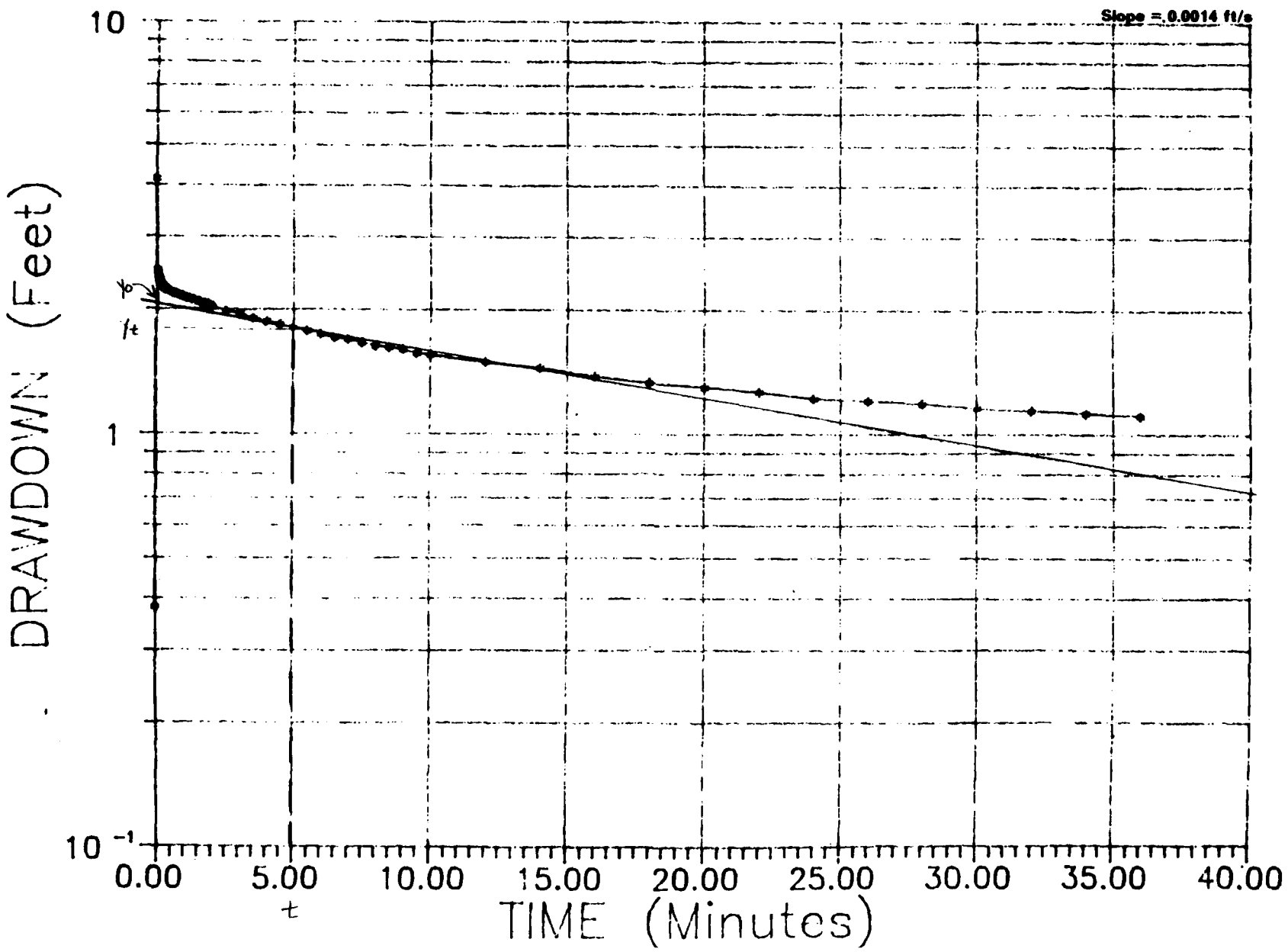

S14-4-2
Slope = 0.0578 ft/s
10
$10^{-1}$
$10^{-2}$
$h_0$
$\frac{1}{2}h_0$
DRAWDOWN (Feet)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
TIME (Minutes)

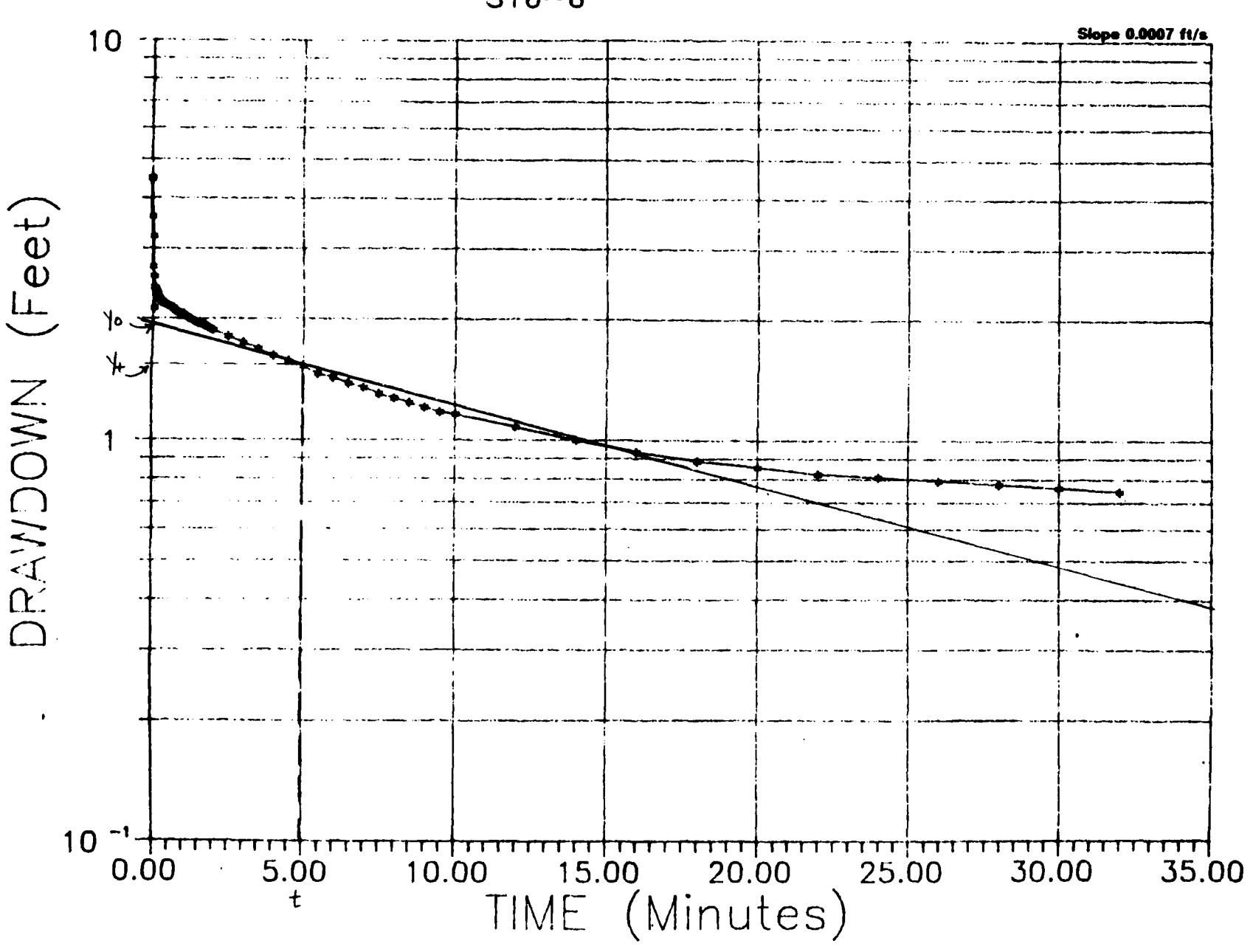

S16-1
Slope 0.00355 ft/s
1
DRAWDOWN (Feet)
10 -1
0.00
10.00
20.00
30.00
40.00
50.00
TIME (Minutes)

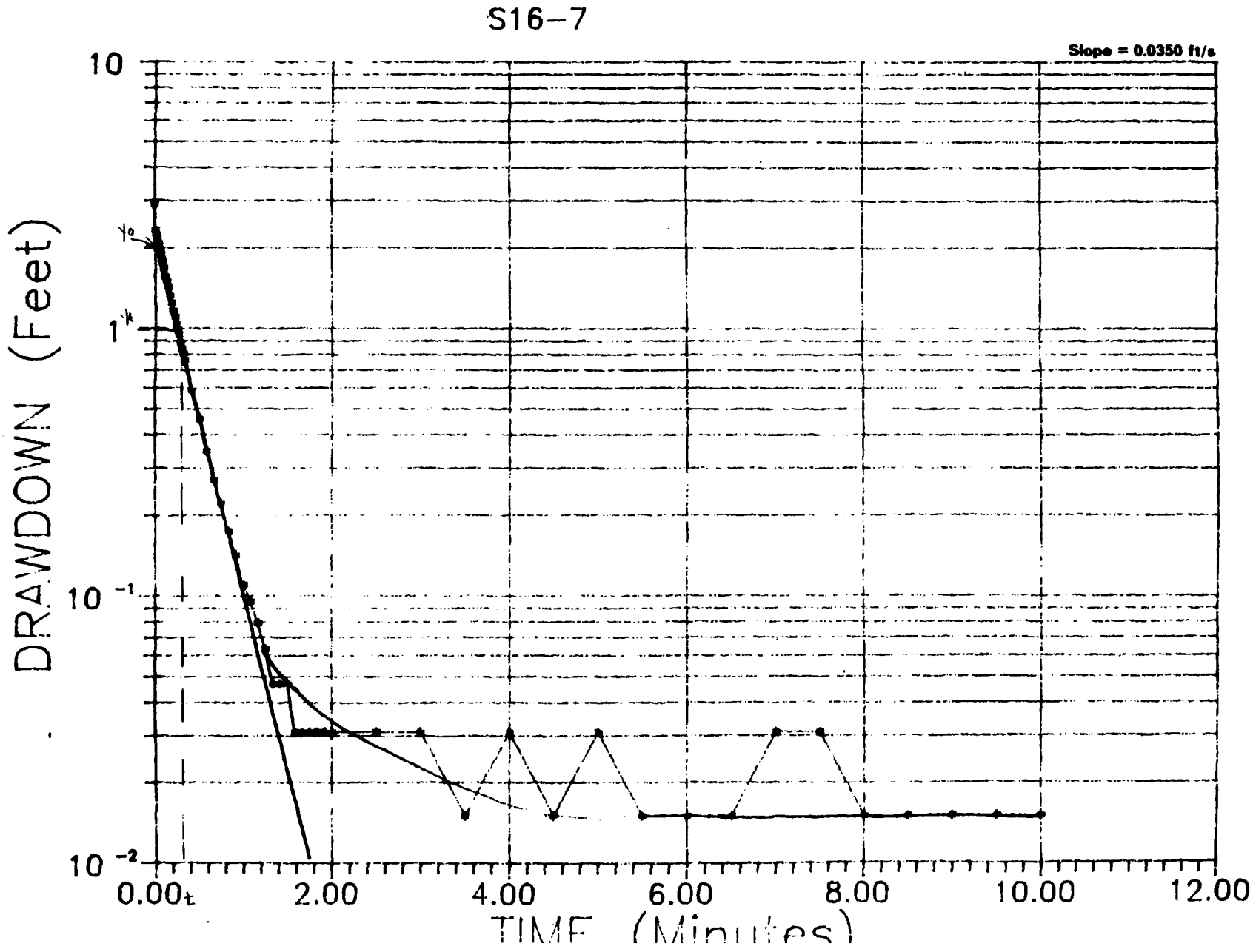

S16--2
Slope 0.0007 ft/s
10
$y_o$
1
$y_t$
$10^{-1}$
DRAWDOWN (Feet)
0.00
10.00
20.00
30.00
40.00
50.00
t
TIME (Minutes)

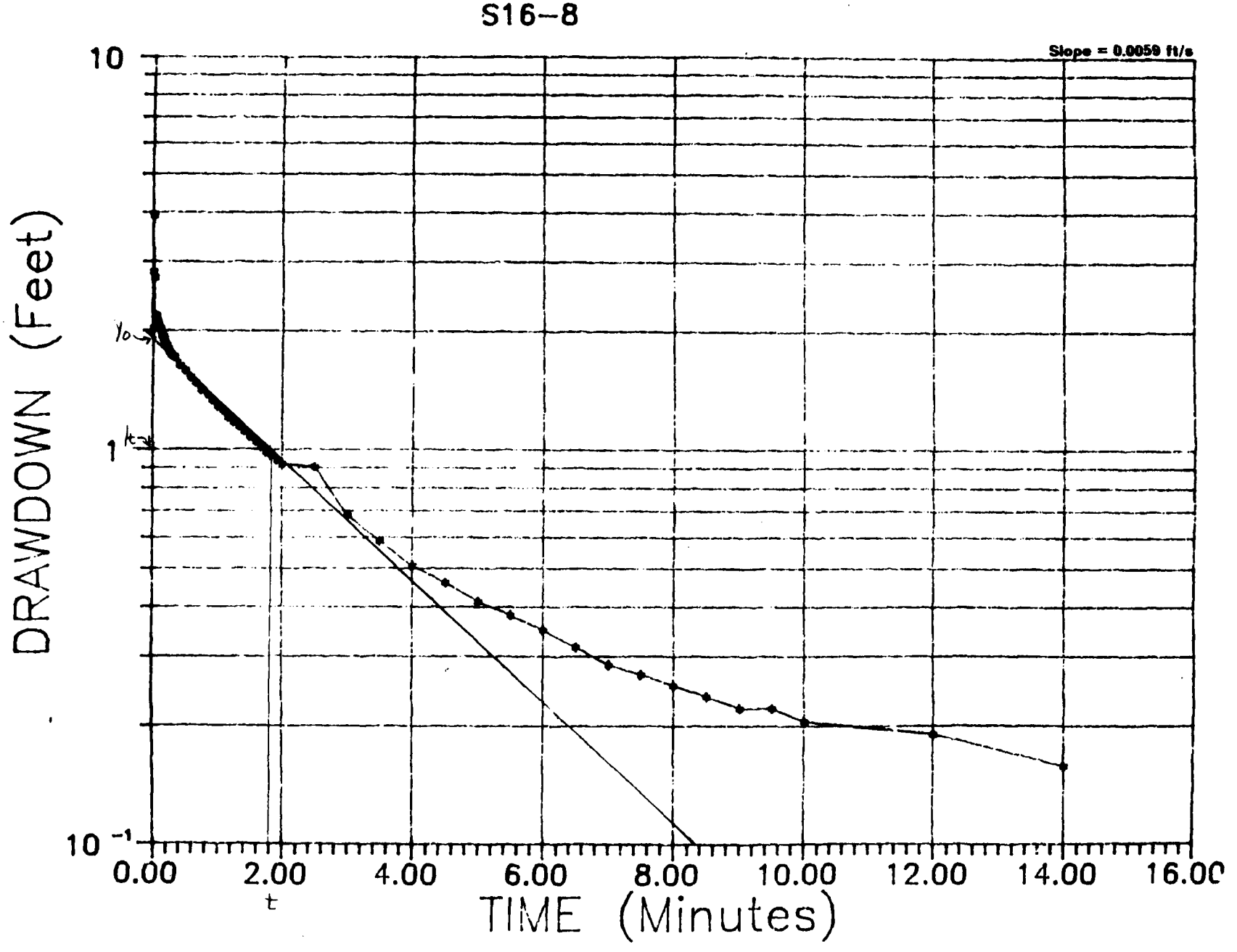

S16-3
Slope = 0.00107 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)

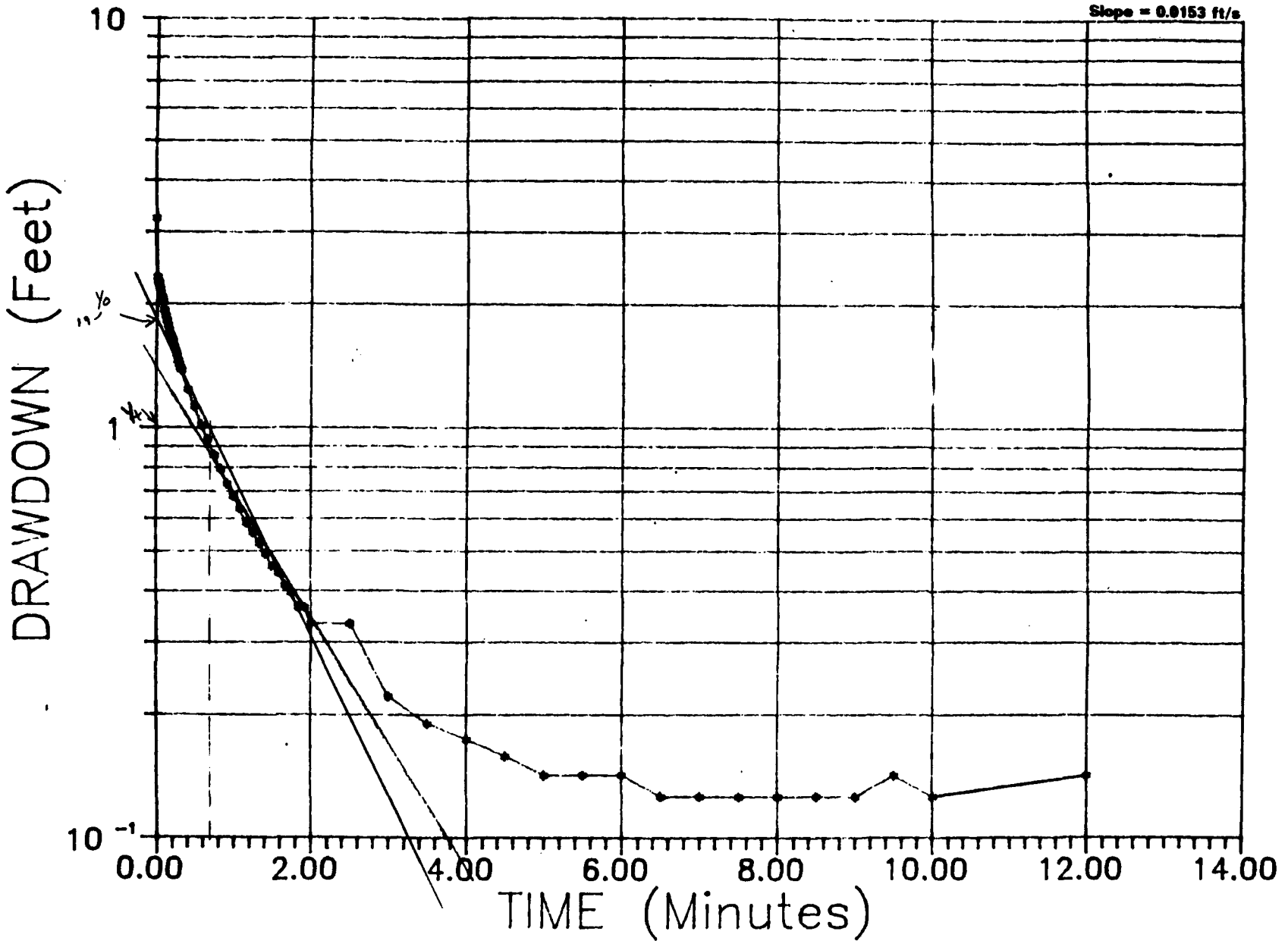

S16-4
Slope = 0.0014 ft/s
10
1
DRAWDOWN (Feet)
0.00 t
10.00
20.00
30.00
40.00
50.00
TIME (Minutes)

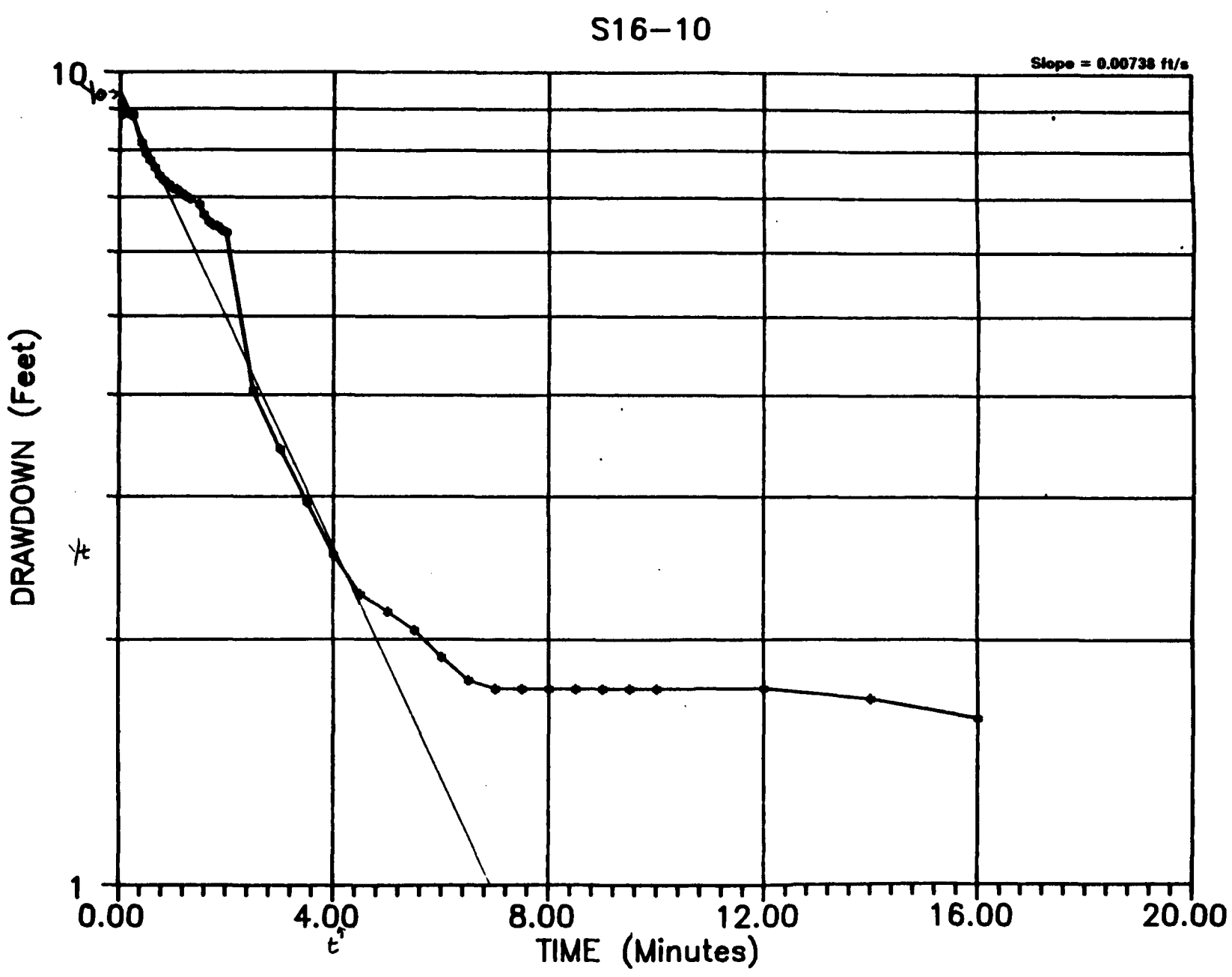

S16-5
Slope = 0.0014 ft/s
10
1
$10^{-1}$
DRAWDOWN (Feet)
$y_0$
$y_t$
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
t
TIME (Minutes)

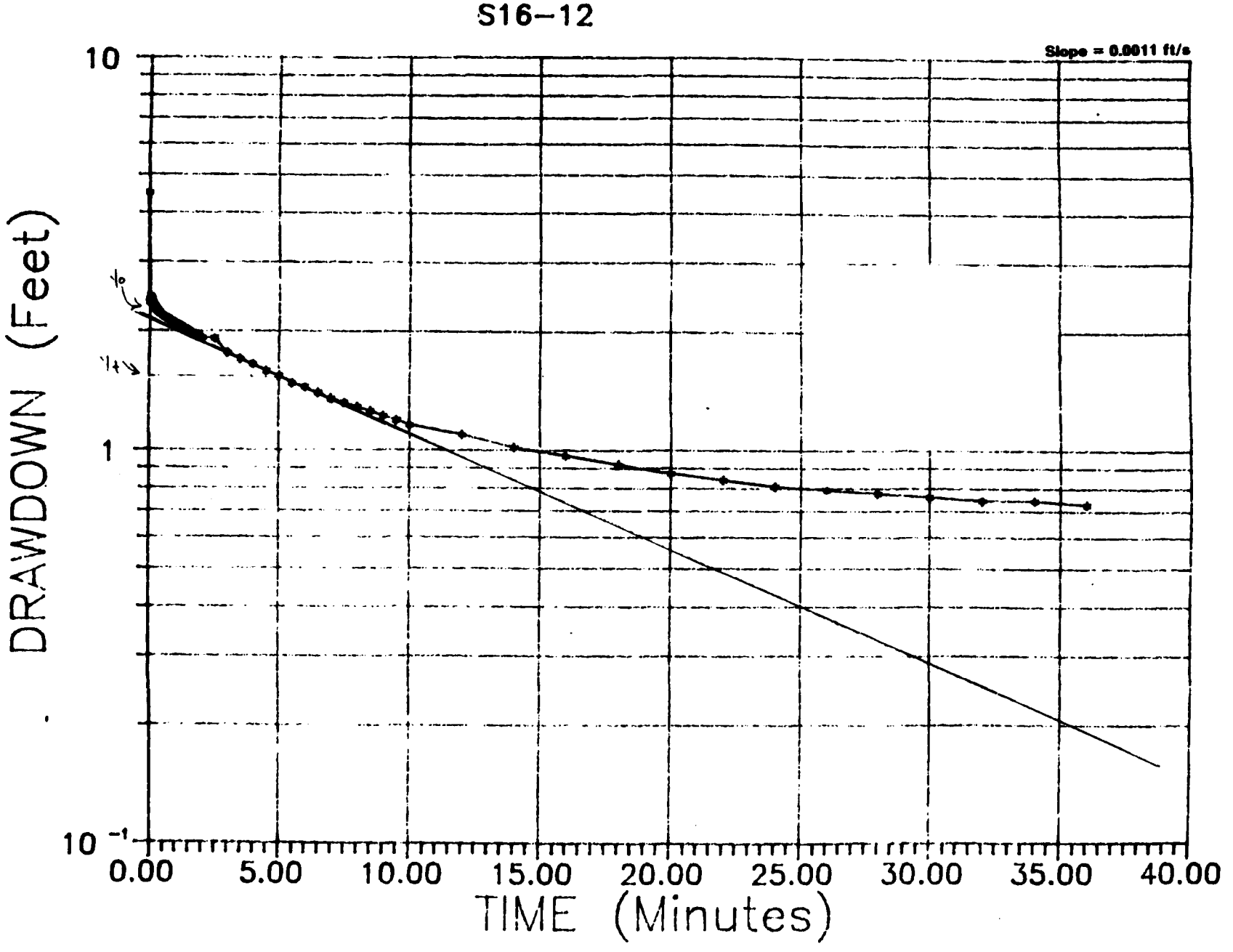

S16-6
Slope 0.0007 ft/s
10
1
$10^{-1}$
$y_0$
$y_t$
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
t
TIME (Minutes)

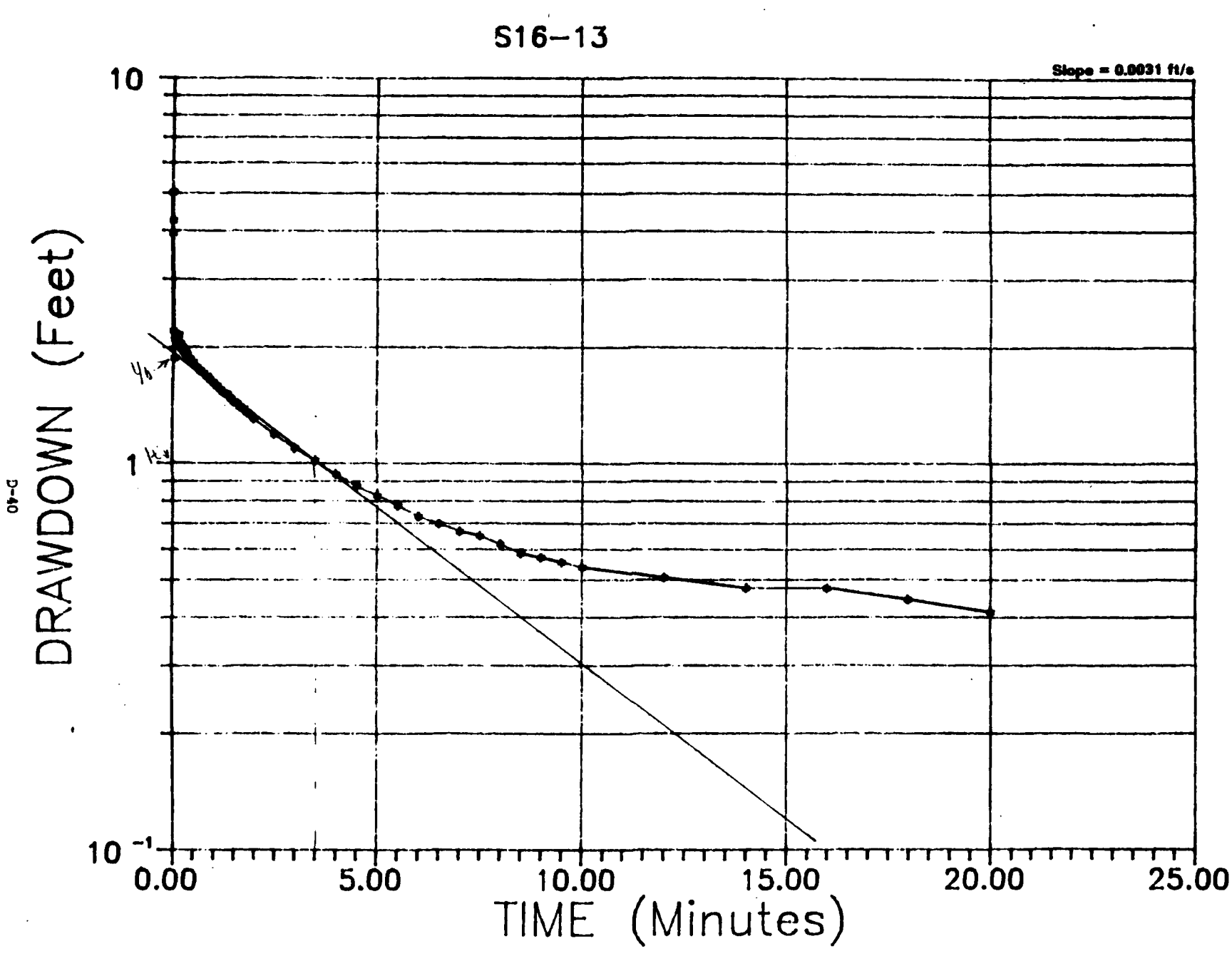

S16-7
Slope = 0.0350 ft/s
10
$y_o$
1
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
$0.00_t$
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)


S16-8
Slope = 0.0059 ft/s
10
1
$10^{-1}$
$y_o$
$t_{\frac{1}{2}}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
t
TIME (Minutes)

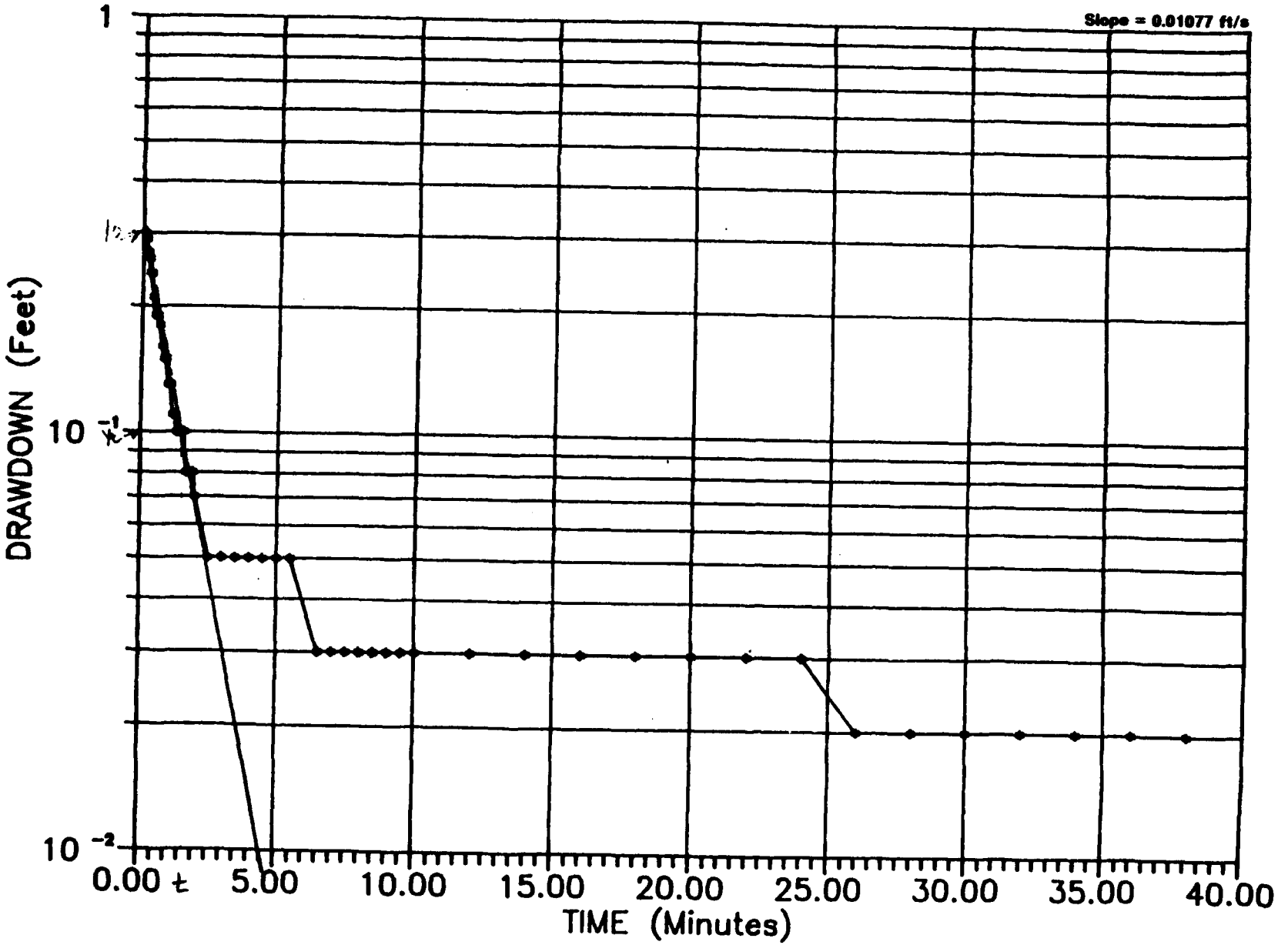

S16-9
Slope = 0.0153 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)


S16-10
Slope = 0.00738 ft/s
10
1
DRAWDOWN (Feet)
0.00
4.00
8.00
12.00
16.00
20.00
TIME (Minutes)

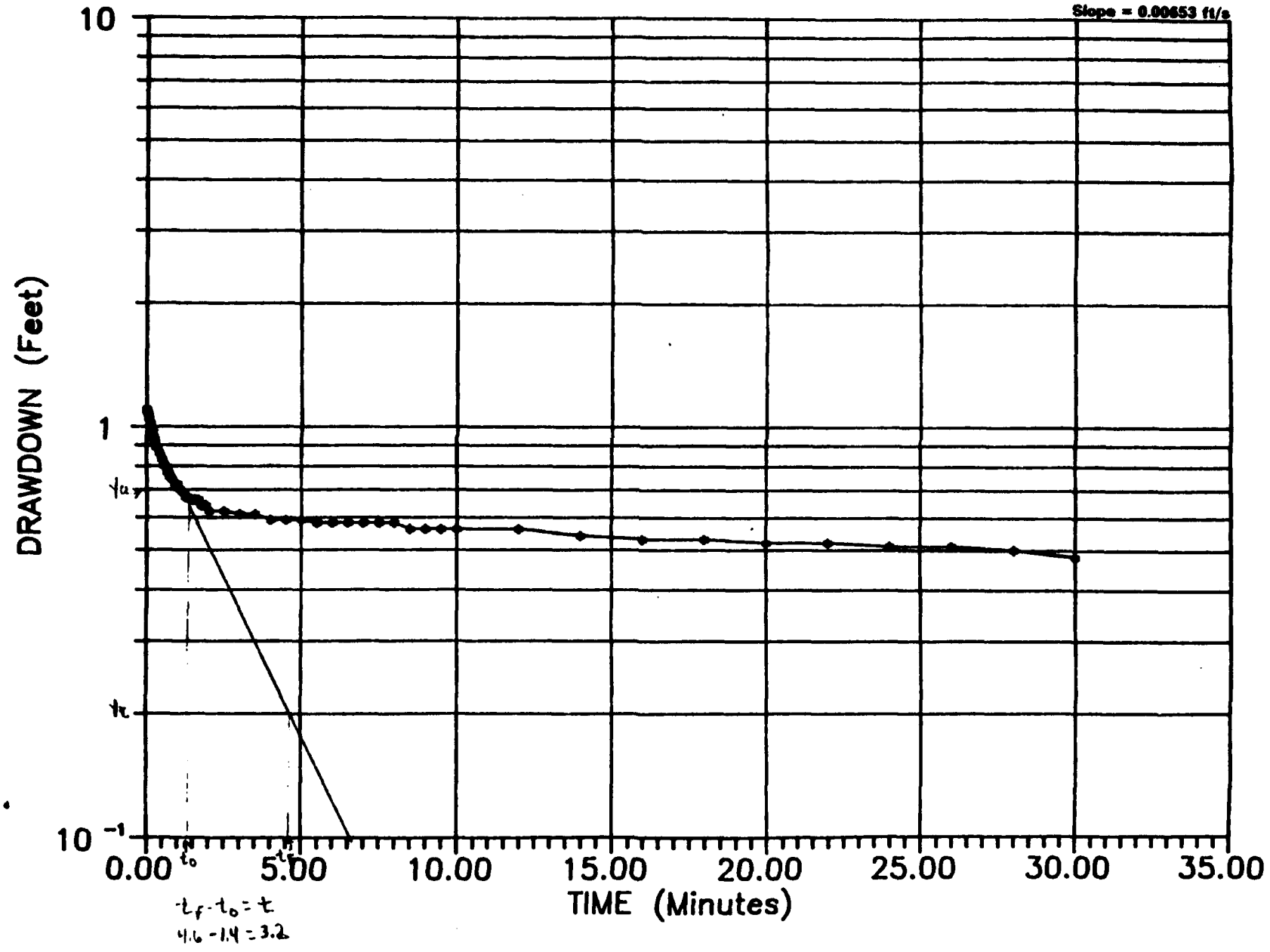

S16-12
Slope = 0.0011 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
TIME (Minutes)

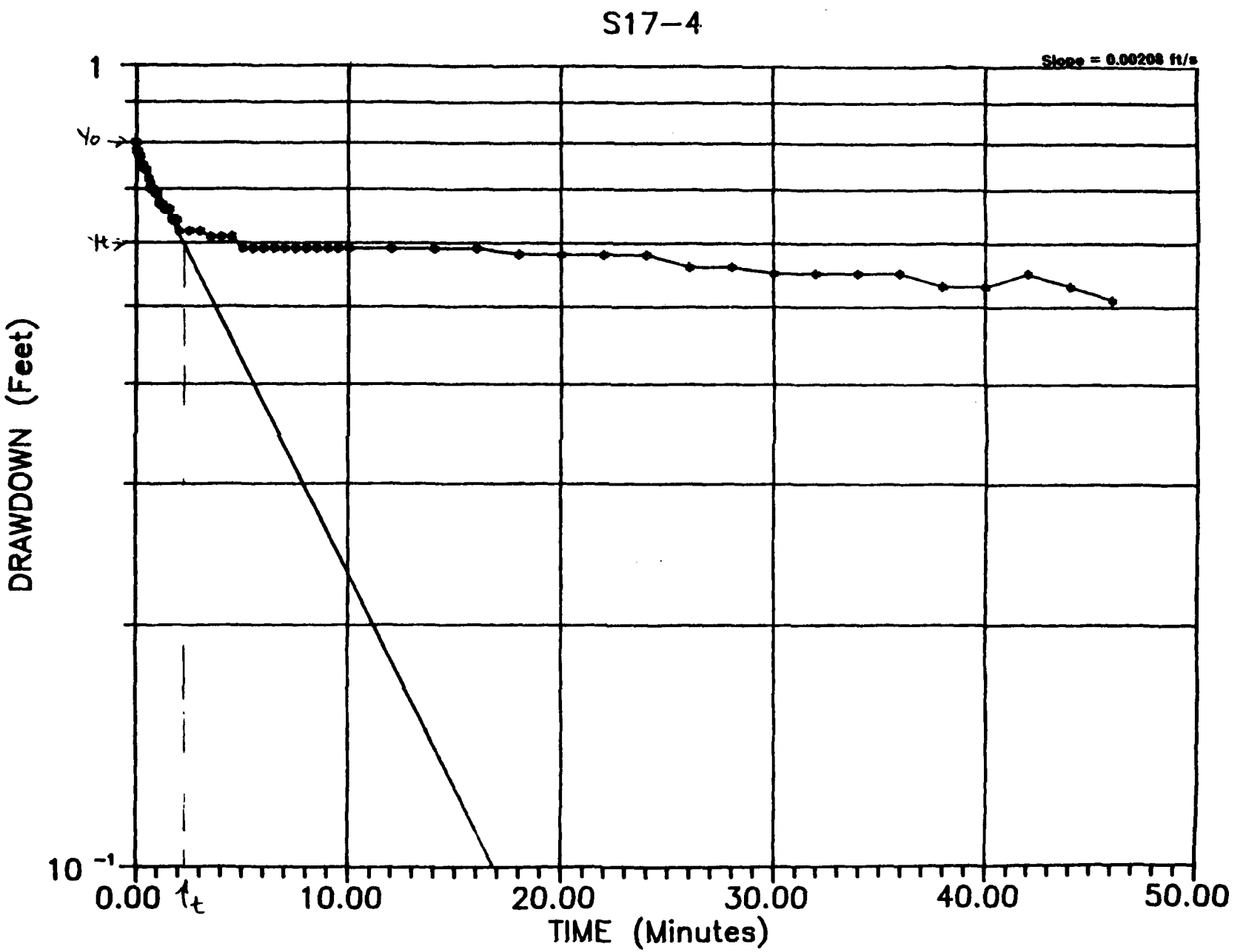

S16-13
Slope = 0.0031 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
TIME (Minutes)

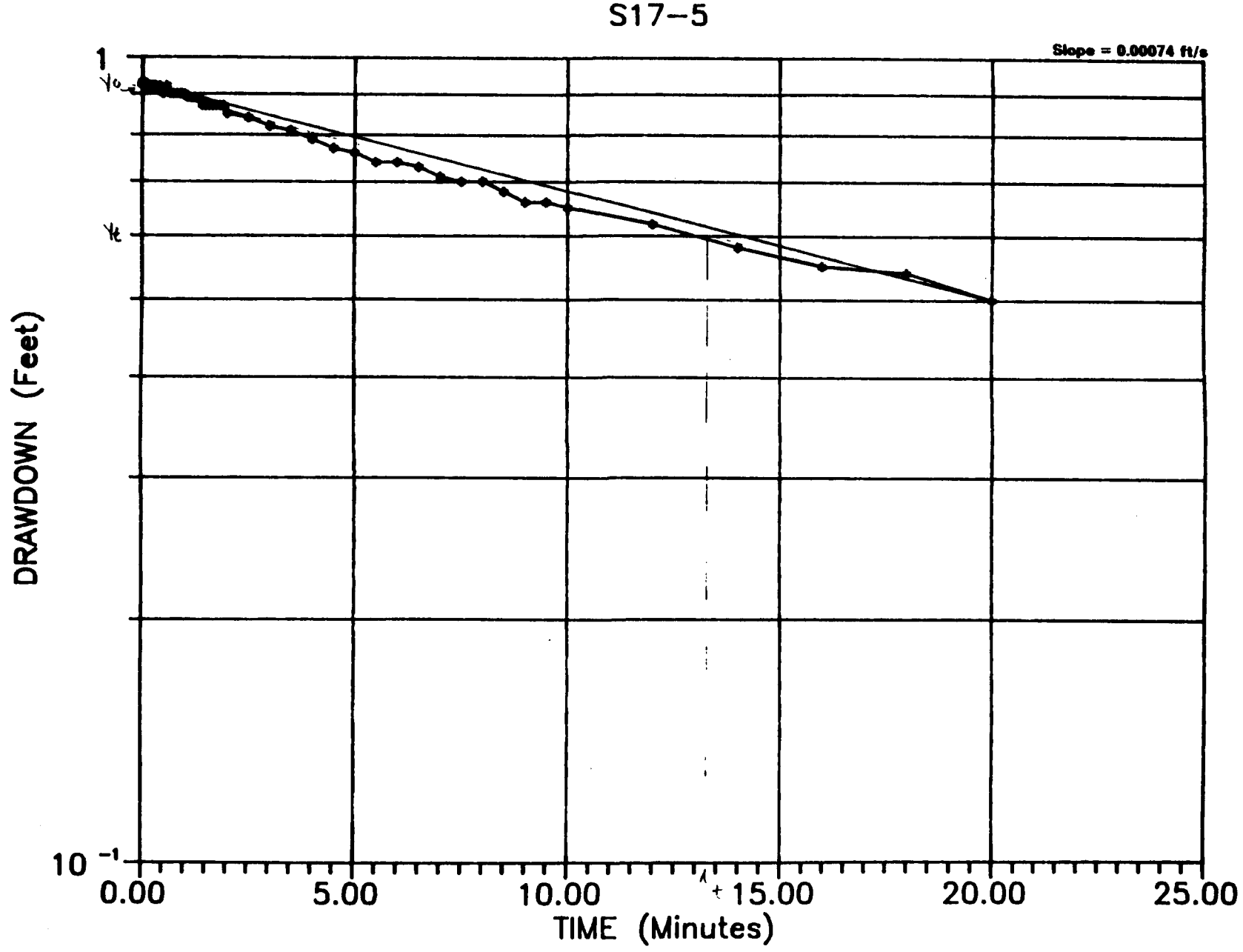
S17-2

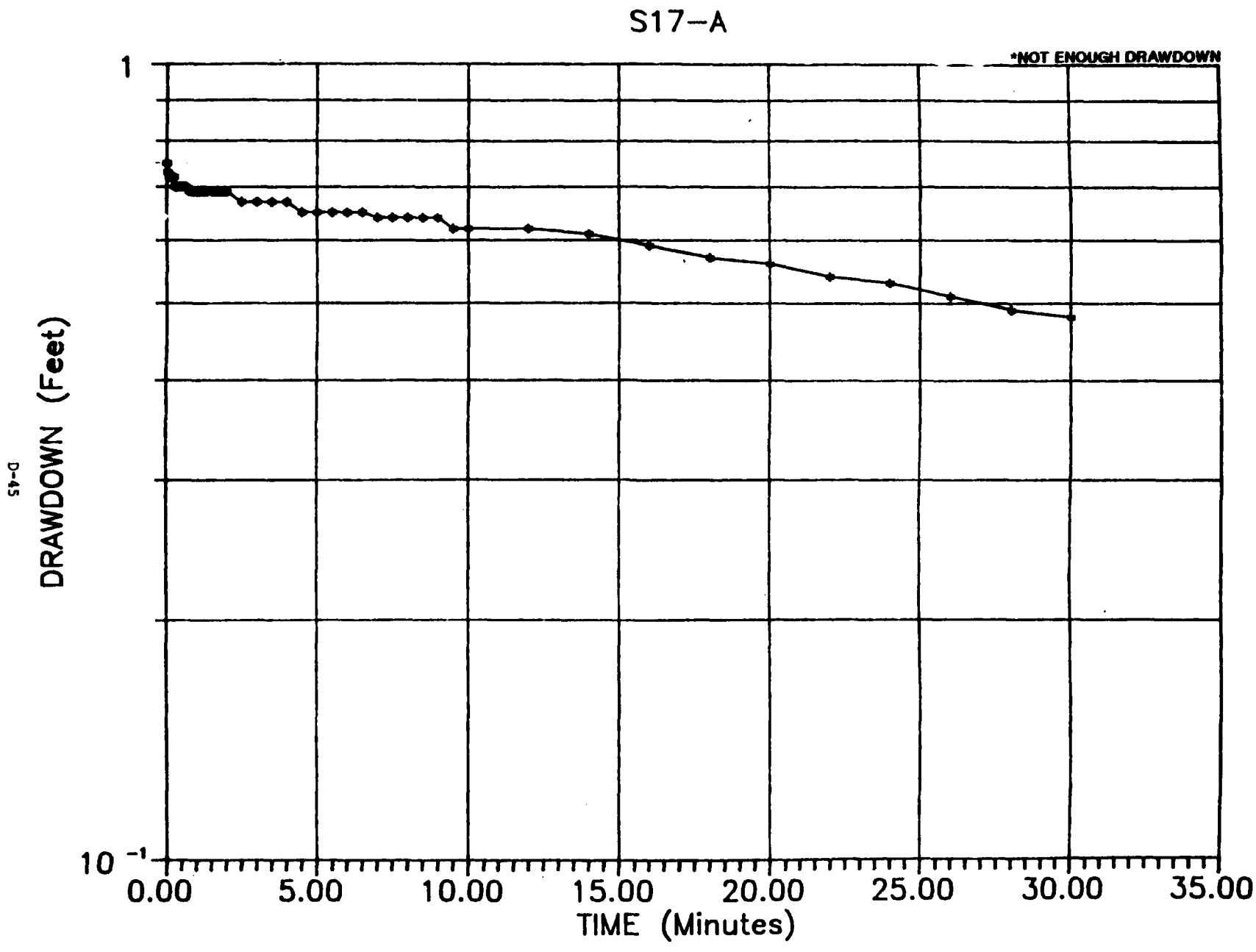

Slope = 0.01077 ft/s
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
TIME (Minutes)

S17-3

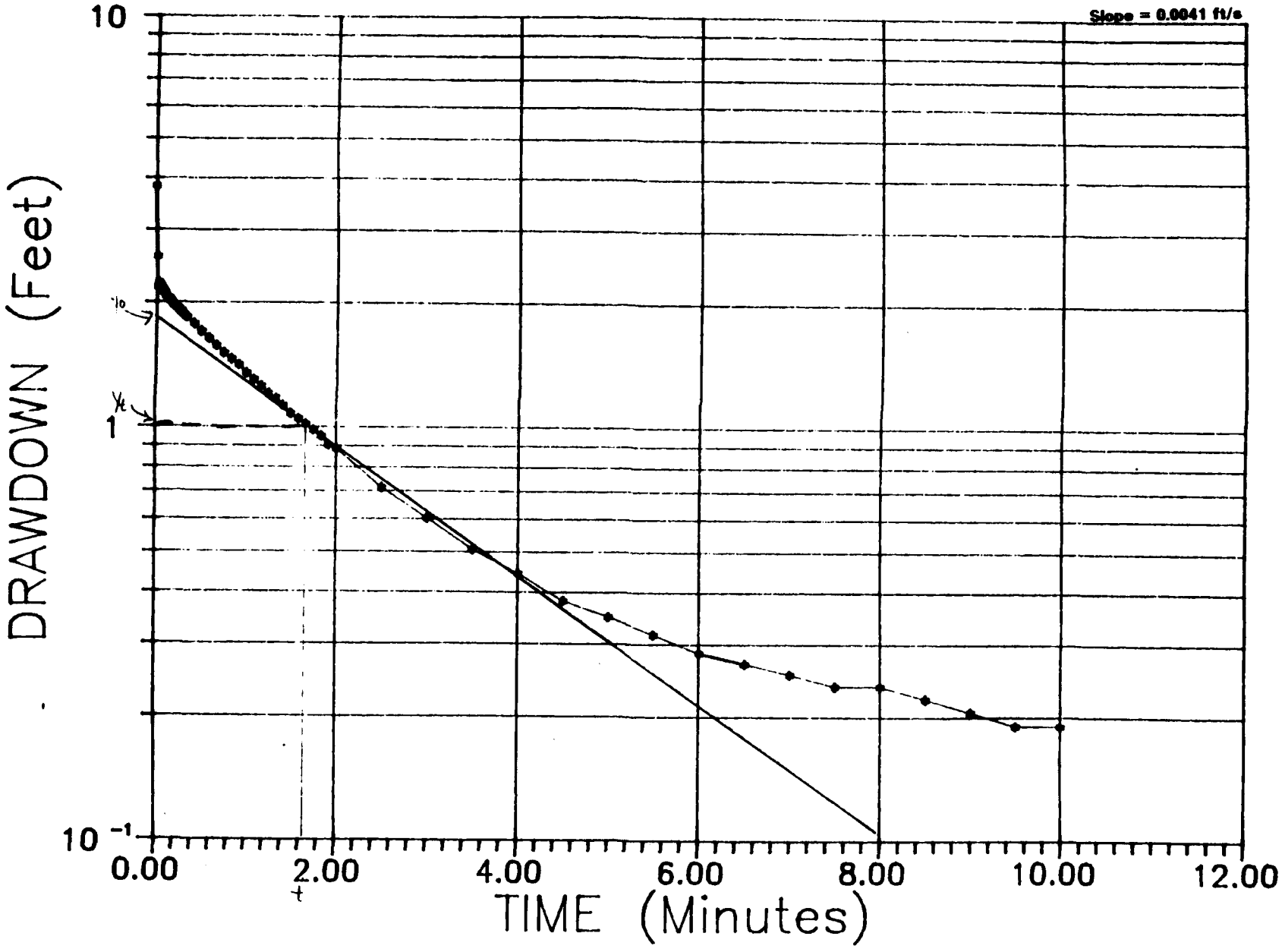

Slope = 0.00653 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
TIME (Minutes)
$t_o$
$t_f$
$t_f - t_o = t$
4.6 - 1.4 = 3.2

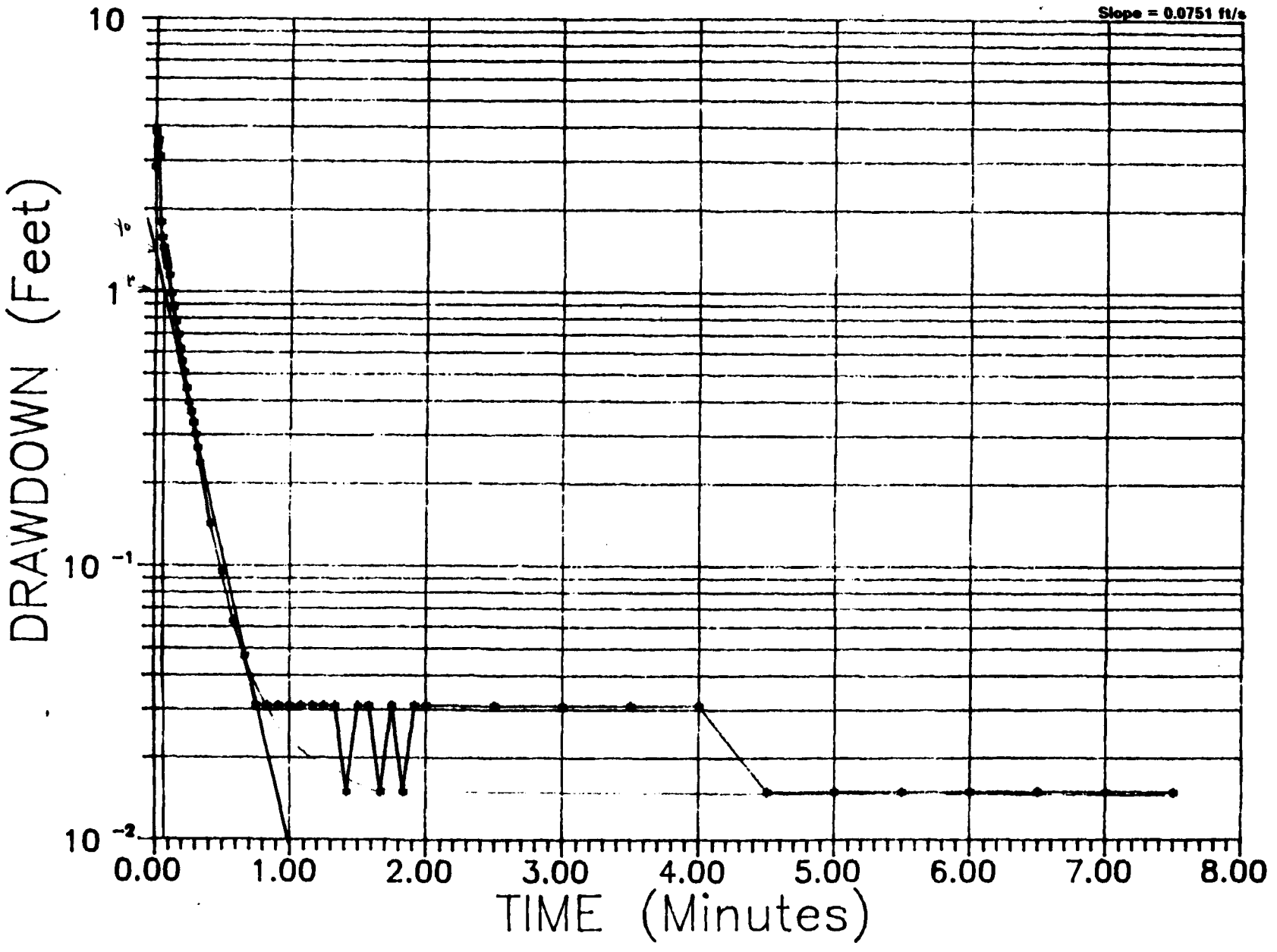

S17-4
Slope = 0.00208 ft/s
1
$y_o$
$y_t$
$10^{-1}$
DRAWDOWN (Feet)
0.00
$t_t$
10.00
20.00
30.00
40.00
50.00
TIME (Minutes)

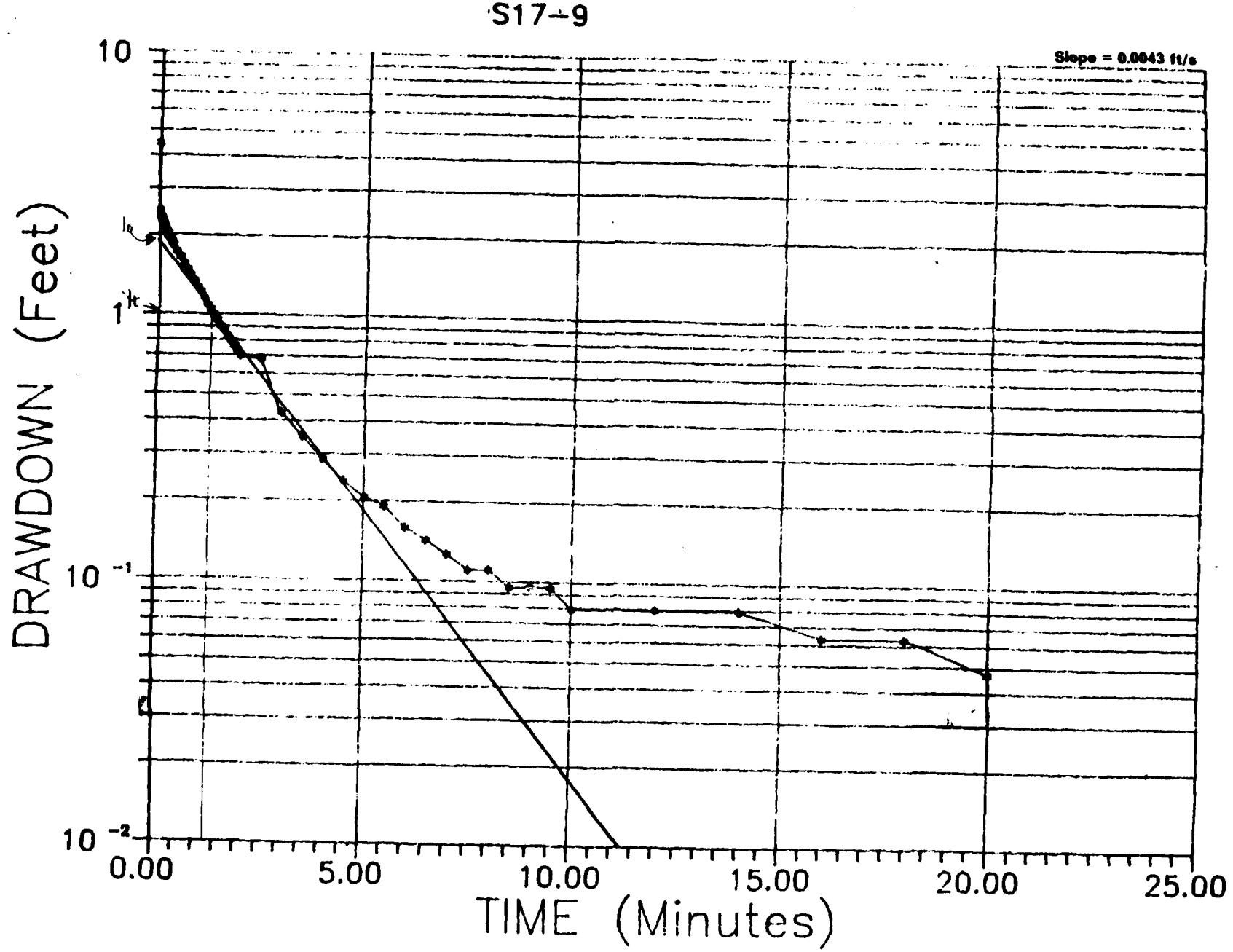

S17-5
Slope = 0.00074 ft/s
1
$y_0$
$y_t$
$10^{-1}$
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
TIME (Minutes)

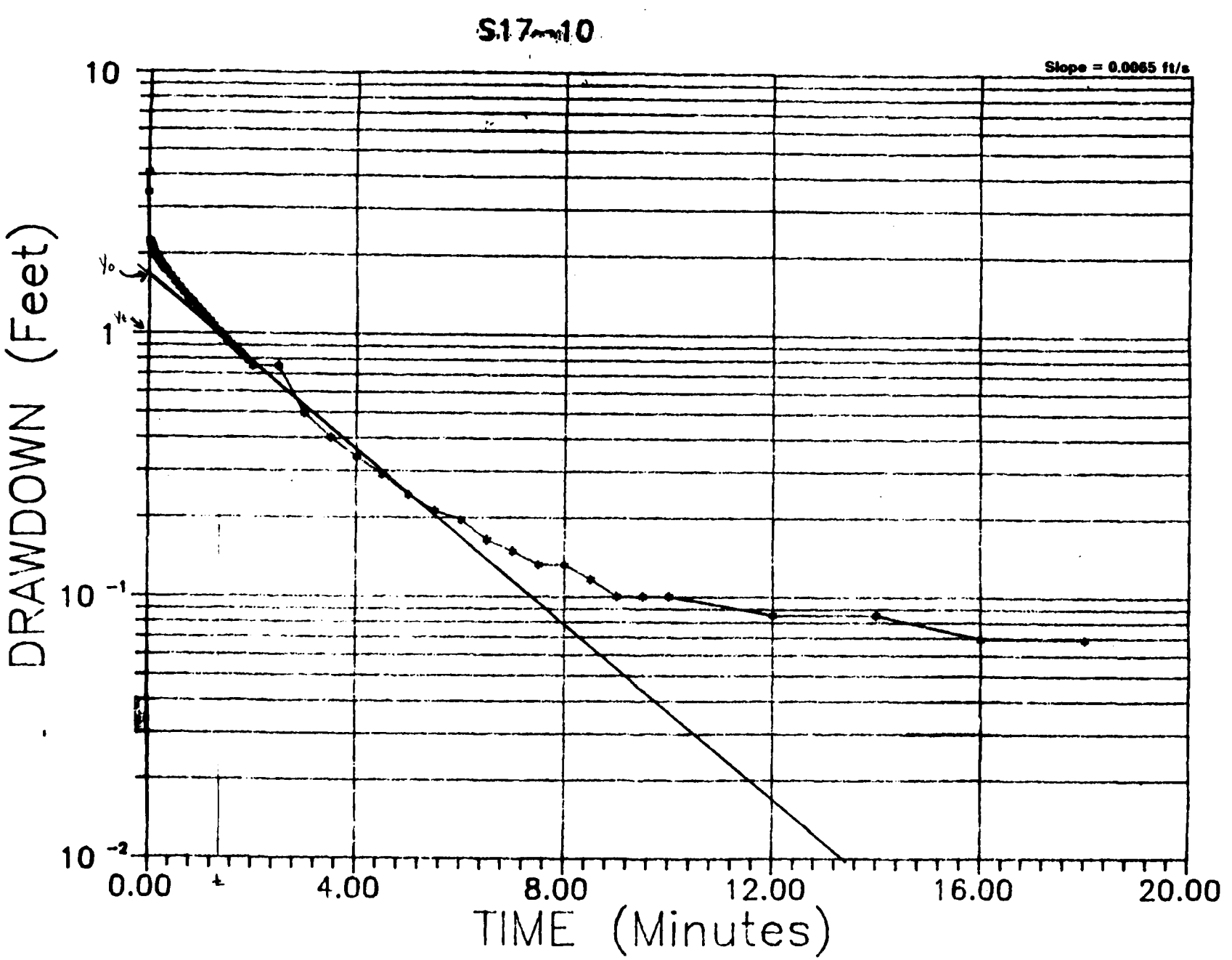

S17-A
*NOT ENOUGH DRAWDOWN
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
TIME (Minutes)

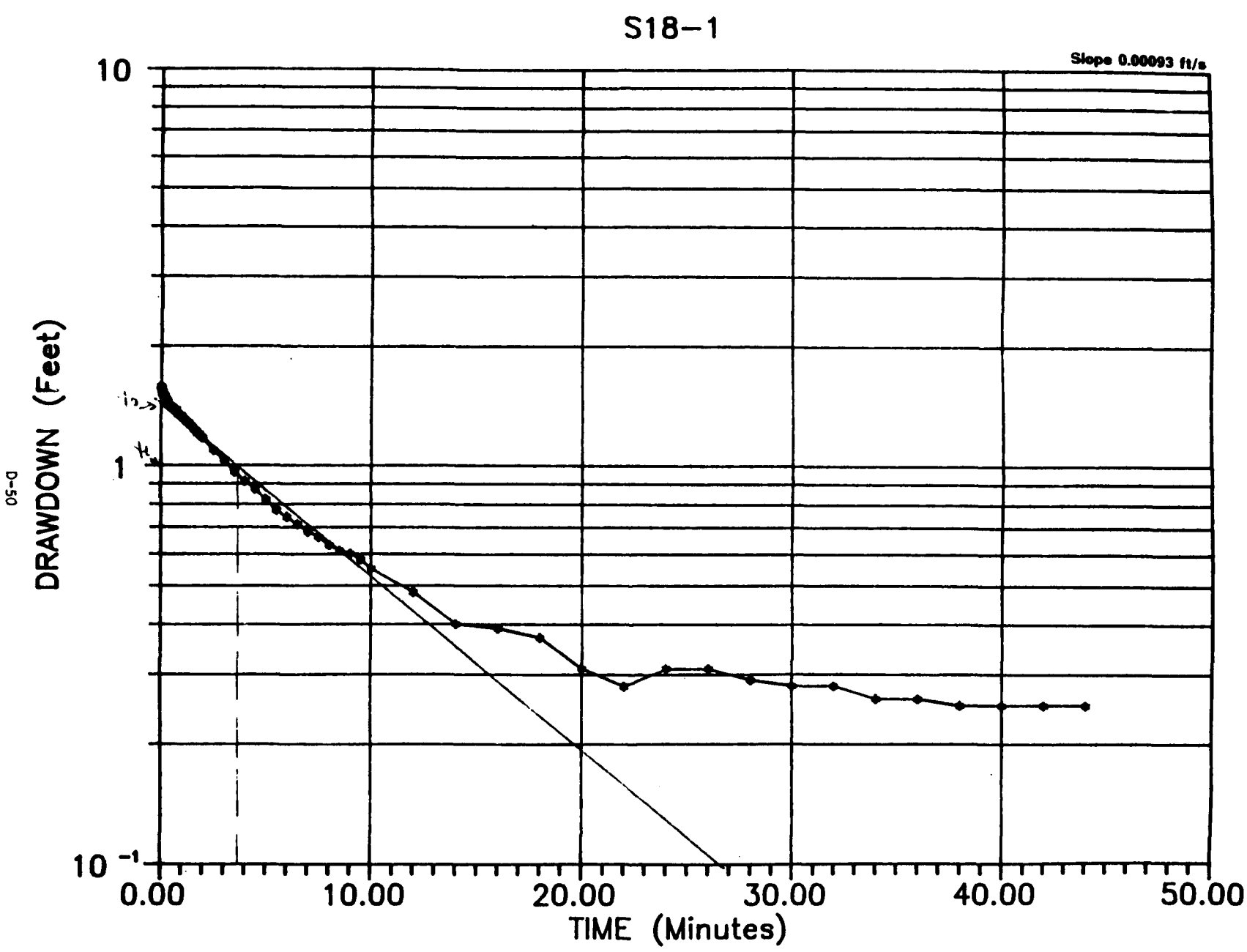
S17-7

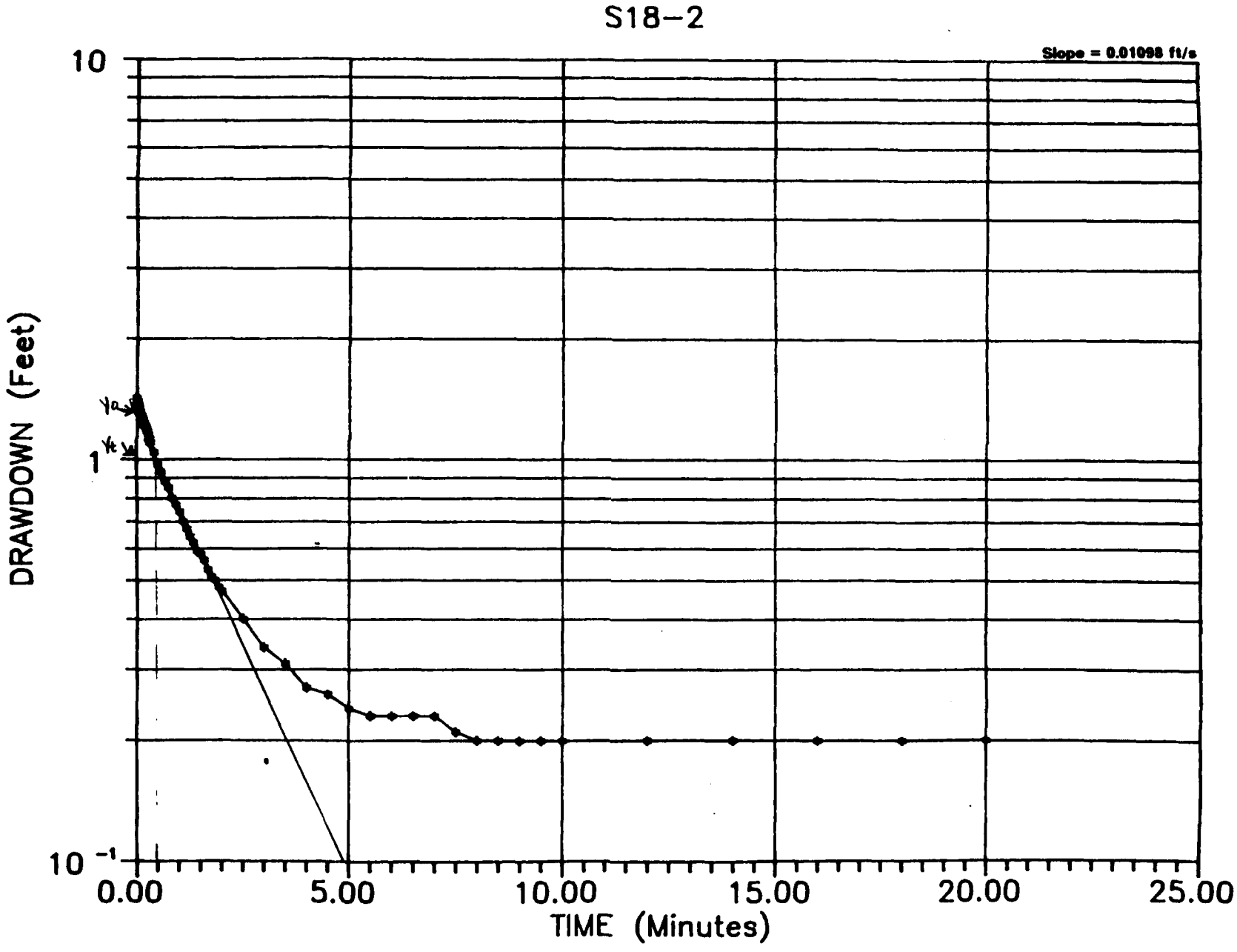

Slope = 0.0041 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
TIME (Minutes)
t
D-46

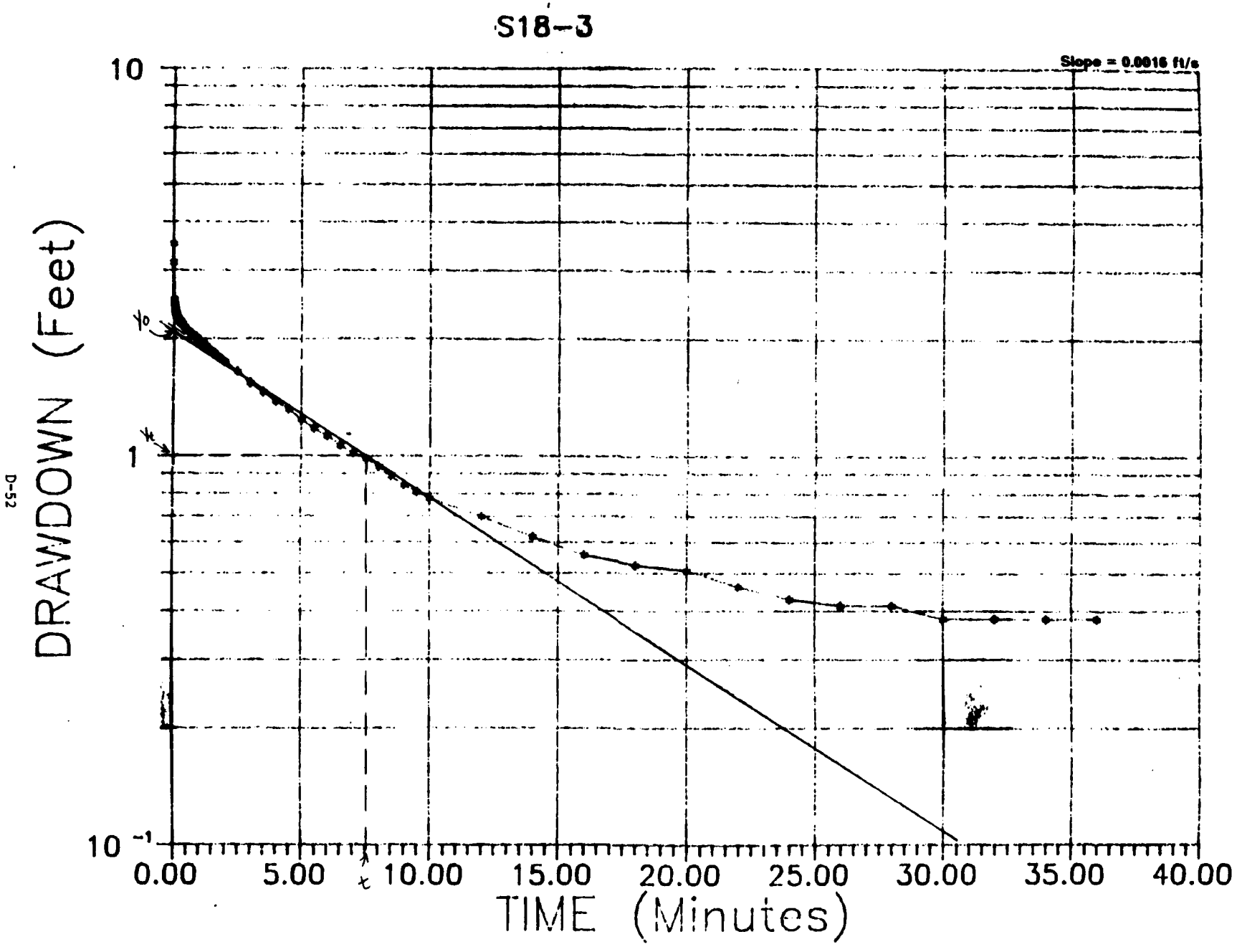

S17-8
Slope = 0.0751 ft/s
10
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
TIME (Minutes)

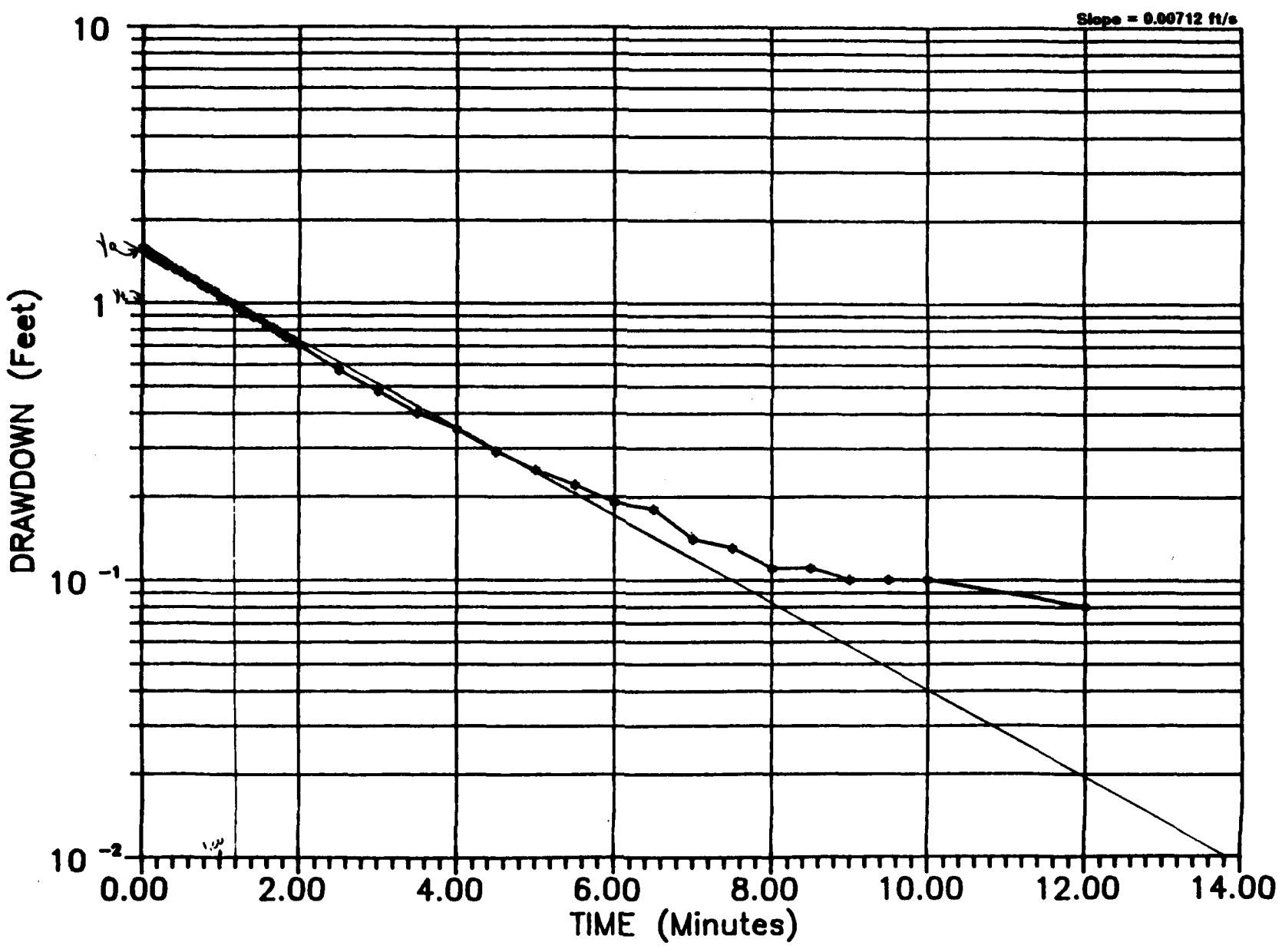

S17-9
Slope = 0.0043 ft/s
10
$I_0$
1
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
TIME (Minutes)


S.17-10
Slope = 0.0065 ft/s
10
$y_0$
1
$y_t$
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
0.00
4.00
8.00
12.00
16.00
20.00
TIME (Minutes)

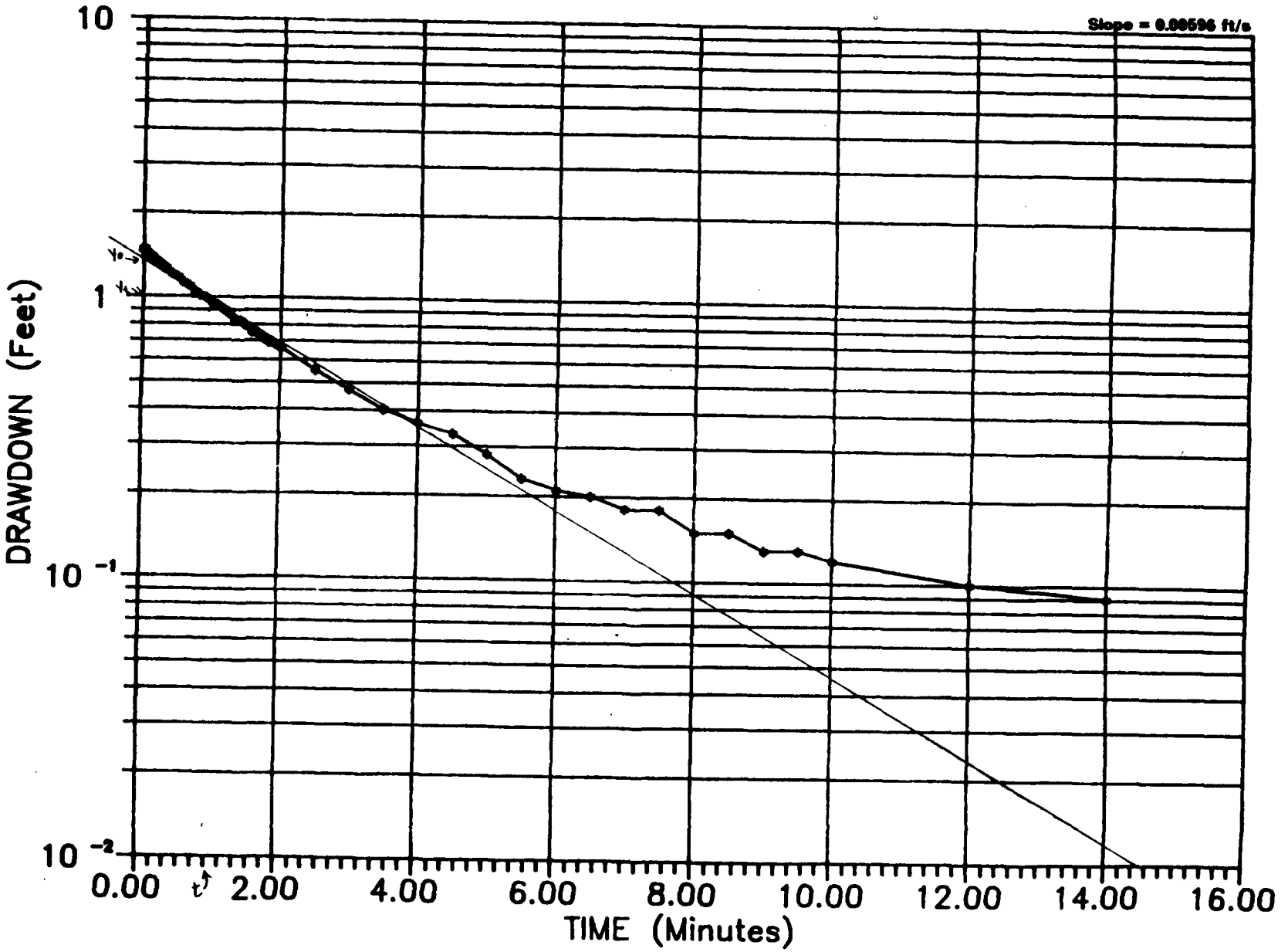

S18-1
Slope 0.00093 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
10.00
20.00
30.00
40.00
50.00
TIME (Minutes)

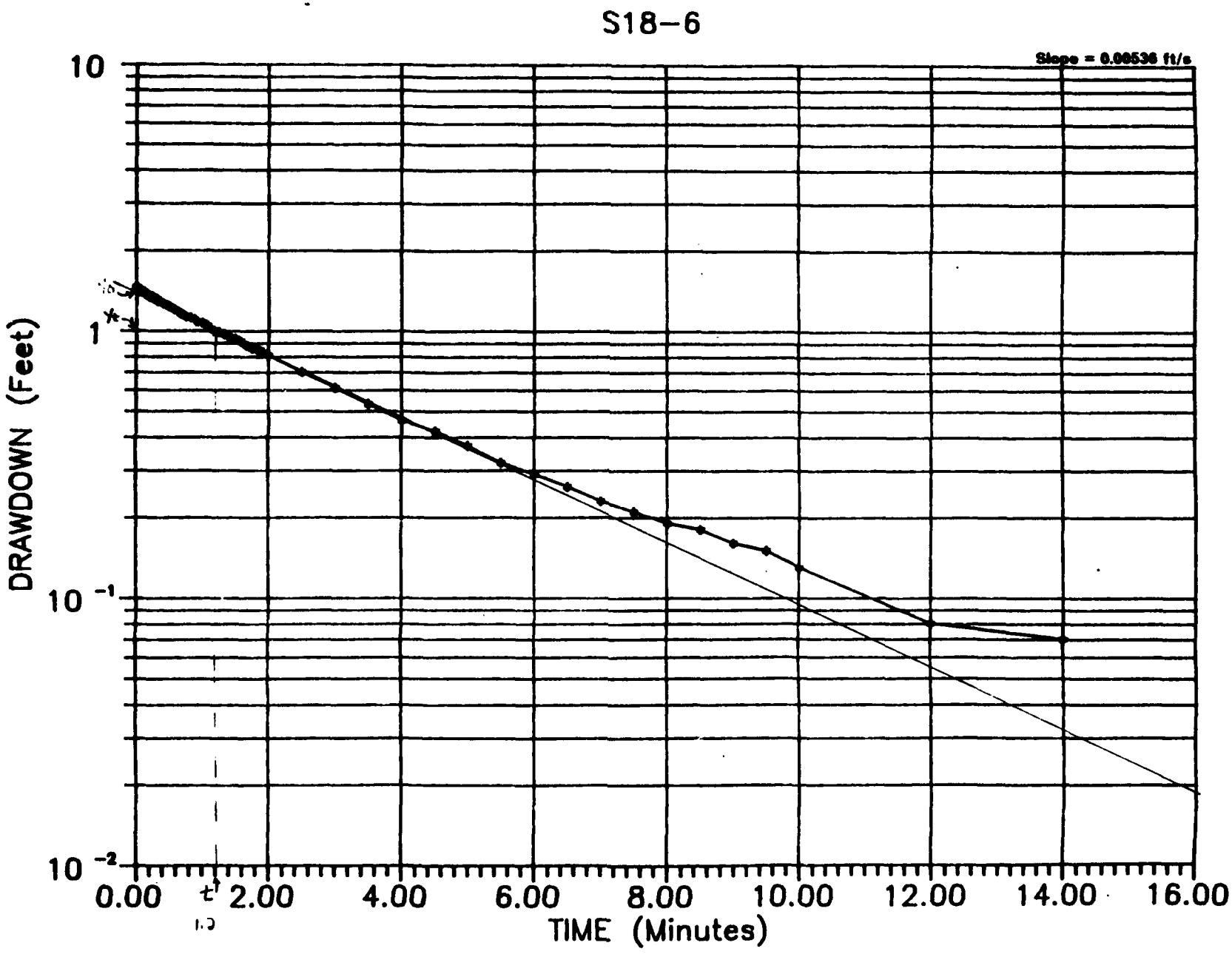

S18-2
Slope = 0.01098 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
TIME (Minutes)


S18-3
Slope = 0.0016 ft/s
10
1
10 -1
DRAWDOWN (Feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
TIME (Minutes)

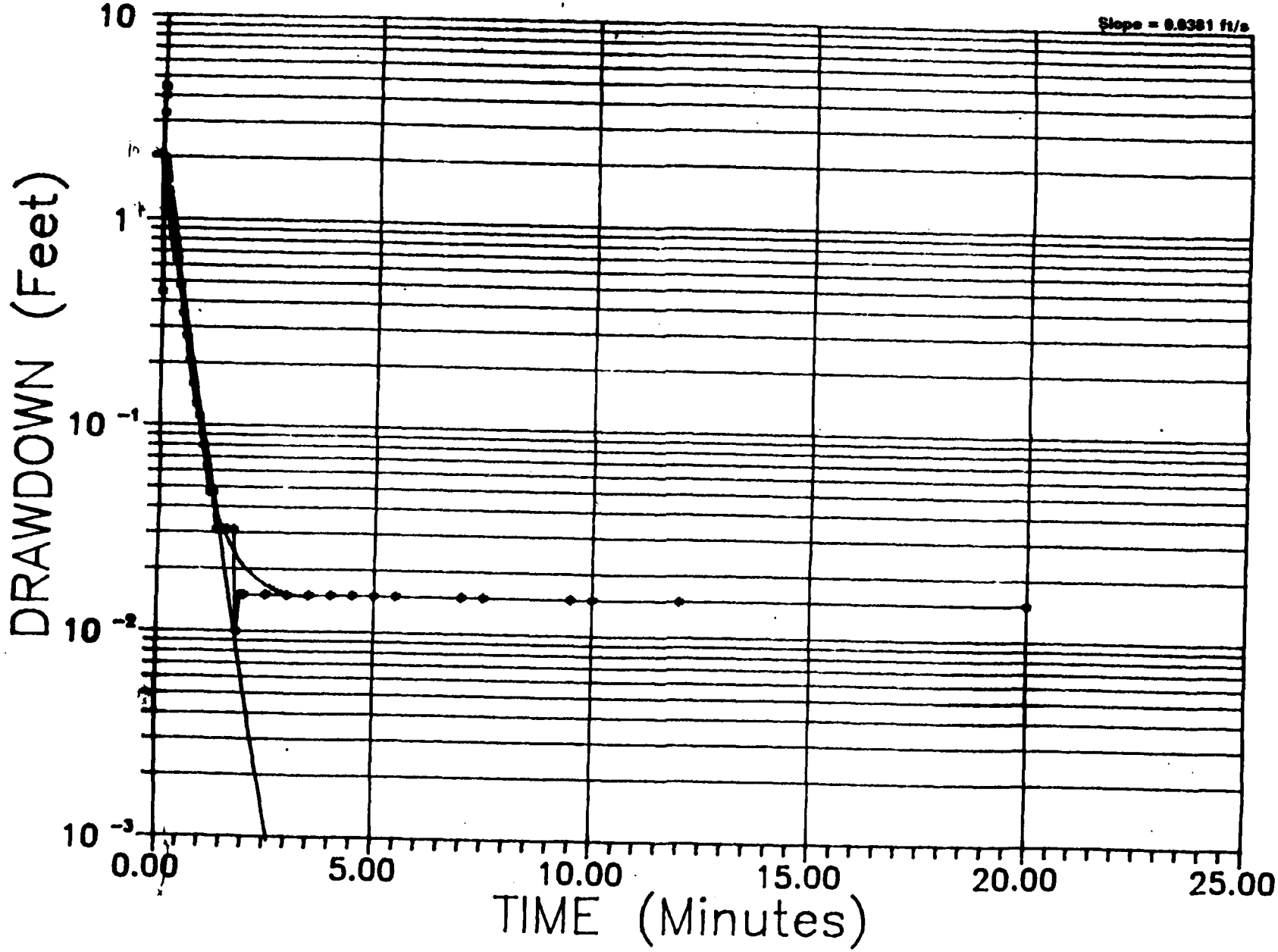

S18-4
Slope = 0.00712 ft/s
10
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
TIME (Minutes)

S18-5


Slope = 0.00596 ft/s
10
1
10 -1
10 -2
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)


S18-6
Slope = 0.00536 ft/s
10
1
$10^{-1}$
$10^{-2}$
DRAWDOWN (Feet)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
TIME (Minutes)

S18-7


Slope = 0.0381 ft/s
DRAWDOWN (Feet)
10
1
10 -1
10 -2
10 -3
0.00
5.00
10.00
15.00
20.00
25.00
TIME (Minutes)

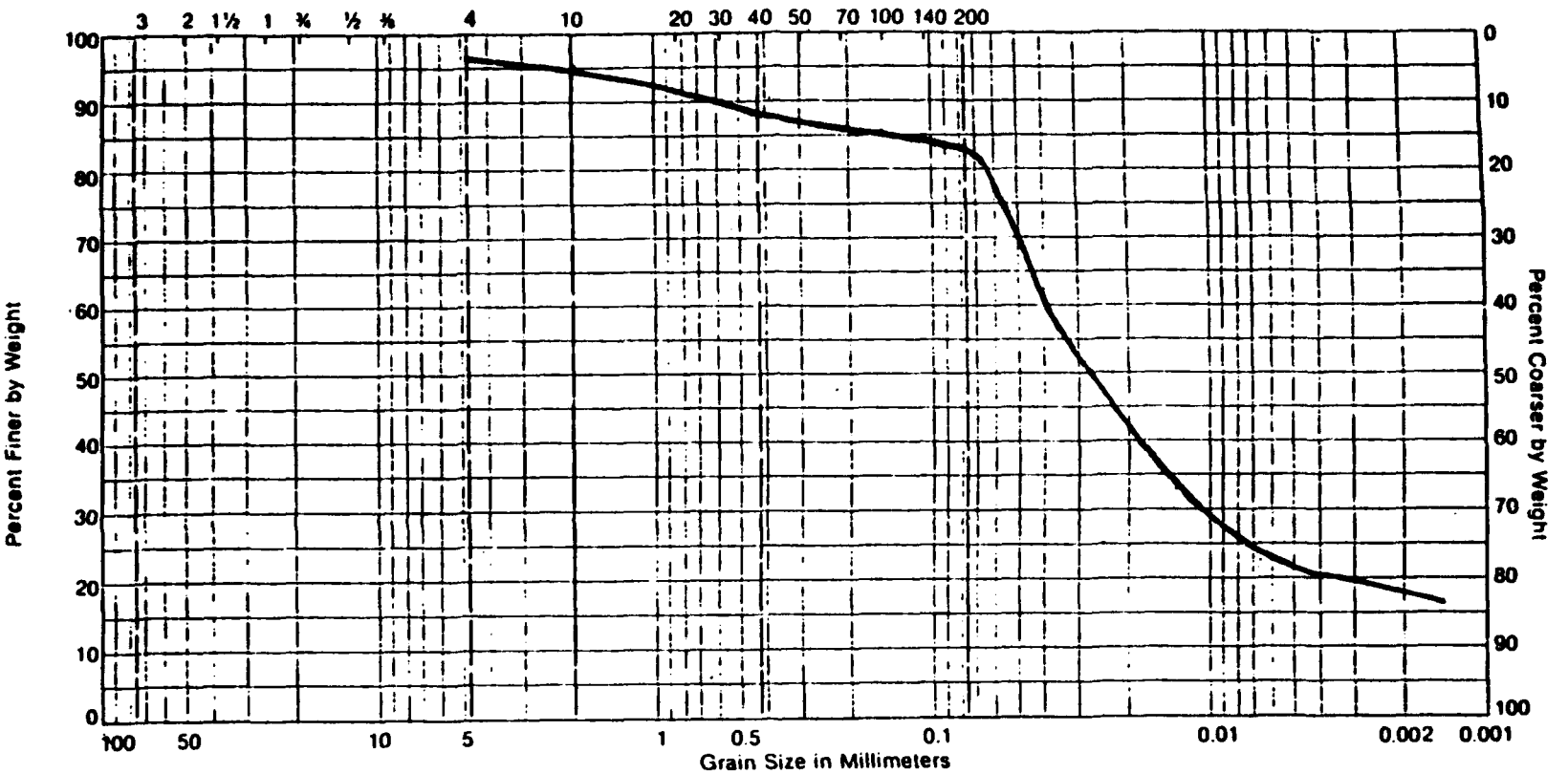
**ALLUVIAL SILTY CLAY**

Project: Lake City Army Ammunition Plant SUMMARY OF SOIL TESTS
Independence, Missouri

Job No. A-1061

Date Jan. - Feb., 1983

| Boring No. | Sample No. | Depth or Elevation | W % | Dry Unit Weight pcf | Atterberg Limits | | | Grain Size % | | | Symbol From Plastic Chart | Unconfined Compression | | Swell | | Permeability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | LL | PL | PI | Sand | Silt | Clay | | tsf | % E | Pres. psf | % Vol. Increase | |
| MW 1-6 | ST1 | 4.5 - 6.0 | 26.6 | 98.1 | 46 | 20 | 26 | 2 | 72 | 27 | CL | | | | | $7.64 \times 10^{-9}$ cm/sec. |
| MW 1-7 | ST-1 | 9.5 -11.0 | 24.5 | 101.7 | 51 | 20 | 31 | 0 | 63 | 37 | CH | | | | | $2.28 \times 10^{-9}$ cm/sec. |
| MW 1-8 | ST-2 | 19.5 -21.0 | 31.1 | 90.6 | 33 | 22 | 11 | 0 | 78 | 22 | CL | | | | | $2.01 \times 10^{-7}$ cm/sec. |
| MW 1-9 | ST-1 | 9.5 -11.0 | 25.4 | 101.8 | 41 | 20 | 21 | 0 | 59 | 41 | CL | | | | | $9.6 \times 10^{-9}$ cm/sec. |
| MW 1-10 | ST-1 | 15.0 -16.5 | 27.8 | 97.4 | 39 | 20 | 19 | 2 | 76 | 22 | CL | | | | | $6.0 \times 10^{-8}$ cm/sec. |
| MW 2-5 | ST-1 | 9.5 -11.0 | 27.8 | 97.2 | 33 | 23 | 10 | 3 | 84 | 13 | CL | | | | | $5.23 \times 10^{-8}$ cm/sec. |
| MW 2-6 | ST-1 | 14.5 -16.0 | 27.9 | 98.3 | 40 | 21 | 19 | 3 | 69 | 28 | CL | | | | | $4.14 \times 10^{-8}$ cm/sec. |
| MW 2-7 | ST-1 | 10.0 -11.5 | 27.7 | 97.7 | 41 | 21 | 20 | 2 | 70 | 28 | CL | | | | | $3.11 \times 10^{-9}$ cm/sec. |
| MW 6-7 | ST-2 | 15.0 -16.5 | 27.2 | 97.6 | 71 | 20 | 51 | 0 | 72 | 28 | CH | | | | | $7.41 \times 10^{-10}$ cm/sec. |
| MW 10-5 | ST-1 | 24.5 -26.0 | 22.4 | 105.5 | 37 | 23 | 14 | 17 | 65 | 18 | CL | | | | | $1.61 \times 10^{-7}$ cm/sec. |




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 10-5 | ST-1 | 24.5-26 | 37 | | 23 | CL |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

GRAIN SIZE ANALYSIS

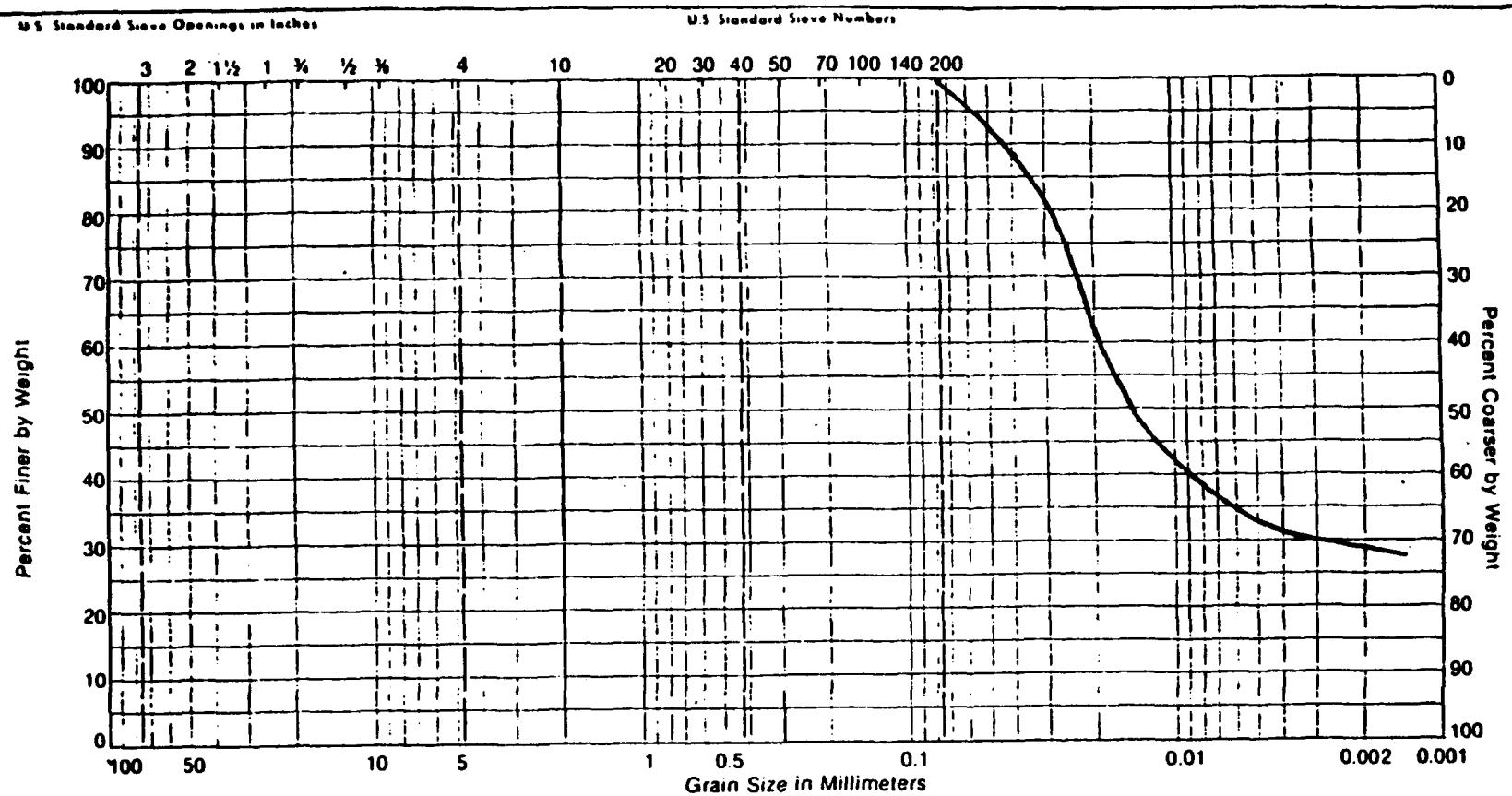
D-58

LAYNE WESTERN COMPANY, INC.

LAYNE WESTERN COMPANY, INC.

D-59

# GRAIN SIZE ANALYSIS




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

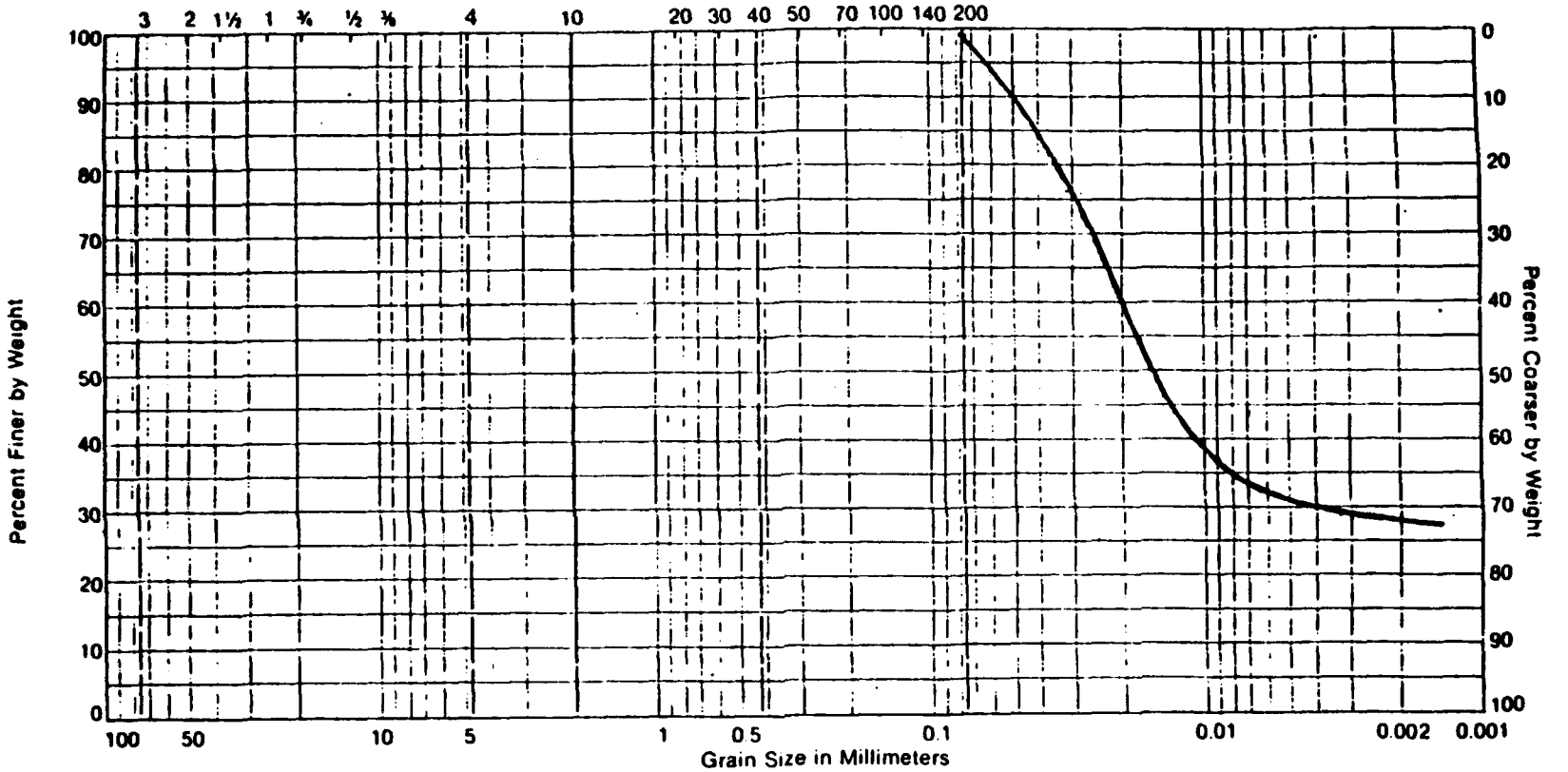
| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 6-7 | ST-2 | 15-16.5 | 71 | | 20 | CH |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

LAYNE WESTERN COMPANY, INC.

GRAIN SIZE ANALYSIS



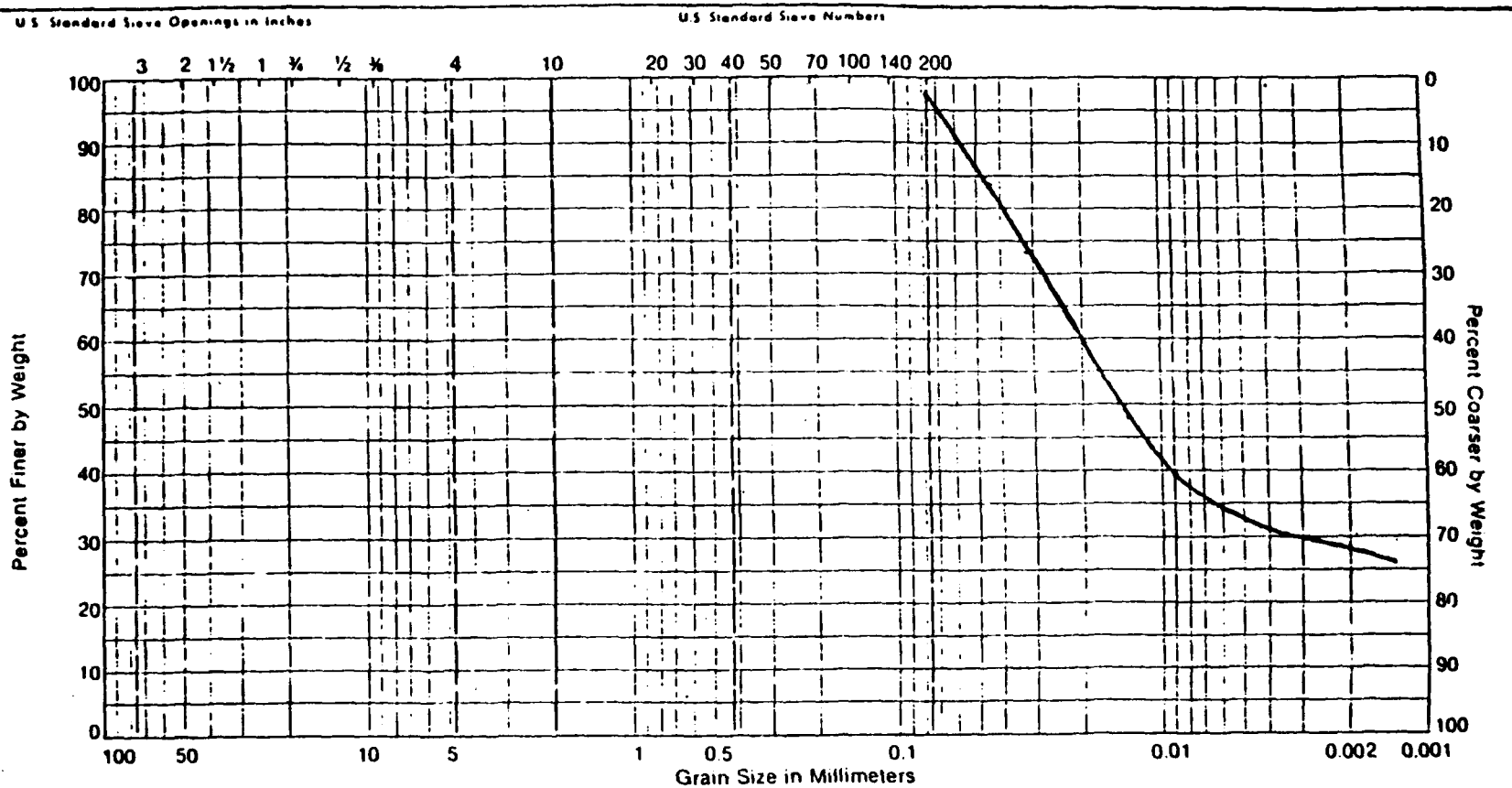

| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 2-7 | ST-1 | 10-11.5 | 41 | | 21 | CL |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

D-60




GRAIN SIZE ANALYSIS

| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 2-6 | ST-1 | 14.5-16 | 40 | | 21 | CL |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project: Lake City Army Ammunition Plant

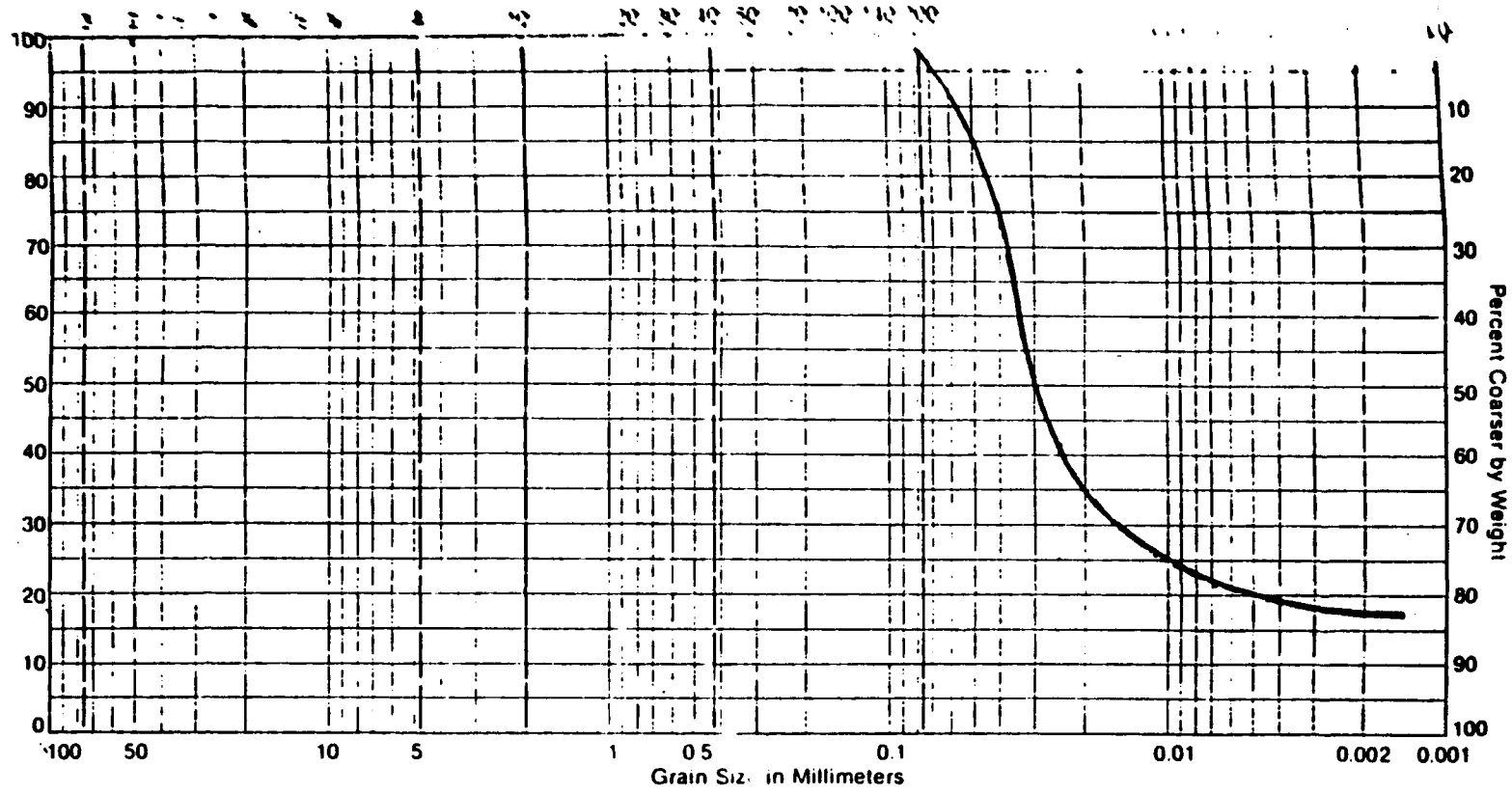
Date Tested: 1/28/83

D-61

LAYNE WESTERN COMPANY, INC.

U S Standard Sieve Openings in Inches

U S Standard Sieve Numbers




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | INE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 2-5 | ST-1 | 9.5-11 | 33 | | 23 | CL |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

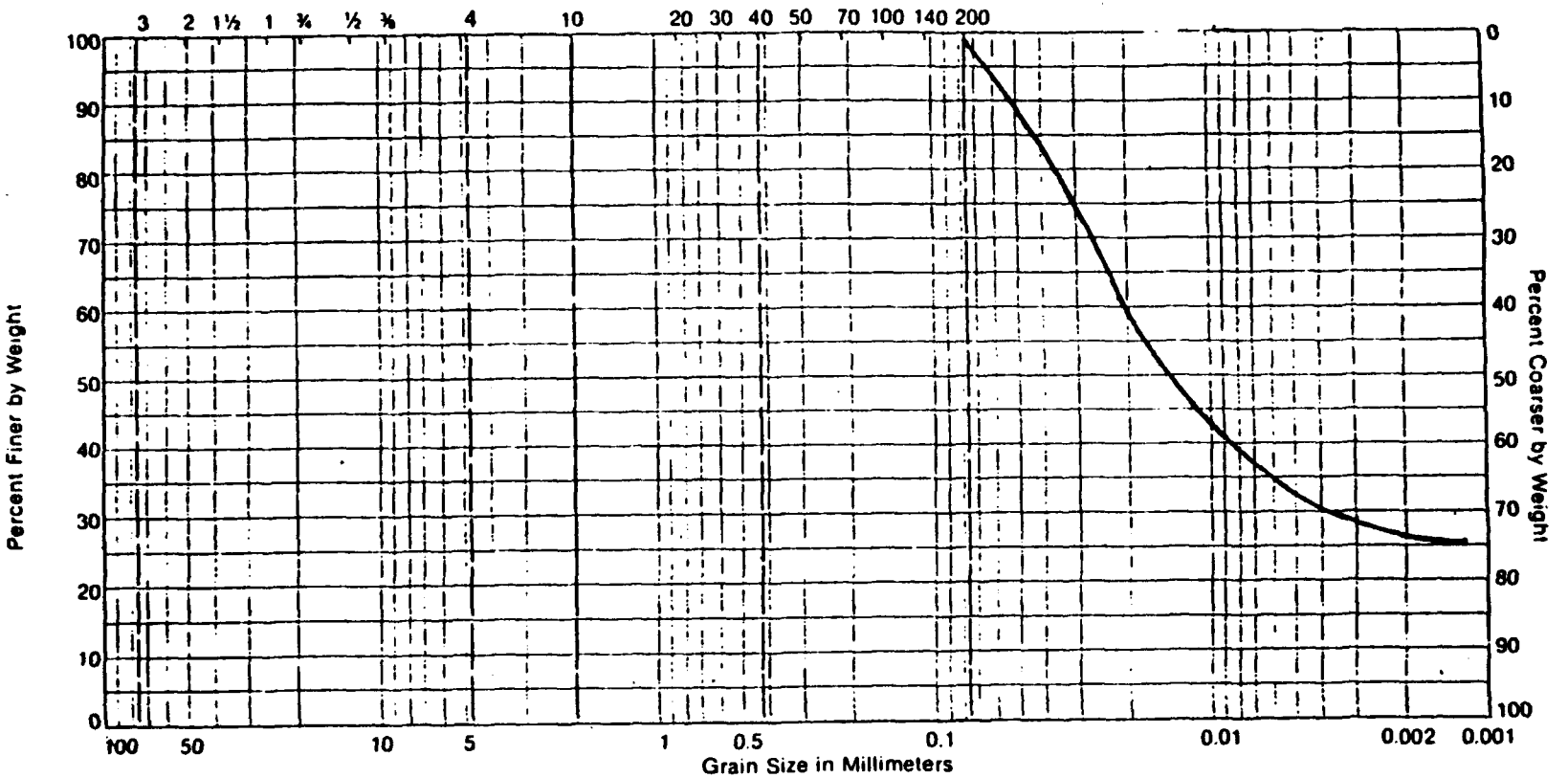
GRAIN SIZE ANALYSIS

D-62

LAYNE WESTERN COMPANY, INC.

U S Standard Sieve Openings in Inches

U S Standard Sieve Numbers




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 1-10 | ST-1 | 15-16.5 | 39 | | 20 | CL |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

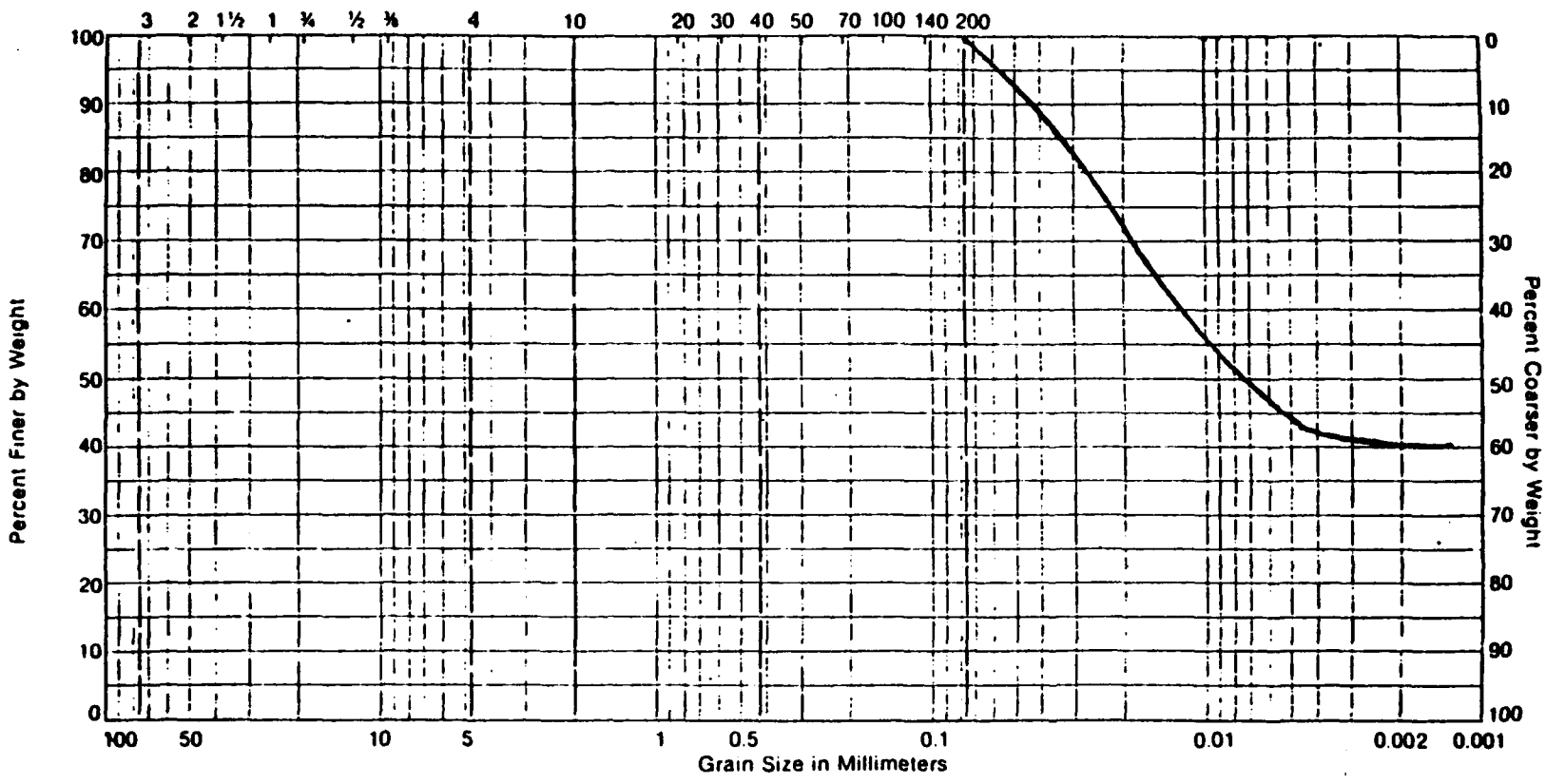
Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

GRAIN SIZE ANALYSIS

D-63

LAYNE WESTERN COMPANY, INC.




GRAIN SIZE ANALYSIS

| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

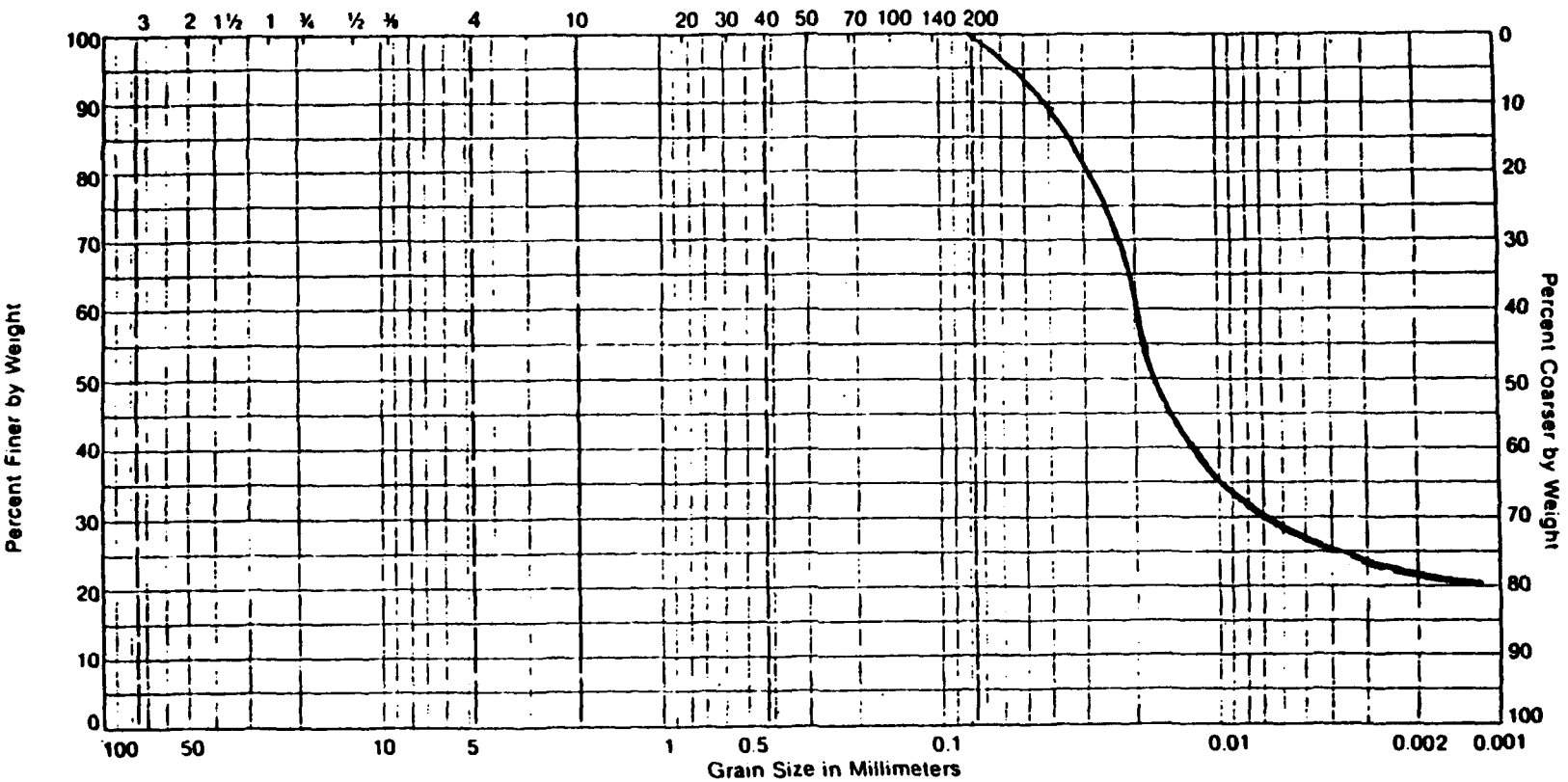
| Boring No. | Sample No. | Sample Depth | LL | w. | PL | Classification |
|---|---|---|---|---|---|---|
| MW 1-9 | ST-1 | 9.5-11 | 41 | | 20 | CL |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

D-64

LAYNE WESTERN COMPANY, INC.




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 1-8 | ST-2 | 19.5-21 | 33 | | 22 | CL |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

D-65

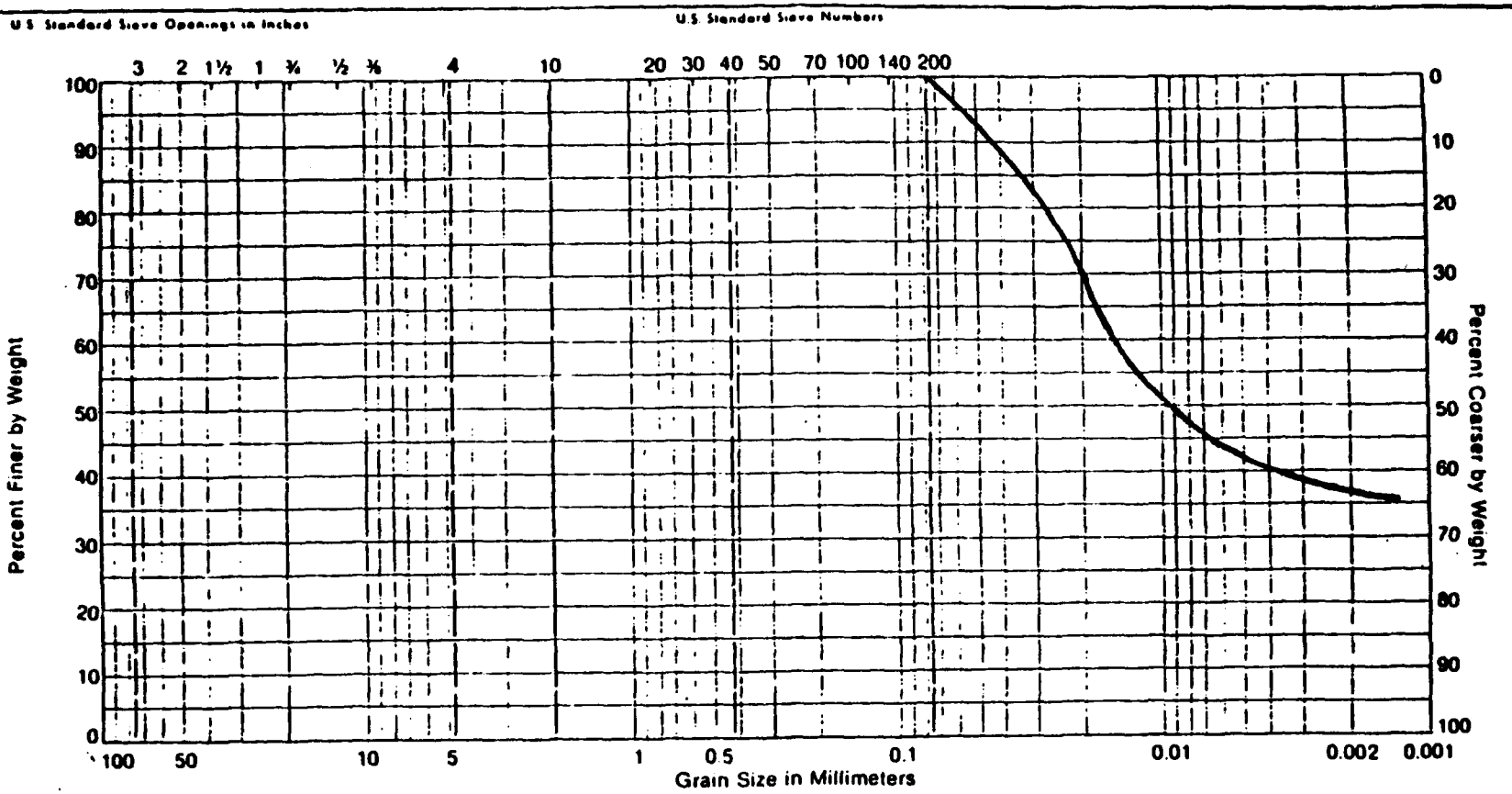
LAYNE WESTERN COMPANY, INC.

GRAIN SIZE ANALYSIS

LAYNE WESTERN COMPANY, INC.

D-66

# GRAIN SIZE ANALYSIS



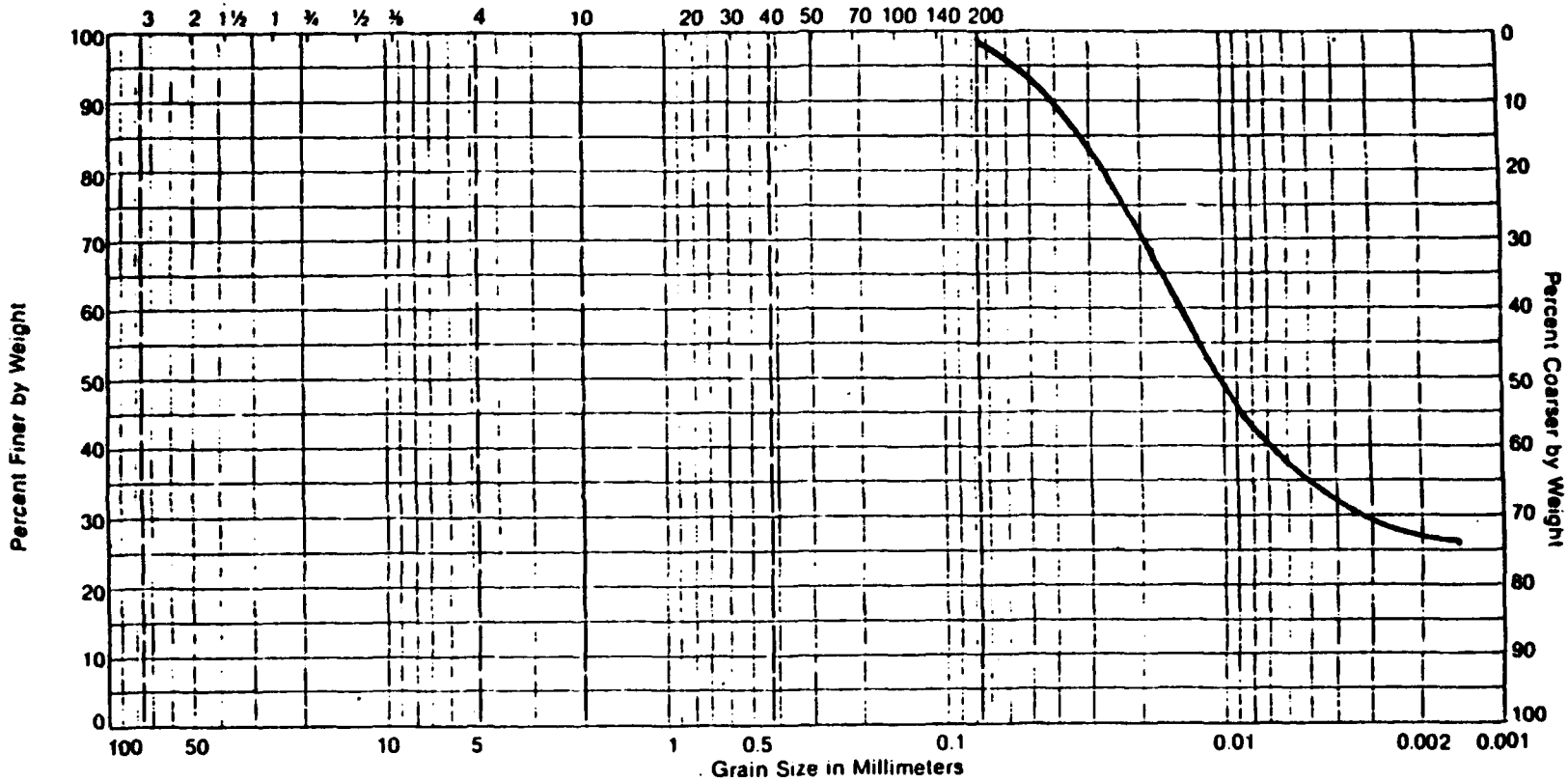

| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 1-7 | ST-1 | 9.5-11 | 51 | | 20 | CH |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

# GRAIN SIZE ANALYSIS




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 1-6 | ST-1 | 4.5-6.0 | 46 | | 20 | CL |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project: Lake City Army Ammunition Plant

Date Tested: 1/28/83

D-67

LAYNE WESTERN COMPANY, INC.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 2-7 Sample No: ST1 Depth: 10.0-11.5'

Description: Gray brown silty clay w/iron & dark stains & nodules, firm

Moisture Content: 27.7

Wet Unit Weight: 124.7

Dry Unit Weight: 97.7

Permeability Coefficient for this sample: $3.11 \times 10^{-9}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 2-6 Sample No: ST1 Depth: 14.5-16.0'

Description: Gray brown silty clay w/iron stains, firm

Moisture Content: 27.9

Wet Unit Weight: 125.7

Dry Unit Weight: 98.3

Permeability Coefficient for this sample: $4.14 \times 10^{-8}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 2-5 Sample No: ST1 Depth: 9.5-11.0'

Description: Gray brown silty clay w/iron stains, firm

Moisture Content: 27.8

Wet Unit Weight: 124.2

Dry Unit Weight: 97.2

Permeability Coefficient for this sample: $5.23 \times 10^{-8}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW2-1 Sample No: ST1 Depth: 10-11.5'

Description: Very stiff, gray brown silty clay, with iron stains and nodules.

Moisture Content: 25.0

Wet Unit Weight: 125.1

Dry Unit Weight: 100.1

Permeability Coefficient for this sample: $3.62 \times 10^{-8}$ cm./sec.

This permeability coefficient indicates a nearly impermeable material.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 1-10 Sample No: ST1 Depth: 15.0-16.5'

Description: Gray brown silty clay w/iron & dark nodules, firm

Moisture Content: 27.8

Wet Unit Weight: 124.5

Dry Unit Weight: 97.4

Permeability Coefficient for this sample: $6.06 \times 10^{-8}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 1-9 Sample No: ST1 Depth: 9.5-11.0'

Description: Gray brown silty clay w/iron nodules & stains, firm

Moisture Content: 25.4

Wet Unit Weight: 127.7

Dry Unit Weight: 101.8

Permeability Coefficient for this sample: $9.60 \times 10^{-9}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 1-8 Sample No: ST2 Depth: 19.5-21.0'

Description: Brown w/trace gray silty clay w/iron stains, firm

Moisture Content: 31.1

Wet Unit Weight: 118.7

Dry Unit Weight: 90.6

Permeability Coefficient for this sample: $2.01 \times 10^{-7}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 1-7 Sample No: ST1 Depth: 9.5-11.0'

Description: Gray brown silty clay w/trace gravel, iron nodules & stains, very stiff

Moisture Content: 24.5

Wet Unit Weight: 126.6

Dry Unit Weight: 101.7

Permeability Coefficient for this sample: $2.78 \times 10^{-9}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 1-6 Sample No: ST1 Depth: 4.5-6.0'

Description: Gray brown silty clay, iron stain & nodules, firm

Moisture Content: 26.6

Wet Unit Weight: 124.3

Dry Unit Weight: 98.1

Permeability Coefficient for this sample: $7.64 \times 10^{-9}$ cm/sec.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 10-5 Sample No: ST1 Depth: 24.5-26.0'

Description: Olive brown shaly clay, very stiff

Moisture Content: 22.4

Wet Unit Weight: 129.1

Dry Unit Weight: 105.5

Permeability Coefficient for this sample: $1.61 \times 10^{-7}$ cm/sec.

ALLUVIAL SAND

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 9-3 Sample No: Bag #1 Depth: 33'-44'

Description: Gray fine to medium sand with trace of silt.

Moisture Content:

Wet Unit Weight:

Dry Unit Weight:

Permeability Coefficient for this sample: $1.1 \times 10^{-2}$ cm/sec.

This permeability coefficient for this sample indicates a medium degree of permeability.

## PERMEABILITY TEST

Job Name: Lake City Army Ammunition Plant

Well No: MW 9-2 Sample No: Bag #1 Depth: 32.5'-40.0'

Description: Gray silty fine to medium sand

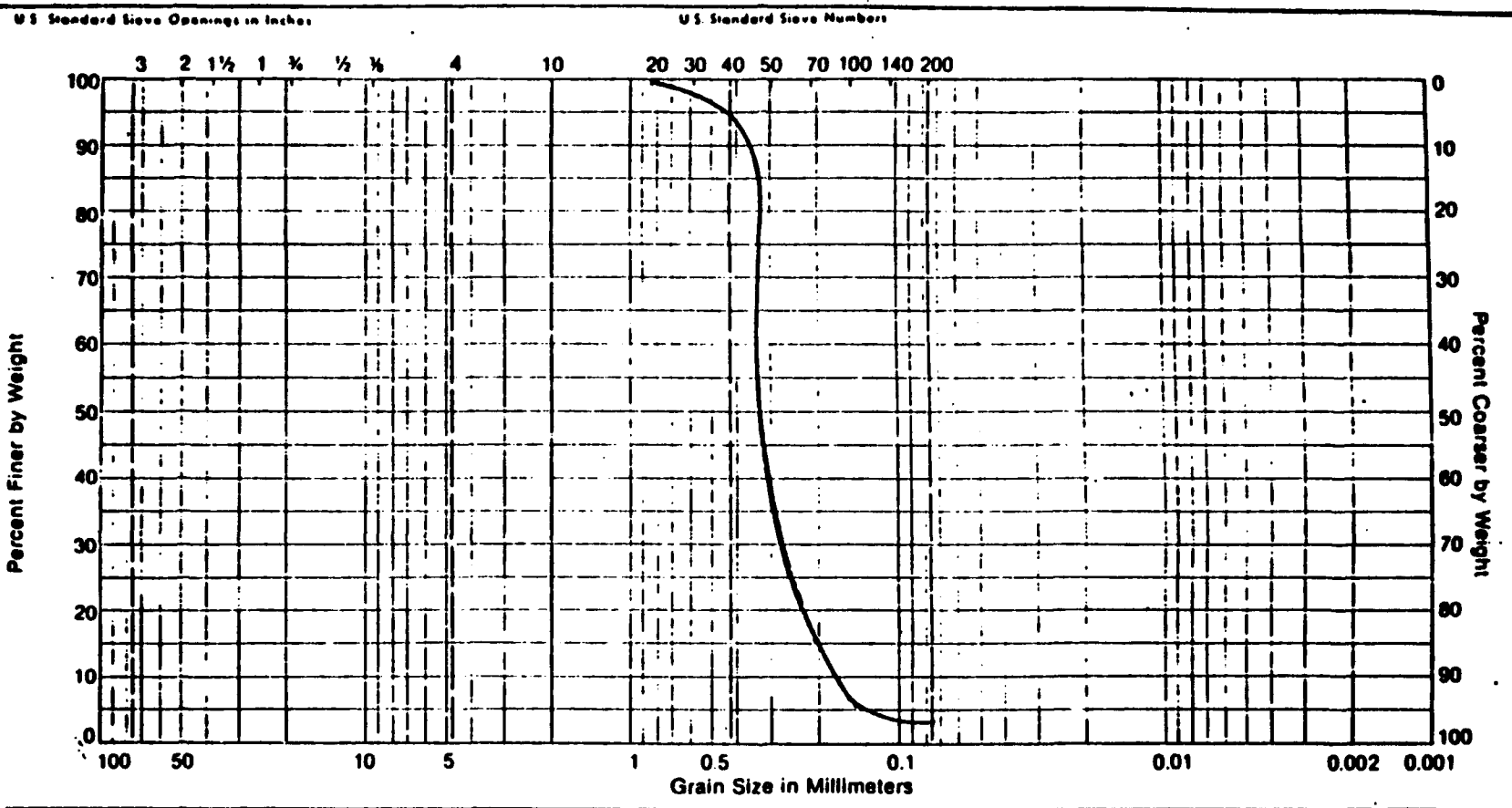
Moisture Content: _____

Wet Unit Weight: _____

Dry Unit Weight: _____

Permeability Coefficient for this sample: $9.0 \times 10^{-3}$ cm/sec.

This permeabilty coefficient indicates a medium degree of permeability for this sample.




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| MW 7-3A | BAG | 34-37' | | | | 3% gravel |
| | | | | | | 52% medium sand |
| | | | | | | 42% fine sand |
| | | | | | | 3% silt and clay |

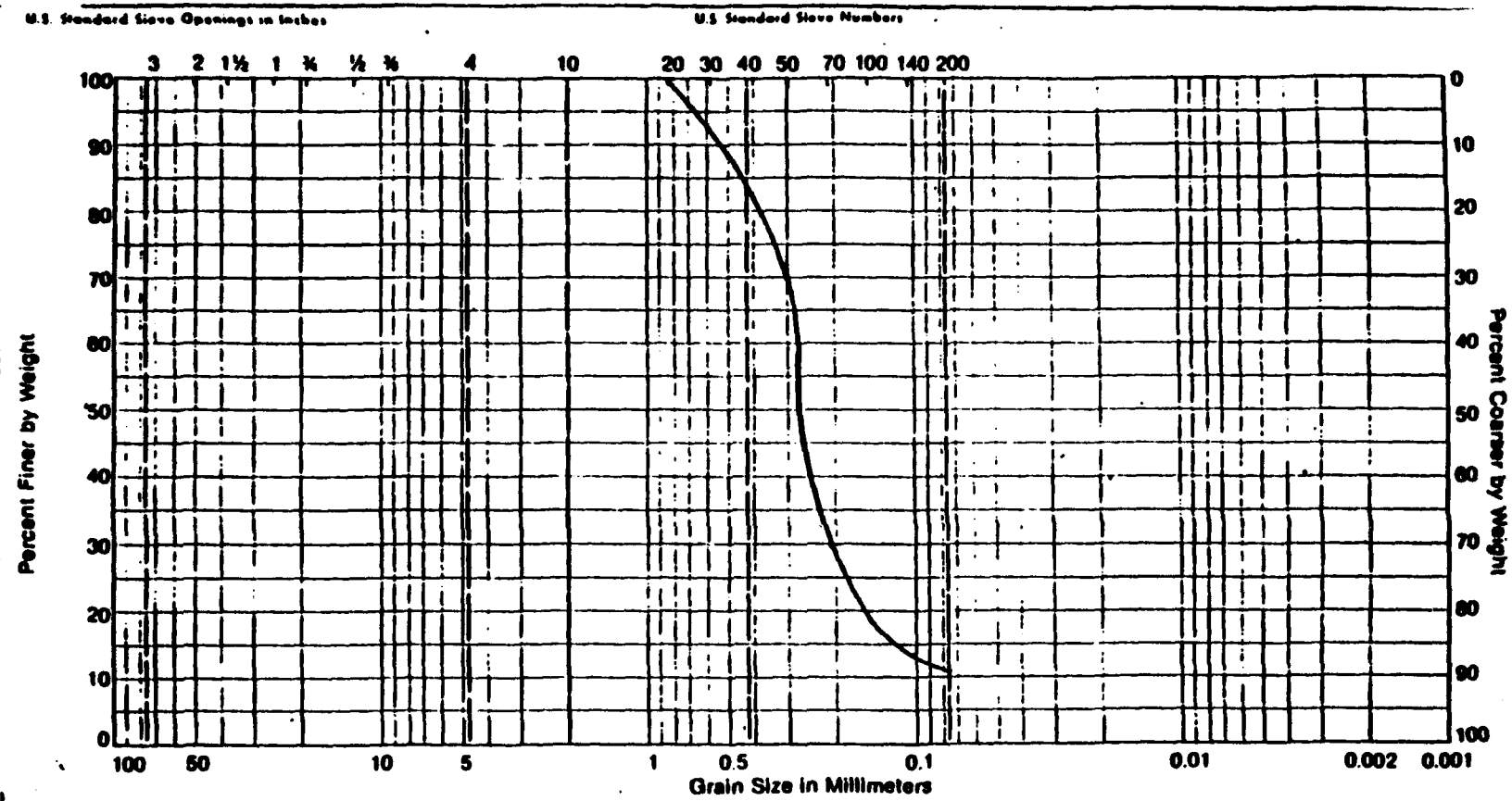
Project: Lake City AAP
Independence, Missouri

Date Tested: 9-16-81

GRAIN SIZE ANALYSIS

LAYNE WESTERN COMPANY, INC.

D-80



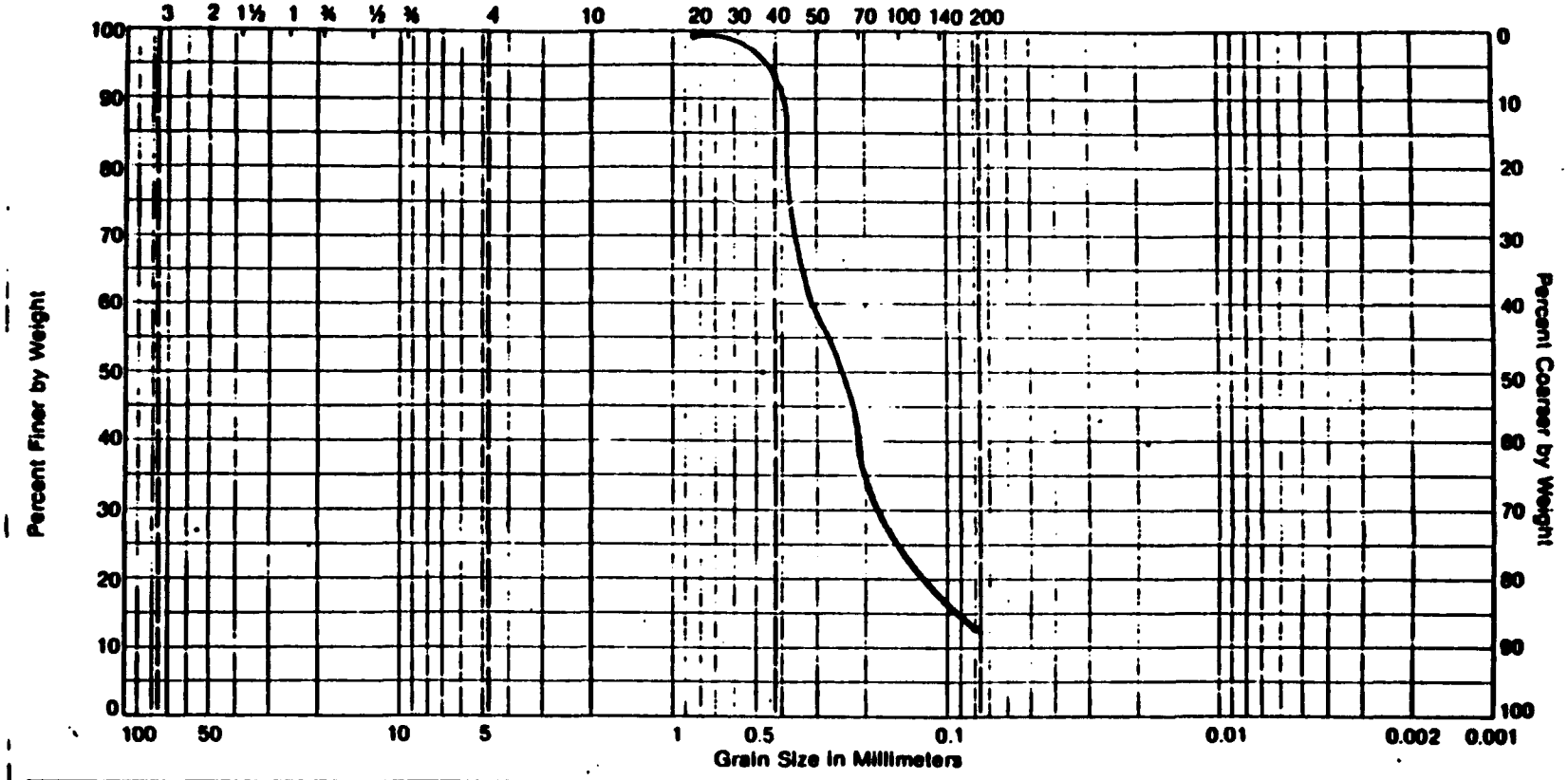

| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| 3-5 | SS1 | 9.5-11 | | | | 0% Gravel |
| | | | | | | 15% M to C sand |
| | | | | | | 73% Fine sand |
| | | | | | | 12% Clayed Silt |

Project: Lake City AAP

Independence, Missouri

Date Tested: 9-14-81




| | | | | | | |
|---|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES | |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT | CLAY |

| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| 3-3 | ST1 | 9.5-11' | | | | 0% gravel<br>17% medium sand<br>90% fine sand<br>1% coarse sand |

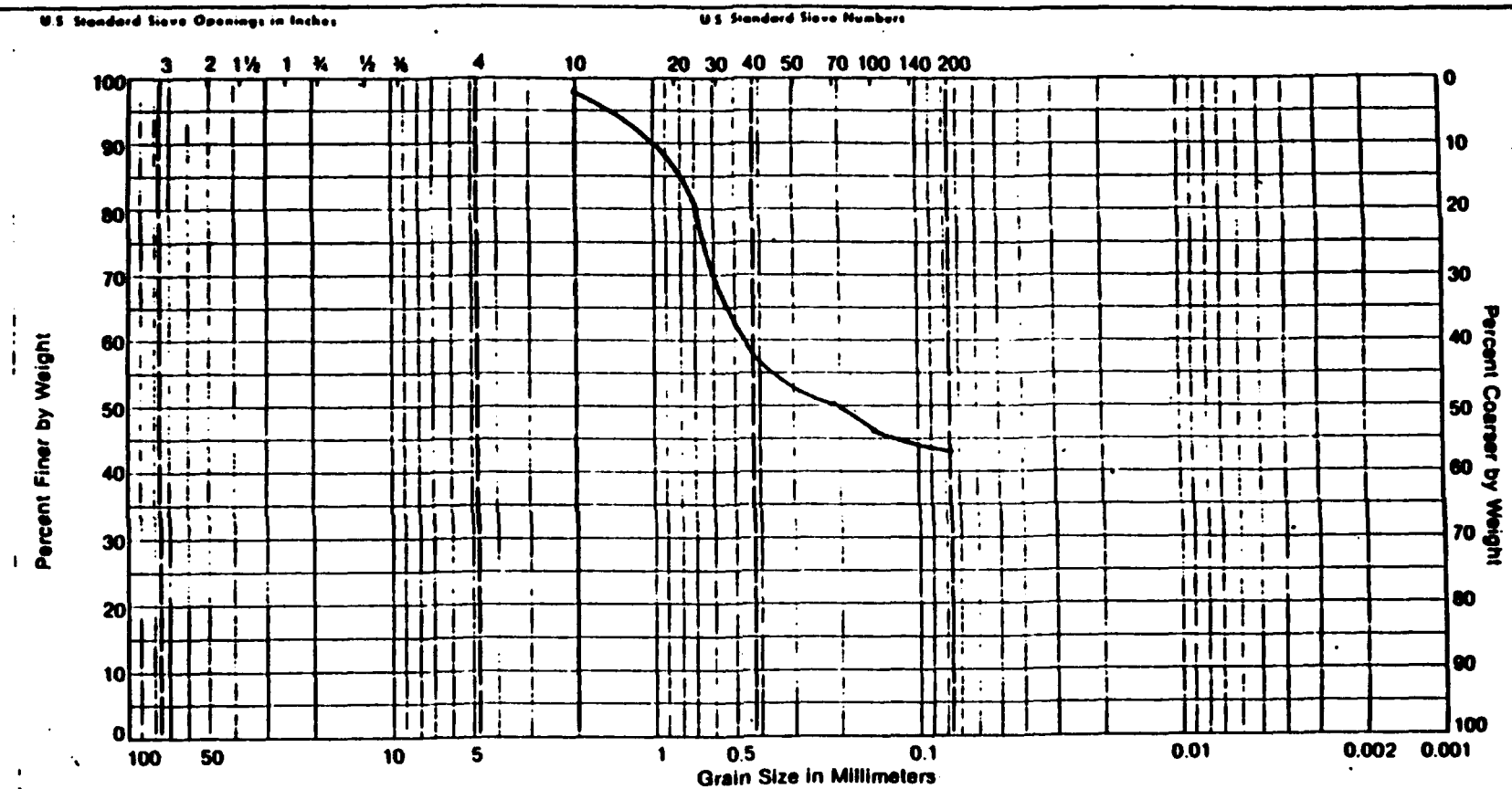
Project: Lake City AAP

Independence, Missouri

Date Tested: 9-14-81

LAYNE WESTERN COMPANY, INC.

GRAIN SIZE ANALYSIS




| | | | | | |
|---|---|---|---|---|---|
| UNIFIED | GRAVEL | COARSE SAND | MEDIUM SAND | FINE SAND | FINES |
| AASHTO | GRAVEL | | COARSE SAND | FINE SAND | SILT / CLAY |

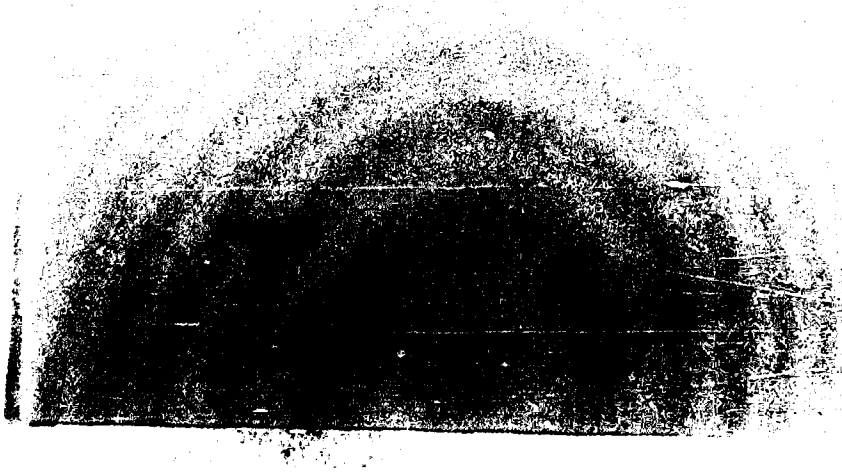
| Boring No. | Sample No. | Sample Depth | LL | w | PL | Classification |
|---|---|---|---|---|---|---|
| 3-1 | SS2 | 19.5-21' | | | | 7% gravel. - 9½ M-C sand 14% fine sand. 69½% silt & cl... |

Project: Lake City AAP
Independence, Missouri

Date Tested: 9-14-81

LAYNE WESTERN COMPANY, INC.

# PRODUCTION WELL PUMP RATE DATA



WESTON MANAGERS DESIGNERS-CONSULTANTS

SHEET 1 of 2

CLIENT/SUBJECT Air Force / Pump Test Data Reduction W.O. NO. 2285-05-10

TASK DESCRIPTION Backcalculation to est. individual pump rates. TASK NO. 0030

PREPARED BY R. Gnat DEPT 1535 DATE 9/23/88 | APPROVED BY

MATH CHECK BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____ | DEPT _____ DATE _____

| Designation | Pump | Calculated Q (gpm) |
|---|---|---|
| A | 17AA | 153 |
| B | 17BB | 350 |
| C | 17CC | * |
| D | 17DD | 433 |
| E | 17E | * |
| F | 17EE | 358 |
| G | 17FF | 150 |
| H | 17GG | * |
| I | — | — |
| J | 17J | * |
| K | 17JJ | 442 |
| L | 17k | 267 |
| M | 17kK | 292 |

* Not used betwn 5/1/88 and 5/16/88
— Pump no in.

WESTON MANAGERS DESIGNERS CONSULTANTS

SHEET 2 of 2

CLIENT/SUBJECT Air Force / Pump Test Data Reduction W.O. NO. 2285-05-10

TASK DESCRIPTION Back calc. to estimate individual pumping rates TASK NO. 0030

PREPARED BY R. Graf DEPT 1535 DATE 9/23/88 | APPROVED BY

MATH CHECK BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____ | DEPT _____ DATE _____

B + D + F + G + M = 95,000 g/hr = 1583 gpm
B + D + F + M = 86,000 g/hr = 1433 gpm
$\therefore Q_G$ = 150 gpm

B + D + F + M = 86,000 g/hr = 1433 gpm
B + F + M = 60,000 g/hr = 1000 gpm
$\therefore Q_D$ = 433 gpm

A + B + k + L = 92,500 g/hr = 1542 gpm
A + B + F + k + L = 114,000 g/hr = 1900 gpm
$\therefore Q_F$ = 358 gpm

B + D + F + M = 83,000 g/hr = 1383 gpm
B + D + k + M = 88,000 g/hr = 1467 gpm
$\therefore K = F + 84 = 358 + 84 = 442$
$\therefore Q_k$ = 442 gpm

A + D + G + k = 90,500 g/hr = 1508 gpm
$\therefore A = 1541 - D - G - K = 433$
$\therefore Q_A$ = 433 gpm

A + B + D + G + k = 111,500 g/hr = 1858 gpm
$\therefore B = 1858 - 1508 = 350$
$\therefore Q_B$ = 350 gpm

M = 1433 - B - D - F = 292
$\therefore Q_M$ = 292 gpm

L = 1542 - A - B - K = 267
$\therefore Q_L$ = 267 gpm

Olin

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5-1-88

| | WELLS MINUTES RUN | SPARLING Meter | SPARLING M Gal. Pump | P H Raw | P H Filter Influent | P H Clear Well | CHEM. ANALYSIS Filter Influent PPM: P | MO | OH | HCO3 | CO3 | H | LIME 19 Bags | LIME Lbs. Used | LIME Grain per Gallon | ALUM 2 Bags | ALUM Lbs. Used | ALUM Grain per Gallon | Clear Well Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 MID | | 249375 | | | | | | | | | | | 12 7 | | | 1 1 | | | |
| 1 AM | | | | | | | | | | | | | 1603 | | | 906 | | | 11.7 |
| 2 AM | | | | | | | | | | | | | | | | | | | |
| 3 AM | | | | | | | | | | | | | | | | | | | |
| 4 AM | | | | | | | | | | | | | | | | | | | |
| 5 AM | | | | | | | | | | | | | | | | | | | |
| 6 AM | | | | | | | | | | | | | | | | | | | |
| 7 AM | | | | | | | | | | | | | | | | | | | |
| 8 AM | | | | | | | | | | | | | | | | | | | |
| 9 AM | | | | | | | | | | | | | | | | | | | |
| 10 AM | | | | | | | | | | | | | | | | | | | |
| 11 AM | | | | | | | | | | | | | | | | | | | 6.9 |
| 12 NOON | | 249565 | 140 | 9.8 | 10.6 | 9.2 | 16 | 34 | 0 | 2 | 42 | 28 | 1707 | 304 | 11.2 | 945 | 39 | 1.5 | 9.4 |
| 1 PM | | 249714 | 149 | | | | | | | | | | 2160 | 253 | 11.9 | 978 | 33 | 1.5 | 11.7 |
| 2 PM | | | | | | | | | | | | | | | | | | | 11.0 |
| 3 PM | | | | | | | | | | | | | | | | | | | |
| 4 PM | | | | | | | | | | | | | | | | | | | |
| 5 PM | | | | | | | | | | | | | | | | | | | 9.3 |
| 6 PM | | 249843 | 129 | 9.9 | 9.9 | 9.4 | 12 | 22 | 0 | - | 24 | 20 | 2373 | 213 | 11.6 | 1005 | 27 | 1.5 | 10.9 |
| 7 PM | | 249933 | 96 | | | | | | | | | | 2525 | 153 | 11.8 | 1029 | 24 | 1.8 | 11.7 |
| TOTAL | 76 5 [illegible] 62 | | 558 | | | | | | | | | | | 927 | | | 123 | | |
| Max | | | | | | | | | | | | | | | | | | | |
| Min | | | | | | | | | | | | | | | | | | | |
| Avg | | | | | | | | | | | | | | | | | | | |

Remarks: Jockey off at 7:30 AM
[illegible] On [illegible] Water

D-87

PAGE.002

DEC 19 '91 14:29

OLC 456 **Olin**

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5-2-88

| | WELLS HOURS RUN | | | | | | | | | | | | SPARKLING | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME 43 | | | ALUM 6 | | | Clear Well Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | $HCO_3$ | $CO_3$ | N | Bags | Lbs. Used | Grain per Gallon | Bags | Lbs. Used | Grain per Gallon | |
| 7 AM | | | | | | | | | | | | | | 249932 | | | | | | | | | | | | | | | | |
| 8 AM | | | | | | | | | | | | | | | | | | | | | | | | | 2515 | | | 1029 | | | 11.7 |
| 9 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6.9 |
| 2 AM | | | | | | | | | | | | | | 250640 | 127 | 10.0 | 8.0 | 9.5 | 20 | 24 | 6 | 0 | 40 | 96 | 2240 | 215 | 11.8 | 1060 | 31 | 1.7 | 6.5 |
| 3 AM | | | | | | | | | | | | | | 250 236 | 176 | 8.9 | 9.8 | 9.5 | 11 | 36 | 0 | 0 | 36 | 91 | 3013 | 273 | 10.9 | 1109 | 44 | 1.8 | 6.6 |
| 4 AM | | | | | | | | | | | | | | 250436 | 200 | 9.7 | 9.7 | 9.5 | 16 | 32 | 0 | 0 | 32 | 94 | 3321 | 308 | 10.8 | 1153 | 49 | 1.7 | 6.5 |
| 5 AM | | | | | | | | | | | | | | 250678 | 242 | 9.7 | 9.7 | 9.5 | 12 | 32 | 0 | 0 | 32 | 94 | 3714 | 393 | 11.4 | 1209 | 56 | 1.6 | 6.6 |
| 6 AM | | | | | | | | | | | | | | 250844 | 166 | 9.6 | 9.6 | 9.4 | 12 | 34 | 0 | 10 | 24 | 94 | 3999 | 285 | 12.5 | 1245 | 40 | 1.7 | 8.8 |
| 7 AM | | | | | | | | | | | | | | 251012 | 168 | 9.6 | 9.7 | 9.5 | 12 | 32 | 0 | 8 | 24 | 92 | 4289 | 286 | 11.9 | 1296 | 47 | 1.9 | 9.0 |
| 8 AM | | | | | | | | | | | | | | 251219 | 207 | 9.6 | 9.7 | 9.5 | 12 | 32 | 0 | 8 | 24 | 94 | 4631 | 342 | 11.7 | 1346 | 50 | 1.7 | 11.0 |
| 9 AM | | | | | | | | | | | | | | 251299 | 80 | | | | | | | | | | 4769 | 138 | 12.0 | 1369 | 23 | 1.5 | 11.7 |
| TOTAL | 15 | 13 | | 13 | 12 | 22 | | | | | 6 | 18 | 13 | | | | | | | | | | | | 1241 | | | 340 | | | |
| Max. | | | | | | | | | | | | | | 166 | | | | | | | | | | | | | | | | | |
| Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avg. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

DEC 19 '91 14:30 FAX 003

12/19/91 14:19 003

88-D

Olin

GENERAL LOG NO 7 WATER DEPT. BLDG. NO. 16

Water Supply

DATE 5-4-88

| | WELLS HOURS RUN | | | | | | | | | | | | | SPARLING | | P H | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME 46 | | | ALUM 7 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | $HCO_3$ | $CO_3$ | H | Bags 22 24 | Lbs. Used | Grns. per Gallon | Bags 3 4 | Lbs. Used | Grns. per Gallon | Clear Well % |
| PMID | | | | | | | | | | | | | | 252697 | | | | | | | | | | | 7017 | | | 1722 | | | 11.7 |
| 1 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7.8 |
| 2 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5.1 |
| 3 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7.0 |
| 4 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6.0 |
| 5 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 AM | X | | | X | | | X | | | | X | | | | | | | | | | | | | | | | | | | 6.0 |
| 10 AM | X | | | X | | | X | | | | X | | | 252867 | 190 | 9.6 | 9.5 | 9.1 | 14 | 32 | 0 | 4 | 28 | 96 | 7323 | 306 | 11.3 | 1767 | 45 | 1.7 | 6.6 |
| 11 AM | X | | | X | | | X | | | | X | | | 253066 | 181 | 9.4 | 9.5 | 9.2 | 12 | 36 | 0 | 12 | 24 | 108 | 7613 | 296 | 11.2 | 1811 | 44 | 1.7 | 6.1 |
| 12 N | X | 0.5 | | X | | | X | | | | X | | | 253291 | 223 | 9.3 | 9.3 | 9.2 | 10 | 42 | 0 | 22 | 20 | 102 | 7969 | 356 | 11.2 | 1865 | 54 | 1.7 | 7.0 |
| 1 PM | X | 0.5 | | X | | | X | | | | X | | | 253492 | 201 | 9.2 | 9.2 | 9.1 | 10 | 46 | 0 | 26 | 20 | 108 | 8299 | 330 | 11.5 | 1916 | 51 | 1.8 | 7.5 |
| 2 PM | X | | 0.5 | X | | | X | | | | X | | | 253672 | 180 | 9.2 | 9.2 | 9.0 | 8 | 44 | 0 | 30 | 16 | 106 | 8596 | 297 | 11.6 | 1971 | 45 | 1.8 | 8.0 |
| 3 PM | X | | | X | | | X | | | | X | | | 253827 | 155 | 9.2 | 9.2 | 8.9 | 8 | 44 | 0 | 30 | 16 | 104 | 8893 | 247 | 11.2 | 2001 | 40 | 1.8 | 6.6 |
| 4 PM | X | | | X | | | X | | | | X | | | 253977 | 150 | 9.1 | 9.2 | 8.9 | 8 | 44 | 0 | 22 | 16 | 106 | 9086 | 243 | 11.8 | 2039 | 38 | 1.8 | 11.0 |
| 5 PM | X | 0.5 | 0.5 | | | | X | | | | X | | | 254077 | 106 | | | | | | | | | | 9261 | 181 | 12.0 | 2067 | 28 | 1.8 | 11.7 |
| TOTAL | 8.5 | 1.5 | | 8.5 | | | 8.5 | | | | 8.5 | | | | 1380 | | | | | | | | | | 1256 | | | 345 | | | |
| Max. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avg. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

12/19/91 14:20 004

004

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5-3-88

| | WELLS HOURS RUN | | | | | | | | | | | | SPARKLING | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME Bags | | | ALUM 7 Bags | | | Clear Well PH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | HCO | CO | N | 21 | 22 | Lbs. Used | Grain per Gallon | 4 | 3 | Lbs. Used | Grain per Gallon | |
| 1 PM | | | | | | | | | | | | | | 251299 | | | | | | | | | | | 4764 | | | | 1364 | | | | 11.7 |
| 2 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10.8 |
| 3 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 12 |
| 4 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6.2 |
| 10 PM | | | | | | | | | | | | | | 251489 | 190 | 98 | 98 | 94 | 16 | 34 | 0 | 2 | 32 | 84 | 5072 | 303 | 112 | 1416 | 47 | 1.7 | 7.0 | |
| 11 PM | | | | | | | | | | | | | | 251624 | 135 | 97 | 98 | 95 | 14 | 38 | 0 | 10 | 28 | 94 | 5366 | 294 | 111 | 1462 | 46 | 1.7 | 6.2 | |
| 12 PM | | | | | | | | | | | | | | 251868 | 196 | 96 | 95 | 94 | 14 | 36 | 0 | 8 | 22 | 96 | 5678 | 312 | 113 | 1510 | 48 | 1.7 | 6.5 | |
| 1 AM | | | | | | | | | | | | | | 252054 | 228 | 96 | 95 | 95 | 12 | 36 | 0 | 12 | 24 | 94 | 6054 | 376 | 115 | 1564 | 54 | 1.6 | 7.4 | |
| 2 AM | | | | | | | | | | | | | | 252279 | 183 | 94 | 95 | 94 | 12 | 36 | 0 | 12 | 24 | 94 | 6343 | 289 | 111 | 1609 | 45 | 1.7 | 7.2 | |
| 3 AM | | | | | | | | | | | | | | 252459 | 180 | 93 | 93 | 93 | 10 | 34 | 0 | 14 | 20 | 96 | 6626 | | 110 | 1653 | 44 | 1.7 | 7.1 | |
| 4 AM | | | | | | | | | | | | | | 252602 | 143 | 94 | 93 | 93 | 10 | 34 | 0 | 14 | 20 | 94 | 6852 | 226 | 111 | 1693 | 40 | 1.5 | 11.2 | |
| 5 AM | | | | | | | | | | | | | | 252847 | 245 | | | | | | | | | | 7017 | 165 | 121 | 1722 | 29 | 2.1 | 11.5 | |
| 6 AM | | | | | | | | | | | | | | 1298 | | | | | | | | | | | 2246 | | | 353 | | | | |
| 7 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6.2 |
| 10 AM | | | | | | | | | | | | | | 251489 | 190 | 98 | 98 | 94 | 16 | 34 | 0 | 2 | 32 | 84 | 5072 | 303 | 112 | 1416 | 47 | 1.7 | 7.0 | |
| 11 AM | | | | | | | | | | | | | | 251624 | 135 | 97 | 98 | 95 | 14 | 38 | 0 | 10 | 28 | 94 | 5366 | 294 | 111 | 1462 | 46 | 1.7 | 6.2 | |
| 12 PM | | | | | | | | | | | | | | 251868 | 196 | 96 | 95 | 94 | 14 | 36 | 0 | 8 | 22 | 96 | 5678 | 312 | 113 | 1510 | 48 | 1.7 | 6.5 | |
| 1 PM | | | | | | | | | | | | | | 252054 | 228 | 96 | 95 | 95 | 12 | 36 | 0 | 12 | 24 | 94 | 6054 | 376 | 115 | 1564 | 54 | 1.6 | 7.4 | |
| 2 PM | | | | | | | | | | | | | | 252279 | 183 | 94 | 95 | 94 | 12 | 36 | 0 | 12 | 24 | 94 | 6343 | 289 | 111 | 1609 | 45 | 1.7 | 7.2 | |
| 3 PM | | | | | | | | | | | | | | 252459 | 180 | 93 | 93 | 93 | 10 | 34 | 0 | 14 | 20 | 96 | 6626 | | 110 | 1653 | 44 | 1.7 | 7.1 | |
| 4 PM | | | | | | | | | | | | | | 252602 | 143 | 94 | 93 | 93 | 10 | 34 | 0 | 14 | 20 | 94 | 6852 | 226 | 111 | 1693 | 40 | 1.5 | 11.2 | |
| 5 PM | | | | | | | | | | | | | | 252847 | 245 | | | | | | | | | | 7017 | 165 | 121 | 1722 | 29 | 2.1 | 11.5 | |
| 6 PM | | | | | | | | | | | | | | 1298 | | | | | | | | | | | 2246 | | | 353 | | | | |
| 7 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL | | | | | 5 | | | | | | 17 | 14½ | | | | | | | | | | | | | | | | | | | | | |
| Hrs. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Secs. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

DEC 19 '91 14:31 PAGE.005

GLC 435 **Olin**

# GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

DATE 5/5/88

| | WELLS HOURS RUN | | | | | | | | | | | | | SPARKLING | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME Bags 20 23 | | | ALUM Bags 24 | | | Clear Well PH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | HCO3 | CO3 | N | Lbs. Used | Grain per Gallon | Lbs. Used | Grain per Gallon | |
| PRD | | | | | | | | | | | | | | 234077 | | | | | | | | | | | | | | | | |
| 1 8AM | | | | | | | | | | | | | | | | | | | | | | | | | 9267 | | | 2067 | | | 11.7 |
| 2 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 8AM | 12 | X | | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | 6.3 |
| 10 8AM | | X | | X | | | | | | | X | X | | 254248 | 171 | 9.1 | 9.2 | 8.8 | 8 | 44 | 0 | 26 | 16 | 110 | 9556 | 289 | 11.8 | 2108 | 41 | 1.7 | 6.5 |
| 11 8AM | | X | | X | | | | | | | X | X | | | | | | | | | | | | | | | | | | |
| 12N | | X | | X | | | | | | | X | X | | 254422 | 174 | 9.3 | 9.4 | 8.7 | 12 | 42 | 0 | 18 | 24 | 112 | 8845 | 289 | 11.6 | 2145 | 41 | 1.6 | 6.0 |
| 1PM | X | X | | X | LR | | | | | | X | X | | | | | | | | | | | | | | | | | | |
| 2PM | X | X | | X | | | | | | | X | X | | 254641 | 219 | 9.4 | 9.4 | 8.7 | 12 | 40 | 0 | 16 | 24 | 98 | 200 | 355 | 11.3 | 2201 | 52 | 1.7 | 6.7 |
| 3PM | X | X | | X | LR | | | | | | X | X | | | | | | | | | | | | | | | | | | |
| 4PM | | X | | X | | | | | | | X | X | | 254931 | 190 | 9.4 | 9.4 | 8.8 | 10 | 34 | 0 | 14 | 20 | 94 | 527 | 327 | 12.0 | 2249 | 48 | 1.8 | 7.2 |
| 5PM | | X | | X | | | | | | | X | X | | 255010 | 179 | 9.5 | 9.4 | 8.5 | 10 | 34 | 0 | 14 | 20 | 94 | 5?0 | 293 | 11.5 | 2294 | 45 | 1.8 | 8.6 |
| 6PM | | X | | X | | | | | | | X | X | | 255180 | 170 | 9.5 | 9.4 | 8.5 | 10 | 36 | 0 | 16 | 24 | 96 | 1107 | 287 | 11.8 | 2338 | 44 | 1.8 | 9.2 |
| 7PM | | X | | X | | | | | | | X | X | | 255356 | 176 | 9.5 | 9.4 | 8.5 | 10 | 36 | 0 | 16 | 20 | 92 | 1404 | 287 | 11.8 | 2383 | 45 | 1.8 | 10.9 |
| 8PM | 5R | X | | X | | | | | | | X | X | | 255444 | 88 | | | | | | | | | | 1553 | 144 | 11.6 | 2406 | 23 | 1.8 | 11.6 |
| TOTAL | 3 | 16 | | 16 | | | | | | | 6 | 10 | | 1367 | | | | | | | | | | | 2286 | | | 339 | | | |
| Max | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Min | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avg | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

D-101

DEC 19 '91 14:22

Olin

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5-6-91

| | WELLS HOURS RUN | | | | | | | | | | | | | SPARLING | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME | | | ALUM | | | Clear Well °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1-20 | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | HCO3 | CO2 | H | 3/4 Bags | Lbs. Used | Grain per Gallon | Bags | Lbs. Used | Grain per Gallon | |
| PUD | | | | | | | | | | | | | | | 25544 | | | | | | | | | | | 18 10 | | | 2 3 | | | |
| 9AM | 1 AM | | | | | | | | | | | | | | | | | | | | | | | | | 1553 | | | 2406 | | | 76 |
| | 2 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 98 |
| | 3 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 8.7 |
| | 4 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.8 |
| | 5 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6.1 |
| | 6 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.6 |
| | 7 AM | | | | | | | | | | | | | | 255612 | 168 | 9.6 | 9.8 | 9.1 | 14 | 30 | 0 | 2 | 32 | 90 | 1835 | 282 | 11.8 | 3149 | 43 | 1.8 | 7.1 |
| | 8 AM | | | | | | | | | | | | | | 253779 | 167 | 9.8 | 9.8 | 9.2 | 16 | 32 | 0 | 2 | 32 | 94 | 2103 | 268 | 11.2 | 2452 | 43 | 1.8 | 6.8 |
| | 9 AM | | | | | | | | | | | | | | 255947 | 168 | 9.7 | 9.7 | 9.3 | 16 | 32 | 0 | 0 | 32 | 96 | 2372 | 268 | 11.2 | 2535 | 43 | 1.8 | 6.7 |
| | 10 AM | | | | | | | | | | | | | | 256114 | 167 | 9.7 | 9.5 | 9.3 | 12 | 30 | 0 | 2 | 34 | 98 | 3640 | 368 | 11.2 | 2578 | 43 | 1.8 | 7.1 |
| | 11 AM | | | | | | | | | | | | | | 256281 | 167 | 9.7 | 9.5 | 9.3 | 14 | 30 | 0 | 0 | 32 | 94 | 2908 | 365 | 11.2 | 2661 | 43 | 1.8 | 8.2 |
| | 12 PM | | | | | | | | | | | | | | 256449 | 168 | 9.7 | 9.8 | 9.4 | 12 | 32 | 0 | 2 | 34 | 92 | 3177 | 369 | 11.2 | 2664 | 43 | 1.8 | 10.4 |
| | 1 PM | | | | | | | | | | | | | | 256610 | 161 | 9.8 | 9.7 | 9.4 | 14 | 30 | 0 | 2 | 28 | 92 | 3436 | 359 | 11.3 | 2705 | 41 | 1.8 | 11.2 |
| | 2 PM | | | | | | | | | | | | | | 256712 | 102 | | | | | | | | | | 3611 | 175 | 12.0 | 2730 | 25 | 1.2 | 11.3 |
| | TOTAL | | | | | | | | | | | | | | 1268 | | | | | | | | | | | 2058 | | | 324 | | | |
| | Max. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Avg. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

12/19/91 14:22

007

PAGE.007

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5/7/88

| WELLS HOURS RUN | | | | | | | | | | | | | SPARKLING | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME | | | ALUM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 9L | 9M | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | CH | HCO3 | CO3 | N | Lbs. Used | Grain per Gallon | Lbs. Used | Grain per Gallon | Clear Well PH |
| 7:00 | | | | | | | | | | | | | | 256 712 | | | | | | | | | | | 12 5 | | | 2 1 | | | |
| 8:00 | | | | | | | | | | | | | | | | | | | | | | | | | 3611 | | | 2730 | | | 11.3 |
| 9:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 12 |
| 12:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 11.3 |
| 13:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 11.6 |
| 14:00 | | | | | | | | | | | | | | 326 163 | 51 | 11 | 6.1 | 6.4 | 16 | 32 | 0 | 0 | 52 | 100 | 2665 | 44 | 11.5 | 2743 | 13 | 1.8 | 11.8 |
| 15:00 | | | | | | | | | | | | | | 2:51 121 | 164 | 11 | | 6.4 | 16 | 24 | 0 | 0 | 4 | 28 | 3311 | 287 | 11.4 | 27.5 | 42 | 1.8 | 11.4 |
| 16:00 | | | | | | | | | | | | | | 2:51676 | 165 | | | | | | | | | | 4323 | 244 | 11.1 | 2.42 | 37 | 1.8 | 11.2 |
| 17:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 11.8 |
| 18:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 11.5 |
| 19:00 | | | | | | | | | | | | | | 253 163 | 51 | 9.3 | 9.7 | 9.4 | 16 | 26 | 0 | 0 | 32 | 74 | 4468 | 143 | 11.5 | 2545 | 21 | 1.7 | 11.8 |
| 20:00 | | | | | | | | | | | | | | 251 295 | 132 | | | | | | | | | | 4256 | 227 | 11.7 | 2.27 | 33 | 1.8 | 11.8 |
| | | | | | | | | | | | | | | 423 | | | | | | | | | | | 615 | | | 146 | | | |

DEC 19 '91 14:35 PAGE.002

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

DATE 1/5/91

| WELLS HOURS RUN | | | | | | | | | | | | | SPARKLE | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME 20 Bags | | | ALUM 2 Bags | | | Clear Well Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | HCO3 | CO3 | H | | Lbs. Used | Grain per Gallon | | Lbs. Used | Grain per Gallon | |
| 7PM | | | | | | | | | | | | | | 25'1252 | | | | | | | | | | | 12 8 | | | 2 5 | | | |
| 8PM | | | | | | | | | | | | | | | | | | | | | | | | | 4366 | | | 2516 | | | 11.5 |
| 9PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7AM | | | | | | | | | | | | | | 25'1452 | 107 | 9.5 | 7.1 | 7.5 | 16 | 56 | 0 | 1 | 32 | 50 | 4719 | 333 | 11.5 | 2922 | 46 | 1.6 | 9.1 |
| 8AM | | | | | | | | | | | | | | 22'1642 | 110 | | | | | | | | | | 5203 | 339 | 11.1 | 2962 | 41 | 1.7 | 11.6 |
| 9AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 19.1 |
| 1PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 20 |
| 2PM | | | | | | | | | | | | | | 257796 | 134 | 9.6 | 7.7 | 7.5 | 12 | 56 | 3 | 12 | 24 | 96 | 5427 | 224 | 11.7 | 2995 | 32 | 1.7 | 11.7 |
| 3PM | | | | | | | | | | | | | | 257856 | 90 | | | | | | | | | | 5579 | 152 | 11.8 | 3017 | 22 | 1.7 | 11.7 |
| TOTAL | | | | | | | | | | | | | | 591 | | | | | | | | | | | 152 | | | 141 | | | |
| Max | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Min | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Average | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

11:30 AM ... 151 ...

12/19/91 14:25

003

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5-9 88

| | HRS. RUN | SPARKING Meter | SPARKING M Gal. Pump | P H Raw | P H Filter Influent | P H Clear Well | CHEM. ANALYSIS Filter Influent PPM: P | MO | SiO2 | NCO3 | CO3 | N | LIME 40 Bags 18 22 | Lbs. Used | Grain per Gallon | ALUM Bags 33 | Lbs. Used | Grain per Gallon | Clear Well Pr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-30 | | 357816 | | | | | | | | | | | 5579 | | | 3017 | | | 11.7 |
| | 5A | | | | | | | | | | | | | | | | | | 2.1 |
| | | 358039 | 153 | 9.9 | 9.8 | 9.5 | 14 | 34 | 2 | 0 | 36 | 84 | 5815 | 266 | 12.2 | 3060 | 43 | 2.0 | 7.1 |
| | 5A | 358192 | 153 | 9.9 | 9.9 | 9.5 | 16 | 36 | 0 | 0 | 36 | 88 | 6022 | 252 | 11.5 | 3112 | 42 | 1.9 | 2.0 |
| | | 358373 | 181 | 9.8 | 9.8 | 9.5 | 16 | 32 | 0 | 0 | 32 | 88 | 6390 | 292 | 11.3 | 3148 | 46 | 1.8 | 7.1 |
| | | 358563 | 190 | 9.7 | 9.6 | 9.6 | 10 | 32 | 0 | 12 | 20 | 86 | 6701 | 319 | 11.7 | 3196 | 48 | 1.8 | 7.0 |
| | | 358743 | 180 | 9.5 | 9.6 | 9.4 | 12 | 32 | 0 | 8 | 24 | 78 | 7000 | 299 | 11.6 | 3242 | 46 | 1.8 | 8.5 |
| | 5A | 358900 | 157 | 9.7 | | 9.4 | | 34 | 2 | 16 | 24 | 90 | 7260 | 266 | 11.8 | 3286 | 44 | 1.8 | 10.0 |
| | 5A | 359056 | 156 | 9.9 | 9.5 | 9.4 | 10 | 24 | 0 | 4 | 0 | 92 | 7530 | 264 | 11.8 | 3329 | 43 | 1.9 | 10.9 |
| | | 359134 | 78 | | | | | | | | | | 7663 | 133 | | 3351 | 22 | | 11.7 |
| TOTAL | | | | | | | | | | | | | 2084 | | | 334 | | | |

DEC 19 '91 14:36 PAGE.004

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

START PUMP TEST (10:52)

DATE 5-10-88

| WELLS HOURS RUN | SPARLING Meter | SPARLING Gal. Pump | P H Raw | P H Filter Influent | P H Clear Well | CHEM. ANALYSIS Filter Influent PPM: P | Mn | Fe | Ca | CO | H | LIME Bags 16 Lbs Used | LIME Gals per Gallon | ALUM Bags 7 4 3 Lbs Used | ALUM Gals per Gallon | Clear Well Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 259134 | | | | | | | | | | | 7663 | | 3751 | | 11.7 |
| | 259436 | 176 | 7.6 | 9.6 | 9.2 | 14 | 56 | 0 | 5 | 25 | 96 | 7757 | 324 | 3742 | 54 | 1.9 | 7.3 |
| | 259516 | 156 | 9.4 | 9.4 | 9.2 | 12 | 55 | 0 | 14 | 24 | 95 | 8244 | 307 | 3455 | 56 | 1.9 | 6.5 |
| | 259711 | 195 | 9.4 | 9.4 | 9.2 | 8 | 58 | 0 | 18 | 18 | 95 | 8517 | 319 | 3516 | 51 | 1.8 | 7.4 |
| | 259913 | 202 | 9.3 | 9.2 | 9.1 | 10 | 40 | 0 | 20 | 20 | 100 | 8953 | 336 | 3659 | 53 | 1.8 | 7.2 |
| | 260116 | 203 | 9.4 | 9.3 | 9.0 | 12 | 38 | 0 | 14 | 24 | 100 | 9301 | 348 | 3612 | 53 | 1.8 | 8.0 |
| | 260292 | 176 | 9.4 | 9.4 | 9.0 | 12 | 34 | 0 | 10 | 24 | 96 | 9554 | 273 | 3659 | 47 | 1.9 | 10.0 |
| | 260442 | 150 | 9.5 | 9.5 | 9.0 | 12 | 32 | 0 | 8 | 24 | 96 | 9838 | 294 | 3704 | 42 | 1.9 | 11.0 |
| | 260510 | 68 | | | | | | | | | | 9949 | 111 | 3718 | 17 | 1.8 | 11.7 |
| | 1390 | | | | | | | | | | | 2286 | | 367 | | | |

12/19/91 14:26

005

PAGE.005

006 1-20

# GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 14

PUMP TEST
DATE 5-11-88

| Time | Sparling Meter | M Gal. Pump | PH Raw | PH Filter Influent | PH Clear Well | Chem. P | Chem. MO | Chem. OH | Chem. HCO | Chem. CO | Chem. H | Lime Bags (1923) | Lime Lbs. Used | Lime Grain per Gallon | Alum Bags (32) | Alum Lbs. Used | Alum Grain per Gallon | Clear Well Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 266 516 | | | | | | | | | | | 5449 | | | 3718 | | | 11.7 |
| | | | | | | | | | | | | | | | | | | 2.8 |
| | 266 671 | 161 | 9.5 | 9.4 | 9.6 | 16 | 36 | . | 6 | 33 | 32 | 6226 | 271 | 11.5 | 3759 | 41 | 1.5 | 9.1 |
| | 266 829 | 158 | 9.9 | 9.5 | 9.6 | 19 | 35 | 6 | 16 | 28 | 34 | 6456 | 313 | 11.9 | 3799 | 46 | 1.5 | 2.3 |
| | 267 [illegible] | 171 | 9.6 | 9.6 | 9.1 | 14 | 32 | 1 | 4 | 26 | 32 | 6787 | 363 | 12.4 | 3888 | 46 | 1.9 | 2.6 |
| | 261212 | 202 | 9.6 | 9.6 | 9.1 | 12 | 42 | 0 | 18 | 24 | 43 | 1120 | 333 | 11.5 | 3897 | 52 | 1.8 | 3.3 |
| | 261407 | 195 | 9.6 | 9.6 | 9.1 | 12 | 42 | 0 | 18 | 24 | 44 | 1446 | 326 | 11.7 | 3948 | 51 | 1.8 | 4.1 |
| | 261556 | 149 | 9.6 | 9.6 | 9.2 | 12 | 40 | 0 | 16 | 24 | 46 | 1698 | 352 | 11.8 | 3989 | 41 | 1.9 | 9.9 |
| | 261735 | 179 | 9.6 | 9.6 | 9.2 | 12 | 38 | 0 | 14 | 24 | 46 | 1991 | 302 | 11.9 | 4031 | 42 | 1.7 | 10.8 |
| | 261930 | 95 | | | | | | | | | | 2146 | 155 | 11.4 | 4052 | 21 | 1.5 | 11.7 |
| TOTAL | | 1330 | | | | | | | | | | | 2197 | | | 334 | | |

Wells — Hours Run (totals): 15, 10, 15, 10, 9

D-97

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

Pump TEST

DATE 5-12-88

| WELLS HOURS RUN | | | | | | | | | | | | SPARKLING | | P H | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME Days 43 | | | ALUM Days 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6A | 6B | 7 | 8 | 9 | 10A | 11 | 12 | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | SH | HCO3 | CO3 | N | 22 | 19 | Lbs Used | Grain per Gallon | 4 | 2 | Lbs Used | Grain per Gallon | Clear Well Ft. |
| | | | | | | | | | | | | | 241830 | | | | | | | | | | | 2146 | | | 4052 | | | 11.7 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | 261978 | 48 | 9.5 | 9.4 | 9.2 | 12 | 30 | 0 | 6 | 28 | 94 | 2230 | 184 | 12.3 | 4083 | 3.3 | 4.8 | 6.0 |
| | | | | | | | | | | | | | 262151 | 383 | 9.5 | 9.5 | 9.3 | 12 | 46 | 6 | 12 | 24 | 142 | 2345 | 335 | 11.6 | 4134 | 5.1 | 1.9 | 7. |
| | | | | | | | | | | | | | 262283 | 262 | 9.6 | 9.4 | 9.1 | 14 | 38 | 6 | 14 | 26 | 168 | 2346 | 341 | 11.5 | 4142 | 5.3 | 1.5 | 7. |
| | | | | | | | | | | | | | 262434 | 171 | 9.5 | 9.6 | 9.1 | 12 | 50 | 6 | 14 | 24 | 96 | 3193 | 257 | 11.7 | 4237 | 4.7 | 1.9 | 7.2 |
| | | | | | | | | | | | | | 262611 | 157 | 9.5 | 9.5 | 9.1 | 14 | 34 | 6 | 6 | 28 | 96 | 3453 | 260 | 11.6 | 4282 | 4.7 | 1.9 | 7.2 |
| | | | | | | | | | | | | | 262765 | 158 | 9.5 | 9.6 | 9.1 | 14 | 32 | 6 | 8 | 28 | 94 | 3711 | 256 | 11.4 | 4323 | 4.1 | 1.8 | 7.0 |
| | | | | | | | | | | | | | 262928 | 155 | 9.5 | 9.6 | 9.1 | 12 | 32 | 6 | 8 | 24 | 50 | 3971 | 260 | 11.4 | 4363 | 4.6 | 1.8 | 6.8 |
| | | | | | | | | | | | | | 263084 | 156 | 9.5 | 9.7 | 9.1 | 12 | 34 | 0 | 10 | 24 | 80 | 4226 | 255 | 11.4 | 4403 | 4.6 | 1.8 | 6.8 |
| | | | | | | | | | | | | | 263166 | 82 | | | | | | | | | | 4357 | 131 | | 4424 | 2.1 | | 11.7 |
| | | | | | | | | | | | | | 1336 | | | | | | | | | | | 211 | | | 372 | | | |

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

HRS FINISHED PUMP TEST
HRS STARTED RECOVERY
DATE 5-13-91

| WELLS | SPARLING | | PH | | | CHEM. ANALYSIS | | | | | | | LIME | | | ALUM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HOURS RUN | | | | | | Filter Influent PPM: | | | | | | | Bags 37 | | | Bags 6 | | | |
| 1 2 3 4 5 6 7 8 9 10 11 12 | Meter | Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | HCO3 | CO3 | N | | 18 19 | Lbs Used | Grain per Gallon | 3 3 | Lbs Used | Grain per Gallon | Clear Well pH |
| | 263166 | | | | | | | | | | | | 4357 | | | 4924 | | | 11.7 |
| | 263357 | 191 | 9.5 | 9.6 | 9.2 | 0 | 30 | 0 | 10 | 34 | 96 | | 4681 | 324 | 11.9 | 4475 | 51 | 1.9 | 8.2 |
| | 263537 | 180 | 9.5 | 9.6 | 9.2 | 12 | 34 | 0 | 18 | 24 | 92 | | 4491 | 310 | 12.0 | 4524 | 49 | 1.9 | 8.2 |
| | 263655 | 118 | 9.5 | 9.6 | 9.2 | 12 | 34 | 0 | 10 | 24 | 94 | | 5196 | 285 | 12.1 | 4558 | 34 | 2.0 | 7.5 |
| | 263771 | 116 | 9.7 | 9.7 | 9.2 | 14 | 32 | 0 | 4 | 28 | 92 | | 5397 | 201 | 12.1 | 4592 | 34 | 2.1 | 7.1 |
| | 263895 | 124 | 9.7 | 9.8 | 9.2 | 16 | 32 | 0 | 0 | 32 | 94 | | 5600 | 203 | 11.1 | 4623 | 31 | 1.7 | 6.0 |
| | 263993 | 98 | 9.8 | 9.8 | 9.2 | 16 | 30 | 2 | 0 | 32 | 94 | | 5722 | 122 | 11.5 | 4641 | 18 | 1.7 | 7.5 |
| | 264162 | 169 | 9.8 | 9.8 | 9.2 | 16 | 32 | 0 | 0 | 32 | 90 | | 6036 | 304 | 11.3 | 4690 | 49 | 1.8 | 6.8 |
| | 264322 | 160 | | | | | | | | | | | 6294 | 168 | 11.7 | 4731 | 41 | 1.8 | 11.7 |
| | 1156 | | | | | | | | | | | | 1937 | | | 307 | | | |

DEC 19 '91 14:41
PAGE.003
12/19/91 14:30
003

OLC-40B Olin

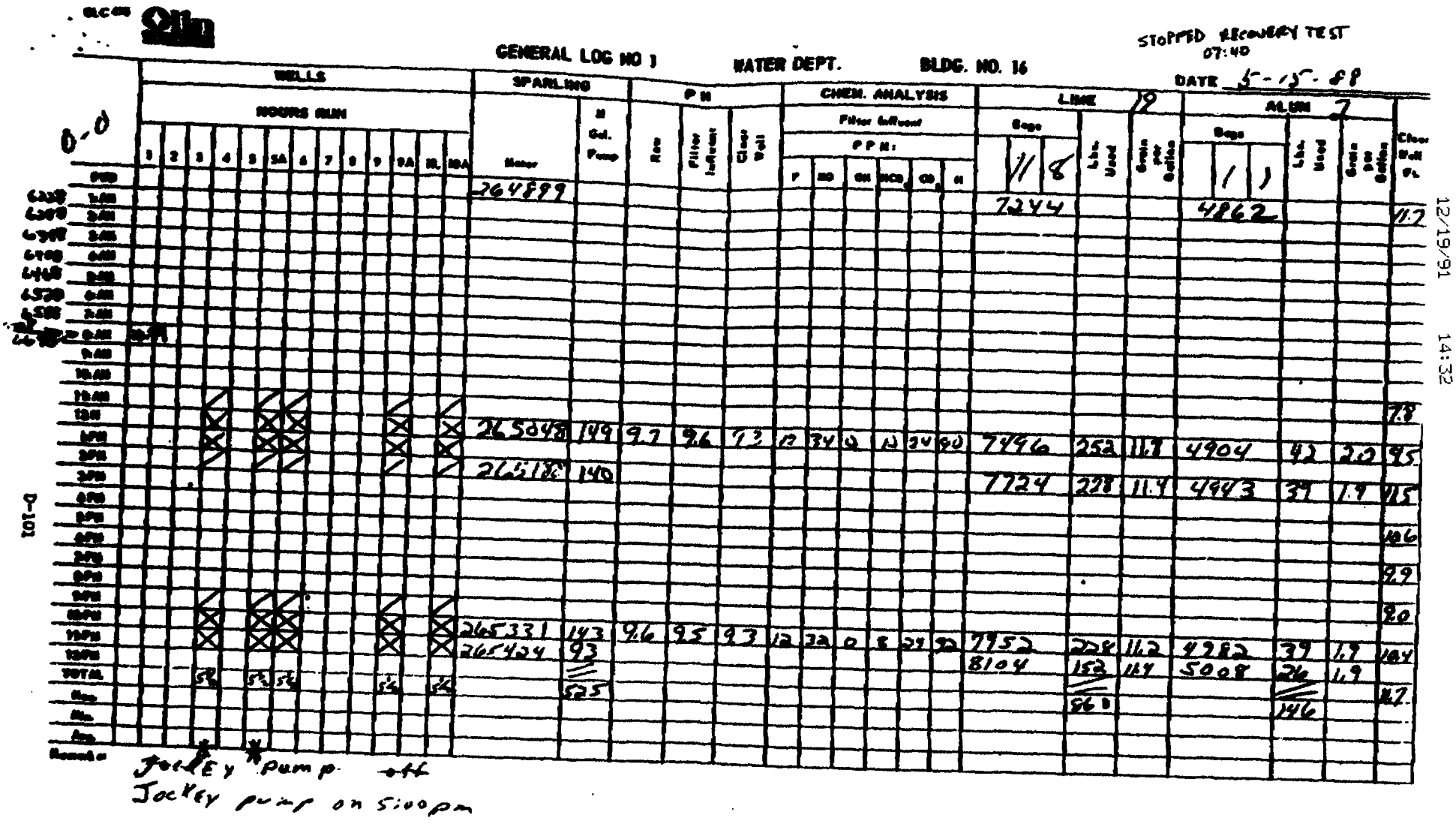
D-D

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

Recovery Test
DATE 5-14-88

| | WELLS – HOURS RUN | | | | | | | | | | | | | SPARLING | | P H | | | CHEM. ANALYSIS – Filter Influent – P P M: | | | | | | LIME | | | ALUM | | | Clear Well |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | [illegible] | 5 | [illegible] | [illegible] | 7 | 8 | 9 | [illegible] 9A | [illegible] | [illegible] | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | $HCO_3$ | $CO_3$ | H | Bags | Lbs. Used | Grains per Gallon | Bags | Lbs. Used | Grains per Gallon | Ph. |
| PSD | | | | | | | | | | | | | | | | | | | | | | | | | 10 9 | | | 0 2 | | | |
| [illegible] | | | | | | | | | | | | | | 264322 | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | 6294 | | | 4231 | | | 11.7 |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | [illegible] | | X | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | X | | | X | X | | | | | | X | | | | | | | | | | | | | | | | | | |
| [illegible] | | | X | | | X | X | | | | | | X | 264480 | 159 | 9.7 | 9.8 | 9.4 | 16 | 34 | 0 | 2 | 32 | 83 | 6556 | 262 | 11.6 | 4764 | 23 | 1.5 | 9.2 |
| [illegible] | [illegible] | | X | | | X | X | | | | | | X | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | X | 264641 | 161 | | | | | | | | | | 6823 | 267 | 11.6 | 4796 | 32 | 1.4 | 11.5 |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10.5 |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 9.9 |
| [illegible] | [illegible] | | / | | | / | / | | | | | | / | | | | | | | | | | | | | | | | | | |
| [illegible] | | | X | | | X | X | | | | | | X | | | | | | | | | | | | | | | | | | 8.7 |
| [illegible] | | | X | | | X | X | | | | X | | X | 264761 | 120 | 8.6 | 9.5 | 9.4 | 14 | 34 | 0 | 6 | 28 | 92 | 7020 | 197 | 11.5 | 4827 | 31 | 1.8 | 7.4 |
| [illegible] | [illegible] | | / | | | / | / | | | | / | | / | | | | | | | | | | | | | | | | | | |
| TOTAL | | | 7 | | | 7 | 7 | | | | 13 | | 7 | 264899 | 138 | | | | | | | | | | 7244 | 226 | 11.4 | 4862 | 35 | 1.8 | 11.7 |
| Max. | | | | | | | | | | | | | | = | | | | | | | | | | | = | | | = | | | |
| Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avg. | | | | | | | | | | | | | | 577 | | | | | | | | | | | 950 | | | 131 | | | |
| Remarks | | | * | | | * | | | | | | | | | | | | | | | | | | | | | | | | | |

D-100



GENERAL LOG NO 1 — WATER DEPT. — BLDG. NO. 16

STOPPED RECOVERY TEST 07:40

DATE 5-15-91

WELLS — HOURS RUN: 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A

| SPARLING Meter | SPARLING Gal. Pump | PH Raw | PH Filter Influent | PH Clear Well | CHEM. ANALYSIS Filter Influent PPM: P | MO | OH | HCO3 | CO3 | H | LIME Bags 11 | LIME Lbs Used | LIME Grain per Gallon | ALUM Bags 7 | ALUM Lbs Used | ALUM Grain per Gallon | Clear Well PH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 264899 | | | | | | | | | | | 7244 | | | 4862 | | | 11.2 |
| 265048 | 149 | 9.7 | 9.6 | 9.3 | 12 | 34 | 0 | 12 | 34 | 30 | 7446 | 252 | 11.9 | 4904 | 42 | 2.0 | 9.5 |
| 265182 | 140 | | | | | | | | | | 7724 | 228 | 11.4 | 4943 | 39 | 1.9 | 9.5 |
| | | | | | | | | | | | | | | | | | 10.6 |
| | | | | | | | | | | | | | | | | | 9.9 |
| | | | | | | | | | | | | | | | | | 9.0 |
| 265331 | 143 | 9.6 | 9.5 | 9.3 | 12 | 32 | 0 | 8 | 24 | 32 | 7952 | 228 | 11.2 | 4982 | 39 | 1.9 | 10.4 |
| 265424 | 93 | | | | | | | | | | 8104 | 152 | 11.4 | 5008 | 26 | 1.9 | |
| TOTAL | 525 | | | | | | | | | | | 961 | | | 146 | | 11.7 |

Jockey pump off
Jockey pump on 5:00pm

Olin

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16 DATE 5-16-88

| | WELLS HOURS RUN | | | | | | | | | | | | | SPARLING | | PH | | | CHEM. ANALYSIS Filter Influent PPM: | | | | | | LIME Bags 19 19 | | | ALUM Bags 3 2 | | | Clear Well Ph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | Meter | M Gal. Pump | Raw | Filter Influent | Clear Well | P | MO | OH | $HCO_3$ | $CO_2$ | H | Lbs. Used | Grain per Gallon | Lbs. Used | Grain per Gallon | |
| MID | | | | | | | | | | | | | | 265424 | | | | | | | | | | | 8104 | | | 5008 | | | |
| 1AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9AM | | X | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | 6.5 |
| 10AM | | X | | X | | | | | | | X | | X | 265601 | 177 | 9.4 | 9.3 | 9.3 | 10 | 30 | 0 | 10 | 20 | 100 | 8392 | 288 | 11.4 | 5055 | 47 | 1.9 | 7.3 |
| 11AM | | X | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | |
| 12N | | X | | X | | | | | | | X | | X | 265778 | 177 | 9.5 | 9.2 | 9.3 | 14 | 34 | 0 | 6 | 28 | 98 | 8678 | 286 | 11.3 | 5101 | 46 | 1.8 | 7.3 |
| 1PM | | X | | X | | X | | | | | X | | X | | | | | | | | | | | | | | | | | |
| 2PM | | X | | X | | X | | | | | X | | X | 265982 | 204 | 9.5 | 9.3 | 9.2 | 12 | 34 | 0 | 10 | 24 | 96 | 9010 | 332 | 11.4 | 5149 | 48 | 1.6 | 7.6 |
| 3PM | | X | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | |
| 4PM | | X | | X | | | | | | | X | | X | 266158 | 176 | 9.5 | 9.3 | 9.2 | 10 | 32 | 0 | 12 | 20 | 92 | 9294 | 284 | 11.3 | 5195 | 46 | 1.8 | 7.7 |
| 5PM | | X | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | |
| 6PM | | X | | X | | | | | | | X | | X | 266333 | 175 | 9.5 | 9.3 | 9.2 | 10 | 32 | 0 | 12 | 20 | 92 | 9577 | 283 | 11.3 | 5240 | 45 | 1.8 | 9.4 |
| 7PM | | X | | | | | | | | | X | | X | | | | | | | | | | | | | | | | | |
| 8PM | | X | | | | | | | | | X | | X | 266476 | 143 | 9.5 | 9.3 | 9.2 | 10 | 32 | 0 | 12 | 20 | 92 | 9806 | 229 | 11.2 | 5276 | 36 | 1.8 | 9.9 |
| 9PM | | X | | | | | | | | | X | | X | | | | | | | | | | | | | | | | | |
| 10PM | | X | | | | | | | | | X | | X | 266617 | 141 | 9.5 | 9.4 | 9.2 | 10 | 34 | 0 | 14 | 20 | 90 | 32 | 226 | 11.2 | 5312 | 36 | 1.8 | 11.2 |
| 11PM | | / | | | | | | | | | / | | / | | | | | | | | | | | | | | | | | |
| 12PM | | | | | | | | | | | | | | 266717 | 100 | | | | | | | | | | | | | | | | |
| TOTAL | | 18 | | 10 | | 2 | | | | | 12 | | 14 | 1297 | | | | | | | | | | | 194 | 462 | 11.3 | 5337 | 25 | 1.8 | 11.7 |
| Max. | | | | | | | | | | | | | | | | | | | | | | | | | 2590 | | | 529 | | | |
| Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avg. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks

D-102

OLC 435 Olin Water Services

GENERAL LOG NO 1 WATER DEPT. BLDG. NO. 16

STOPPED RECOVERY TEST 07:40

DATE 5-15-88

0.0

| | WELLS HOURS RUN 1 | 2 | 3 | 4 | 5 | 5A | 6 | 7 | 8 | 9 | 9A | 10 | 10A | SPARLING Meter | M Gal. Pump | PH Raw | PH Filter Influent | PH Clear Well | CHEM. ANALYSIS Filter Influent PPM: P | MO | OH | $HCO_3$ | $CO_3$ | H | LIME Bags 1/2 | Lbs. Used | Grain per Gallon | ALUM Bags 1/2 | Lbs. Used | Grain per Gallon | Clear Well Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PWD | | | | | | | | | | | | | | 264899 | | | | | | | | | | | | | | | | | |
| 6238 1 AM | | | | | | | | | | | | | | | | | | | | | | | | | 7244 | | | 4862 | | | 11.7 |
| 6288 2 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6348 3 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6408 4 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6468 5 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6528 6 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6588 7 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6648 8 AM | 10.9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 AM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7.8 |
| 12 N | | | | | | | | | | | | | | 265048 | 149 | 9.7 | 9.6 | 7.3 | 10 | 34 | 0 | 12 | 24 | 20 | 7496 | 252 | 11.8 | 4904 | 42 | 2.0 | 9.5 |
| 1 PM | | | | | | | | | | | | | | 265187 | 140 | | | | | | | | | | 7724 | 228 | 11.4 | 4943 | 39 | 1.9 | 11.5 |
| 2 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10.6 |
| 3 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 9.9 |
| 4 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 9.0 |
| 5 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 PM | | | | | | | | | | | | | | 265331 | 143 | 9.6 | 9.5 | 9.3 | 12 | 32 | 0 | 8 | 24 | 22 | 7952 | 224 | 11.2 | 4982 | 39 | 1.9 | 10.4 |
| 11 PM | | | | | | | | | | | | | | 265424 | 93 | | | | | | | | | | 8104 | 152 | 11.4 | 5008 | 26 | 1.9 | |
| 12 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 11.7 |
| TOTAL | | | 5½ | | 5½ | 5½ | | | | | 5½ | | 5½ | | 525 | | | | | | | | | | | 880 | | | 146 | | |
| Max. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Min. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avg. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Remarks: Jockey pump off

Jockey pump on 5:00pm

D-101

# APPENDIX E

## EQUATIONS USED FOR ANALYSIS OF PUMPING TEST DATA

**Barometric Efficiency (BE)**

$$BE = \frac{wdh}{dP_a}$$ where

$w$ = unit weight of water
$dh$ = change in head
$dP_a$ = change in atmospheric pressure

**Relationship of Aquifer Storage (S) to BE**

$$s = \frac{n\beta\rho_w g}{BE}$$ where,

$n$ = porosity
$\beta$ = aquifer compressibility
$\rho_w$ = density of water
$g$ = gravitational constant

**Equations for calculating aquifer characteristics for a leaky system with release from storage from the aquitard layer and partially penetrating wells (Hantush, 1964; Walton 1979).**

$$s = \frac{Q}{4\pi T} W(u,T)+W\left(\frac{r}{m}\sqrt{P_v/P_h}\ l',d',y'\right)$$ where,

$s$ = drawdown (ft).
$T$ = transmissivity
$Q$ = discharge
$W(u,T)$ = well function for a leaky confined aquifer
$W(r/m\sqrt{P_v/P_h})$ = well function correction for a leaky confined aquifer with partially penetrating wells having no storage capacity and long pumping periods.
$r$ = radial distance from the pumping well to the observation well (ft.)
$m$ = aquifer thickness
$P_v$ = vertical permability of aquifer
$P_h$ = horizontal permeability of aquifer
$l',d',y'$ = define geometry of production well and observation wells relative.
$s$ = $\frac{Tt}{1.87\ r^2}$ where,
$u$ = dimensionless parameter of the well function exponential defined through curve matching.
$t$ = time (days)
$T$ = transmissivity (gpd/ft)

# APPENDIX F

# STATISTICAL BACKGROUND VALUES

Calculation of statistical significance of individual parameter data with average background data using Cochran's Approximation to the Behrens-Fisher students' t-test as adapted from 40CFR Part 264, Appendix IV.

Calculate the mean ($\bar{X}_B$) and variance ($S^2_B$) for background data.

For the monitoring date, the analytical result constitutes the value ($V_m$), and its variance ($S^2_m$) will be zero.

This data is used to calculate a t-statistic (t*), and a comparison t-statistic ($t_c$).

The value of t* is calculated as follows:

$$t^* = \frac{V_m - \bar{X}_B}{\sqrt{(S^2_B/N_B) + (S^2_m/N_m)}}$$

If the value of t* is negative ($X_B > V_m$), then there can be no significant increase, since the background is greater than the monitoring point.

If the value of t* is positive ($V_m > X_B$) then the $t_c$ value must be calculated for comparison:

$$t_c = \frac{(S^2_B/N_B)\ (t_B\ ) + (S^2_m/N_m)\ (tm)}{(S^2_B/N_B) + (S^2_m/N_m)}$$

Since the monitoring value variance ($S_m^2$) is zero, the formula reduces to:

$$t_c = \frac{(S^2_B/N_B)\ (t_B)}{(S^2_B/N_B)} = t_B$$

If the value of $t^*$ is equal to or larger than $t_c$, then there most likely has been a significant increase for the parameter.

If the value of $t^*$ is less than $t_c$, then there most likely has not been a significant increase for the parameter.

The use of zero variance for the monitoring value is rather conservative, since no allowance for analytical variability is considered.

However, this conservative approach may be justified under these circumstances.

Solve for the value $V_m$ where $t^* = t_c$.

IF a discrete monitoring value is $\geq V_m$ then there most likely has been a significant increase above background for the parameter.

IF a discrete monitoring value is $< V_m$ then there most likely has not been a significant increase above background for the parameter.

$$t^* = \frac{V_m - \bar{X}_B}{\sqrt{\frac{S^2_B}{N_B} + \frac{S^2_m}{0}}} = \frac{V_m - \bar{X}_B}{\sqrt{\frac{S^2_B}{N_B}}} = \frac{V_m - \bar{X}_B}{\frac{S_B}{\sqrt{N_B}}}$$

$$V_m = t^*\left(\frac{S_B}{\sqrt{N_B}}\right) + \bar{X}_B = \bar{X}_B + t_B \frac{S_B}{\sqrt{N_B}}$$

where $\bar{X}_B$ = Background mean
$t_B$ = From T-Table one tail at $N_B - 1$ degrees of Freedom (df)
$S_B$ = Background stand. deviation
$N_B$ = Number of backg. samples

Example:

| Background Data |
|---|
| 10 units |
| 15 units |
| 20 units |
| 25 units |

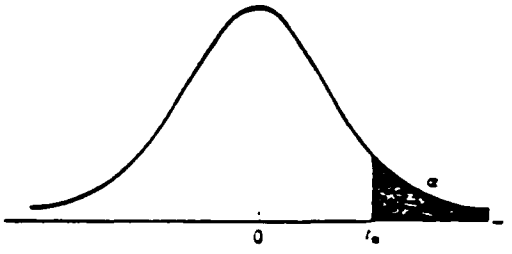
| Monitoring Data | Significant Above Background |
|---|---|
| 20 | NO |
| 18 | NO |
| 30 | YES |
| 35 | yes |
| 10 | No |
| 40 | yes |
| 25 | YES |

$N_B = 4$
$\bar{X}_B = 17.5$
$S_B = 5.59$
$\alpha = .05$ (95% confidence - one tail)
$F = 4-1 = 3$
$t_B = 2.353$

$$V_m = 17.5 + 2.353\left(\frac{5.59}{\sqrt{4}}\right) = 24.08$$

Therefore all monitoring data shown above that is $\geq V_m$ falls outside the 95% confid... level &

## TABLE E Student $t$ Distribution




The following table provides the values of $t_\alpha$ that correspond to a given upper-tail area $\alpha$ and a specified number of degrees of freedom.

| Degrees of Freedom | Upper-Tail Area $\alpha$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | .4 | .25 | .1 | .05 | .025 | .01 | .005 | .0025 | .001 | .0005 |
| 1 | 0.325 | 1.000 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 127.32 | 318.31 | 636.62 |
| 2 | .289 | 0.816 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 14.089 | 22.327 | 31.598 |
| 3 | .277 | .765 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 7.453 | 10.214 | 12.924 |
| 4 | .271 | .741 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 5.598 | 7.173 | 8.610 |
| 5 | 0.267 | 0.727 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 4.773 | 5.893 | 6.869 |
| 6 | .265 | .718 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 4.317 | 5.208 | 5.959 |
| 7 | .263 | .711 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 4.029 | 4.785 | 5.408 |
| 8 | .262 | .706 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 3.833 | 4.501 | 5.041 |
| 9 | .261 | .703 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 3.690 | 4.297 | 4.781 |
| 10 | 0.260 | 0.700 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 3.581 | 4.144 | 4.587 |
| 11 | .260 | .697 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 3.497 | 4.025 | 4.437 |
| 12 | .259 | .695 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 3.428 | 3.930 | 4.318 |
| 13 | .259 | .694 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 3.372 | 3.852 | 4.221 |
| 14 | .258 | .692 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 3.326 | 3.787 | 4.140 |
| 15 | 0.258 | 0.691 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 3.286 | 3.733 | 4.073 |
| 16 | .258 | .690 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 3.252 | 3.686 | 4.015 |
| 17 | 2.57 | .689 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.222 | 3.646 | 3.965 |
| 18 | .257 | .688 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.197 | 3.610 | 3.922 |
| 19 | .257 | .688 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.174 | 3.579 | 3.883 |
| 20 | 0.257 | 0.687 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.153 | 3.552 | 3.850 |
| 21 | .257 | .686 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.135 | 3.527 | 3.819 |
| 22 | .256 | .686 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.119 | 3.505 | 3.792 |
| 23 | .256 | .685 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.104 | 3.485 | 3.767 |
| 24 | .256 | .685 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.091 | 3.467 | 3.745 |
| 25 | 0.256 | 0.684 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.078 | 3.450 | 3.725 |
| 26 | .256 | .684 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.067 | 3.435 | 3.707 |
| 27 | .256 | .684 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.057 | 3.421 | 3.690 |
| 28 | .256 | .683 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.047 | 3.408 | 3.674 |
| 29 | .256 | .683 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.038 | 3.396 | 3.659 |
| 30 | 0.256 | 0.683 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.030 | 3.385 | 3.646 |
| 40 | .255 | .681 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 2.971 | 3.307 | 3.551 |
| 60 | .254 | .679 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 2.915 | 3.232 | 3.460 |
| 120 | .254 | .677 | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 | 2.860 | 3.160 | 3.373 |
| ∞ | .253 | .674 | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 2.807 | 3.090 | 3.291 |

SOURCE: E.S. Pearson and H.O. Hartley, *Biometrika Tables for Statisticians*, Vol. I. London: Cambridge University Press, 1966. Partly derived from Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group Ltd., London (previously published by Oliver & Boyd, Edinburgh, 1963). Reproduced with permission of the authors and publishers.

| BACKGROUND GROUNDWATER | | Well 1-4 | | Well 1-5 | Well 4-6 | | Well 8-6 | | Well 11-3 | | Well 17-1 | Detection Level | $X_B$ | $S_B$ | Vm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Round 1 | Round 2 | Round 2 | Round 1 | Round 2 | Round 1 | Round 2 | Round 1 | Round 2 | Round 1 | | | | Log | Anti-Log |
| Antimony | dis | ND | ND | ND | ND | 0.67 | ND | ND | ND | ND | ND | 0.18 | 0.23 | 0.15 | 0.32 | 2.07 |
| | tot | ND | ND | ND | ND | 1.06 | ND | ND | ND | ND | ND | 0.18 | 0.27 | 0.26 | 0.42 | 2.64 |
| Arsenic | dis | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.40 | — | — | — | 2.51 |
| | tot | ND | ND | 1.23 | ND | ND | 0.71 | 0.88 | ND | ND | ND | 0.40 | 0.56 | 0.27 | 0.72 | 5.21 |
| Barium | dis | | 2.05 | 2.51 | | 2.12 | | 2.14 | | 2.37 | | 1.10 | 2.25 | 0.17 | 2.41 | 2.58 |
| | tot | | 2.13 | 3.17 | | 2.19 | | 2.60 | | 2.56 | | 1.10 | 2.52 | 0.39 | 2.89 | 780. |
| Beryllium | dis | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.05 | — | — | — | 0.05 |
| | tot | 0.47 | -0.30 | -0.26 | -0.70 | -0.70 | -0.15 | -0.09 | -0.22 | -0.30 | -0.04 | -1.30 | -0.23 | 0.32 | -0.04 | 0.90 |
| Cadmium | dis | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.41 | — | — | — | 2.55 |
| | tot | ND | ND | 1.39 | ND | 1.52 | ND | ND | ND | ND | ND | 0.41 | 0.62 | 0.42 | 0.86 | 7.31 |
| Chromium | dis | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.27 | — | — | — | 18.62 |
| | tot | ND | ND | 1.69 | ND | 1.54 | ND | ND | ND | ND | ND | 1.27 | 1.34 | 0.14 | 1.42 | 26.38 |
| Copper | dis | ND | ND | ND | 0.70 | ND | ND | ND | ND | ND | 0.56 | -0.05 | 0.09 | 0.27 | 0.25 | 1.76 |
| | tot | 1.85 | 1.04 | 2.30 | 1.19 | 0.59 | 1.62 | 1.48 | 1.35 | 1.48 | 1.12 | -0.05 | 1.40 | 0.45 | 1.66 | 45.82 |

| | | Well 1-4 | | Well 1-5 | Well 4-6 | | Well 8-6 | | Well 11-3 | | Well 17-1 | Detection Level | | | Vm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Round 1 | Round 2 | Round 2 | Round 1 | Round 2 | Round 1 | Round 2 | Round 1 | Round 2 | Round 1 | | XB | SB | log | anti-log |
| Lead | dis | 0.50 | 0.92 | ND | ND | ND | ND | ND | ND | 0.75 | ND | 0.10 | 0.29 | 0.30 | 0.46 | 2.91 |
| | tot | 1.76 | ND | 1.65 | 0.55 | ND | 1.36 | 1.30 | ND | 1.42 | 1.57 | 0.10 | 0.99 | 0.66 | 1.37 | 23.58 |
| Mercury | dis | -0.70 | ND | ND | ND | ND | ND | ND | ND | ND | ND | -1.10 | -1.06 | 0.12 | -0.99 | 0.08 |
| | tot | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | -1.10 | — | — | — | 0.08 |
| Nickel | dis | 1.15 | ND | ND | 1.22 | ND | ND | ND | 1.28 | ND | ND | 0.68 | 0.84 | 0.25 | 0.98 | 9.66 |
| | tot | 1.90 | ND | 2.54 | 1.16 | 0.99 | 1.48 | 1.68 | 1.5 | 1.71 | 1.45 | 0.68 | 1.51 | 0.49 | 1.79 | 62.23 |
| Selenium | dis | 0.87 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.40 | — | — | — | 2.51 |
| | tot | ND | 0.75 | ND | ND | ND | ND | ND | ND | ND | ND | 0.40 | 0.43 | 0.10 | 0.48 | 3.79 |
| Silver | dis | ND | ND | ND | ND | ND | ND- | ND | ND | ND | ND | -1.05 | — | — | — | 0.09 |
| | tot | ND | -0.68 | -0.28 | ND | ND | ND | -0.49 | ND | ND | ND | -1.05 | -0.88 | 0.27 | -0.72 | 0.19 |
| Zinc | dis | 2.65 | 1.52 | 1.32 | 2.43 | 1.48 | 2.71 | 1.26 | 2.96 | ND | 2.90 | 0.93 | 2.02 | 0.74 | 2.45 | 281. |
| | tot | 2.87 | 1.79 | 3.04 | 3.04 | 2.85 | 2.77 | 2.36 | 2.99 | 2.34 | 2.98 | 0.93 | 2.70 | 0.39 | 2.93 | 844. |

## BACKGROUND SOILS

| | BGS1 | BGS2 | BGS3 | BGS4 | $\bar{X}$ | $S_B$ | Vm log | Vm antilog |
|---|---|---|---|---|---|---|---|---|
| Barium | 2.28 | 2.17 | 2.41 | 2.31 | 2.29 | 0.09 | 2.40 | 249 ug/g |
| Beryllium | -0.55 | -0.55 | -0.35 | -0.51 | -0.49 | 0.08 | -0.41 | 0.40 ug/g |
| Chromium | 1.11 | 1.12 | 1.13 | 1.11 | 1.12 | 0.01 | 1.13 | 13.49 ug/g |
| Copper | 1.05 | 1.11 | 1.35 | 1.18 | 1.17 | 0.11 | 1.30 | 19.95 ug/g |
| Lead | 0.89 | 0.80 | 1.17 | 1.02 | 0.97 | 0.14 | 1.13 | 13.49 ug/g |
| Nickel | 1.35 | 1.56 | 1.29 | 1.31 | 1.38 | 0.11 | 1.51 | 32.36 ug/g |
| Zinc | 1.83 | 2.10 | 1.99 | 1.93 | 1.96 | 0.10 | 2.08 | 120.2 ug/g |
| Arsenic | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.00 | 0.45 | 2.82 ug/g |
| Cadmium | -0.46 | -0.46 | -0.46 | -0.46 | -0.46 | 0.00 | -0.46 | 0.35 ug/g |
| Mercury | -1.30 | -1.30 | -1.30 | -1.30 | -1.30 | 0.00 | -1.30 | 0.05 ug/g |
| Antimony | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.00 | 0.10 | 1.26 ug/g |
| Silver | -0.49 | -0.49 | -0.49 | -0.49 | -0.49 | 0.00 | -0.49 | 0.32 ug/g |
| Selenium | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.00 | 0.02 | 1.05 ug/g |

# Background Surface Water Inorganics

| | SW-16 |
|---|---|
| Copper | 4.93 ug/l |
| Nickel | 12.00 ug/l |
| Zinc | 404.00 ug/l |
| all others | ND |

(only one background sample was collected)

# APPENDIX G

# CHEMICAL DATA

The LCAAP Level Three chemical data will be submitted at a later date as a separate addendum to this RI.

# APPENDIX H

# TOXICITY SUMMARIES

# APPENDIX H
# TOXICITY SUMMARIES

## Antimony

Antimony was detected in the monitoring well within the production well capture zone, Area 1, 2, 4, 5, 8, and 17 groundwater wells, in surface water in the Area 13 drainage ditch, the pond, and Ditch B, and in subsurface soil in Area 15.

Antimony is a metal which occurs both in the trivalent and pentavalent oxidation states (EPA 1980). Absorption of this metal via oral and inhalation routes of exposure is low (EPA 1980). Humans and animals exposed acutely orally or through inhalation to either trivalent or pentavalent forms of antimony displayed electrocardiogram (ECG) changes and myocardial lesions (EPA 1980). Pneumoconiosis has been observed in humans exposed by acute inhalation and dermatitis has occurred in individuals exposed either orally or dermally. Oral administration of therapeutic doses in humans has been associated with nausea, vomiting, and hepatic necrosis (EPA 1980). Chronic exposure by inhalation of antimony has lead to respiratory effects including microphage proliferation and activity, fibrosis and pneumonia in animals (EPA 1980). A single report (Balyeava 1967) noted an increase in spontaneous abortions, premature births, and gynecological problems in 318 female workers exposed to a mixture of antimony metal, antimony trioxide, and antimony pentasulfide dusts.

EPA (1988) derived an oral RfD of $4 \times 10^{-4}$ mg/kg/day for antimony based on a chronic oral study (Schroeder et al. 1970) in which rats given the metal in drinking water had altered blood glucose and blood cholesterol levels and decreased lifespan. By using an uncertainty factor of 1,000, a LOAEL of 0.35 mg/kg/day was used to derive the oral RfD.

Arsenic

Arsenic was detected in groundwater in the production wells, the monitoring well within the production well capture zone, and Area 1, 2, 3, 4, 5, 6, 7, 8, 16, and 17 wells and in surface water in the pond and Ditch B. It was also detected in sediments in the Area 13 and 16 drainage ditches, the Area 16 leachate seep, Ditch B, and the big ditch. In surface soils, arsenic was detected in Area 9 and 13 and in subsurface soils in Area 8, 14, and 15.

Both inorganic and organic forms of arsenic are readily absorbed via the oral and inhalation routes. Soluble forms are more readily absorbed than the insoluble forms (EPA 1984). Approximately 95% of soluble inorganic arsenic administered to rats is absorbed from the gastrointestinal tract (Coulson et al. 1935, Ray-Bettley and O'Shea 1975). Approximately 70%-80% of arsenic deposited in the respiratory tract of humans has been shown to be absorbed (Holland et al. 1959). Dermal absorption is not significant (EPA 1984). Acute exposure of humans to metalic arsenic has been associated with gastrointestinal effects, hemolysis, and neuropathy (EPA 1984). Chronic exposure of humans to this metal can produce toxic effects on both the peripheral and central nervous systems, keratosis, hyperpigmentation, precancerous dermal lesions, and cardiovascular damage (EPA 1984). Arsenic is embryotoxic, fetotoxic, and teratogenic in several animals species (EPA 1984). Arsenic is a known human carcinogen. Epidemiological studies of workers in smelters and in plants manufacturing arsenical pesticides have shown that inhalation of arsenic is strongly associated with lung cancer and perhaps with hepatic angiosarcoma (EPA 1984). Ingestion of arsenic has been linked to a form of skin cancer and more recently to bladder, liver, and lung cancer (Tseng 1977, Tseng et al. 1968, Chen et al. 1986).

EPA has classified arsenic in Group A--Human Carcinogen--and has developed inhalation (EPA 1988a) and (1988b) oral cancer potency factors of 50 $(mg/kg/day)^{-1}$ and 1.75 $(mg/kg/day)^{-1}$, respectively. The inhalation potency factor is the geometric mean value of potency factors derived from four

occupational exposure studies on two different exposure populations (EPA 1984). The oral cancer potency factor was based on an epidemiological study in Taiwan which indicated an increased incidence of skin cancer in individuals exposed to arsenic in drinking water (Tseng 1977). EPA (1988b) has reported an oral reference dose (RfD) of $1x10^{-3}$ mg/kg/day based on the study by Tseng (1977) in which blackfoot disease was observed in humans exposed to arsenic in their drinking water. An uncertainty factor of 1 was used to develop the RfD. The EPA is currently reviewing the oral RfD (EPA 1988a).

Barium

Barium was detected in the monitoring well within the production well capture zone and Area 6 groundwater wells.

Adverse effects in humans following oral exposure to soluble barium compounds include gastroenteritis, muscular paralysis, hypertension, ventricular fibrillation, and central nervous system damage (EPA 1984, Perry et al. 1983). Inhalation of barium sulfate or barium carbonate in occupationally exposed workers has been associated with baritosis, a benign pneumoconiosis (Goyer 1986). Experimental animals exposed chronically to barium in drinking water developed increased blood pressure (EPA 1984). Inhalation of barium carbonate dust by experimental animals has been associated with reduced sperm count, increased fetal mortality, and atresia of the ovarian follicles (EPA 1984 Tarasenko et al. 1977).

EPA (1988) derived an oral reference dose (RfD) based on a chronic rat study in which a lowest-observed-adverse-effect level (LOAEL) for increased blood pressure was observed (Perry et al. 1983). Using the LOAEL of 5.1 mg/kg/day and an uncertainty factor of 100, an oral RfD of $5x10^{-2}$ mg/kg/day was calculated. EPA (1989) has also developed an inhalation RfD of $1.4x10^{-4}$ mg/kg/day for barium based on a study by Tarasenko et al. (1977). In this study rats were exposed to barium carbonate dust at airborne concentrations of up to 5.2 $mg/m^3$ for 4-6 months. Adverse effects noted at

this concentration included decreased body weight, alterations in liver function, and increased fetal mortality. An uncertainty factor of 1,000 was used in developing the RfD.

Benzene

Benzene was detected in groundwater in the production wells, the monitoring well within the production well capture zone, Area 16, and Area 17. In surface water, it was detected in Area 16 and in the big ditch. It was not detected in sediments or soils.

Benzene is readily absorbed following oral and inhalation exposure (EPA 1985). The toxic effects of benzene in humans and other animals following exposure by inhalation include central nervous system effects, hematological effects, and immune system depression. In humans, acute exposures to high concentrations of benzene vapors has been associated with dizziness, nausea, vomiting, headache, drowsiness, narcosis, coma, and death (NAS 1976). Chronic exposure to benzene vapors can produce reduced leukocyte, platelet, and red blood cell counts (EPA 1985). Benzene induced both solid tumors and leukemias in rats exposed by gavage (Maltoni et al. 1985). Many studies have also described a causal relationship between exposure to benzene by inhalation (either alone or in combination with other chemicals) and leukemia in humans (IARC 1982).

Applying EPA's criteria for evaluating the overall evidence of carcinogenicity to humans, benzene is classified in Group A (Human Carcinogen) based on adequate evidence of carcinogenicity from epidemiological studies. EPA (1988) derived both an oral and an inhalation cancer potency factor for benzene of $2.9 \times 10^{-2}$ $(mg/kg/day)^{-1}$. This value was based on several studies in which increased incidences of nonlymphocytic leukemia were observed in humans occupationally exposed to benzene principally by inhalation (Rinsky 1981, Ott 1978, Wong 1983). EPA is currently reviewing an oral RfD for benzene and its status is pending.

Beryllium

Beryllium was detected in all groundwater wells except the residential well and Area 9 through 14 wells. It was also detected in surface water in the Area 16 leachate seep, in sediments in the Area 16 leachate seep and drainage ditch, ditch B, and the big ditch, in Area 9 surface soil, and in Area 8 and 15 subsurface soil.

Beryllium is not readily absorbed by any route of exposure. Occupational exposure to beryllium results in bone, liver and kidney disposition (EPA 1986). In humans, acute respiratory effects due to beryllium exposure include rhinitis, pharyngitis, tracheobronchitis, and acute pneumonitis. Dermal exposure to soluble beryllium compounds can cause contact dermatitis, ulceration and granulomas (Hammond and Beliles 1980). Ocular effects include conjunctivitis and corneal ulceration from splash burns. The most common clinical symptom caused by chronic beryllium exposure is granulomatous lung inflammation (IARC 1980, EPA 1986). Chronic skin lesions sometimes appear after a long latent period in conjunction with the pulmonary effects. Systemic effects from beryllium exposure may include right heart enlargement with accompanying cardiac failure, liver and spleen enlargement, cyanosis, digital clubbing, and kidney stone development (EPA 1986). Beryllium has been shown to be carcinogenic in experimental animals resulting primarily in lung and/or bone tumors when given by injection, intratracheal administration, or inhalation (EPA 1986). Several epidemiological studies have suggested that occupational exposure to beryllium may result in an increased lung cancer risk although the data are inconclusive (EPA 1986).

Beryllium has been classified by EPA in Group B2--Probable Human Carcinogen based on increased incidences of lung cancer and osteosarcomas in animals (EPA 1988). EPA (1988) has calculated an inhalation cancer potency factor of 8.4 $(mg/kg/day)^{-1}$ based on the relative risk for lung cancer, estimated from an epidemiological study by Wagoner et al. (1980). EPA (1988) has also developed an oral reference dose (RfD) for beryllium of $5.0 \times 10^{-3}$ mg/kg/day based on a

study by Schroeder and Mitchner (1975) in which rats exposed to 0.54 mg/kg/day beryllium sulfate (the highest dose tested) in drinking water for a lifetime did not exhibit adverse effects; an uncertainty factor of 100 was used to develop the RfD.

Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate was detected in all groundwater wells except the production wells, the residential well, and Area 12 wells. It was also detected in surface water samples in Area 16 and in Ditch B.

Bis(2-ethylhexyl)phthalate, also known as di-ethylhexyl phthalate (DEHP), is readily absorbed following oral or inhalation exposure (EPA 1980). Chronic exposure to relatively high concentrations of DEHP in the diet can cause retardation of growth and increased liver and kidney weights in laboratory animals (NTP 1982, EPA 1980). Reduced fetal weight and increased number of resorptions have been observed in rats exposed orally to DEHP (EPA 1980). DEHP is reported to be carcinogenic in rats and mice, causing increased incidences of hepatocellular carcinomas or neoplastic nodules following oral administration (NTP 1982).

DEHP has been classified in Group B2--Probable Human Carcinogen (EPA 1986). EPA (1988) calculated an oral cancer potency factor for DEHP of $1.4 \times 10^{-2}$ $(mg/kg/day)^{-1}$ based on data from the NTP (1982) study. EPA has recommended an oral reference dose (RfD) for DEHP of 0.02 mg/kg/day based on a study by Carpenter et al. (1953) in which increased liver weight was observed in female guinea pigs exposed to 19 mg/kg bw/day in the diet for 1 year (EPA 1988); an uncertainty factor of 1,000 was used to develop the RfD.

Cadmium

Cadmium was detected in the monitoring well within the production well capture zone, Area 2, 4, 5, 8, 9, 10, 11 and 14 groundwater well, in sediments in the

Area 13 and 16 drainage ditches, ditch B, and the big ditch, in Area 9 surface soils, and in Area 8, 14 and 15 subsurface soils.

Gastrointestinal absorption of cadmium in humans ranges from 5-6% (EPA 1985a). Pulmonary absorption of cadmium in humans is reported to range from 10% to 50% (CDHS 1986). Cadmium bioaccumulates in humans, particularly in the kidney and liver (EPA 1985a,b). Chronic oral or inhalation exposure of humans to cadmium has been associated with renal dysfunction, itai-itai disease (bone damage), hypertension, anemia, endocrine alterations, and immunosuppression. Renal toxicity occurs in humans at a renal cortex concentration of cadmium of 200 ug/g (EPA 1985b). Epidemiological studies have demonstrated a strong association between inhalation exposure to cadmium and cancers of the lungs, kidney, and prostate (EPA 1985b, Thun et al. 1985). In experimental animals, cadmium induces injection-site sarcomas and testicular tumors. When administered by inhalation, cadmium chloride is a potent pulmonary carcinogen in rats. Cadmium is a well-documented animal teratogen (EPA 1985b).

EPA (1988, 1989) classified cadmium as a Group B1 agent (Probable Human Carcinogen) by inhalation. This classification applies to agents for which there is limited evidence of carcinogenicity in humans from epidemiologic studies. EPA (1989) derived an inhalation cancer potency factor of 6.1 $(mg/kg/day)^{-1}$ for cadmium based on epidemiologic studies in which respiratory tract tumors were observed (Thun et al. 1985, EPA 1985b). Using renal toxicity as an endpoint, and a safety factor of 10, EPA (1980, 1987, 1988) has derived two separate oral reference doses (RfD). The RfD associated with oral exposure to drinking water is $5x10^{-4}$ mg/kg/day, and is based upon the lowest-observed-adverse-effect level (LOAEL) of 0.005 mg/kg in humans (Friberg et al. 1974). The RfD associated with exposure to cadmium in food or other nonaqueous oral exposures is $1x10^{-3}$ mg/kg/day.

Carbon Tetrachloride

Carbon tetrachloride ($CCl_4$) is readily absorbed following oral and inhalation exposure. About 60% of an oral dose was absorbed by 6 hours, and up to 86% was absorbed by 24 hours. Absorption from the lung has been estimated at about 30% (EPA 1984). $CCl_4$, like many other chlorinated hydrocarbons, acts as a central nervous system depressant (ACGIH 1986). The toxic effects of oral and inhalation exposure to $CCl_4$ in humans and animals include damage to the liver, kidney and lung, although the liver is the most sensitive tissue (EPA 1985, Bruckner et al 1986). In animals, acute oral administration produces fatty infiltration and histological alterations in the liver. High doses produce irreversible liver damage and necrosis while the effects observed following lower doses are largely reversible (EPA 1985). Humans occupationally exposed to 5-15 ppm of $CCl_4$ experience biochemical alterations, nausea, headaches and in more severe cases, liver dysfunction (jaundice, enlargement and fatty infiltration) (ACGIH 1986, EPA 1984). Animals chronically exposed to $CCl_4$ exhibit effects similar to those observed following acute exposure. Prenatal toxicity has been demonstrated in mammalian fetuses and neonates after inhalation exposure in pregnant rats (EPA 1984), although $CCl_4$ has not been shown to be teratogenic (EPA 1985). Carbon tetrachloride is a carcinogen in animals producing mainly hepatic neoplasms. Oral administration of 30 mg/kg/day or higher for 6 months have been found to produce an increased frequency of hepatomas, hepatocellular adenomas and hepatocellular carcinomas in mice, rats and hamsters (EPA 1985).

EPA (1988) has classified $CCl_4$ as a B2 agent (probable human carcinogen). The cancer potency factor for both oral and inhalation exposure is $1.3 \times 10^{-1}$ $(mg/kg/day)^{-1}$. EPA (1988) established the cancer potency factor based on several gavage studies in which hepatocellular carcinomas and hepatomas were observed in rats, mice and hamsters (Della Porta et al. 1961, Edwards et al. 1942, NCI 1976a, 1976b, 1977). EPA (1988) has derived an oral reference dose (RfD) of $7 \times 10^{-4}$ mg/kg/day based on a subchronic rat gavage study in which liver lesions were the most sensitive effect (Bruckner et al. 1986). A no

observed adverse effect level (NOAEL) of 0.71 mg/kg/day and an uncertainty factor of 1,000 were used to derive the RfD.

Carcinogenic PAHs

Carcinogenic PAHs were detected in Area 18 groundwater wells and in sediments at the Area 13 drainage ditch, the Area 16 leachate seep and drainage ditch, the pond and Ditch B.

PAHs occur in the environment as complex mixtures containing numerous PAHs of varying carcinogenic potencies. Only a few components of these mixtures have been adequately characterized, and only limited information is available on the relative potencies of different compounds.

PAH absorption following oral exposure is inferred from the demonstrated toxicity of PAHs following ingestion (EPA 1984a). PAH absorption following inhalation exposure is inferred from the demonstrated toxicity of PAHs following inhalation (EPA 1984a). PAHs are also absorbed following dermal exposure (Kao et al. 1985). It has been suggested that simultaneous exposure to carcinogenic PAHs such as benzo[a]pyrene and particulate matter can increase the effective dose of the compound (ATSDR 1987). Acute effects from direct contact with PAHs and related materials are limited primarily to phototoxicity; the primary effect is dermatitis (NIOSH 1977). PAHs have also been shown to cause cytotoxicity in rapidly proliferating cells throughout the body; the hematopoietic system, lymphoid system, and testes are frequent targets (Santodonato et al. 1981). Destruction of the sebaceous glands, hyperkeratosis, hyperplasia, and ulceration have been observed in mouse skin following dermal application of the carcinogenic PAHs (Santodonato et al. 1981). The carcinogenic PAHs have also been shown to have an immunosuppressive effect in animals (ATSDR 1987). Nonneoplastic lesions are seen in animals exposed to the more potent carcinogenic PAHs only after exposure to levels well above those required to elicit a carcinogenic response. Carcinogenic PAHs are believed to induce tumors both at the site of

application and systemically. Neal and Rigdon (1967) reported that oral administration of 250 ppm benzo[a]pyrene for approximately 110 days led to forestomach tumors in mice. Thyssen et al. (1981) observed respiratory tract tumors in hamsters exposed to up to 9.5 $mg/m^3$ benzo[a]pyrene for up to 96 weeks.

Benzo[a]pyrene is representative of the carcinogenic PAHs and is classified by EPA in Group B2--Probable Human Carcinogen--based on sufficient evidence of carcinogenicity from animal studies and inadequate evidence from epidemiological studies (EPA 1984c). EPA (1984a) calculated an oral cancer potency factor of 11.5 $(mg/kg/day)^{-1}$ for carcinogenic PAHs (specifically benzo[a]pyrene) based on the study by Neal and Rigdon (1967). EPA (1984a) calculated an inhalation cancer potency factor of 6.1 $(mg/kg/day)^{-1}$ for benzo[a]pyrene based on the study by Thyssen et al. (1981). These potency factors are currently undergoing a reevaluation based on recalculation of the data.

Chlorobenzene

Chlorobenzene was detected in the residential groundwater well.

Evidence from toxicity studies suggests that chlorobenzene is absorbed after oral, inhalation, and dermal exposure (EPA 1985). Acute and chronic exposures to chlorobenzene have been associated in humans and experimental animals with central nervous system (CNS) effects, liver and kidney lesions, and respiratory distress. Results of reproductive studies with rats and dogs also indicate that chlorobenzene induces testicular lesions (EPA 1985).

EPA (1988a,b) derived an oral chronic RfD for chlorobenzene of $3x10^{-2}$ mg/kg/day based on a study by Monsanto (1967) in which dogs administered chlorobenzene in capsules for 90 days exhibited liver and kidney effects; an uncertainty factor of 1,000 was used to develop the RfD. EPA (1988a,b) also reported an inhalation chronic RfD for chlorobenzene of $5x10^{-3}$ mg/kg/day based

on a study by Dilley (1977) in which rats exposed to chlorobenzene for 120 days exhibited liver and kidney effects; an uncertainty factor of 10,000 was used to develop the RfD.

Chloroethane

Chloroethane was detected in groundwater in the monitoring well within the production well capture zone and Area 5 wells and in surface water at the Area 16 leachate seep.

Chloroethane is primarily absorbed through the lungs, although some dermal absorption may occur. Absorption and excretion of chloroethane occurs rapidly via the lungs; it is not metabolized to a significant degree (Clayton and Clayton 1981). Severe acute inhalation of chloroethane by humans produces minor neurological effects that are manifested as stupor and lack of coordination, and in some incidences as cardiac arrhythmia produced by the potentiation of adrenalin (Clayton and Clayton 1981). Acute inhalation of chloroethane by animals has produced histological or pathological changes in the liver, brain, and lungs (Troshina 1964). Chronic exposure of animals to chloroethane produced kidney damage and fatty changes in the liver, and at high levels has upset cardiac rhythm (EPA 1985). Studies assessing the mutagenicity and carcinogenicity of chloroethane are currently being conducted (EPA 1985).

Chloroform

Chloroform was detected only in Area 17 groundwater wells.

Chloroform, a trihalomethane, is rapidly absorbed through the respiratory and gastrointestinal tracts in humans and experimental animals; dermal absorption from contact of the skin with liquid chloroform can also occur (EPA 1985). In humans, acute exposures to chloroform may result in depression of the central nervous system, hepatic and renal damage and death caused by ventricular

fibrillation following an acute ingested dose of 10 ml (EPA 1984). Acute exposure to chloroform may also cause irritation to the skin, eyes, and gastrointestinal tract (EPA 1984, 1985). In experimental animals, chronic exposure may lead to fatty cyst formation in the liver (Heywood et al. 1979), renal, and cardiac effects and central nervous system depression (EPA 1985). Chloroform has been reported to induce renal epithelial tumors in rats (Jorgenson et al. 1985) and hepatocellular carcinomas in mice (NCI 1976). Suggestive evidence from human epidemiological studies indicates that long-term exposure to chloroform and other trihalomethanes in contaminated water supplies may be associated with an increased incidence of bladder tumors (EPA 1985).

Chloroform has been classified by EPA as a Group B2 Carcinogen (Probable Human Carcinogen) (EPA 1988). EPA (1988) developed an oral cancer potency factor for chloroform of $6.1 \times 10^{-3}$ $(mg/kg/day)^{-1}$ based on a study in which kidney tumors were observed in rats exposed to chloroform in drinking water (Jorgenson et al. 1985). An inhalation cancer potency factor of $8.1 \times 10^{-2}$ $(mg/kg/day)^{-1}$ has been developed by EPA (1988) based on an NCI (1976) bioassay in which liver tumors were observed in mice. EPA (1988) also derived an oral reference dose (RfD) of 0.01 mg/kg/day for chloroform based on a chronic bioassay in dogs in which liver effects were observed at 12.9 mg/kg/day (Heywood et al. 1979); an uncertainty factor of 1,000 was used to derive the RfD.

Chromium

Chromium was detected in the monitoring well within the production well capture zone, Area 2 through 8, 11, 12, 14, 16 and 17 groundwater wells, and the residential well. It was also detected in surface water in the Area 13 drainage ditch, in sediments in the Area 13 drainage ditch, Ditch A, Ditch B, the big ditch, and the unnamed ditch, and in surface soils in Areas 9 and 13.

Chromium exists in two states, as chromium (III) and as chromium (VI). Following oral exposure, absorption of chromium (III) is low while absorption of chromium (VI) is high (EPA 1987). Chromium is an essential micronutrient and is not toxic in trace quantities (EPA 1980). High levels of soluble chromium (VI) and chromium (III) can produce kidney and liver damage following acute oral exposure; target organs affected by chronic oral exposure remain unidentified (EPA 1984). Chronic inhalation exposure may cause respiratory system damage (EPA 1984). Further, epidemiological studies of worker populations have clearly established that inhaled chromium (VI) is a human carcinogen; the respiratory passages and the lungs are the target organs (Mancuso 1975, EPA 1984). Inhalation of chromium (III) or ingestion of chromium (VI) or (III) has not been associated with carcinogenicity in humans or experimental animals (EPA 1984). Certain chromium salts have been shown to be teratogenic and embryotoxic in mice and hamsters following intravenous or intraperitoneal injection (EPA 1984).

EPA has classified inhaled chromium (VI) in Group A--Probable Human Carcinogen by the inhalation route (EPA 1988b). Inhaled chromium (III) and ingested chromium (III) (EPA 1988a) and (VI) (EPA 1988b) have not been classified with respect to carcinogenicity. EPA (1988b) developed an inhalation cancer potency factor of 41 $(mg/kg/day)^{-1}$ for chromium (VI) based on an increased incidence of lung cancer in workers exposed to chromium over a 6 year period, and followed for approximately 40 years (Mancuso 1975). EPA (1988b) derived an oral reference dose (RfD) of $5.0 \times 10^{-3}$ mg/kg/day for chromium (VI) based on a study by MacKenzie et al. (1958) in which no observable adverse effects were observed in rats exposed to 2.4 mg chromium (VI)/kg/day in drinking water for 1 year. A safety factor of 500 was used to derive the RfD. EPA (1988a) developed an oral RfD of 1 mg/kg/day for chromium (III) based on a study in which rats were exposed to chromic oxide baked in bread; no effects due to chromic oxide treatment were observed at any dose level (Ivankovic and Preussman 1975). A safety factor of 1000 was used to calculate the oral RfD.

Copper

Copper was detected in all groundwater wells, in all surface water areas except the unnamed ditch, in all but ditch A, big ditch, and unnamed ditch sediments, in Area 9 surface soils, and in Area 8 and 15 subsurface soils.

Copper is an essential element. A daily copper intake of 2 mg is considered to be adequate for normal health and nutrition; the minimum daily requirement is 10 μg/kg (EPA 1985). In humans, absorption of copper following oral exposure is approximately 60% and is influenced by competition with other metals and the level of dietary protein and ascorbic acid in both humans and animals (EPA 1984). Copper is absorbed following inhalation exposures, although quantitative data on the extent of absorption are unavailable (EPA 1984). Adverse effects in humans resulting from acute exposure to copper at concentrations that exceed these recommended levels by ingestion include salivation, gastrointestinal irritation, nausea, vomiting, hemorrhagic gastritis, and diarrhea (ACGIH 1986). Dermal or ocular exposure of humans to copper salts can produce irritation (ACGIH 1986). Acute inhalation of dusts or mists of copper salts by humans may produce irritation of the mucous membranes and pharynx, ulceration of the nasal septum, and metal fume fever. The latter condition is characterized by chills, fever, headache, and muscle pain. Limited data are available on the chronic toxicity of copper; however, chronic over-exposure to copper by humans has been associated with anemia (ACGIH 1986) and local gastrointestinal irritation (EPA 1987). Results of several animal bioassays suggest that copper compounds are not carcinogenic by oral administration; however, some copper compounds can induce injection-site tumors in mice (EPA 1985).

EPA (1988) has reported a drinking water standard of 1.3 mg/liter based on local gastrointestinal irritation (EPA 1987). Assuming a 70-kg adult ingests 2 liters of water per day, this concentration is equivalent to a dose of $3.7 \times 10^{-2}$ mg/kg/day. However, EPA (1987) concluded toxicity data were inadequate for the calculation of a reference dose (RfD) for copper.

Cyanide

Cyanide was detected in surface soils in Area 9.

The toxicity of cyanides is strongly dependent on their chemical speciation. Free cyanides are readily absorbed from the gastrointestinal tract, lungs, and skin and, once absorbed, are rapidly distributed throughout the body (EPA 1985). The toxic effects in humans following acute oral exposure to free cyanides include hyperventilation, vomiting, unconsciousness, convulsions, vascular collapse and cyanosis, and death (EPA 1985). Inhalation of high concentrations of hydrogen cyanide (HCN) gas results in almost immediate collapse, respiratory arrest, and death within minutes (DiPalma 1971). Airborne hydrogen cyanide concentrations between 99 and 528 $mg/m^3$ are fatal within 30-60 minutes (NIOSH 1976). There is limited data on chronic exposures of cyanide in humans, although the following effects have been identified in chronic occupationally exposed workers in some epidemiologic studies: neurological dysfunction, lacrimation, abdominal pain, muscular weakness, and shortness of breath (NIOSH 1976). Cyanide appears to be less toxic to animals following chronic exposures than following acute exposures. In animals, chronic oral exposure has produced weight loss, thyroid effects and myelin degeneration (Howard and Hanzal 1955). Cyanide can cause teratogenic effects when subcutaneously administered to hamsters; this teratogenic effect has not been observed in other species although some reproductive toxicity has been noted (EPA 1985).

EPA (1988, 1989) calculated an oral reference dose (RfD) of 0.02 mg/kg/day for cyanide based on a chronic study by Howard and Hanzal (1955) in which rats were maintained on a diet fumigated with hydrogen cyanide and exhibited weight loss, thyroid effects and myelin degeneration. No observed adverse effects (NOAEL) were noted at the highest dose administered (10.8 mg/kg/day). A NOAEL of 10.8 mg/kg/day and a safety factor of 500 were used to derive the RfD (EPA 1988).

1,2-Dichloroethane

1,2-Dichloroethane was detected in groundwater in the monitoring well within the production well capture zone and in Area 16 wells.

Data on the toxicokinetics of 1,2-dichloroethane (1,2-DCA) in humans are limited, but data from animal studies suggest that the chemical is rapidly absorbed following oral and inhalation exposure and after dermal contact with the liquid form of the compound (EPA 1985). Effects of acute inhalation exposure in humans include irritation of mucous membranes in the respiratory tract and central nervous system depression (EPA 1985). Death may occur as a result of respiratory and circulatory failure. Pathological examinations typically show congestion, degeneration, necrosis, and hemorrhagic lesions of the respiratory and gastrointestinal tracts, liver, kidney, spleen, and lungs (EPA 1985). Adverse effects caused by less extreme exposures are generally associated with the gastrointestinal and nervous systems. Occupational exposures to 1,2-DCA vapors result in anorexia, nausea, vomiting, fatigue, nervousness, epigastric pain, irritation of the eyes and respiratory tract, and gastrointestinal, liver, and gallbladder disease (EPA 1984, 1985). Chronic studies in animals also have revealed toxic effects following inhalation exposure including degeneration of the liver (EPA 1985). Available data suggest that 1,2-DCA does not adversely affect reproductive or developmental processes in experimental animals except at maternally toxic levels (EPA 1985). In long-term oral bioassays sponsored by the National Cancer Institute (NCI 1978), increased incidences of squamous-cell carcinomas of the forestomach, mammary gland adenocarcinomas, and hemangiosarcomas have been observed in rats exposed to 1,2-DCA; pulmonary adenomas, mammary adenocarcinomas, and uterine endometrial tumors have been observed in mice exposed to this chemical.

EPA (1988) has classified 1,2-DCA in Group B2 (Probable Human Carcinogen) based on inadequate evidence of carcinogenicity from human studies and

sufficient evidence of carcinogenicity from animal studies. EPA (1988) derived an oral and an inhalation cancer potency factor ($q_1^*$) of $9.1 \times 10^{-2}$ $(mg/kg/day)^{-1}$ for 1,2-DCA based on the incidences of hemangiosarcomas in Osborne-Mendel male rats observed in the NCI (1978) gavage study.

1,1-Dichloroethene

1,1-Dichloroethene was detected in the monitoring well within the production well capture zone, Area 3, 5, 16, and 18 groundwater wells.

1,1-Dichloroethene (1,1-DCE) is rapidly absorbed after oral and inhalation exposures (EPA 1984, 1987). Humans acutely exposed to 1,1-DCE vapors exhibit central nervous system depression. In animals, the liver is the principal target of 1,1-DCE toxicity. Acute exposures result in liver damage which ranges from fatty infiltration to necrosis (EPA 1987). Workers chronically exposed to 1,1-DCE in combination with other vinyl compounds exhibit liver dysfunction, headaches, vision problems, weakness, fatigue and neurological sensory disturbances (EPA 1987). Chronic oral administration of 1,1-DCE to experimental animals results in both hepatic and renal toxicity (EPA 1984). Inhalation or oral exposure of rats and rabbits has produced fetotoxicity and minor skeletal abnormalities, but only at maternally toxic doses. 1,1-DCE vapors produced kidney tumors and leukemia in a single study of mice exposed by inhalation, but the results of other studies were equivocal or negative (EPA 1987, Maltoni et al. 1985).

EPA has classified 1,1-DCE as a Group C agent (Possible Human Carcinogen) and has developed inhalation and oral cancer potency factors of 1.2 $(mg/kg/day)^{-1}$ and 0.6 $(mg/kg/day)^{-1}$, respectively (EPA 1985, 1988). The inhalation potency factor was based on the increased incidence of renal adenocarcinomas in male mice exposed to 1,1-DCE via inhalation for 52 weeks and observed for a total of 121 weeks (Maltoni et al. 1985). The oral potency factor was derived by estimating an upper-limit value from negative bioassay data and assuming that a carcinogenic response occurs via ingestion, although there is no direct

evidence that this is true. EPA (1988) developed an oral reference dose (RfD) of $9x10^{-3}$ mg/kg/day based on the occurrence of hepatic lesions in rats chronically exposed to 1,1-DCE in drinking water (Quast et al. 1983). A safety factor of 1000 was applied to the lowest-observed-adverse-effect level (LOAEL) of 9 mg/kg/day to derive the oral RfD.

trans-1,2-Dichloroethene

*trans*-1,2-Dichloroethene was detected in the production wells, Area 2, 5, 8, 16, and 17 groundwater wells and in surface water in the Area 16 leachate seep.

*trans*-1,2-Dichloroethene is expected to be absorbed by any route of exposure. Information on the health effects of *trans*-1,2-dichloroethene is limited. In humans, *trans*-1,2-dichloroethene is a central nervous system depressant, and exposure to high concentrations can result in anesthetic effects (Irish 1963). Inhalation exposure of rats to 200 ppm has been associated with pneumonic infiltration of the lungs and progressive fatty degeneration of the liver (Freundt et al. 1977). Acute exposure to higher dose levels can cause narcosis and death in rats (Torkelson and Rowe 1981).

EPA (1985) proposed a maximum contaminant level goal (MCLG) of 70 µg/liter for both *cis*- and *trans*-1,2-dichloroethene based on the adjusted acceptable daily intake (AADI) of 350 µg/liter, assuming 20% of the exposure is via drinking water. EPA (1988) has derived an oral reference dose (RfD) of $2x10^{-2}$ mg/kg/day for *trans*-1,2-dichloroethene based on a 90-day drinking water study conducted in mice (Barnes et al. 1985). A no-observed-adverse-effect level (NOAEL) of 17 mg/kg/day for increased serum alkaline phosphatase and an uncertainty factor of 1,000 were used to derive the RfD.

1,2-Dichloropropane

1,2-Dichloropropane was only detected in Area 17 groundwater wells.

1,2-Dichloropropane is absorbed following ingestion and inhalation exposure. Adverse effects associated with acute exposure in humans have included CNS depression, narcosis, headache, and mucous membrane irritation. In animals, effects associated with acute exposure have included histopathological changes in the liver, kidney, and adrenals. Altered serum enzyme activities were also reported (EPA 1985). Chronic or subchronic exposure of experimental animals to 1,2-dichloropropane has been associated with reduced body weight, liver necrosis, centrilobular congestion, altered CNS function, and altered serum enzyme activities (EPA 1985). DeLorenzo et al. (1977) reported that 1,2-dichloropropane induced reverse and forward mutations in some test species. The compound also induced sister chromatid exchanges and chromosomal aberrations in Chinese hamster ovary cells *in vitro* (NTP 1986). 1,2-Dichloropropane caused a dose-related increased incidence of hepatocellular adenomas in rats (NTP 1986).

1,2-Dichloropropane is categorized in Group B2--Probable Human Carcinogen (EPA 1989). This chemical has an oral cancer potency factor of $6.8 \times 10^{-2}$ $(mg/kg/day)^{-1}$ based on an increased incidence of hepatocellular adenomas in mice in the study conducted by NTP (1986) (EPA 1989).

1,3-DNB

1,3-DNB was detected in the monitoring well within the production well capture zone, Area 4, 6, and 16 groundwater wells.

Absorption of the dinitrobenzene (DNB) isomers (1,2-DNB, 1,3-DNB, and 1,4-DNB) have not been well characterized, however ready absorption through the skin is a major factor in its toxicity (ACGIH 1986). Occupational exposures to the DNB isomers have been associated with methemoglobinemia and respiratory tract

irritation. Prolonged exposures of humans to dinitrobenzene may result in anemia, liver damage and cyanosis (Beard and Noe 1981). In animals, subchronic oral exposures have resulted in retarded growth, decreased hemoglobin concentrations, splenic enlargement and hemosiderin deposits. Testicular atrophy and decreased spermatogenesis have also been observed in male rats following oral exposures (Cody et al. 1981).

EPA 1988 has developed an oral reference dose (RfD) of $1.0 \times 10^{-4}$ mg/kg/day for 1,3-DNB based on a subchronic drinking water study in rats. This study identified a lowest-observed-effect-level (LOEL) of 8 ppm for increased splenic weight and a no-observed-effect-level (NOAEL) of 3 ppm (0.40 mg/kg/day) (Cody et al. 1981). The RfD was calculated using the NOAEL and an uncertainty factor of 3000.

2,4 and 2,6 - Dinitrotoluene

Both 2,4-DNT and 2,6-DNT were detected in the monitoring well within the production well capture zone and in Area 17 groundwater wells. 2,4-DNT was also detected in Area sediments in Ditch A. 2,6-DNT was also detected in Area 2 groundwater wells and in Area 8 subsurface soils.

Dinitrotoluene (DNT) is rapidly absorbed following inhalation, dermal and oral exposure, and once absorbed, is distributed throughout the body. DNT undergoes oxidative and reductive metabolism with the primary sites of metabolic activity in the liver and small intestine (Schut et al. 1982). The blood, liver, and neuromuscular systems are the primary target organs for DNT toxicity in both humans and experimental animals. In humans, symptoms resulting from subchronic and chronic exposures to DNT include cyanosis, dizziness, headaches, dyspnea and brown urine (Etnier 1987). Long term occupational exposures also have been correlated with an increase in ischemic heart disease (Levine et al. 1986). In rats, chronic exposure to mixtures of 2,4- and 2,6-DNT in the diet has been reported to significantly increase the incidence of liver tumors (Ellis et al. 1979). Bioassays using the individual

isomers indicate that most of the carcinogenicity of 2,4-DNT/2,6-DNT mixtures can be attributed to the 2,6-isomer, and that pure 2,4-DNT is not carcinogenic (Leonard et al. 1987). These data are not conclusive, however.

EPA (1988) reported an oral potency factor for 2,4-DNT of 0.68 $(mg/kg/day)^{-1}$. Etnier (1987) developed an oral potency factor of 4.83 $(mg/kg/day)^{-1}$ for 2,6-DNT. The potency factor for 2,4-DNT was derived based on the study of Ellis et al. (1979) in which progressive development of hepatocellular carcinomas was reported in male and female Charles River CD rats following exposure doses of 35 and 45 mg/kg/day, respectively, for more than a year. The potency factor for 2,6-DNT was derived using the data of Leonard et al. (1987) which indicated a statistically significant increase in the incidence of hepatocarcinomas in male Fischer 344 rats fed 7 and 14 mg/kg/day pure 2,6-DNT for 1 year.

Di-n-butyl phthalate

Di-n-butyl phthalate was detected only in sediments in the Area 16 drainage ditch.

Di-n-butyl phthalate is readily absorbed following oral and inhalation exposure (EPA 1980). Acute exposures of di-n-butyl phthalate aerosol in mice have produced irritation of the eyes and upper respiratory tract mucous membranes. Extreme exposures result in labored breathing, ataxia, paresis, convulsions and death from paralysis of the respiratory system (ACGIH 1986). Workers chronically exposed to di-n-butyl phthalate in combination with other phthalate plasticizers have exhibited pain, numbness and spasms in the upper and lower extremities. Further evaluation revealed vestibular dysfunction and polyneuritis (ACGIH 1986). Reduced fetal weight, increased numbers of resorptions, and dose-related musculoskeletal abnormalities have been observed among fetuses from rats and mice exposed to very high doses of di-n-butyl phthalate during gestation (Shiota and Nishimura 1982).

EPA (1988) calculated an oral reference dose (RfD) for di-n-butyl phthalate based on a study by Smith (1953) in which male Sprague-Dawley rats were fed a diet containing dibutyl phthalate for a period of 1 year. One-half of all rats receiving the highest dibutyl phthalate concentration (1.25% of diet, or 600 mg/kg/day) died during the first week of exposure. The remaining animals survived the study with no apparent adverse effects. Using a NOAEL of 125 mg/kg/day (0.25% dibutyl phthalate in diet) and an uncertainty factor of 1,000, an oral reference dose (RfD) of 0.1 mg/kg/day was derived; a LOAEL of 600 mg/kg/day (1.25% dibutyl phthalate in diet) was observed in this study.

Di-n-octyl phthalate

Di-n-octyl phthalate was detected in the monitoring well within the production well capture zone, Area 1, 10, and 16 groundwater wells.

Di-*n*-octyl phthalate is not especially toxic. It is a severe eye and a mild skin irritant in rabbits (NIOSH 1985, NTP/IRLG 1982, EPA 1980). Fetotoxicity and developmental abnormalities were observed in the offspring of rats administered 5 g/kg intraperitoneal injections on days 6 to 15 of gestation (NTP/IRLG 1982, EPA 1980).

Ethylbenzene

Ethylbenzene was detected in Area 17 groundwater wells and in surface water in the Area 16 leachate seep.

Ethylbenzene is absorbed via inhalation and distributed throughout the body in rats; the highest levels were detected in the kidney, lung, adipose tissue, digestive tract, and liver (Chin et al. 1980). In humans, short-term inhalation exposure to 435 mg/m$^3$ ethylbenzene for 8 hours can result in sleepiness, fatigue, headache, and mild eye and respiratory irritation (Bardodej and Bardodejova 1970); eye irritation has also been observed in experimental animals exposed to ethylbenzene (EPA 1987). Increased weights

and cloudy swelling were observed in the liver and kidney of rats exposed to ethylbenzene by stomach tube at a dose of 408 mg/kg/day for 182 days (Wolf et al. 1956). A single oral dose of ethylbenzene administered by stomach tube to male and female Wistar-derived rats was reported to have an $LD_{50}$ of 3,500 mg/kg body weight, with systemic effects occurring primarily in the liver and kidney (Wolf et al. 1956). Maternal toxicity was observed in rats exposed by inhalation to 4,348 $mg/m^3$ ethylbenzene for 6-7 hours/day during the first 19 days of gestation (Hardin et al. 1981).

EPA (1988) derived an oral reference dose of 0.1 mg/kg/day for ethylbenzene based on the chronic study by Wolf et al. (1956) in which no liver or kidney effects were observed in rats exposed to 136 mg/kg/day. An uncertainty factor of 1,000 was applied to the no-observed-effect-level to derive the reference dose.

HMX

HMX was detected in the monitoring well within the production well capture zone, Area 3, 4, 6, 7, 11, 12, 17 and 18 groundwater wells and in surface water in Ditch A.

HMX is absorbed to a very limited extent following oral exposure. In rats and mice, between 70 and 85% of the administered dose was eliminated in the feces within 4 days (Cameron 1986). No data were found in the available literature regarding pulmonary or dermal absorption.

EPA (1988) developed an RfD based on a subchronic study in which groups of 20 male and 20 female Fischer 344 rats received HMX in the diet for 13 weeks (Everett et al. 1985). Dietary concentrations corresponded to dosages of 0, 50, 150, 450, 1350 and 4000 mg/kg bw for males and 0, 50, 115, 270, 620 and 1500 mg/kg bw for th emales. Histopathologic changes were observed in the liver of males at the three highest dose levels, and in the kidneys of females in the three highest dose groups, indicating sexual differences in the target

organ responses of rats. Based on these results, lowest-observed-adverse-effect levels (LOAEL) of 150 and 270 mg/kg/day and no-observed-adverse-effect levels (NOAEL) of 50 and 115 mg/kg/day were identified for males and females, respectively. The RfD of 0.05 mg/kg/day was derived by applying an uncertainty factor of 1000 to the NOAEL for males.

Lead

Lead was detected in groundwater in all areas except the residential wells, in surface water in Area 13 and 16 drainage ditches, the Area 16 leachate seep, and ditch B, in sediments in all areas sampled, in Area 9 and 13 surface soils, and in Area 8 and 15 subsurface soils.

Absorption of lead from the gastrointestinal tract of humans is estimated at 10%-15%. For adult humans, the deposition rate of particulate airborne lead is 30%-50%, and essentially all of the lead deposited is absorbed. Lead is stored in the body in the kidney, liver and bone (EPA 1984). The major adverse effects in humans caused by lead include alterations in the hematopoietic and nervous systems. The toxic effects are generally related to the concentration of this metal in blood. Blood concentration levels of over 80 $\mu$g/dl in children and over 100 $\mu$g/dl in sensitive adults can cause severe, irreversible brain damage, encephalopathy, and possible death. Lower blood concentrations of lead (30-40 $\mu$g/dl) have been associated in humans with altered nerve conduction, altered testicular function, renal dysfunction, and anemia. Lead exposure also has been associated in humans with spontaneous abortions, premature delivery, and early membrane rupture in humans; however, reliable exposure estimates are lacking in these cases. Decreased fertility, fetotoxic effects, and skeletal malformations have been observed in experimental animals exposed to lead (EPA 1984). Chronic oral ingestion of certain lead salts (lead acetate, lead phosphate, lead subacetate) has been associated in experimental animals with increased renal tumors. Doses of lead that induced kidney tumors were high and were beyond the lethal dose in humans (EPA 1985).

EPA classified certain lead salts in Group B2--Probable Human Carcinogen (EPA 1985), although no cancer potency factor has been established (EPA 1988). This category applies to those agents for which there is sufficient evidence of carcinogenicity in animals and inadequate evidence of carcinogenicity in humans. EPA (1985) has noted that the available data provide an insufficient basis on which to regulate lead acetate, phosphate and subacetate as human carcinogens. EPA (1988) has also considered it inappropriate to develop a reference dose (RfD) for inorganic lead and lead compounds, since many of the health effects associated with lead intake occur essentially without a threshold.

Mercury

Mercury was detected in the Area 13 drainage ditch surface waters and sediments, in ditch B sediments, in Area 9 surface soils, and in Area 8 and 9 subsurface soils.

In humans, inorganic mercury is absorbed following inhalation and oral exposure, however only 7% to 15% of administered inorganic mercury is absorbed following oral exposure (EPA 1984, Rahola et al. 1971, Task Group on Metal Accumulation 1973). Organic mercury is almost completely absorbed from the gastrointestinal tract and is assumed to be well absorbed via inhalation in humans (EPA 1984). A primary target organ for inorganic compounds is the kidney. Acute and chronic exposures of humans to inorganic mercury compounds have been associated with anuria, polyuria, proteinuria, and renal lesions (Hammond and Beliles 1980). Chronic occupational exposure of workers to elemental mercury vapors (0.1 to 0.2 $mg/m^3$) has been associated with mental disturbances, tremors, and gingivitis (EPA 1984). Animals exposed to inorganic mercury for 12 weeks have exhibited proteinuria, nephrotic syndrome and renal disease (Druet et al. 1978). Rats chronically administered inorganic mercury (as mercuric acetate) in their diet have exhibited decreased body weights and significantly increased kidney weights (Fitzhugh et al.

1950). The central nervous system is a major target for organic mercury compounds. Adverse effects in humans, resulting from subchronic and chronic oral exposures to organic mercury compounds have included destruction of cortical cerebral neurons, damage to Purkinje cells, and lesions of the cerebellum. Clinical symptoms following exposure to organic mercury compounds have included paresthesia, loss of sensation in extremities, ataxia, and hearing and visual impairment (WHO 1976). Embryotoxic and teratogenic effects, including malformations of the skeletal and genitourinary systems, have been observed in animals exposed orally to organic mercury (EPA 1984). Both organic and inorganic compounds are reported to be genotoxic in eukaryotic systems (Leonard et al. 1984).

EPA (1989) has reported an oral RfD for methyl mercury of $3x10^{-4}$ mg/kg/day based on studies investigating central nervous system effects in humans exposed to mercury (EPA 1980); an uncertainty factor of 10 was used to develop the RfD. EPA (1989) has also reported an oral reference dose of $3x10^{-4}$ mg/kg/day for inorganic mercury based on a chronic rat study in which kidney effects were observed (Fitzhugh et al. 1950). An uncertainty factor of 1,000 was used to derive the RfD.

Methylene chloride

Methylene chloride was detected in Area 5, 7, and 17 groundwater wells.

Methylene chloride is absorbed following oral and inhalation exposure. The amount of airborne methylene chloride absorbed following inhalation exposure increases in direct proportion to its concentration in inspired air, the duration of exposure, and physical activity. Dermal absorption has not been accurately measured (EPA 1988). Acute human exposure to methylene chloride may result in irritation of eyes, skin, and respiratory tract; central nervous system depression; elevated carboxyhemoglobin levels; and circulatory disorders that may be fatal. Chronic exposure of animals can produce renal and hepatic toxicity (EPA 1988). Methylene chloride is mutagenic for

*Salmonella typhimurium* and produces mitotic recombination in yeast (EPA 1988). Several inhalation studies conducted in animals provide clear evidence of methylene chloride's carcinogenicity. There is only suggestive evidence in experimental animals that hepatocellular carcinomas and neoplastic nodules arise from oral exposure (EPA 1985a,b).

EPA (1989) classified methylene chloride in Group B2--Probable Human Carcinogen. It has been concluded by EPA (1985b) that the induction of distant site tumors from inhalation exposure and the borderline significance for induction of tumors in a drinking water study are an adequate basis for concluding that methylene chloride be considered a probable human carcinogen via ingestion as well as inhalation. EPA (1989) derived an inhalation cancer potency factor of $1.4 \times 10^{-2}$ $(mg/kg/day)^{-1}$ based on the results of a National Toxicology Program (NTP) inhalation bioassay conducted in rats and mice (NTP 1986). Mammary tumors were noted in rats, while lung and liver tumors were observed in mice.. EPA (1988) determined an oral cancer potency factor of $7.5 \times 10^{-3}$ $(mg/kg/day)^{-1}$ based on the results of the NTP (1986) inhalation bioassay and on an ingestion bioassay conducted by the National Coffee Association (NCA 1983). In the NCA study, hepatocellular adenomas and/or carcinomas were observed in male mice. An oral reference dose (RfD) of 0.06 mg/kg/day has been developed by EPA (1989) based on a 2-year rat drinking water bioassay (NCA 1982) that identified no-observed-effect levels (NOELs) of 5.85 and 6.47 mg/kg/day for male and female rats, respectively. Liver toxicity was observed at doses of 52.58 and 58.32 mg/kg/day for males and females, respectively. An uncertainty factor of 100 was used to derive the RfD.

Nickel

Nickel was detected in all areas where groundwater leachate seep and drainage ditch, ditches A and B, and the big ditch, and in sediments in the Area 13 drainage ditch and the big ditch.

Nickel compounds can be absorbed following inhalation, ingestion, or dermal exposure. The amount absorbed depends on the dose administered and the chemical and physical form of the particular nickel compound (EPA 1986). Dermal exposure of humans to nickel produces allergic contact dermatitis (EPA 1986). Adverse effects associated with acute exposure in animals have included depressed weight gain, altered hematological parameters, and increased iron deposition in blood, heart, liver, and testes (EPA 1987). Chronic or subchronic exposure of experimental animals to nickel has been associated with reduced weight gain, degenerative lesions of the male reproductive tract, asthma, nasal septal perforations, rhinitis, sinusitis, hyperglycemia, decreased prolactin levels, decreased iodine uptake, and vasoconstriction of the coronary vessels (EPA 1986). Teratogenic and fetotoxic effects have been observed in the offspring of exposed animals (EPA 1986). Inhalation exposure of experimental animals to nickel carbonyl or nickel subsulfide induces pulmonary tumors (EPA 1986). Several nickel salts cause localized tumors when administered by subcutaneous injection or implantation. Epidemiological evidence indicates that inhalation of nickel refinery dust and nickel subsulfide is associated with cancers of the nasal cavity, lung, larynx, kidney, and prostate (EPA 1986).

Nickel refinery dust and nickel subsulfide are both categorized in Group A--Human Carcinogens. These classifications are based on an increase incidence of lung and nasal tumors observed in workers occupationally exposed to nickel refinery dust. These materials have inhalation cancer potency factors of 0.84 $(mg/kg/day)^{-1}$ and 1.7 $(mg/kg/day)^{-1}$, respectively (EPA 1988). Nickel carbonyl is categorized in Group B2--Probable Human Carcinogen; however, a potency factor has not been derived for nickel carbonyl (EPA 1988). EPA (1988) derived an oral reference dose (RfD) for nickel of $2x10^{-2}$ mg/kg/day based on a study by Ambrose et al. (1976) in which rats administered 5 mg/kg/day (NOAEL) nickel in the diet for 2 years did not experience decreased weight gain observed in animals administered 50 mg/k/gday (LOAEL). A safety factor of 300 was used to calculate the RfD.

Nitrobenzene

Nitrobenzene was detected only in Area 16 groundwater wells.

Nitrobenzene is absorbed by all possible routes, but absorption primarily occurs through the respiratory tract and skin (EPA 1980); approximately 80% of inhaled nitrobenzene is absorbed (EPA 1980). In humans long-term occupational exposure to nitrobenzene can result in cyanosis, methemoglobinemia, jaundice, anemia, sulfhemoglobinemia, and dark urine (EPA 1980). Short-term exposure to high levels of nitrobenzene can result in cyanosis, and if severe, the individual can go into a coma (Piotrowski 1967). Hematologic, adrenal, renal, and hepatic lesions have been reported in rats and mice exposed to nitrobenzene in air for 90 days (CIIT 1984). There is also limited evidence that exposure to nitrobenzene can result in changes in the tissues of the chorion and placenta in pregnant women (Dorigan and Hushon 1976); menstrual disturbances after chronic nitrobenzene exposure have also been reported (EPA 1980).

EPA (1988a) developed an inhalation RfD for nitrobenzene of $6x10^{-4}$ mg/kg/day based on a study in which hematological, adrenal, renal, and hepatic lesions were observed in mice following inhalation exposure to nitrobenzene (CIIT 1984) and using an uncertainty factor of 10,000. EPA (1988b) also developed an oral RfD for nitrobenzene of $5x10^{-4}$ mg/kg/day based on the CIIT study based on route-to-route extrapolation and using an uncertainty factor of 10,000 (EPA 1988).

N-nitrosodiphenylamine

N-nitrosodiphenylamine was detected in the monitoring well within the production well capture zone, Area 8 and 12 groundwater wells.

N-Nitrosodiphenylamine (NDPA) is absorbed following ingestion. In rats NDPA can cross the placenta (EPA 1980). Its acute oral toxicity in rats is very

low (Druckrey et al. 1967). In subchronic feeding studies conducted in rats, weight reduction was reported. Trace amounts of pigmentation were observed in hepatic Kupffer cells of male mice (NCI 1979). When NDPA was administered to rats late in pregnancy, neoplasms were induced in the offspring (EPA 1980). Significant increases in the incidence of urinary bladder carcinomas in male and female rats were reported. A dose related trend in fibromas of the subcutis and skin among male rats was also observed (NCI 1979).

NDPA by ingestion is categorized in Group B2--Probable Human Carcinogen. This compound has an oral cancer potency factor of $4.9 \times 10^{-3}$ $(mg/kg/day)^{-1}$ (EPA 1988). This value was based on an increased incidence of bladder tumors in male and female rats (NCI 1979).

Noncarcinogenic PAHs

Noncarcinogenic PAHs were detected in Area 1 groundwater wells and in sediments in the Area 13 drainage ditch, the Area 16 drainage ditch, the pond and Ditch B.

Polycyclic aromatic hydrocarbons (PAHs) occur in the environment as complex mixtures of which only a few components have been adequately characterized. Only limited information is available on the relative potencies of the "noncarcinogenic" PAHs. However, many have been shown to have some weak carcinogenic activity, or to act as promoters or cocarcinogens.

PAH absorption following oral and inhalation exposure is inferred from the demonstrated toxicity of PAHs following these routes of administration (EPA 1984a). PAHs are also absorbed following dermal exposure (Kao et al. 1985). Acute effects from direct contact with PAHs and related materials are limited primarily to phototoxicity; the primary effect is dermatitis (NIOSH 1977). PAHs have also been shown to cause cytotoxicity in rapidly proliferating cells throughout the body; the hematopoietic system, lymphoid system, and testes are frequent targets (Santodonato et al. 1981). Some of the noncarcinogenic PAHs

have been shown to cause systemic toxicity but these effects are generally seen at high doses (Santodonato et al. 1981). Slight morphological changes in the liver and kidney of rats have been reported following oral exposure to acenaphthene for 40 days (EPA 1984a). Subchronic oral administration of naphthalene to rabbits and rats has resulted in cataract formation (EPA 1984b). EPA (1988) developed an oral reference dose of 0.4 mg/kg/day for naphthalene based on the development of ocular and systemic lesions in rats (Schmahl 1955, EPA 1986) and occupational data on coke oven workers. An uncertainty factor of 100 was applied to the animal data in the development of the reference dose.

Phenol

Phenol was detected only in surface water in the Area 16 leachate seep.

Phenol is readily absorbed through the gut, by inhalation, and percutaneously (EPA 1980). Signs of acute phenol toxicity in humans and experimental animals are central nervous system depression, collapse, coma, cardiac arrest, and death. Acutely toxic doses can also cause extensive necrosis at the site of exposure (eyes, skin, oropharynx) (EPA 1980). In experimental animals subchronic oral and inhalation studies suggest that kidney, pulmonary, myocardial, and liver damage are associated with exposure, although many of these studies were poorly designed (EPA 1980, 1984). Phenol exhibited tumor-promoting activity in the mouse skin painting system following initiation with 9,10-dimethyl-1,2-benzanthracene (DMBA) or benzo[a]pyrene (B[a]P), and it exhibited cutaneous carcinogenic activity in a sensitive mouse strain when applied at concentrations that produced repeated skin damage (EPA 1980).

The oral RfD calculated by EPA (1988) has been withdrawn and is pending further review. An inhalation acceptable intake chronic (AIC) of 1.4 mg/person/day (0.02 mg/kg/day) was recommended by EPA (1984) based on the threshold limit value of 19 $mg/m^3$ phenol established by the American

Conference of Governmental Industrial Hygienists (ACGIH 1983). EPA has not yet established an inhalation RfD (EPA 1988).

RDX

RDX was detected in all groundwater wells except the production wells and the residential well.

RDX is slowly absorbed in humans and laboratory animals following oral and inhalation exposures (Etnier 1986). No data are available regarding dermal absorption, but because RDX is relatively lipid insoluble, skin absorption is unlikely (Rosenblatt 1980). In humans, the toxic effects of RDX have been on the central nervous system (CNS). Chronic exposures in humans have been associated with generalized convulsions and unconsciousness, followed by temporary amnesia and disorientation (Stokinger et al. 1982). In animals, hepatotoxicity, anemia, and testicular and urogenital lesions have been reported following chronic exposures, in addition to CNS effects (Levine et al. 1983).

No conclusive evidence of carcinogenicity has been shown for RDX. RDX was not found to be carcinogenic in Fisher 344 rats (Levine et al. 1983) or Sparague-Dawley rats (Hart 1977) exposed to RDX in the diet for 2 years. However, Lish et al. (1984) reported a statistically significant increase in the combined incidence of hepatocellular carcinomas and adenomas in female B6C3F1 mice fed RDX in the diet for two years.

EPA (1988) derived a reference dose (RfD) of 0.003 mg/kg/day for RDX based on a chronic study in which male and female Fischer rats received RDX in the diet for 24 months at dosages of 0, 0.3, 1.5, 8.0, or 40 mg/kg bw/day (Levine et al. 1983). Rats in the three highest dose groups experienced statistically significant increases in mortality, anemia with secondary splenic lesions, hepatotoxicity, cataracts, and urogenital lesions. A lowest-observed-adverse-effect level (LOEAL) of 1.5 mg/kg/day was identified based on suppurative

inflammation of the prostate. The no-observed-adverse-effect-level (NOAEL) was 0.3 mg/kg/day.

EPA (1989) has classified RDX in Group C -- possible human carcinogen and has developed an oral potency factor of 0.11 $(mg/kg/day)^{-1}$. The potency factor was based on the increased incidence of combined hepatocellular carcinomas and adenomas in female mice receiving RDX in the diet for two years at doses of 7, 35 or 100 mg/kg.

Selenium

Selenium was detected in the monitoring well within the production well capture zone, Areas 1, 2, and 7 groundwater wells, in ditch B surface waters, and in Area 9 surface soils.

Results of studies with humans and experimental animals indicate that certain selenium compounds are readily absorbed from the gastrointestinal tract following oral exposure (EPA 1984). The pulmonary absorption of selenium following inhalation exposure has not been well studied, although there are reports suggesting that selenium is absorbed to some extent by this route (EPA 1984). Selenium is an essential element and therefore is nontoxic at doses necessary for normal health and nutrition. NAS (1980) reported that an adequate and safe selenium intake for an adult human ranges from 0.05 mg/day to 0.2 mg/day. However, exposure to selenium at levels that exceed these standards has been associated with adverse health effects. Such effects observed in experimental animals following subchronic or chronic oral exposure to various selenium compounds have included anemia, reduced growth, increased mortality, and lesions of the liver, heart, kidney, and spleen (EPA 1984). In humans, chronic oral exposure to selenium has been associated with alopecia, dermatitis, discoloration of the skin, loss of fingernails, muscular dysfunction, convulsions, paralysis, and increased incidences of dental caries (EPA 1984). Headaches and respiratory irritation have been noted in humans following acute inhalation exposure (EPA 1984). Studies with a variety of

animals have suggested that selenium may be teratogenic; however, these studies are limited in that exposure levels are not well characterized (EPA 1984).

Oral and inhalation reference doses (RfD) of $3.0x10^{-3}$ mg/kg/day and $1.0x10^{-3}$ mg/kg/day, respectively, have been derived by EPA (1984, 1988). The oral RfD value was based on a study by Yang et al. (1983) in which humans exposed to selenium in the diet at doses of 3.2 mg/day developed loss of hair, loss of fingernails, dermatitis, and muscular dysfunction. By applying an uncertainty factor of 15 and a LOAEL of 3.2 mg/day, EPA (1984) determined the oral RfD value of $3x10^{-3}$ mg/kg/day. The oral RfD is currently under review by the oral RfD Work Group at EPA (1988). The inhalation RfD value was based on an occupational study by Glover (1967) in which workers exposed to airborne concentrations of selenium developed dermatitis and gastrointestinal disturbances. An uncertainty factor of 10 was used to determine the inhalation RfD (EPA 1988).

Silver

Silver was detected in all areas except Area 14 and the residential well. It was also detected in surface waters in the Area 16 leachate seep.

Silver in various forms is absorbed to a limited extent following oral and inhalation exposures (EPA 1985). The acute toxic effects in humans following oral exposure to silver include corrosive damage to the GI tract leading to shock, convulsions, and death. In animals, acute exposure has been shown to affect the central nervous system and to cause respiratory paralysis (Hill and Pillsbury 1939). The primary effect of silver in humans following chronic exposures, is argyria, a permanent bluish-metallic discoloration of the skin and mucous membranes, which can be either localized or generalized. Silver also accumulates in the blood vessels and connective tissue (EPA 1985).

EPA (1988) derived an oral reference dose (RfD) of $3.0 \times 10^{-3}$ mg/kg/day for silver based on the human case reports of Gaul and Staud (1935), Blumberg and Carey (1934), and East et al. (1980). In these studies, argyria was observed at an average dose of silver of 0.0052 mg/kg/day, to which an uncertainty factor of 2 was applied.

Tetrachloroethene

Tetrachloroethene was detected in the monitoring well within the production well capture zone, Area 7, 16, and 17 wells, and the residential well. It was also seen in surface water in the Area 16 leachate seep. Tetryl was detected in the monitoring well capture zone and Area 12 and 17 groundwater wells.

Tetryl

Tetryl was detected in the monitoring well within the production well capture zone and Area 12 and 17 groundwater wells.

Information on the toxicity of tetryl is sparse. It has been shown to be mutagenic in DNA repair assays (McGregor et al. 1980). In occupational situations it has been shown to be a skin sensitizer following air exposures and a TLV of 1.5 mg/m3 has been recommended for tetryl (ACGIH 1988). An oral reference dose can be derived from the TLVs by assuming complete absorption of a chemical by both inhalation and ingestion, an inhalation volume of 10 $m^3$ per eight-hour work day, and a 5 day work week. In addition, a safety factor of 100 is applied to the TLV to account for sensitive members of the population and for the use of an exposure level that is higher than a no-effect level in deriving the RfD. (See Layton et al. 1986 for a more complete discussion of this methodology.) Using this approach, an RfD of 0.0015 mg/kg/day is derived.

Toluene

Toluene was detected in Area 17 groundwater wells and the residential well and in surface water in the Area 16 leachate seep.

Toluene is absorbed in humans following both inhalation and dermal exposure (EPA 1985). In humans, the primary acute effects of toluene vapor are central nervous system (CNS) depression and narcosis. These effects occur at concentrations of ~ 200 ppm (754 mg/m$^3$) (von Oettingen et al. 1942a,b). In experimental animals, acute oral and inhalation exposures to toluene can result in central nervous system (CNS) depression and lesions of the lungs, liver, and kidneys (EPA 1987). The earliest observable sign of acute oral toxicity in animals is depression of the CNS, which becomes evident at approximately 2,000 mg/kg (Kimura et al. 1971). In humans, chronic exposure to toluene vapors at concentrations of approximately 200 and 800 ppm has been associated with CNS and peripheral nervous system effects, hepatomegaly, and hepatic and renal function changes (EPA 1987). Toxic effects following prolonged exposure of experimental animals to toluene are similar to those seen following acute exposure (Hanninen et al. 1976, von Oettingen et al. 1942a). A dose-related reduction in hematocrit values was observed in rats chronically exposed to toluene (CIIT 1980). There is some evidence in mice that oral exposure to greater than 0.3 ml/kg toluene during gestation results in embryotoxicity (Nawrot and Staples 1979). Inhalation exposure of up to 1,000 mg/m$^3$ by pregnant rats during gestation has been associated with significant increases in skeletal retardation (Hudak and Ungvary 1978).

EPA (1988a) has derived an oral risk reference dose (RfD) of 0.3 mg/kg/day for toluene based on a 24-month inhalation study in which rats were exposed to concentrations as high as 300 ppm (29 mg/kg/day) and hematological parameters were examined (CIIT 1980). No adverse effects were observed in any of the treated animals. Using a no-observed-adverse-effect level (NOAEL) of 29 mg/kg/day and an uncertainty factor of 100, the oral RfD was derived. EPA

(1988b) reported an inhalation RfD for toluene of 1.0 mg/kg/day also based on this CIIT study in which CNS effects were noted and an uncertainty factor of 100 was used.

1,1,1-Trichloroethane

1,1,1-Trichloroethane was detected in Area 1, 5, and 17 groundwater wells.

Like other chlorinated aliphatic hydrocarbons, 1,1,1-trichloroethane (1,1,1-TCA, methyl chloroform) is rapidly and completely absorbed following both the oral and inhalation exposure. Pulmonary absorption is initially large and gradually decreases to a steady-state condition. Absorption through the skin is slow. 1,1,1-TCA distributes throughout the body and readily crosses the blood-brain barrier (EPA 1984). The most notable toxic effects of 1,1,1-TCA inhalation exposure in humans and animals are central nervous system depression, including anesthesia at very high concentrations, and impairment of coordination, equilibrium, and judgment at lower concentrations (350 ppm and above). In both humans and animals, cardiovascular effects, including premature ventricular contractions, decreased blood pressure, and sensitization to epinephrine-induced arrhythmia can result from acute exposure to high concentrations of 1,1,1-TCA vapor (EPA 1985). Fatty liver changes have been reported in guinea pigs following subchronic inhalation exposure (Torkelson et al. 1958). NTP (1984) reported preliminary results of bioassays in rats and mice indicating that oral administration of 1,1,1-TCA increases the incidence of hepatocellular carcinomas in female mice but not for male rats. This study was inadequate to evaluate the carcinogenicity of 1,1,1-TCA in female rats and male mice.

EPA (1988a) calculated an oral reference dose (RfD) for 1,1,1-trichloroethane based on an inhalation study by Torkelson et al. (1958) in which rats, rabbits, guinea pigs and monkeys were exposed to 1,1,1-TCA vapor. A no-observed-adverse-effect (NOAEL) of 500 ppm (2,730 $mg/m^3$, or 90 mg/kg/day) was identified from this study. Using the NOAEL of 90 mg/kg/day and an

uncertainty factor of 1,000, a RfD of $9x10^{-2}$ mg/kg/day was derived. An inhalation RfD of 0.3 mg/kg/day for 1,1,1-TCA also has been determined by EPA (1988b) based on this same study, in which hepatotoxicity was observed in guinea pigs. An uncertainty factor of 1,000 was used in calculating the RfD.

1,1,2-Trichloethane

1,1,2-Trichloroethane was detected in Area 16 and 17 groundwater wells.

1,1,2-Trichloroethane (1,1,2-TCA) is rapidly absorbed from oral, inhalation and dermal exposures (Torkelson and Rowe 1981, Arena 1979). In humans, acute oral and inhalation exposures to 1,1,2-TCA result in central nervous system (CNS) depression, equilibrium disturbances, vertigo, headaches, lassitude, hypotension, anesthesia and coma (Arena 1979). Acute oral and inhalation administration to animals produces liver and kidney damage, irritation to the eyes and nose, CNS depression, and death due to respiratory arrest (ACGIH 1986, Torkelson and Rowe 1981). In dogs the hepatotoxic effects include hepatocyte vacuolation, enzyme induction, fatty degeneration and necrosis (NRC 1977, Torkelson and Rowe 1981). The hepatoxicity and nephrotoxicity of 1,1,2-TCA has been found to be potentiated by pretreatment with certain halogenated organic compounds and solvents. Dermal exposures result in irritation and injury to the skin from defatation (Torkelson and Rowe 1981). Evidence suggests that 1,1,2-TCA is embryo toxic to chicken eggs (Elovaara 1979). 1,1,2-TCA was found to be weakly mutagenic in S. Cerevisiae (Torkelson and Rowe 1981). Oral administration of 1,1,2-TCA has been associated with the induction of hepatocellular carcinomas and pheochromocytomas in mice but not in rats (NCI 1978, Weisburger 1977)

EPA has classified 1,1,2-TCA in group C (Possible Human Carcinogen). This category applies to agents for which there is limited evidence of carcinogenicty in animals. EPA (1988) has derived a cancer potency factor of $5.7x10^{-2}$ $(mg/kg/day)^{-1}$ for both oral and inhalation exposures based on an increased incidence of liver tumors in mice (NCI 1978). EPA (1988) has also

established an oral reference dose (RfD) of $4.0 \times 10^{-3}$ mg/kg/day for 1,1,2-TCA based upon clinical chemistry alterations in mice given 3.9 mg/kg/day in drinking water. (White et al 1985, Sanders et al 1985). An uncertainty factor of 1.000 was used to calculate the RfD.

Trichloroethene

Trichloroethene was detected in groundwater in the production wells, the monitoring well within the production well capture zone and Area 5, 8, 16, and 17 wells. It was also detected in surface water in the Area 16 leachate seep and the big ditch.

Absorption of trichloroethene (TCE) from the gastrointestinal tract is virtually complete. Absorption following inhalation exposure is proportional to concentration and duration of exposure (EPA 1985). TCE is a central nervous system depressant following acute and chronic exposures. In humans, single oral doses of 15 to 25 ml (21 to 35 grams) of TCE have resulted in vomiting and abdominal pain, followed by transient unconsciousness (Stephens 1945). High-level exposure can result in death due to respiratory and cardiac failure (EPA 1985). Hepatotoxicity has been reported in human and animal studies following acute exposure to TCE (EPA 1985). Nephrotoxicity has been observed in animals following acute exposure to TCE vapors (ACGIH 1986, Torkelson and Rowe 1981). Subacute inhalation exposures of mice have resulted in transient trichloroethene-induced increased liver weights (Kjellstrand et al. 1983). Industrial use of TCE is often associated with adverse dermatological effects including reddening and skin burns on contact with the liquid form, and dermatitis resulting from vapors. These effects are usually the result of contact with concentrated solvent, however, and no effects have been reported after exposure to TCE in dilute, aqueous solutions (EPA 1985). Trichloroethene has caused significant increases in the incidence of hepatocellular carcinomas in mice (NCI 1976) and renal tubular-cell neoplasms in rats exposed by gavage (NTP 1983), and pulmonary adenocarcinomas in mice following inhalation exposure (Fukuda et al. 1983). Trichloroethene was

mutagenic in *Salmonella typhimurium* and in *E. coli* (strain K-12), utilizing liver microsomes for activation (Greim et al. 1977).

EPA (1988) classified trichloroethene in Group B2--Probable Human Carcinogen based on inadequate evidence in humans and sufficient evidence of carcinogenicity from animals studies. EPA (1988) derived an oral cancer potency factor of $1.1 \times 10^{-2}$ $(mg/kg/day)^{-1}$ and an inhalation cancer potency factor of $4.6 \times 10^{-3}$ $(mg/kg/day)^{-1}$ based on the mouse liver tumor data in the NCI (1976) and NTP (1983) gavage studies. EPA (1987) developed an oral reference dose (RfD) of $7.35 \times 10^{-3}$ mg/kg/day based on a subchronic inhalation study in rats in which elevated liver weights were observed following exposure to 55 ppm, 5 days/week for 14 weeks (Kimmerle and Eben 1973). A safety factor of 1,000 was used to calculate the RfD. However, this RfD is currently under review by EPA.

1,3,5-TNB

1,3,5-TNB was detected in the monitoring well within the production well capture zone, Area 4, 7, 9, 12, and 17 groundwater wells and in surface water in the Area 13 drainage ditch and the Area 16 leachate seep.

Information on the toxicicty of 1,3,5-trinitrobenzene is sparse. It has been shown to be mutagenic in DNA repair assays (McGregor et al. 1980). Acute oral toxicity also has been demonstrated with $LD_{50}$ values of 572 mg/kg, 450 mg/kg, and 730 mg/kg being reported for mice, rats and guinea pigs, respectively (EPA 1987). Quantitative information on nonlethal effects in humans and animals is lacking. However, exposure in humans has been associated with methemoglobia, cyanosis, headache, nausea and other effects. An oral RfD of 0.0025 mg/kg/day is derived by applying a conversion factor of 5x10-6 to the oral RfD of 450 mg/kg, as recommended by Layton et al. (1986).

Vinyl chloride

Vinyl chloride was detected in groundwater in the production wells, the monitoring wells within the production well capture zone, and Area 5 and 16 wells.

Vinyl chloride is rapidly absorbed in rats following oral and inhalation exposure, while dermal absorption of vinyl chloride is minor (EPA 1985). At high inhalation exposure levels, workers have experienced dizziness, headaches, euphoria, and narcosis. In experimental animals, inhalation exposure to high levels of vinyl chloride can induce narcosis and death. Lower doses result in ataxia, narcosis, congestion and edema of the lungs, and hyperemia in the liver (EPA 1985). Chronic inhalation exposure of workers to vinyl chloride is associated with hepatotoxicity, central nervous system disturbances, pulmonary insufficiency, cardiovascular toxicity, gastrointestinal toxicity, and acro-osteolysis (EPA 1985). Experimental animals chronically exposed via inhalation or ingestion have exhibited effects involving the liver, spleen, kidneys, hematopoietic system, and skeletal system (EPA 1984). Feron et al. (1975) found that administration of vinyl chloride to rats by gavage resulted in hematologic, biochemical, and organ-weight effects at doses above 30 mg/kg/day. Evidence for an association between human exposure to vinyl chloride and birth defects or fetal loss is conflicting (EPA 1987). Human exposure to vinyl chloride has been associated with an increased incidence of hepatic angiosarcoma and brain, lung, and hemolymphopoietic cancers. In animal studies, chronic inhalation and ingestion of vinyl chloride at levels as low as 1.7 and 5 mg/kg/day have induced cancer in the liver and in other tissues of rats and mice (IARC 1979; Feron et al. 1981; Maltoni et al. 1980, 1981).

EPA (1988) has classified vinyl chloride in Group A (Human Carcinogen) based on adequate evidence of carcinogenicity from epidemiological studies.

EPA (1988) reported an oral cancer potency factor ($q_1^*$) of 2.3 $(mg/kg/day)^{-1}$ for vinyl chloride based on the long-term ingestion study in rats in which lung tumors were observed (Feron et al. 1981). The inhalation cancer potency factor for vinyl chloride is $2.95 \times 10^{-1}$ $(mg/kg/day)^{-1}$ (EPA 1988) and is based on a chronic inhalation studies conducted by Maltoni et al. (1980, 1981) in which liver tumors were observed in rats.

Zinc

Zinc was detected in groundwater in all areas except Area 3, in surface water in Area 16 leachate seep and drainage ditch, ditch A, ditch B, and the big ditch, in sediments in Area 13 drainage ditch and ditch B, in Area 9 surface soils, and in Area 8 and 9 subsurface soils.

Zinc is absorbed in humans following oral exposure; however, insufficient data are available to evaluate absorption following inhalation exposure (EPA 1984). Zinc is an essential trace element that is necessary for normal health and metabolism and therefore is nontoxic in trace quantities (Hammond and Beliles 1980). However exposure to zinc at concentrations that exceed recommended levels has been associated with a variety of adverse effects. Chronic and subchronic inhalation exposure of humans to zinc has been associated with gastrointestinal disturbances, dermatitis, and metal fume fever, a condition characterized by fever, chills, coughing, dyspnea, and muscle pain (EPA 1984). Chronic oral exposure of humans to zinc may cause anemia and altered hematological parameters. Reduced body weights have been observed in studies in which rats were administered zinc in the diet. There is no evidence that zinc is teratogenic or carcinogenic (EPA 1984).

EPA (1988) has derived an oral reference dose (RfD) of $2x10^{-1}$ mg/kg/day based on studies in which anemia and reduced blood copper were observed in humans exposed to oral zinc doses of 2.14 mg/kg/day (Pories et al. 1967, Prasad et al. 1975). A safety factor of 10 was used in developing the RfD.

# APPENDIX I

## LIST OF COMMON AND SCIENTIFIC NAMES OF WILDLIFE SPECIES AT LCAAP

APPENDIX I

LIST OF COMMON AND SCIENTIFIC NAMES OF WILDLIFE SPECIES AT LCAAP

| Common Name | Scientific Name |
|---|---|
| Birds | |
| Canada goose | Branta canadensis |
| wood duck | Aix sponsa |
| bobwhite quail | Colinus virginianus |
| wild turkey | Meleagris gallopavo silvestris |
| woodcock | Philohela minor |
| mourning dove | Zenaidura macroura |
| Cooper's hawk | Accipiter cooperii |
| red-shouldered hawk | Buteo lineatus |
| red-tailed hawk | Buteo jamaicensis |
| sharp-shinned hawk | Accipiter striatus |
| kestrel | Falco sparverius |
| barn owl | Tyto alba |
| screech owl | Otus asio |
| great horned owl | Bubo virginianus |
| common flicker | Colaptes auratus |
| downy woodpecker | Dendrocopos pubescens |
| red-bellied woodpecker | Centurus carolinus |
| red-headed woodpecker | Melanerpes erythrocephalus |
| common raven | Corvus corax |
| common crow | Corvus brachyrhynchos |
| fish crow | Corvus ossifragus |
| blue jay | Cyanocitta cristata |
| loggerhead shrike | Lanius ludovicianus |
| eastern meadowlark | Sturnella magna |
| robin | Turdus migratorius |
| Carolina wren | Thryothorus ludovicianus |
| American goldfinch | Spinus tristis |
| horned lark | Eremophila alpestris |
| tufted titmouse | Parus bicolor |
| white-breasted nuthatch | Sitta carolinensis |

APPENDIX I

LIST OF COMMON AND SCIENTIFIC NAMES OF WILDLIFE SPECIES AT LCAAP
(Continued)

| Common Name | Scientific Name |
|---|---|
| **Mammals** | |
| coyote | *Canis latrans* |
| white-tailed deer | *Odocoileus virginianus* |
| gray fox | *Urocyon cinereoargenteus* |
| red fox | *Vulpes fulva* |
| muskrat | *Ondatra zibethicus* |
| opossum | *Didelphis virginiana* |
| eastern cottontail rabbit | *Sylvilagus aquaticus* |
| raccoon | *Procyon lotor* |
| striped skunk | *Mephitis mephitis* |
| fox squirrels | *Sciurus niger* |
| **Fish** | |
| largemouth bass | *Micropterus salmoides* |
| bluegill | *Lepomis macrochirus* |
| green sunfish | *Lepomis cyanellus* |
| channel catfish | *Ictalurus punctatus* |
| blue catfish | *Ictalurus furcatus* |
| golden shiner | *Notropis crysoleucas* |