LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection
Section 404165, Cleo Springs, Oklahoma

Prepared by

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Prepared for

Federal Highway Administration
LTPP Division, HNR-40
Turner-Fairbanks Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101

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15. Supplementary Notes

16. Abstract

This report contains a description of the instrumentation installation activities and initial data collection for test section 404165, which is a part of the LTPP Core Seasonal Monitoring Program. This asphalt concrete surfaced pavement test section, which is located on US-60 in the westbound lane, approximately 3.5 km west of SR-58 near Cleo Springs, Oklahoma, was instrumented on March 29-30, 1994. The instrumentation installed included time domain reflectometry probes for moisture content, thermistor probes for temperature, tipping-bucket rain gauge, an observation well to monitor the ground water table, and an on-site data logger. Initial data collection was performed on March 29, 1994, which consisted of deflection measurements with a Falling Weight Deflectometer (FWD), elevation measurements, temperature measurements and TDR measurements. The report contains a description of the test site and its location, the instruments installed at the site and their locations, characteristics of the installed instruments and probes, problems encountered during installation, specific site circumstances and deviations from the standard guidelines, and a summary of the initial data collection.

17. Key Words	18. Distribution Statement
Pavement, Highway, Instrumentation, Monitoring, Time Domain Reflectometry, Thermistor, Observation Well, Test Equipment, Field Tests.	

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SEASONAL INSTRUMENTATION STUDY
INSTRUMENTATION INSTALLATION
OKLAHOMA SECTION 404165/40SA

I. Introduction

The seasonal instrumentation installation of Section 404165 was performed on March 29-30, 1994, and was the eighth one completed in the Southern Region.

The GPS-1 test section resides in Seasonal Cell 13 and is located in a dry-no freeze zone. The site (see Figure A-1) is in the westbound lane on US-60, approximately 3.5 km west of SR-58 near Cleo Springs, Oklahoma. The highway consists of one 3.7 m wide travel lane in each direction. The outside shoulder is 3.0 m wide.

The average maximum daily temperature for the months of June through August is 34°C and the average minimum daily temperature for the months of December through February is -4°C. The average annual precipitation is 803 mm.

The pavement is a flexible structure consisting of approximately 64 mm of asphalt concrete over 159 mm of bituminous base. The subgrade is classified as silty sand. The typical soil profile under the pavement is illustrated in Figure A-2. This information was obtained from bore holes drilled during the GPS material sampling and testing. The dry densities of the unbound layers are given in Table 1.

Table 1. Layer Thicknesses and Dry Densities of the Unbound Layers

Material	Layer Thickness (mm)	In Situ Dry Density (kg/m^3)
Asphalt Concrete	64	- - -
Base	159	- - -
Subgrade	- - -	1354

The annual average daily traffic (AADT) in the GPS lane is almost 1750, of which 20% is truck traffic. The estimated annual ESALs on the GPS lane were 244,000. This information is based on traffic data collected on-site.

Installation of the instrumentation was completed through the cooperative efforts of the Oklahoma Department of Transportation (Oklahoma DOT) and the Federal Highway Administration (FHWA) Southern Region Coordination Office (SRCO) staff from Brent Rauhut Engineering Inc. (BRE). The following is a list of the personnel who participated in the installation:

Jon Peacock	SRCO, Brent Rauhut Engineering
Steve Davis	SRCO, Brent Rauhut Engineering
Robin Belt	SRCO, Brent Rauhut Engineering
David Ooten	Oklahoma DOT
Mike Sawyer	Oklahoma DOT
Trent Fitz	Oklahoma DOT
George Murray	Oklahoma DOT

II. Instrumentation Installation

Pre-Installation Activities

A pre-installation meeting was held at the Oklahoma DOT offices on February 22, 1994. The meeting agenda appears in Appendix B. At the planning meeting, roles and responsibilities for all the various tasks to be performed during installation were assigned. A slide presentation was given, highlighting the order of operations for the installations in Delta, Colorado and Grand Rapids, Minnesota.

A site inspection and a manual distress survey were performed on November 5, 1992 by Jerry Daleiden (SRCO). Deflection testing was conducted on April 27, 1993. The 5+00 end of the test section was selected for instrumentation, based on the amount of distress present and uniformity of the deflection profile. Both the deflection plots and distress survey data can be found in Appendix A.

Equipment Installed

The equipment installed at the test site included instrumentation for measuring air and subsurface temperature, rainfall and subsurface moisture contents. An equipment cabinet was installed to house the cable leads from the instrumentation, the data logger and the battery pack. The observation well to measure the depth to the water table and the benchmark were installed in June 1994 by the Oklahoma DOT. A list of the equipment installed, with the respective serial numbers, is in Table 2.

Table 2. Equipment Installed

Equipment	Quantity	Serial Number
Instrument Hole		
MRC Thermistor Probe	1	183 (40 AT)
TDR Sensors	10	40A01-40A10
Equipment Cabinet		
CR10 Data Logger	1	16558
Battery Package	1	5533
Weather Station		
Tipping-Bucket Rain Gauge	1	12078-693
Air Temperature Probe	1	3042
Observation Well	1	None

Equipment Check/Calibration

Prior to installation, all instrumentation was checked or calibrated. The CR10 Data Logger was wired according to the Guidelines and the air temperature probe and thermistor probe were connected and monitored over a period of several hours to ensure that the sensors were working. The tipping-bucket was also connected to the data logger and the calibration was checked according to the method recommended by the manufacturer. These tests indicated that the air temperature probe and thermistor probe were working properly and that the tipping-bucket measurement was within the manufacturer's specifications.

In addition to the above tests, the distances between sensors in the thermistor probe were measured and are presented in Table 3.

Table 3. Sensor Spacing in MRC Thermistor Probe

Unit	Channel Nº.	Distance from Top of Unit (mm)	Remarks
1	1	Not Measured	This unit was installed in the AC layer.
	2	Not Measured	
	3	Not Measured	
2	4	22	This unit was installed in the base and subgrade.
	5	91	
	6	172	
	7	250	
	8	323	
	9	477	
	10	629	
	11	783	
	12	934	
	13	1082	
	14	1239	
	15	1392	
	16	1544	
	17	1697	
	18	1846	

Location of Instrumentation

The instrumentation was installed at Station 5+20 of the test section. Approximately 800 mm from the lane edge, in the outside wheel path, a 457 mm square was removed from the pavement and a 254 mm diameter hole, 2.3 m deep, was drilled to install the thermistor probe and TDR sensors. Cables from the instrumentation were placed in a 51 mm diameter flexible conduit and buried in a 102 mm wide trench leading to the equipment cabinet located approximately 8.2 m from the lane edge.

Installation

Installation of the monitoring equipment was completed on March 30, 1994. Verification that the instrumentation was working was made the following day. The Oklahoma DOT provided the traffic control, augering, pavement sawing, pavement repair materials, and installation of the observation well and permanent benchmark. The monitoring equipment and cabinet installation was performed by the SRCO staff.

The first day of operations included traffic control; site layout and marking; installation of the thermistor probe, TDR probes, air temperature probe, and rain gauge; and wiring of the cabinet. The installation of all equipment was performed according to the procedures outlined in the "LTPP Seasonal Monitoring Program: Instrumentation and Data Collection Guidelines."

To ensure functioning of the TDR sensors during installation, the 1502B cable tester was connected to each sensor as backfilling of the instrumentation hole was performed. If a reasonable trace was displayed, it was assumed the sensor was functioning properly. The trace was printed for each TDR and the moisture content was determined using Topp's equation. The field moisture content was also measured by drying the soil on a propane stove. The TDR moisture contents, position of the TDR sensors and field moisture contents appear in Table 4. The field printed traces appear in Appendix C. Table 5 shows the distance from the top of the pavement to each individual thermistor sensor.

When backfilling of the instrumentation hole was completed, the asphalt concrete surface was patched using cold-mix asphalt. The overcuts from the pavement sawing operation (including the groove for the temperature probe) were also sealed with Dow-Corning 888 crack sealant.

Upon completion of the installation, the ONSITE program was downloaded to the onsite CR10 Data Logger and data from the air temperature probe, rain gauge and thermistor probe were collected overnight and evaluated the second day.

The second day activities included traffic control setup, evaluation of the data collected the previous night, monitoring of the TDR sensors, deflection testing and elevation surveys. The following sections describe these operations.

Table 4. Location of TDR Sensors and Measured Moisture Contents

Sensor Nº.	Sensor Depth (mm)	TDR Moisture Content (%, by wt)	Measured Moisture Content (%, by wt)
40A01	381	14.2	13.2
40A02	533	14.5	12.3
40A03	686	13.6	13.1
40A04	838	12.9	11.6
40A05	991	11.6	9.6
40A06	1143	10.7	9.7
40A07	1295	9.1	7.9
40A08	1448	11.0	10.1
40A09	1753	5.4	7.3
40A10	2057	6.3	7.7

Table 5. Thermistor Sensor Locations

Unit	Channel Nº	Depth from Pavement Surface	Remarks
1	1	25	This unit was installed in the AC layer.
	2	97	
	3	168	
2	4	296	This unit was installed in the base and subgrade.
	5	365	
	6	446	
	7	524	
	8	597	
	9	751	
	10	903	
	11	1057	
	12	1208	
	13	1356	
	14	1513	
	15	1666	
	16	1818	
	17	1971	
	18	2120	

III. Initial Data Collection

Onsite Data Logger

The air temperature, subsurface temperatures and rainfall data were collected by the onsite CR10 Data Logger. The version of the ONSITE program used reads the thermistor probe (18 sensors) every minute. The average temperatures for the first five sensors are recorded hourly and the average temperature for every sensor is saved daily. The maximum and minimum temperature for all sensors are also saved on a daily basis.

The air temperature is read every minute by the ONSITE program and the average temperature is saved both daily and hourly. The maximum and minimum temperatures are saved daily. The precipitation is recorded on both an hourly and daily basis.

Figure D-1 shows the average hourly ambient air temperatures which were collected the night of March 29, 1994. Figure D-2 shows hourly average subsurface temperatures for the first five sensors for the same data collection period. Figure D-3 shows the measured average subsurface temperatures for all 18 sensors during the initial data collection.

Moisture Content Measurement by TDR Sensors

TDR data was collected using the mobile data-logging system provided by the FHWA. The mobile system consists of a CR10 Data Logger, battery pack and two multiplexors for TDR data collection.

To begin data collection using the mobile system the TDR cable leads and 1502B cable reader were connected to the proper channels and the MOBILE program was downloaded from the notebook computer to the CR10 Data Logger. After approximately five minutes, the cable reader was triggered by the MOBILE program and the TDR traces were displayed. The data collection process was completed in approximately five minutes and was automatically repeated four hours later. The data was then uploaded to the notebook computer. Traces displayed on the cable reader indicated that the sensors were working properly. Figures D-4 through D-13 show the plots of the TDR traces obtained approximately 24 hours after installation.

Deflection Measurements

Deflection measurements were made according to the procedures outlined in the "LTPP Seasonal Monitoring Program: Instrumentation Installation and Data Collection Guidelines." At this time no analysis has been performed on this data.

Elevation Surveys

The elevation of the benchmark was assumed to be 0.000 meters and surface elevations were measured following the guidelines. These elevations were measured using a Spectra-Physics Laser Plane 350 level and Lenker rod, and were converted to the SI system using soft conversion factors. The elevations are contained in Appendix D.

IV. Summary

The instrumentation installation on Section 404165 was completed on March 29, 1994 and initial data collection was completed on March 30, 1994. The observation well and benchmark were installed by the Oklahoma DOT in June 1994. Instrumentation and equipment currently at the site includes time domain reflectometry probes for moisture content measurements; a thermistor probe for monitoring temperature gradient changes in the pavement, base and subgrade layers; a tipping-bucket rain gauge; an air temperature probe; an observation well to monitor ground water table movement; a permanent swell and frost-free benchmark; and an on-site data logger and battery pack.

At the time of this report, all of the equipment installed on-site appears to be functioning properly. Thermistor 12 shows a "spike" in Figure D-3 on page D.5, but since the initial collection it has given normal readings. After the initial installation, the alkaline battery pack was replaced with a gel-cell sealed battery.

APPENDIX A

Test Section Background Information

Appendix A contains the following information:

Figure A-1. Site Location Map

Figure A-2. Profile of Test Section Layers

Figure A-3 thru Figure A-8. Plots from FWDCHECK

Figure A-9. Manual Distress Survey Data

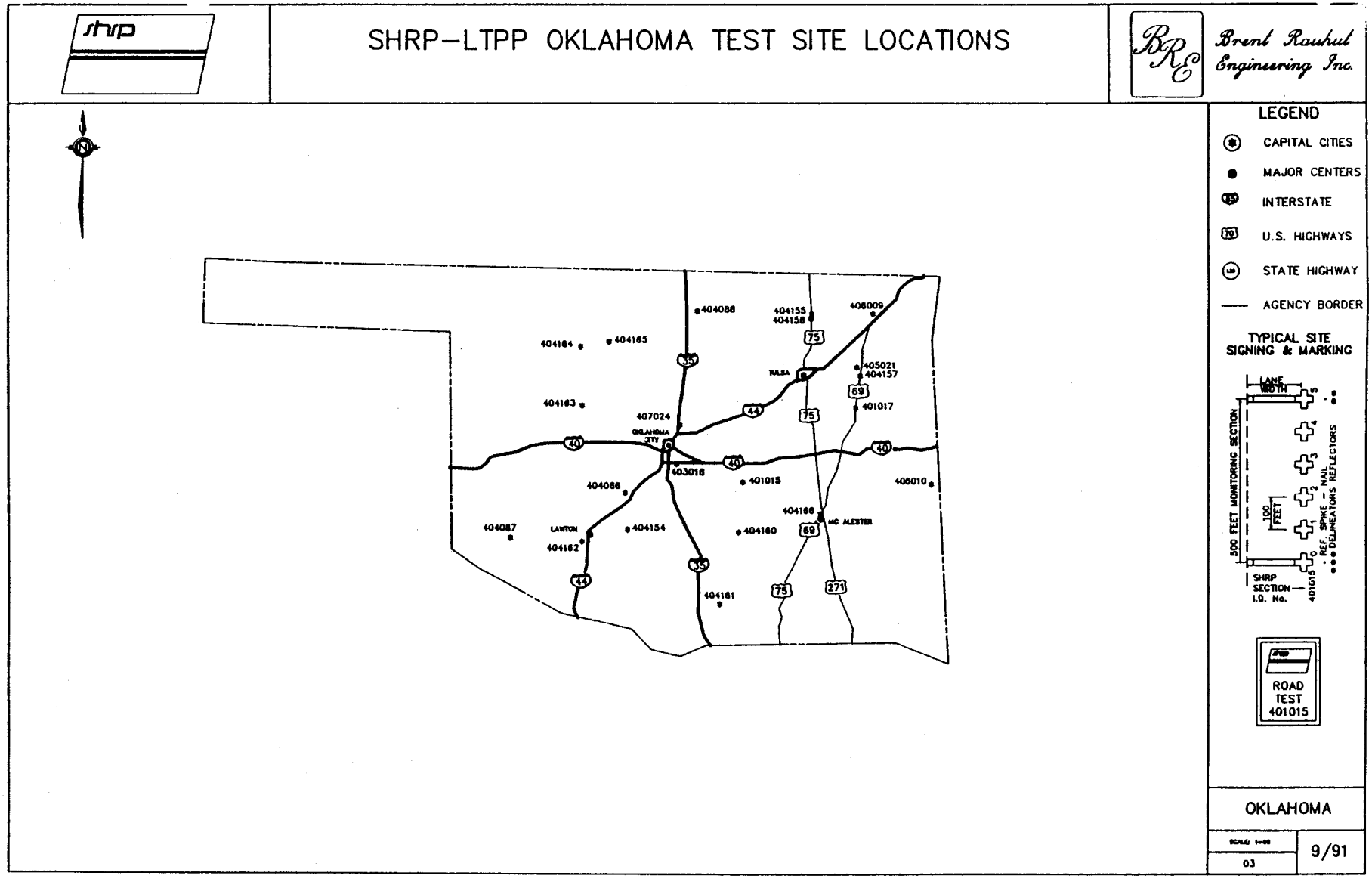


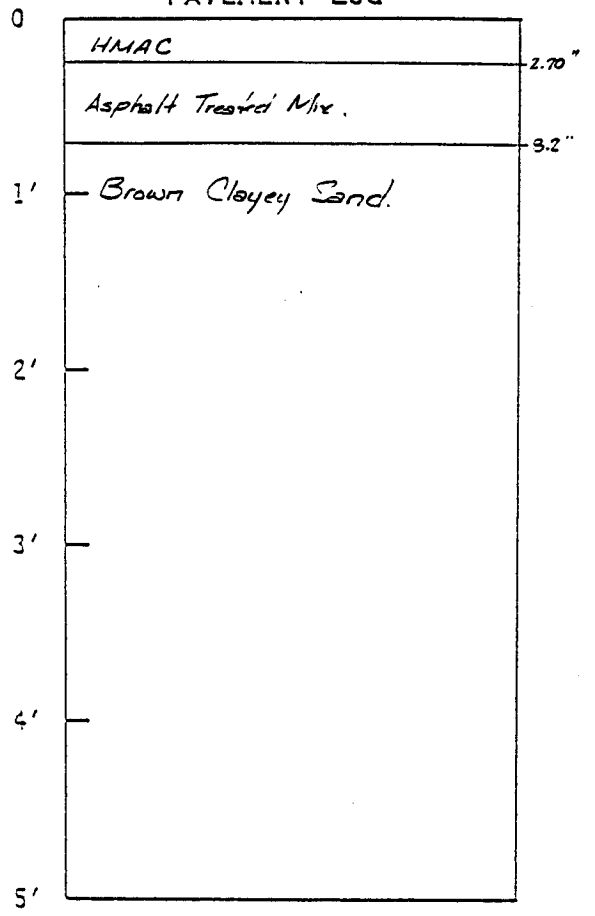
Figure A-1. Location of Test Site, GPS Test Section 404165

APPROXIMATE
SUMMARY OF FIELD LOGS
GPS TEST SECTIONS

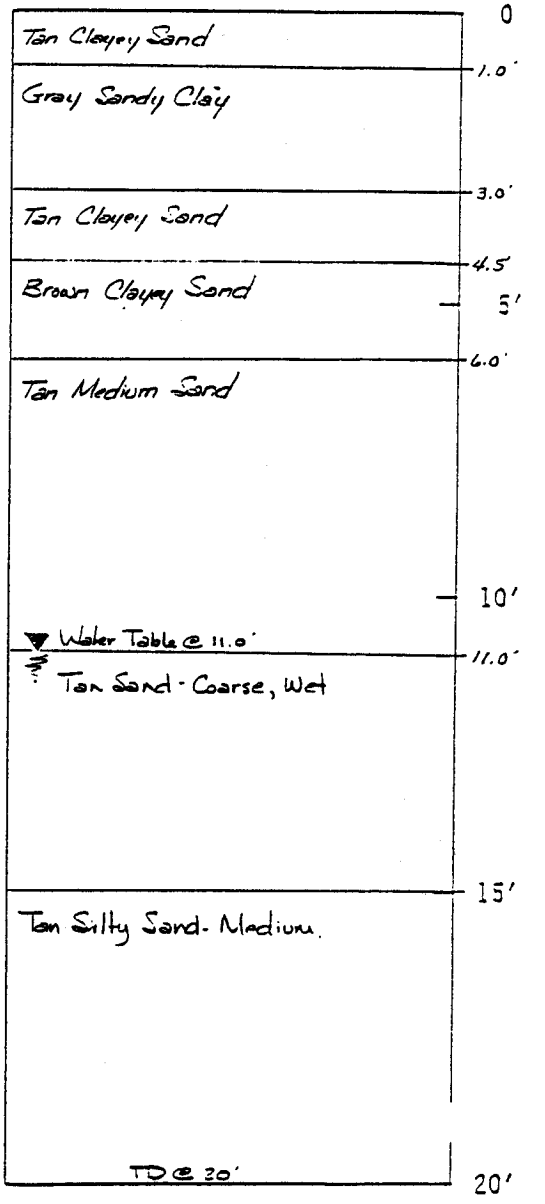
TEST SECTION I.D. No. 404165 — EXPERIMENT No. GPS-2

STATE OKLAHOMA — DATE SAMPLED 5-31-90

PAVEMENT LOG



SHOULDER PROBE LOG



Instructions for Pavement Log:

1. Review logs of bore holes, cores, and test pit to establish approximate depths of layer changes.
2. Draw lines across log above to indicate approximate average layer depths and label to identify the materials.

Instructions for Shoulder Probe Log:

Same as for "Pavement Log," except depths are taken directly from field log.

Depth to Rigid Layer, >20 Ft.
(If Rigid Layer Not Encountered, Enter ">20.")

USE THIS FORM FOR ENTERING ONLY DEPTH TO RIGID LAYER INTO THE DATA BASE!

Figure A-2. Profile of Test Section Layers

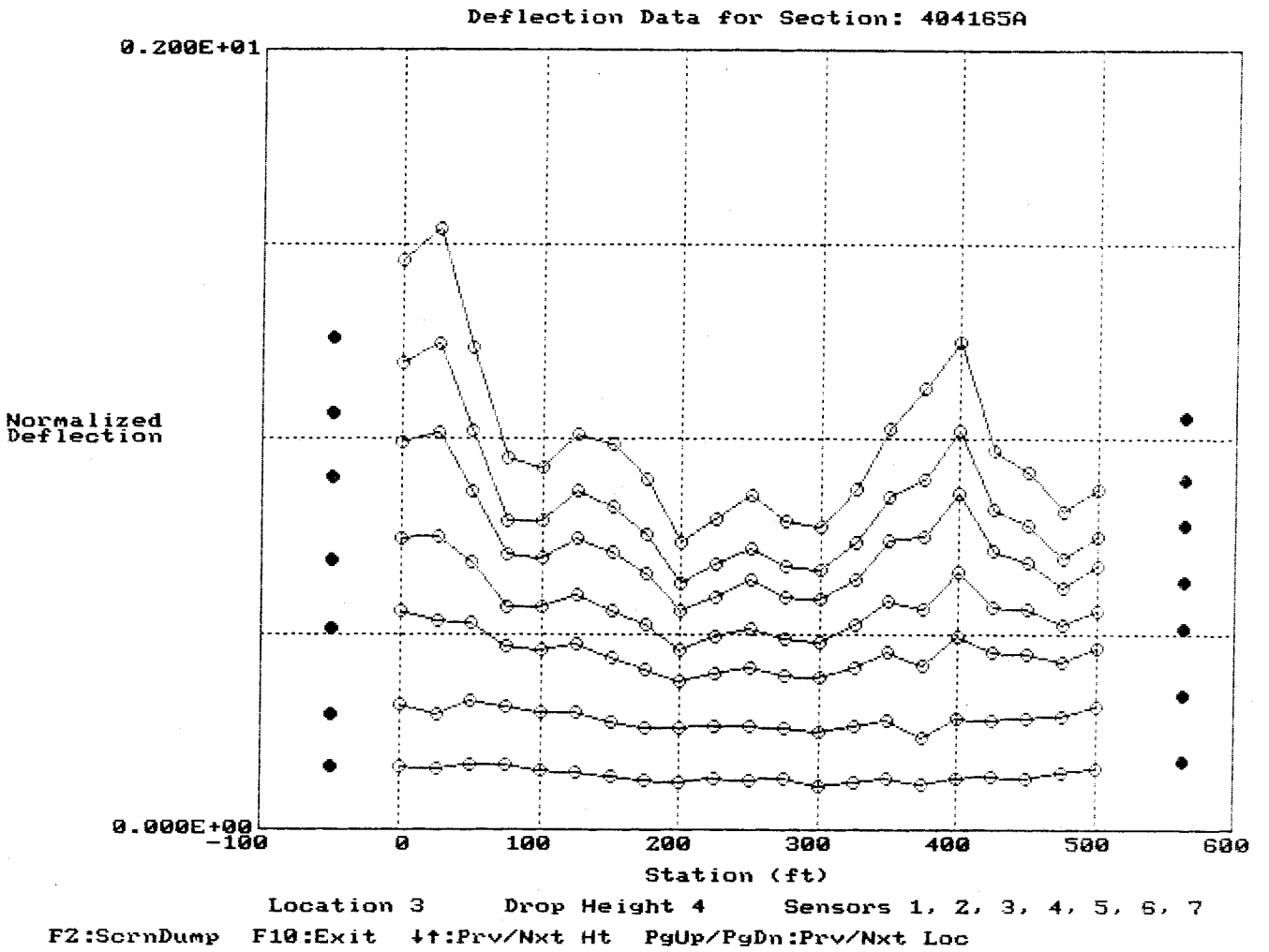


Figure A-3. Deflection Profiles from FWDCHECK

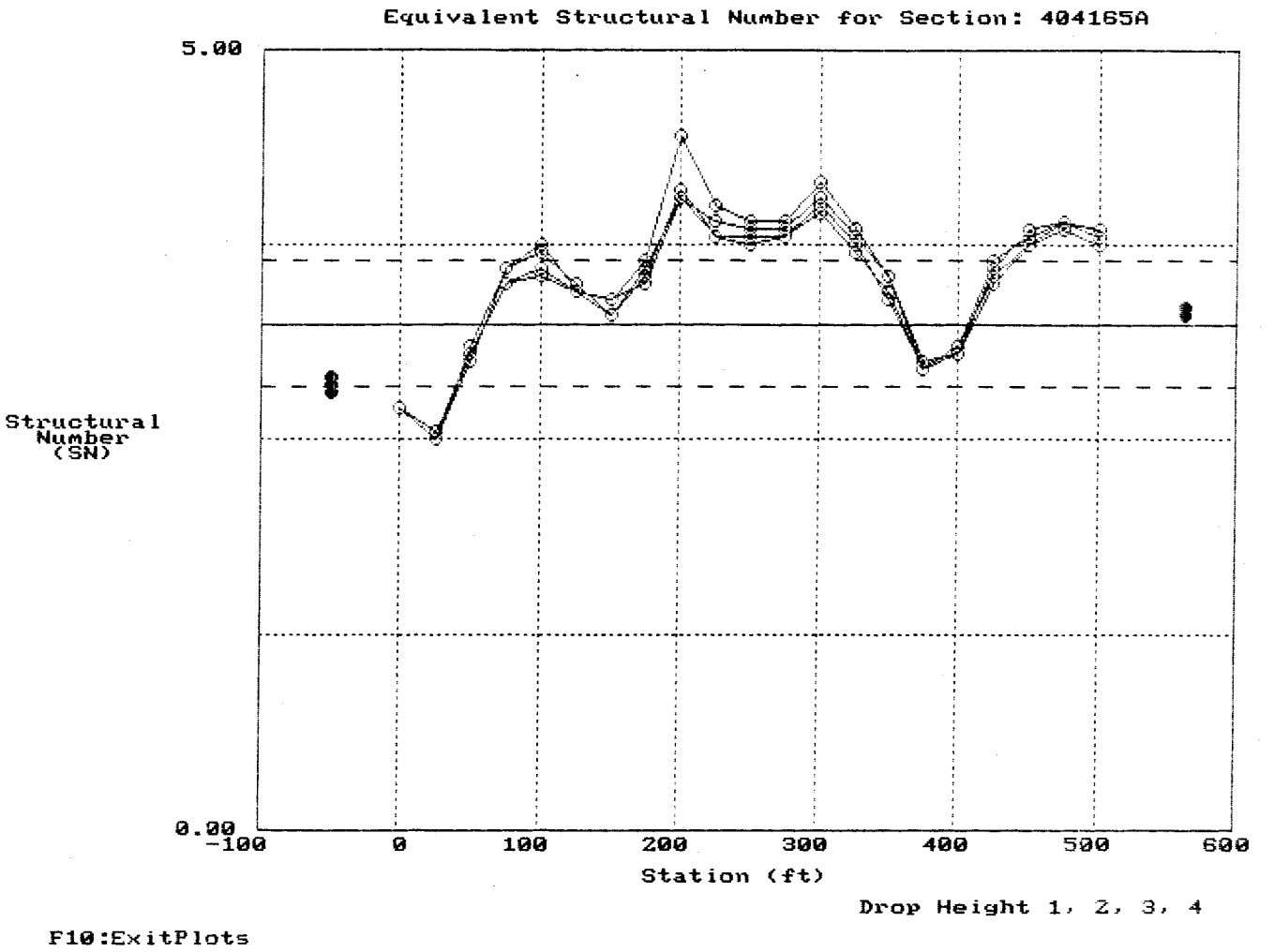


Figure A-4. Structural Number Profiles from FWDCHECK

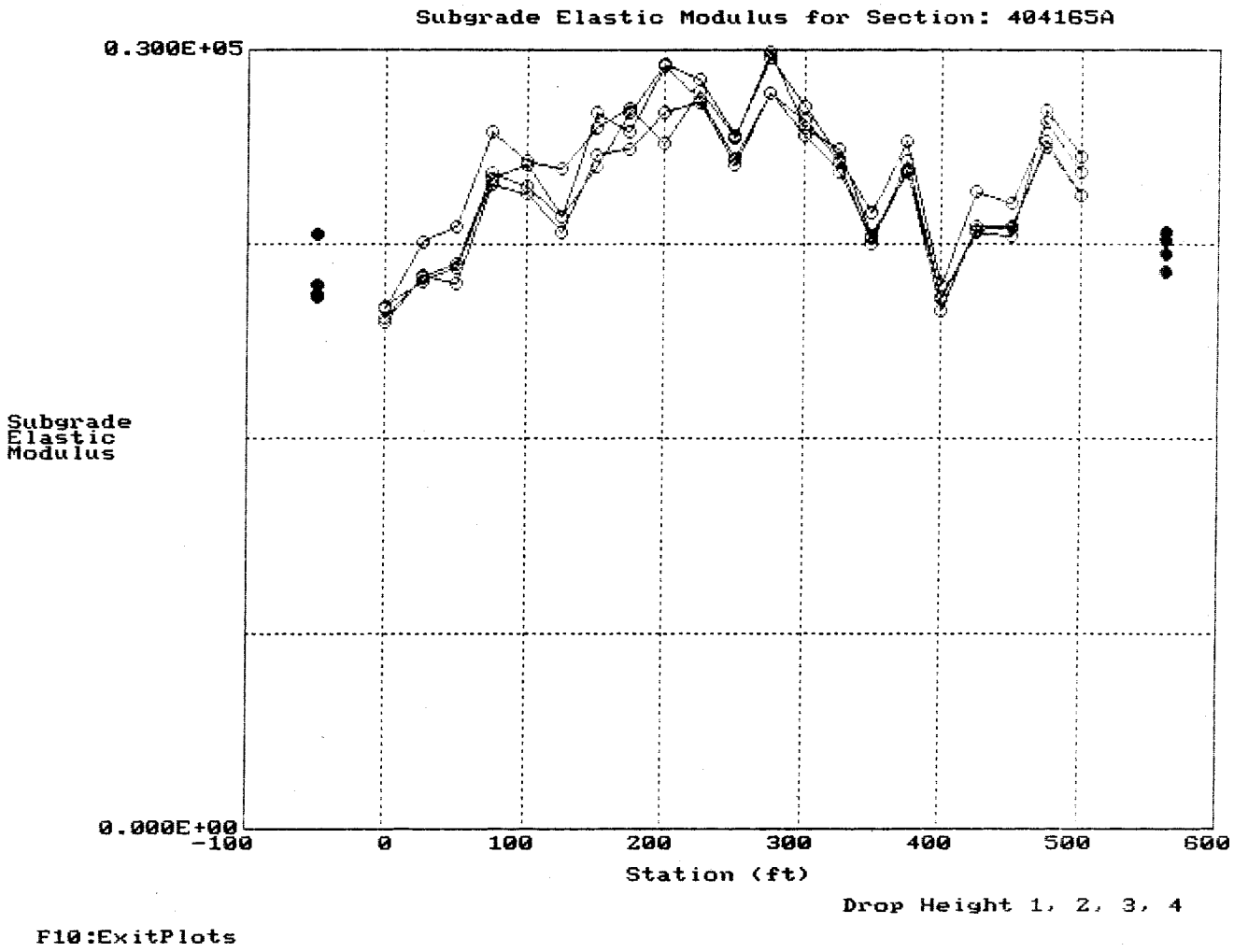


Figure A-5. Subgrade Modulus Profiles from FWDCHECK

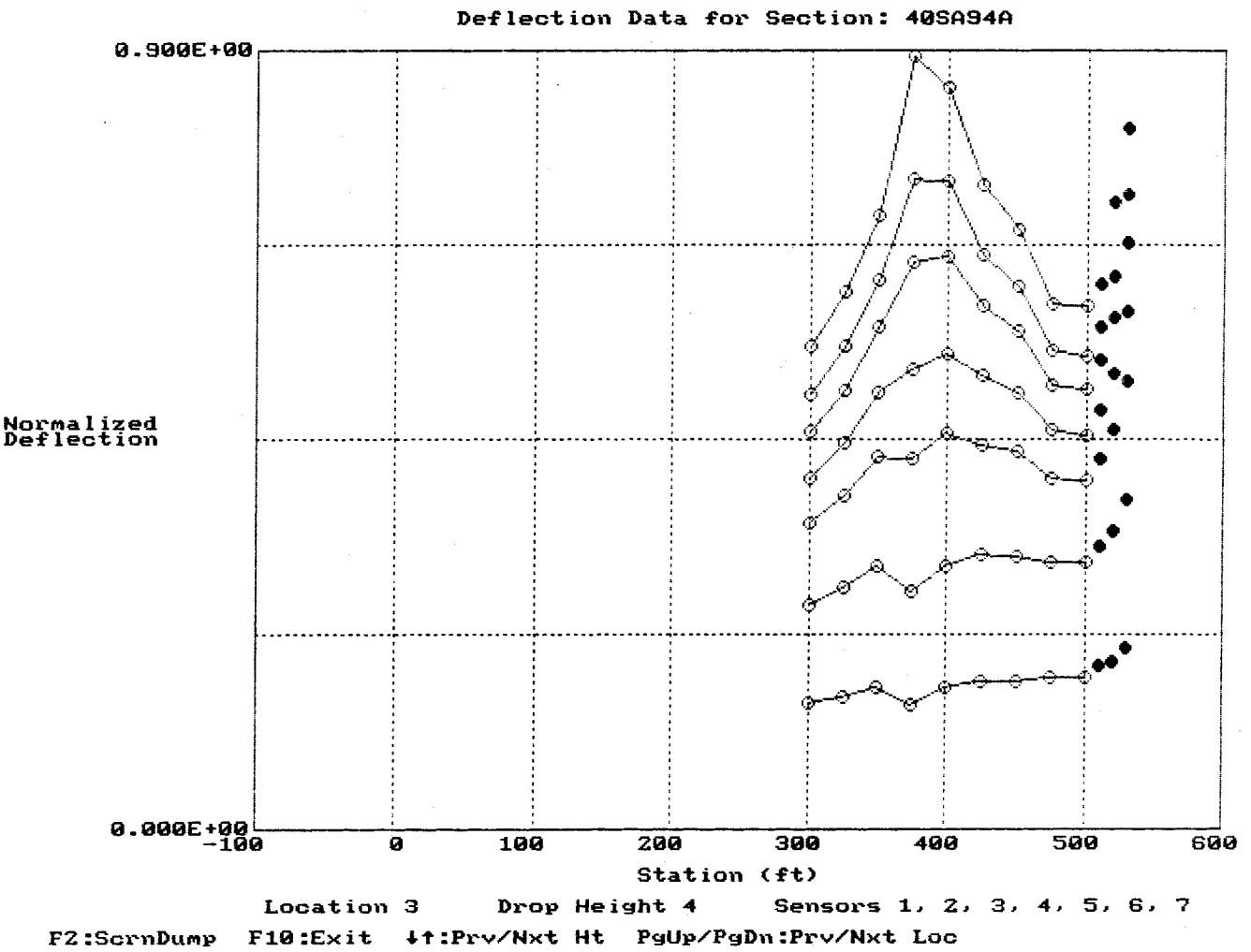


Figure A-6. Deflection Profiles from FWDCHECK on Installation Day

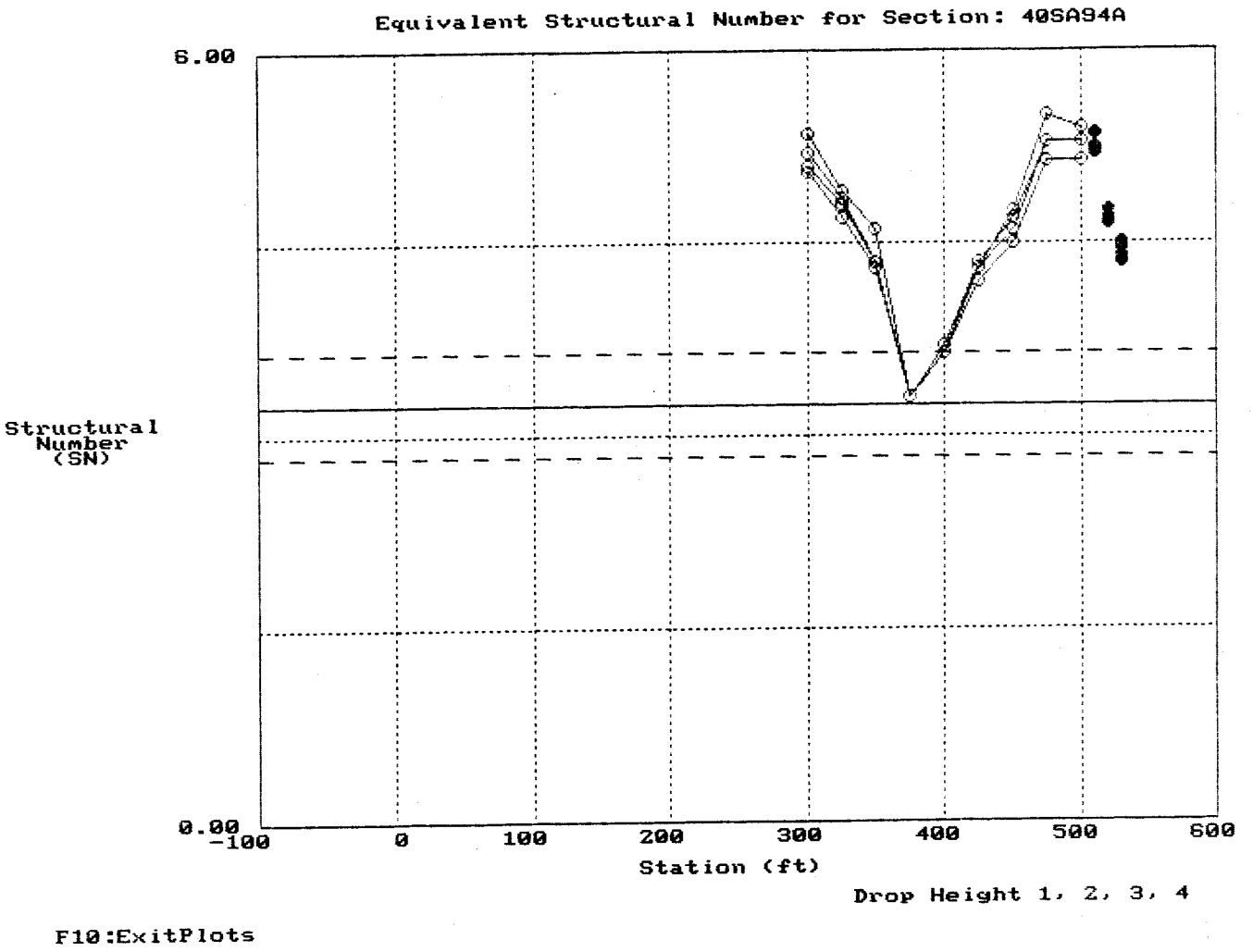


Figure A-7. Structural Number Profiles from FWDCHECK on Installation Day

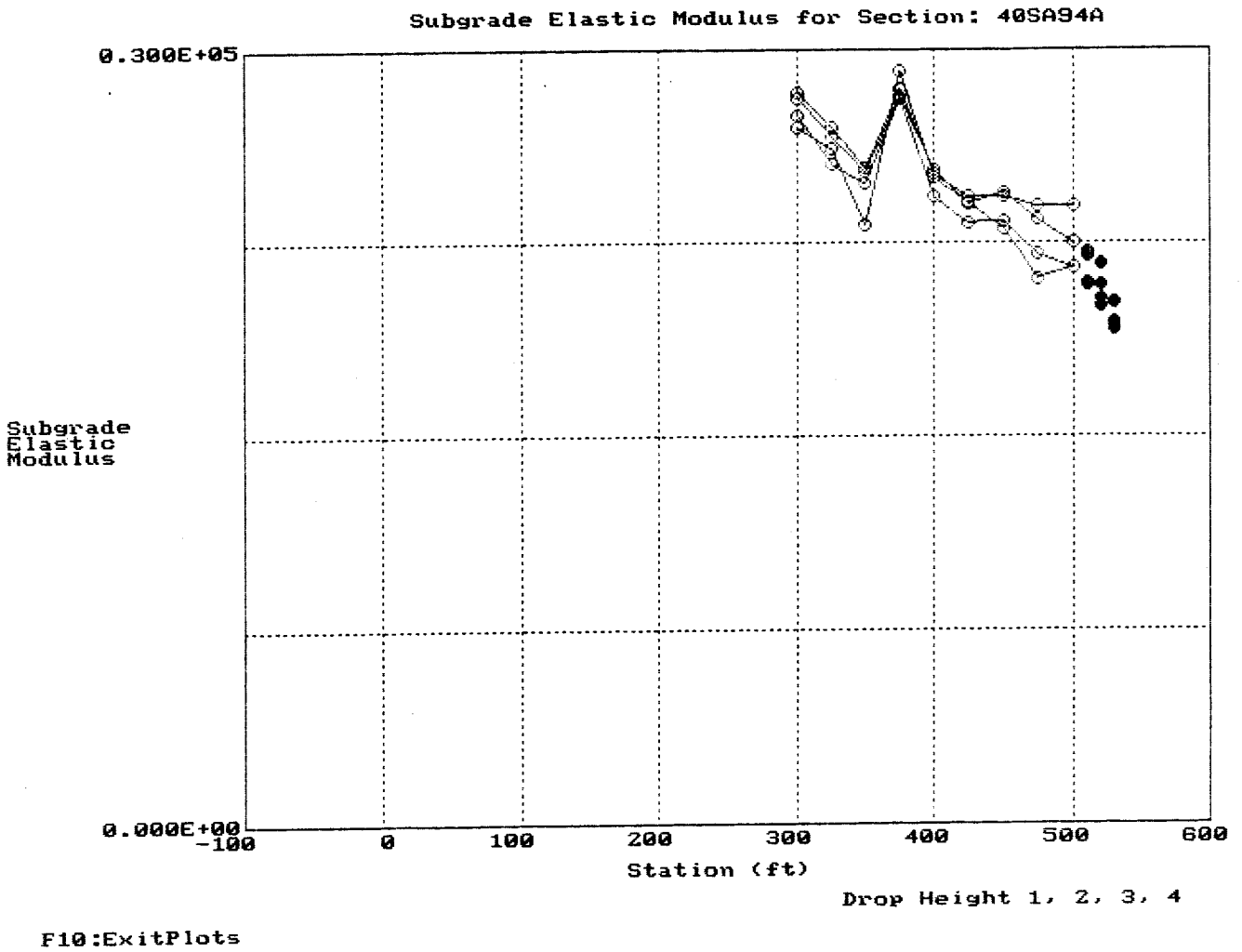


Figure A-8. Subgrade Modulus Profiles from FWDCHECK on Installation Day

Revised December 1, 1992

RECEIVED NOV 0 7 1994

SHEET 1

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 40

SHRP SECTION ID 4165

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 11/03/94

SURVEYORS: JFD, DAO PHOTOS, VIDEO, OR BOTH WITH SURVEY (P, V, B) B
PAVEMENT SURFACE TEMP - BEFORE __ __ 20°C; AFTER __ __ 20°C

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
CRACKING			
1. FATIGUE CRACKING (Square Meters)	__ __ 2.0	__ __ 0.0	__ __ 0.0
2. BLOCK CRACKING (Square Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
3. EDGE CRACKING (Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
4. LONGITUDINAL CRACKING (Meters)			
4a. Wheel Path	__ __ 5.0 ✓	__ __ 0.0	__ __ 0.0
Length Sealed (Meters)	__ __ 1.4 ✓	__ __ 0.0	__ __ 0.0
4b. Non-Wheel Path	__ __ 0.0	__ __ 0.0	__ __ 0.0
Length Sealed (Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
5. REFLECTION CRACKING AT JOINTS Number of Transverse Cracks	__ __ 0	__ __ 0	__ __ 0
Transverse Cracking (Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
Length Sealed (Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
Longitudinal Cracking (Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
Length Sealed (Meters)	__ __ 0.0	__ __ 0.0	__ __ 0.0
6. TRANSVERSE CRACKING Number of Cracks	__ __ 3 ✓	__ __ 0	__ __ 0
Length (Meters)	__ __ 5.7 ✓	__ __ 0.0	__ __ 0.0
Length Sealed (Meters)	__ __ 1.4 ✓	__ __ 0.0	__ __ 0.0
PATCHING AND POTHOLES			
7. PATCH/PATCH DETERIORATION (Number)	__ __ 0.00	__ __ 0.00	__ __ 0.00
(Square Meters)	__ __ 0.00	__ __ 0.00	__ __ 0.00
8. Potholes (Number)	__ __ 0.00	__ __ 0.00	__ __ 0.00
(Square Meters)	__ __ 0.00	__ __ 0.00	__ __ 0.00

Figure A-9. Distress Survey Data

Revised December 1, 1992

SHEET 2

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 40

SHRP SECTION ID 4165

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 11/02/94

SURVEYORS: JFD, DAO

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES (CONTINUED)

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
SURFACE DEFORMATION			
9. RUTTING - REFER TO SHEET 3 FOR SPS-3 OR Form S1 from Dipstick Manual			
10. SHOVING (Number)			00
(Square Meters)			00.0
SURFACE DEFECTS			
11. BLEEDING (Square Meters)	00.0	00.0	00.0
12. POLISHED AGGREGATE (Square Meters)			00.0
13. RAVELING (Square Meters)	00.0	00.0	00.0
MISCELLANEOUS DISTRESSES			
14. LANE-TO-SHOULDER DROPOFF - REFER TO SHEET 3			
15. WATER BLEEDING AND PUMPING (Number)			0
Length of Affected Pavement (Meters)			00.0

16. OTHER (Describe) _____

Figure A-9 (Continued). Distress Survey Data

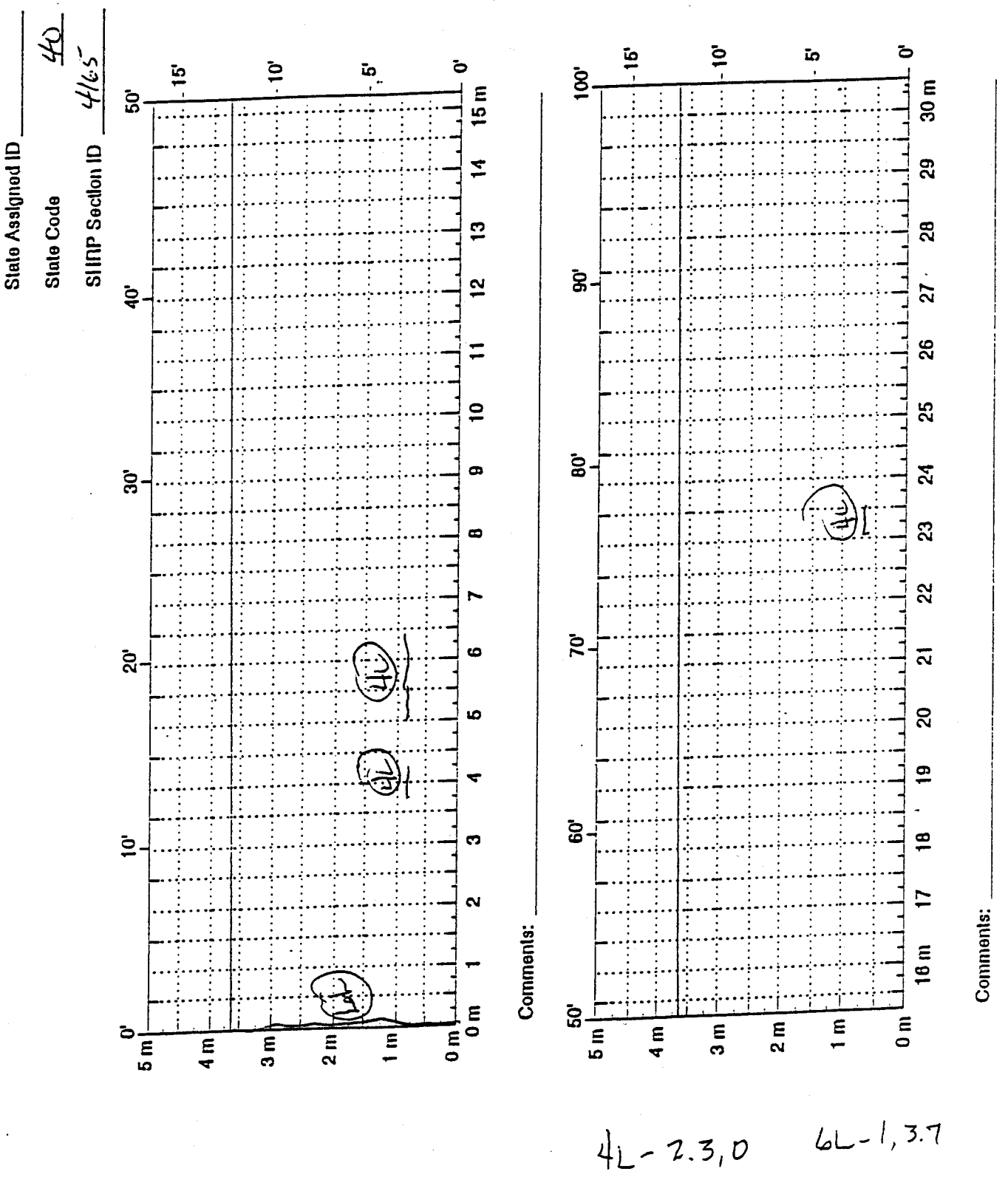


Figure A-9 (Continued). Distress Survey Data

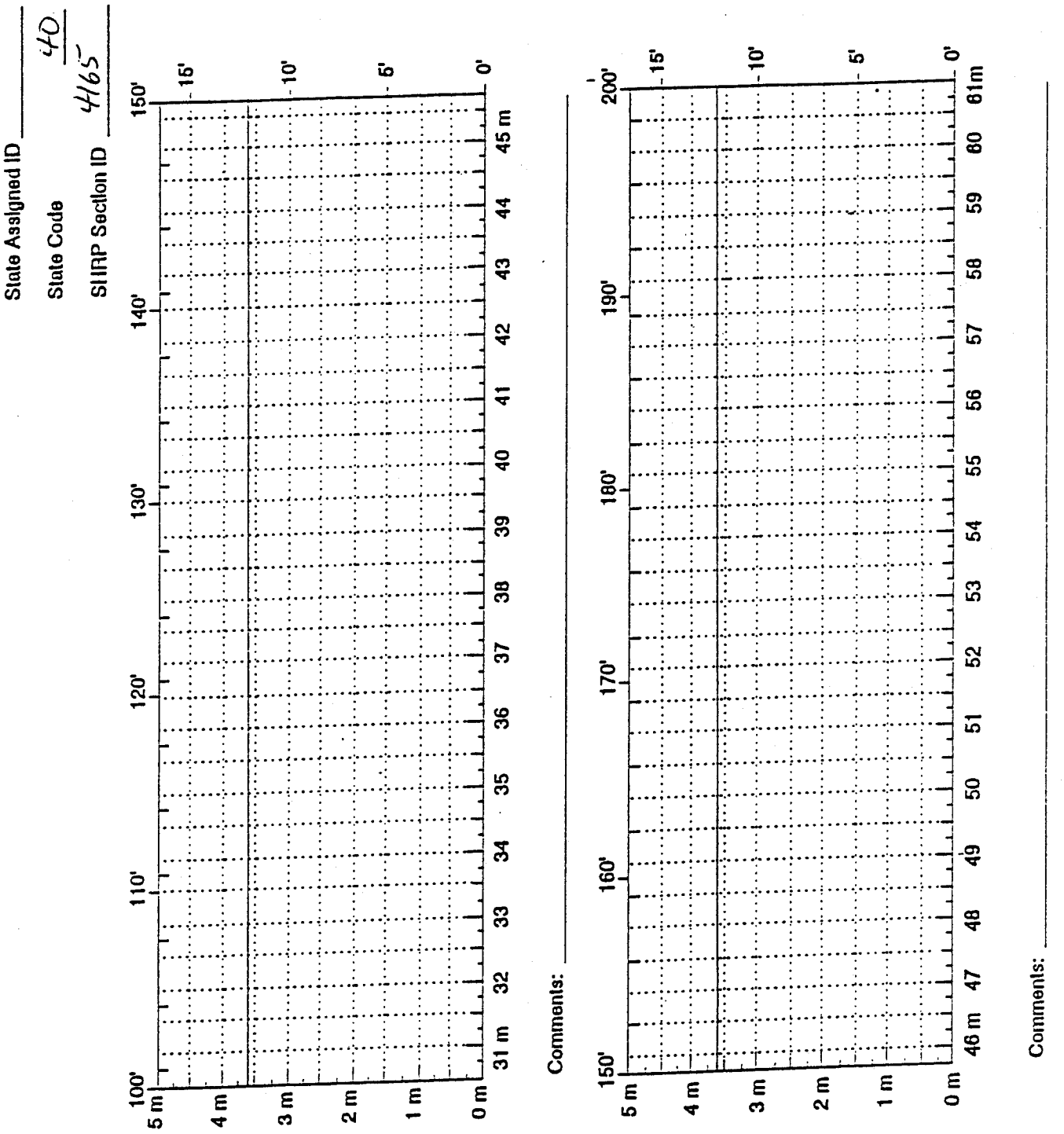


Figure A-9 (Continued). Distress Survey Data

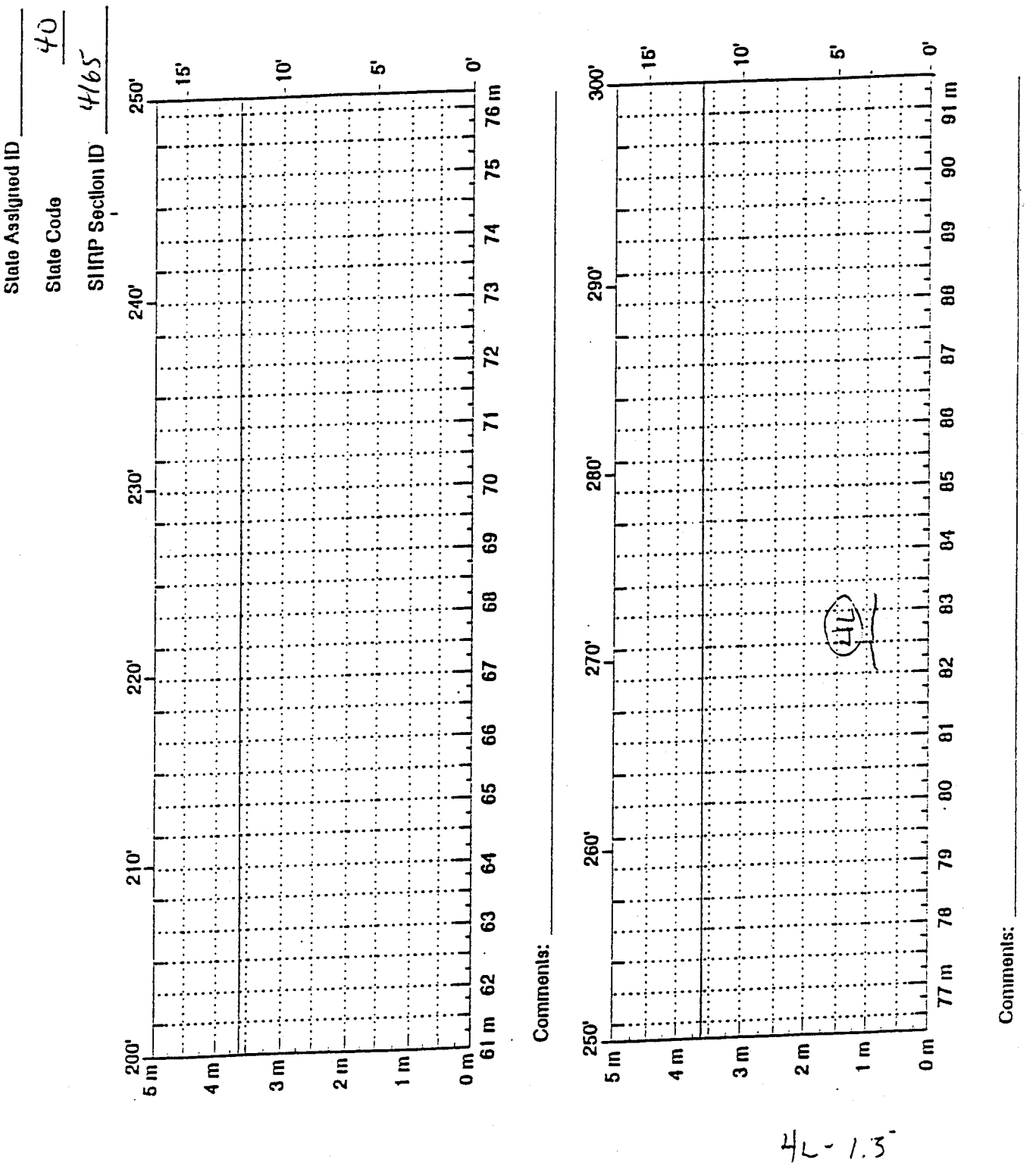
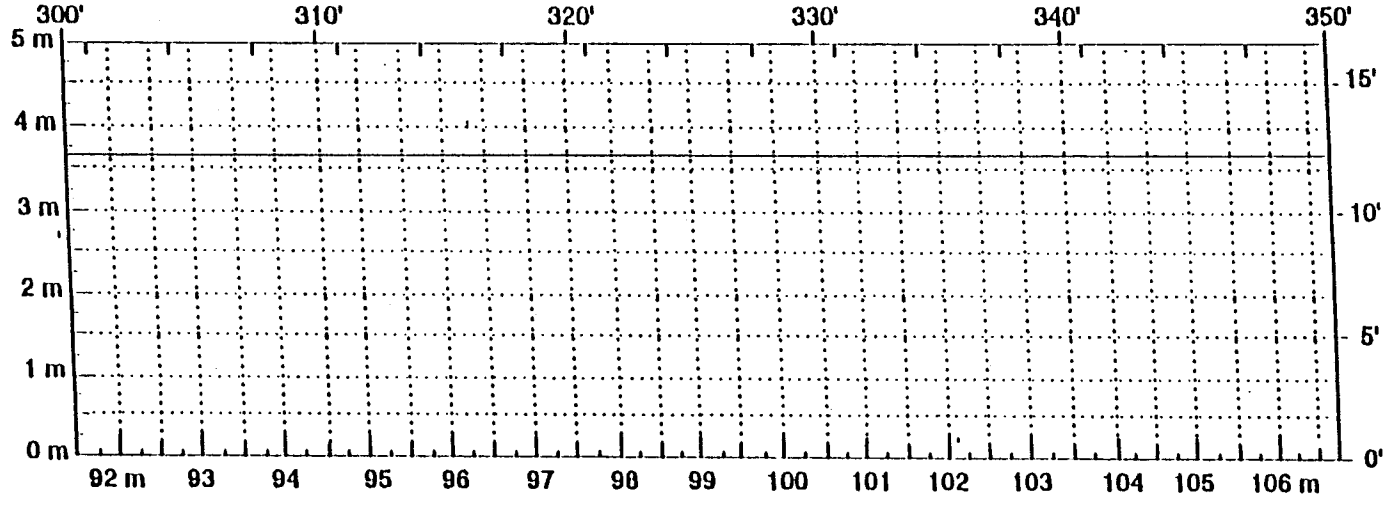


Figure A-9 (Continued). Distress Survey Data

State Assigned ID _____

State Code 40

SHRP Section ID 4165



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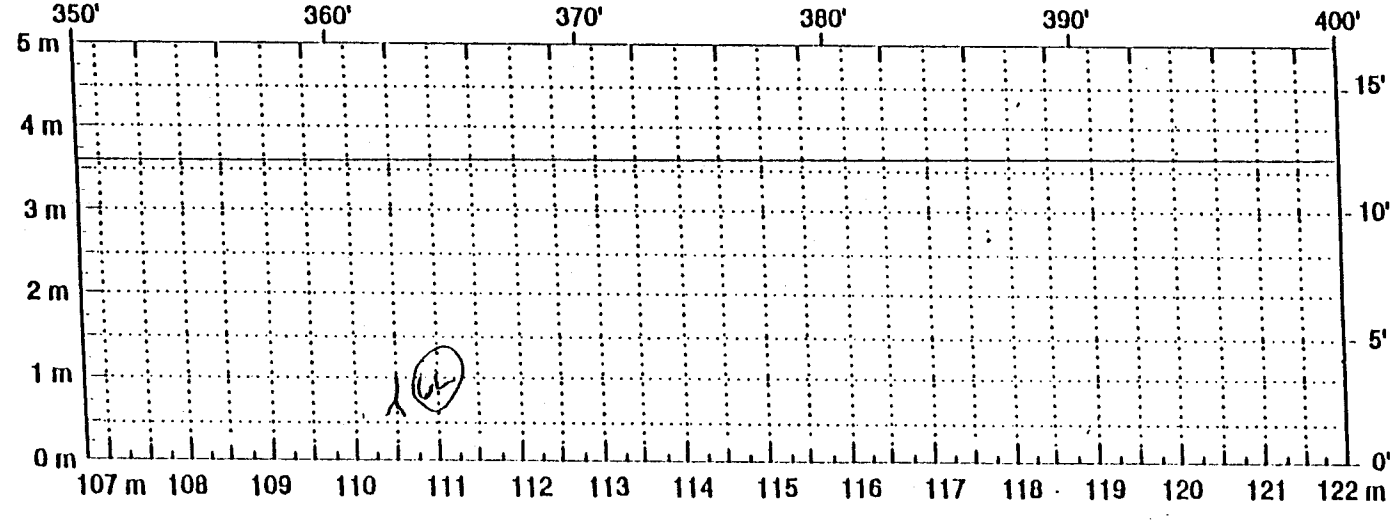


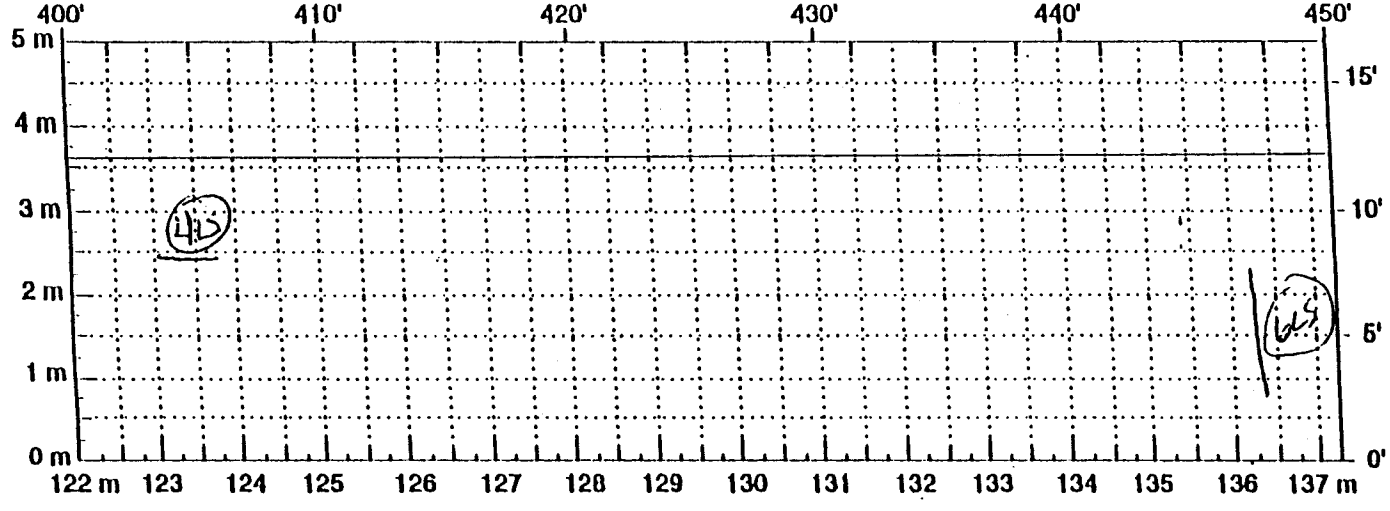
Comment: _____

Figure A-9 (Continued). Distress Survey Data

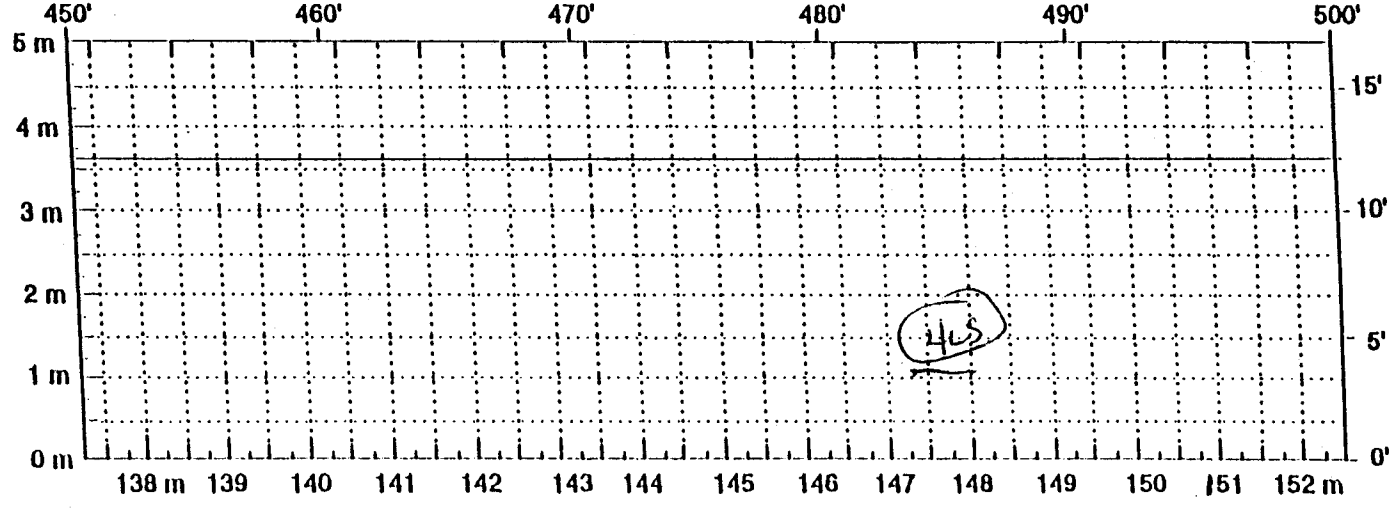
State Assigned ID _____

State Code 40

SHRP Section ID 4165



Comments: _____



4L-1,4,1,4 4L-1,5,1,5

20°C

Comments: _____

Figure A-9 (Continued). Distress Survey Data

APPENDIX B

Pre-installation Activities

Appendix B contains the following information:

Seasonal Monitoring Meeting Agenda

Figure B-1. TDR Traces Obtained During Calibration

SEASONAL MONITORING INSTRUMENTATION
PRELIMINARY PLANNING MEETING

DISCUSSION TOPICS

Introduction

- Objectives of Seasonal Monitoring Program
- Overview of Activities

Site

- Section Location
- Instrumentation Layout
- Planned Rehabilitation and Maintenance
- Underground Utilities

Installation Procedures, Materials and Equipment (Assisted with Slide Presentation)

- Instrumentation: Sensors and Procedures
  - TDR Probes
  - Resistivity Instrumentation
  - Thermistor Probe
  - Air Temperature and Rain Gauge
  - Equipment Cabinet and On-site Instrumentation
  - Observation Piezometer
- Materials and Equipment
  - Drill Rig
  - Pavement Saw
  - Tools
  - Pavement Repair Materials
  - Piezometer Materials
    - Sand
    - Bentonite
    - Access Cover
  - Others

Schedule

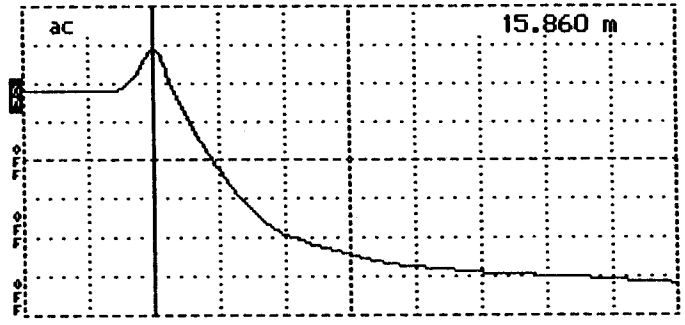
- Pre-installation Meeting
- Traffic Control
- Installation Schedule

Installation Team and Responsibilities

- Participating Highway Agency Staff
  - Drill Crew
  - Traffic Control
  - Project Contacts
- RCOC Staff
- FHWA Staff
- Others

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

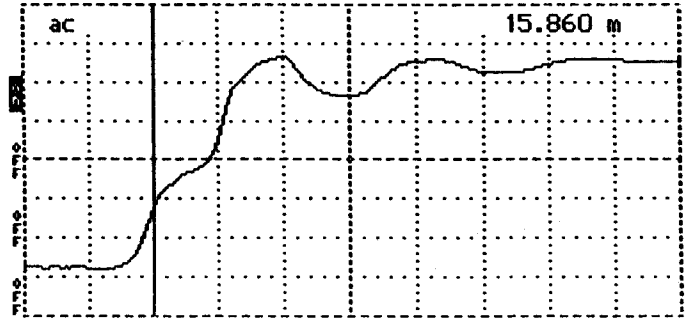
Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 163 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 4102A01
Notes SHORTED
Input Trace J.P.
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 163 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



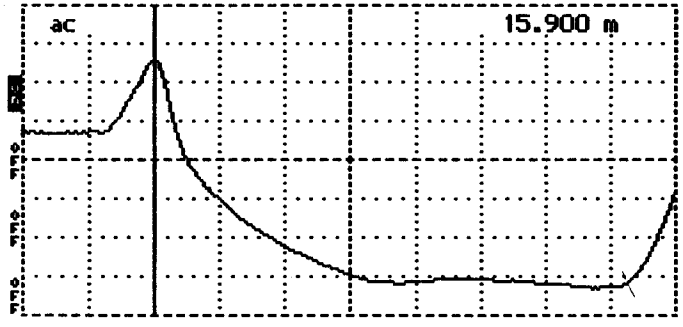
Tektronix 1502B TDR
Date 11/29/93
Cable 4102A01
Notes AIR
Input Trace J.D.
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Figure B-1. TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 77.0 mΩ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A01
Notes WATER
21.1°C
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.22	77.55

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A01 Measured Length of Coax Cable: ___.__ m

Comments: _____

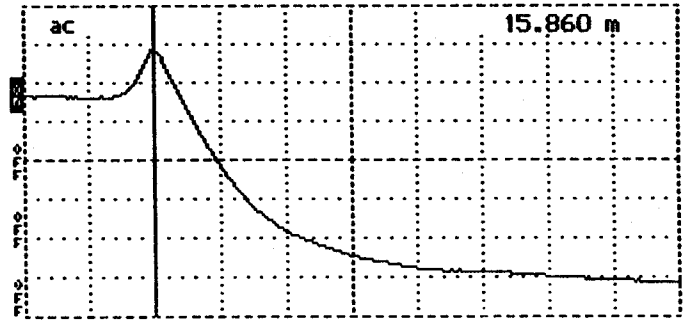
Prepared by: Jon Peacock Employer: BRE

Date (dd/mm/yy): 29/11/93

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 177 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac

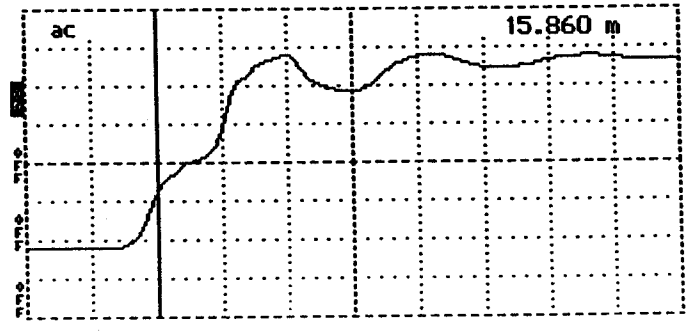


Tektronix 1502B TDR
Date 11-29-93
Cable 40A02
Notes SHORTED
N.D.

Input Trace _____
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	___.___	___.___

Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 177 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A02
Notes IN AIR
N.D.

Input Trace _____
Stored Trace .....
Difference Trace .....

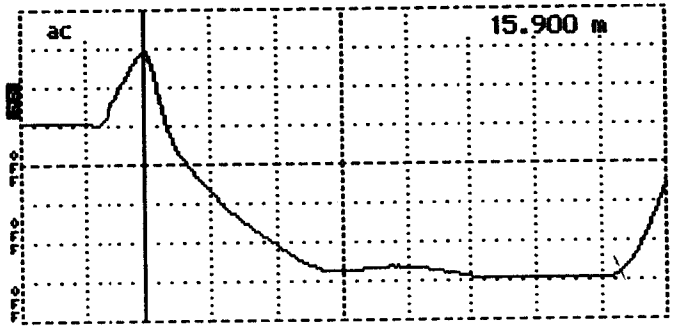
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C__, TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 77.0 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A02
Notes IN WATER
WATER TEMP 21.1
4.0
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.76	76.67

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A02 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

Prepared by: Jon Pedcock Employer: BRE

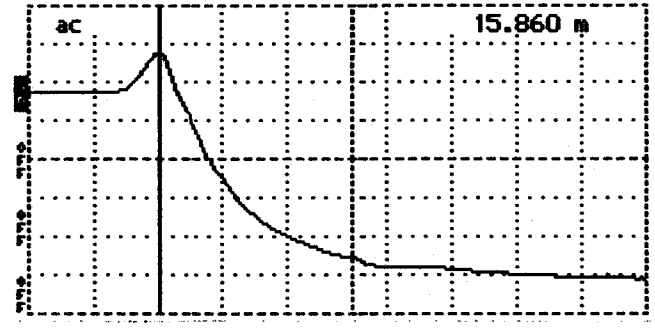
Date (dd/mm/yy): 29/11/93

Data Sheet SMP-C01 TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

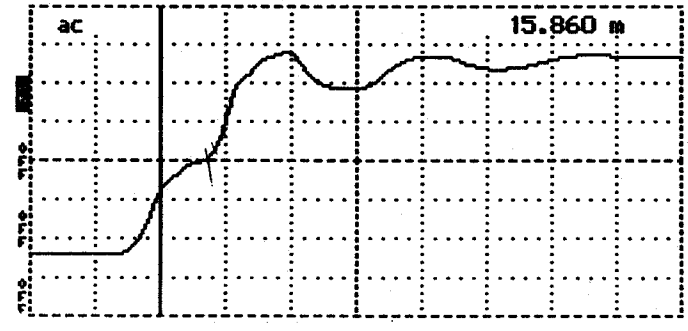
Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A03
Notes Shorted
Input Trace J.P
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A03
Notes Air
Input Trace JP
Stored Trace .....
Difference Trace .....

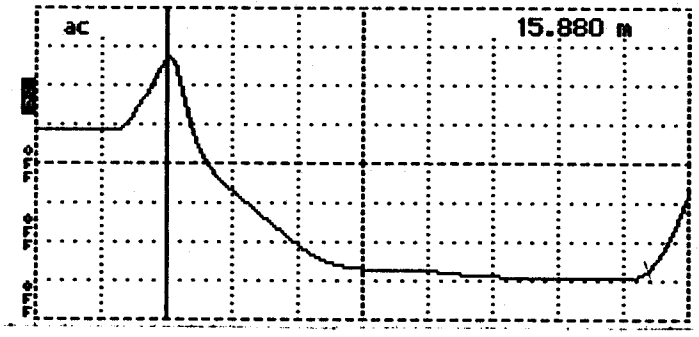
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	.24	1.43

Figure B-1 (Continued). TDR Traces Obtained During Calibration

Data Sheet SMP-C . TDR Probe Check

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.880 m
Distance/Div..... .25 m/div
Vertical Scale.... 79.2 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A03
Notes WATER
21.0°C
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	77.55

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A03 Measured Length of Coax Cable: __.__ m

Comments: _____

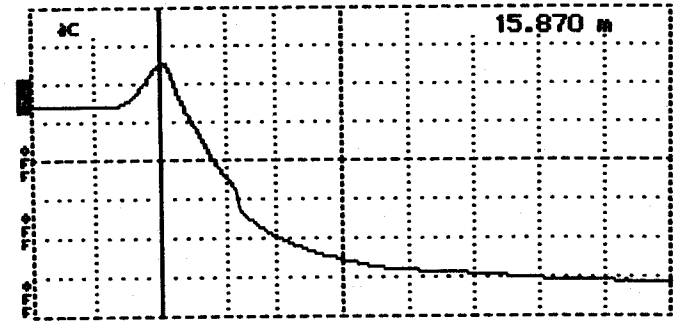
Prepared by: Jon Peacock Employer: BRE

Date (dd/mm/yy): 29/11/93

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

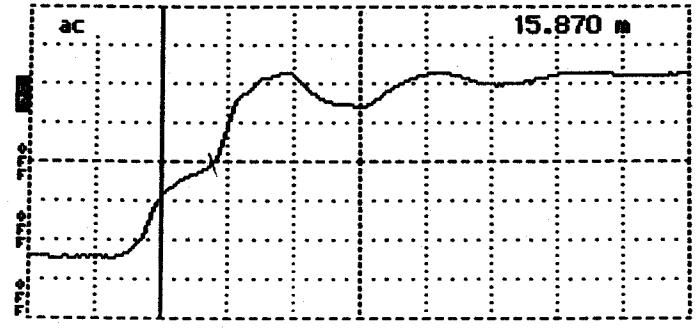
Cursor ..... 15.870 m
Distance/Div..... .25 m/div
Vertical Scale.... 188 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A04
Notes SHORTED N.D.
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.870 m
Distance/Div..... .25 m/div
Vertical Scale.... 188 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A04
Notes IN AIR N.D.
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.890 m
Distance/Div..... .25 m/div
Vertical Scale.... 68.6 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac

Tektronix 1502B TDR
Date 11/29/93
Cable 40A04
Notes WATER
21.1°C
Input Trace J.P.
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.76	76.67

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A04 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

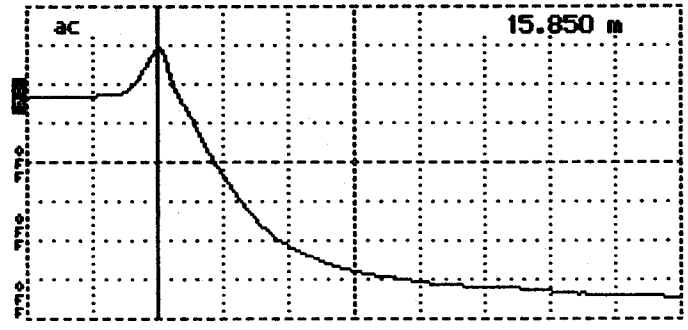
Prepared by: Jon Peacock Employer: BRE

Date (dd/mm/yy): 29/11/93

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

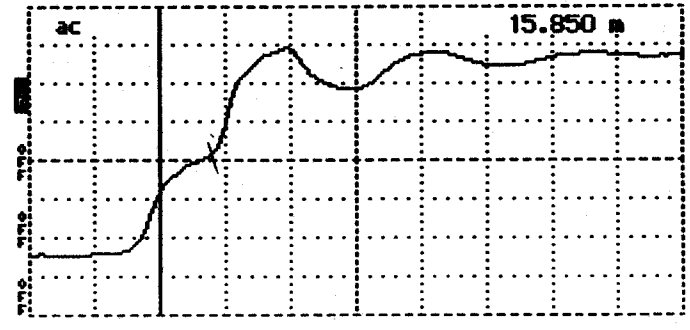
Cursor ..... 15.850 m
Distance/Div..... .25 m/div
Vertical Scale.... 167 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A05
Notes SHORTED
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.850 m
Distance/Div..... .25 m/div
Vertical Scale.... 167 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A05
Notes IN AIR
Input Trace
Stored Trace
Difference Trace

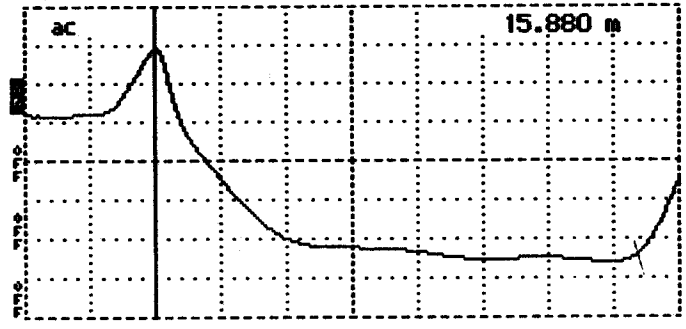
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.880 m
Distance/Div..... .25 m/div
Vertical Scale.... 83.9 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11-29-93
Cable 40A05
Notes IN WATER
WATER TEMP 21.1 C.D.
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	77.55

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A05 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

Prepared by: Jon Peacock Employer: BRE

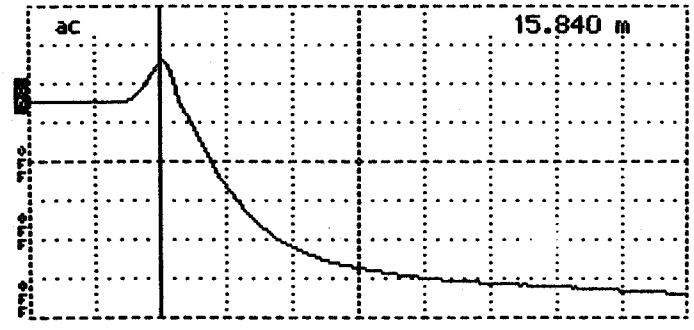
Date (dd/mm/yy): 29/11/93

Data Sheet SMP-C01 TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code: 401 LTPP Section ID: 4165

Cursor ..... 15.840 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac

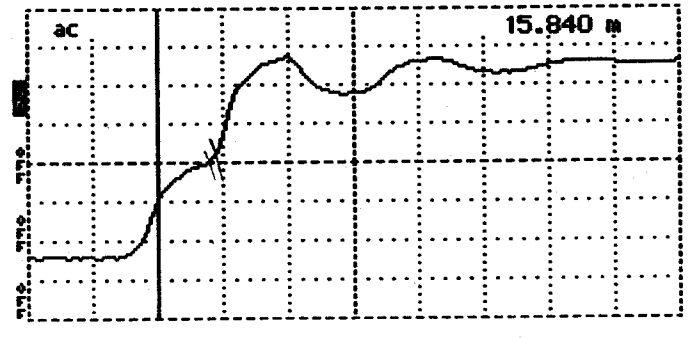


Tektronix 1502B TDR
Date 11/29/93
Cable 40A06
Notes SHORTED

Input Trace J.P.
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.840 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A06
Notes AIR

Input Trace J.P.
Stored Trace .....
Difference Trace .....

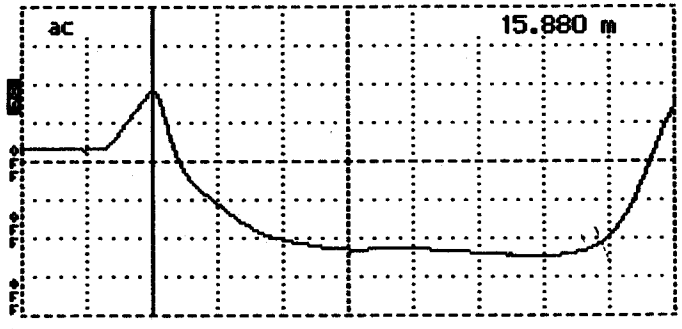
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.74	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.880 m
Distance/Div..... .25 m/div
Vertical Scale.... 96.9 mV/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A06
Notes WATER
21.1°C
Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.79	79.31

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A06 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

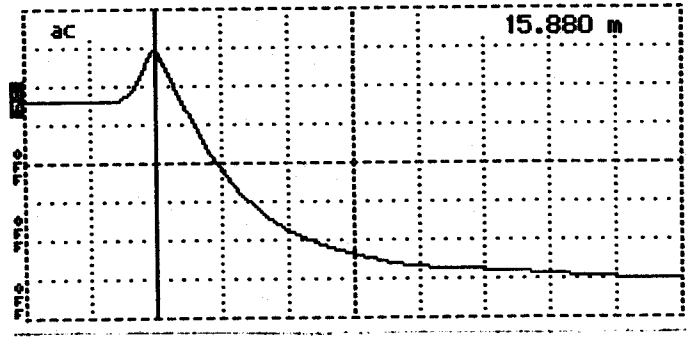
Prepared by: Jon Peacock Employer: BRE

Date (dd/mm/yy): 29/11/93

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

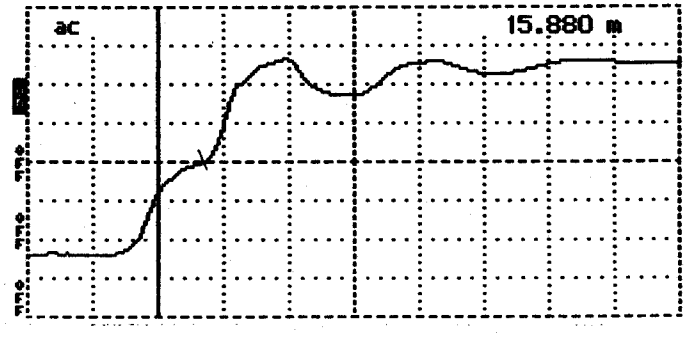
Cursor ..... 15.880 m
Distance/Div..... .25 m/div
Vertical Scale.... 177 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A07
Notes Shorted
Input Trace S.P.
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.880 m
Distance/Div..... .25 m/div
Vertical Scale.... 177 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A07
Notes AIR
21°C
Input Trace _____
Stored Trace .....
Difference Trace .....

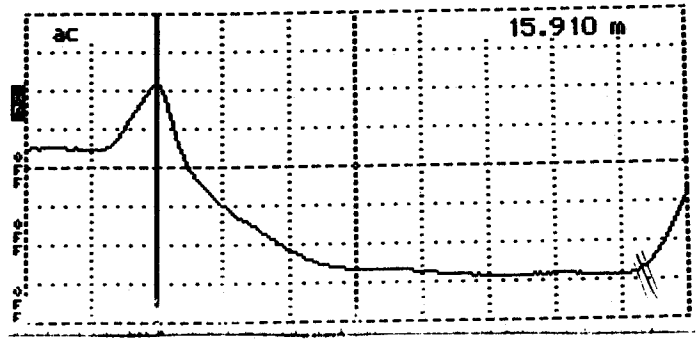
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	.24	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.910 m
Distance/Div..... .25 m/div
Vertical Scale.... 88.9 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B 1
Date 11/29/93
Cable 40A07
Notes water
21.1°C
Input Trace J.P
Stored Trace -----
Difference Trace .

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	22.55

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A07 Measured Length of Coax Cable: ___.__ m

Comments: _____

Prepared by: Jon Peacock Employer: BRE

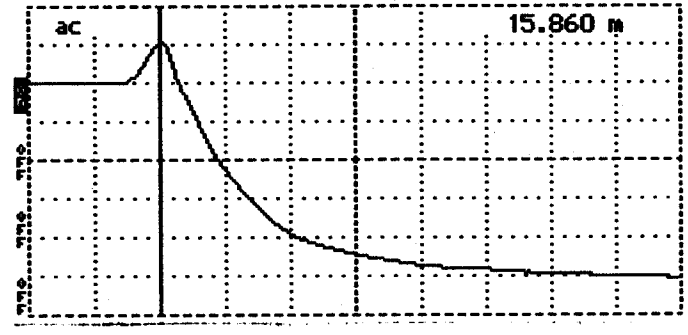
Date (dd/mm/yy): 29/11/93

Data Sheet SMP-C01 TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

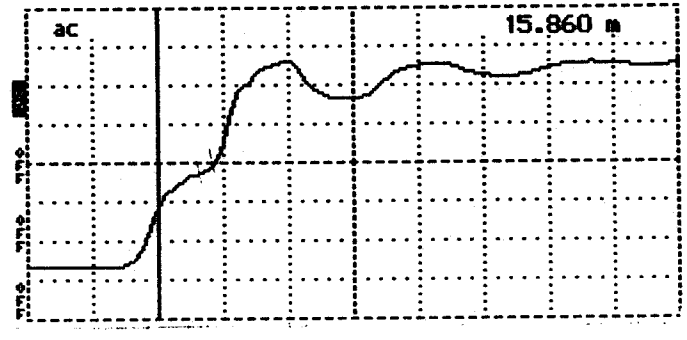
Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 167 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A08
Notes SHORTED
Input Trace JP
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 15.860 m
Distance/Div..... .25 m/div
Vertical Scale.... 167 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A09
Notes AIR
Input Trace JP
Stored Trace .....
Difference Trace .....

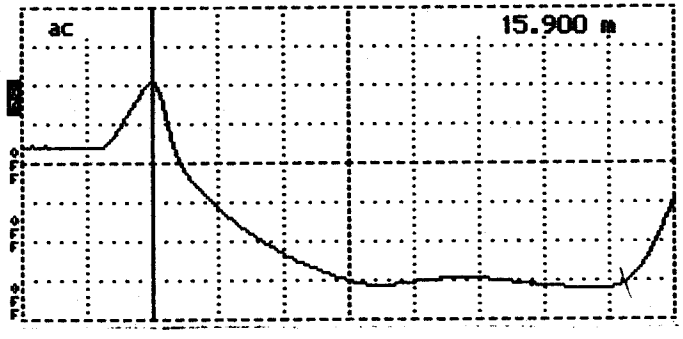
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 86.4 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A08
Notes WATER 21.0°C
Input Trace
Stored Trace
Difference Trace

TDR Trace[1]	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.76	76.67

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A08 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

Prepared by: Jon Fedcock Employer: ERE

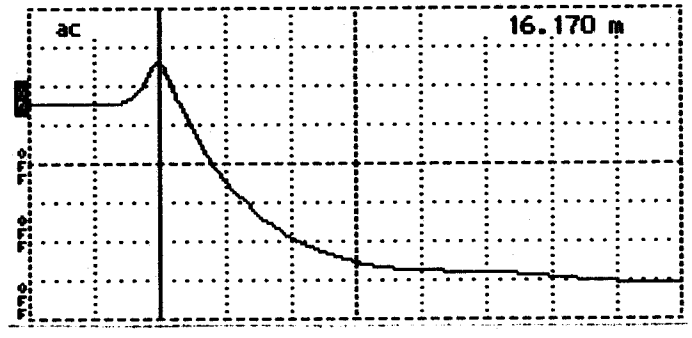
Date (dd/mm/yy): 29/11/93

Data Sheet SMP-C01 TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code 401 LTPP Section ID 4165

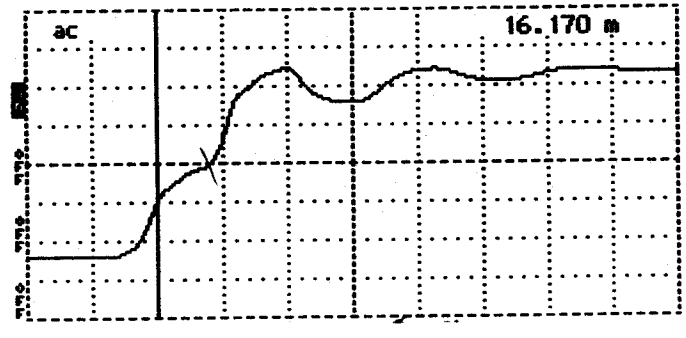
Cursor ..... 16.170 m
Distance/Div..... .25 m/div
Vertical Scale.... 182 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A09
Notes SHORTED
Input Trace JP
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	__.__	__.__

Cursor ..... 16.170 m
Distance/Div..... .25 m/div
Vertical Scale.... 182 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A09
Notes AIR ~~21.0°C~~
Input Trace JP
Stored Trace
Difference Trace

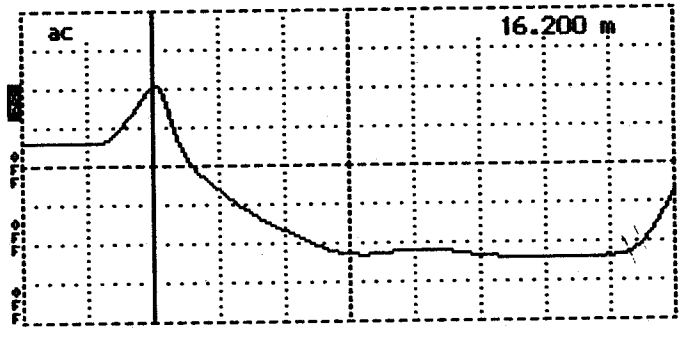
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [40] LTPP Section ID [4165]

Cursor ..... 16.200 m
Distance/Div..... .25 m/div
Vertical Scale.... 100 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A09
Notes WATER
21.0°C

Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.11	77.55

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A09 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

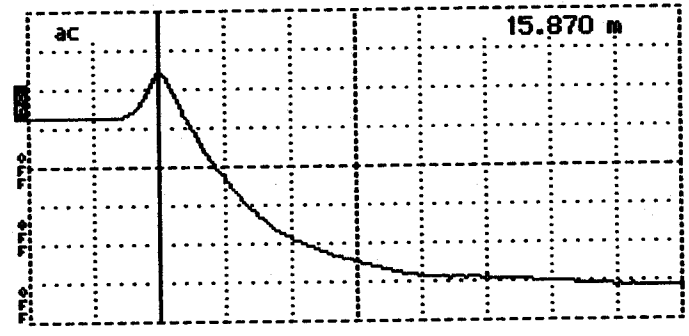
Prepared by: Jon Pezcock Employer: BRE

Date (dd/mm/yy): 29/11/93

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code 401 LTPP Section ID 4165

Cursor ..... 15.870 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac

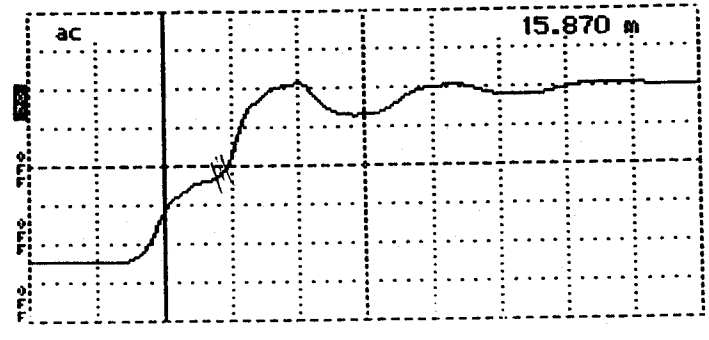


Tektronix 1502B TDR
Date 11/29/93
Cable 4DA 10
Notes SHORTED

Input Trace JR
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_._ _	_ _._ _

Cursor ..... 15.870 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 4DA10
Notes AIR

Input Trace JR
Stored Trace .....
Difference Trace

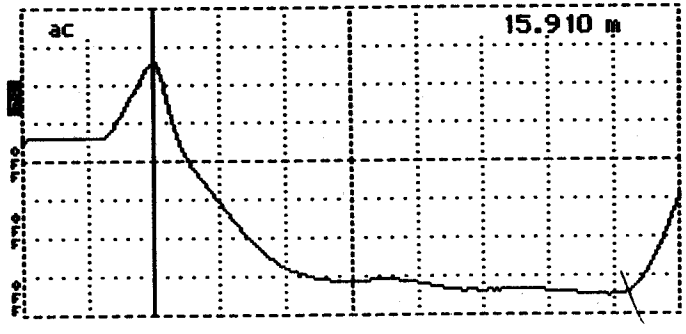
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C . TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code 40 LTPP Section ID 4165

Cursor ..... 15.910 m
Distance/Div..... .25 m/div
Vertical Scale.... 74.8 mρ/div
Vp 0.99
Noise Filter..... 1 avg
Power..... ac



Tektronix 1502B TDR
Date 11/29/93
Cable 40A10
Notes Lying on 21.1°C
Input Trace J P
Stored Trace .....
Difference Trace .....

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.76	26.67

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Assigned Serial Number: 40A10 Measured Length of Coax Cable: __ __ . __ m

Comments: _____

Prepared by: Jon Peacock Employer: BRE

Date (dd/mm/yy): 29/11/93

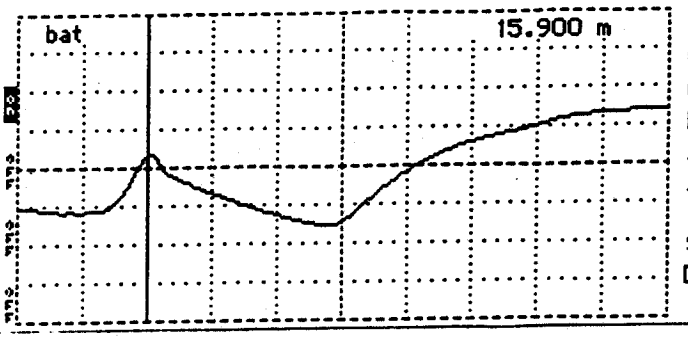
Figure B-1 (Continued). TDR Traces Obtained During Calibration

APPENDIX C

Instrumentation Installation Information

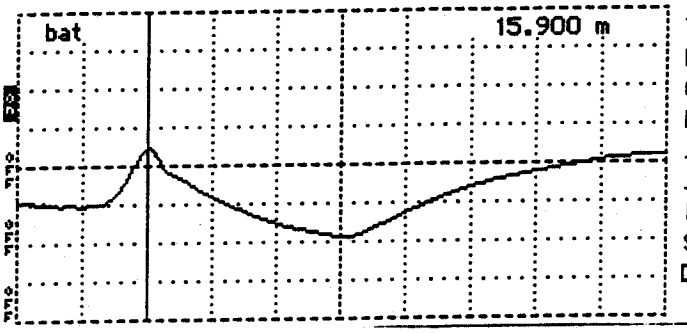
Appendix C contains the following information:

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 145 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... bat



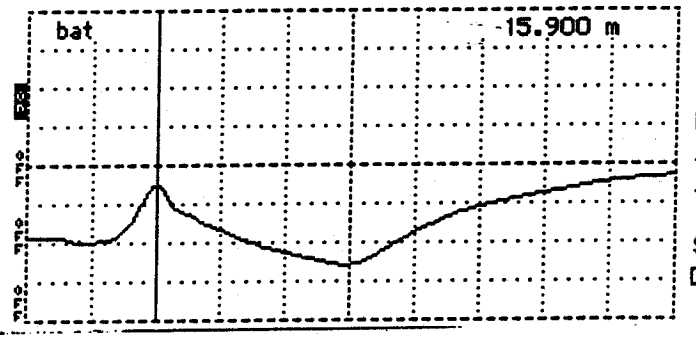
Tektronix 1502B TDR
Date 3/29/94
Cable 01
Notes DEPTH 15'
17:46
Input Trace
Stored Trace
Difference Trace

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 145 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... bat



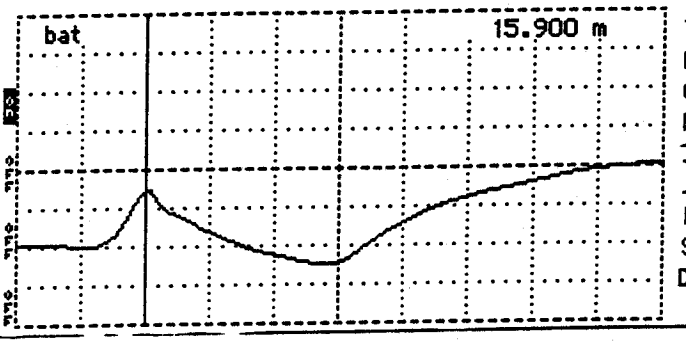
Tektronix 1502B TDR
Date 3/29/94
Cable 02
Notes DEPTH [illegible]
TIME 17:40
Input Trace J.P.
Stored Trace
Difference Trace

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 145 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... bat



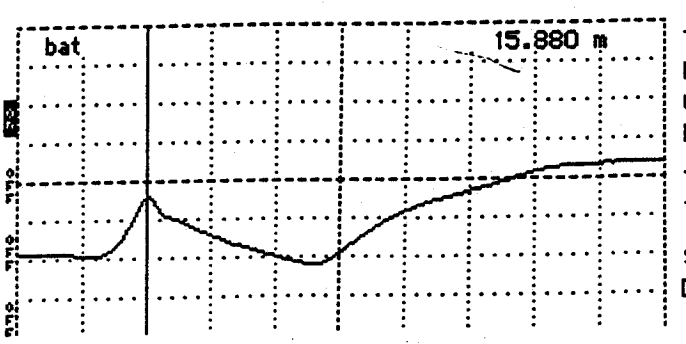
Tektronix 1502B TDR
Date 3/29/94
Cable 03
Notes DEPTH 27'
TIME 17:33
Input Trace J.P.
Stored Trace
Difference Trace

Cursor ..... 15.900 m
Distance/Div..... .25 m/div
Vertical Scale.... 145 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... bat



Tektronix 1502B TDR
Date 3/29/94
Cable 04
Notes DEPTH 33"
TIME 17:26
Input Trace J.P.
Stored Trace
Difference Trace

Cursor ..... 15.880 m
Distance/Div..... .25 m/div
Vertical Scale.... 145 mρ/div
VP 0.99
Noise Filter..... 1 avg
Power..... bat



Tektronix 1502B TDR
Date 3/29/94
Cable 05
Notes DEPTH 39"
TIME 17:19
Input Trace JP
Stored Trace
Difference Trace

Figure C-1. TDR Traces During Installation

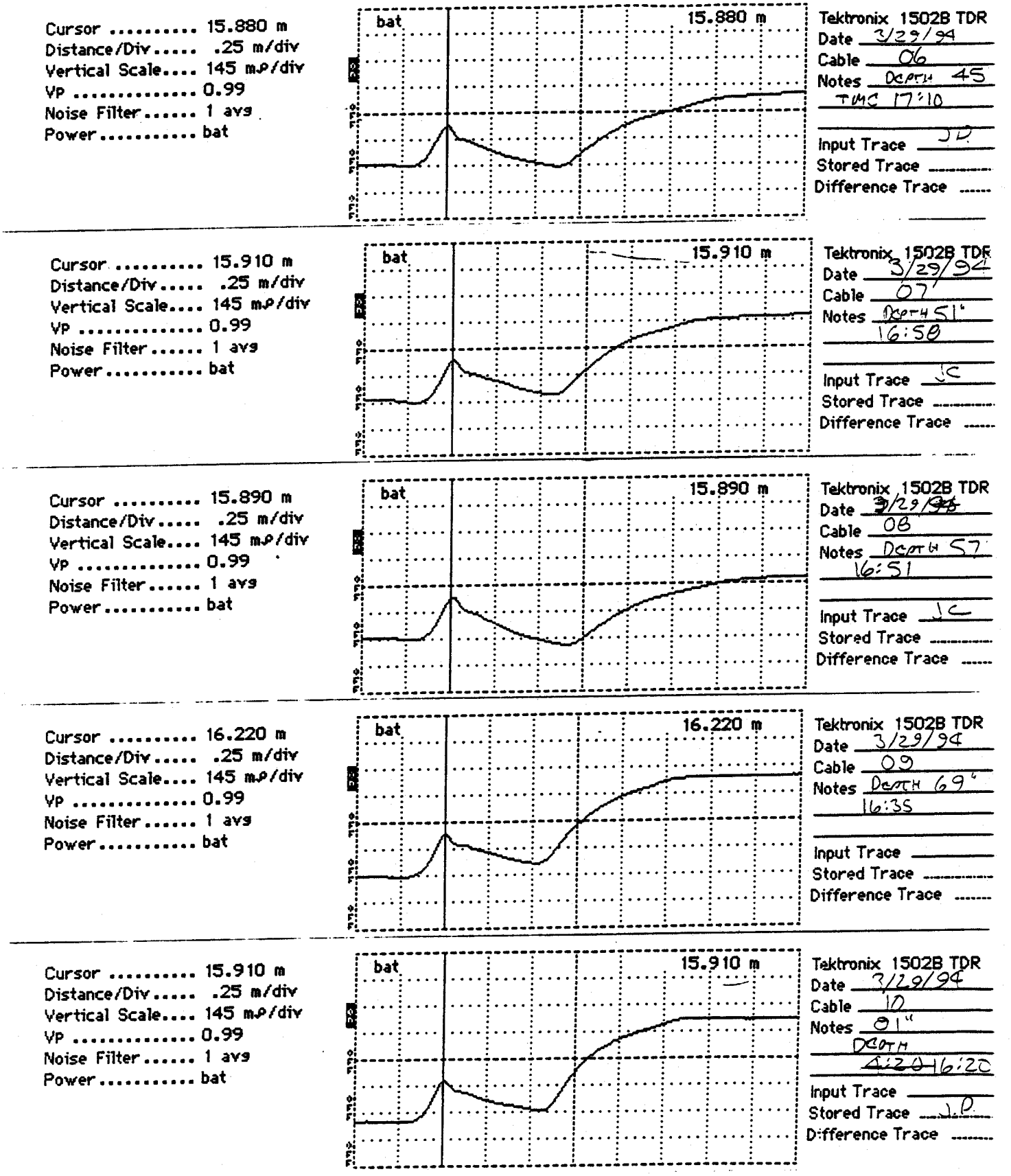


Figure C-1 (Continued). TDR Traces During Installation

Table C-1. Field Measured Moisture Contents

SITE NO. 404165 3/29/94

MOISTURE CONTENTS FOR TDR

TDR #	WT. OF PAN(g)	(WET) PAN & SOIL(g)	(DRY) PAN & SOIL(g)	M.C. (%)
40A10	152.5	287.6	277.9	7.7%
40A09	149.3	324.4	312.5	7.3%
40A08	171.3	328.4	314.0	10.1%
40A07	148.9	298.0	287.1	7.9%
40A06	151.5	295.3	282.6	9.7%
40A05	171.4	331.5	317.5	9.6%
40A04	149.0	322.1	304.1	11.6%
40A03	151.5	324.5	304.5	13.1%
40A02	171.4	392.5	368.2	12.3%
40A01	149.4	355.5	331.4	13.2%

APPENDIX D

Initial Data Collection

Appendix D contains the following support information:

Table D-1.	Raw Data from the On-site Data Logger
Figure D-1.	Measured Air Temperature During Initial Data Collection
Figure D-2.	Measured Average Subsurface Temperature for the First 5 Sensors During Initial Data Collection
Figure D-3.	Measured Average Subsurface Temperature for all 18 Sensors During Initial Data Collection
Figure D-4. thru Figure D-13.	Traces from TDR Sensors
Table D-2.	Elevation Measurements from Installation

Table D-1. Raw Data from the On-Site Datalogger During Initial Data Collection

5,1994,172,100,12.71,21.32,0
6,1994,172,100,33.18,37.09,36.45,38.58,37.92
5,1994,172,200,12.71,20.63,0
6,1994,172,200,31.91,35.72,35.16,37.85,37.59
5,1994,172,300,12.71,19.95,0
6,1994,172,300,30.78,34.48,33.97,37.13,37.22
5,1994,172,400,12.7,19.39,0
6,1994,172,400,29.67,33.29,32.86,36.41,36.8
5,1994,172,500,12.7,18.55,0
6,1994,172,500,28.74,32.23,31.86,35.7,36.36
5,1994,172,600,12.7,18.27,0
6,1994,172,600,27.86,31.24,30.93,35.02,35.9
5,1994,172,700,12.7,19.23,0
6,1994,172,700,27.35,30.45,30.11,34.37,35.44
5,1994,172,800,12.7,22.13,0
6,1994,172,800,28.42,30.56,29.72,33.75,34.98
5,1994,172,900,12.71,25.1,0
6,1994,172,900,31.4,32.21,30.35,33.25,34.52
5,1994,172,1000,12.72,26.63,0
6,1994,172,1000,35.41,35.04,32.07,33.03,34.15
5,1994,172,1100,12.72,28.04,0
6,1994,172,1100,39.23,38.33,34.57,33.22,33.94
5,1994,172,1200,12.73,29.32,0
6,1994,172,1200,43.22,41.65,37.19,33.77,33.87
5,1994,172,1300,12.74,30.32,0
6,1994,172,1300,46.8,45,40.08,34.59,34.02
5,1994,172,1400,12.74,30.92,0
6,1994,172,1400,49.41,47.86,42.77,35.66,34.37
5,1994,172,1500,12.74,31.53,0
6,1994,172,1500,51.79,50.39,45.13,36.87,34.88
5,1994,172,1600,12.74,31.95,0
6,1994,172,1600,52.77,52.05,47.03,38.12,35.5
5,1994,172,1700,12.74,32.21,0
6,1994,172,1700,52.61,52.52,48.14,39.3,36.22
5,1994,172,1800,12.74,31.83,0
6,1994,172,1800,51.08,52.37,48.52,40.29,36.94
5,1994,172,1900,12.74,31.07,0
6,1994,172,1900,48.41,50.74,47.98,41.07,37.65
5,1994,172,2000,12.74,28.9,0
6,1994,172,2000,44.99,48.37,46.54,41.54,38.24
5,1994,172,2100,12.73,25.23,0
6,1994,172,2100,41.51,45.58,44.47,41.61,38.69
5,1994,172,2200,12.72,23.57,0
6,1994,172,2200,38.89,43.1,42.31,41.32,38.91
5,1994,172,2300,12.71,21.9,0
6,1994,172,2300,36.81,41,40.34,40.78,38.96
1,1994,172,2400,12.72,12.75,1714,12.69,649,25.41,32.9,1644,18.09,600,0,4067
2,1994,172,2400,39.05,40.85,38.63,37.22,36.33,35.51,34.77,34.04,32.68,31.23,30.08,29.2,28.47,27.84,27.29,26.45,25.64,24.95

Site 404165

May 6, 1994

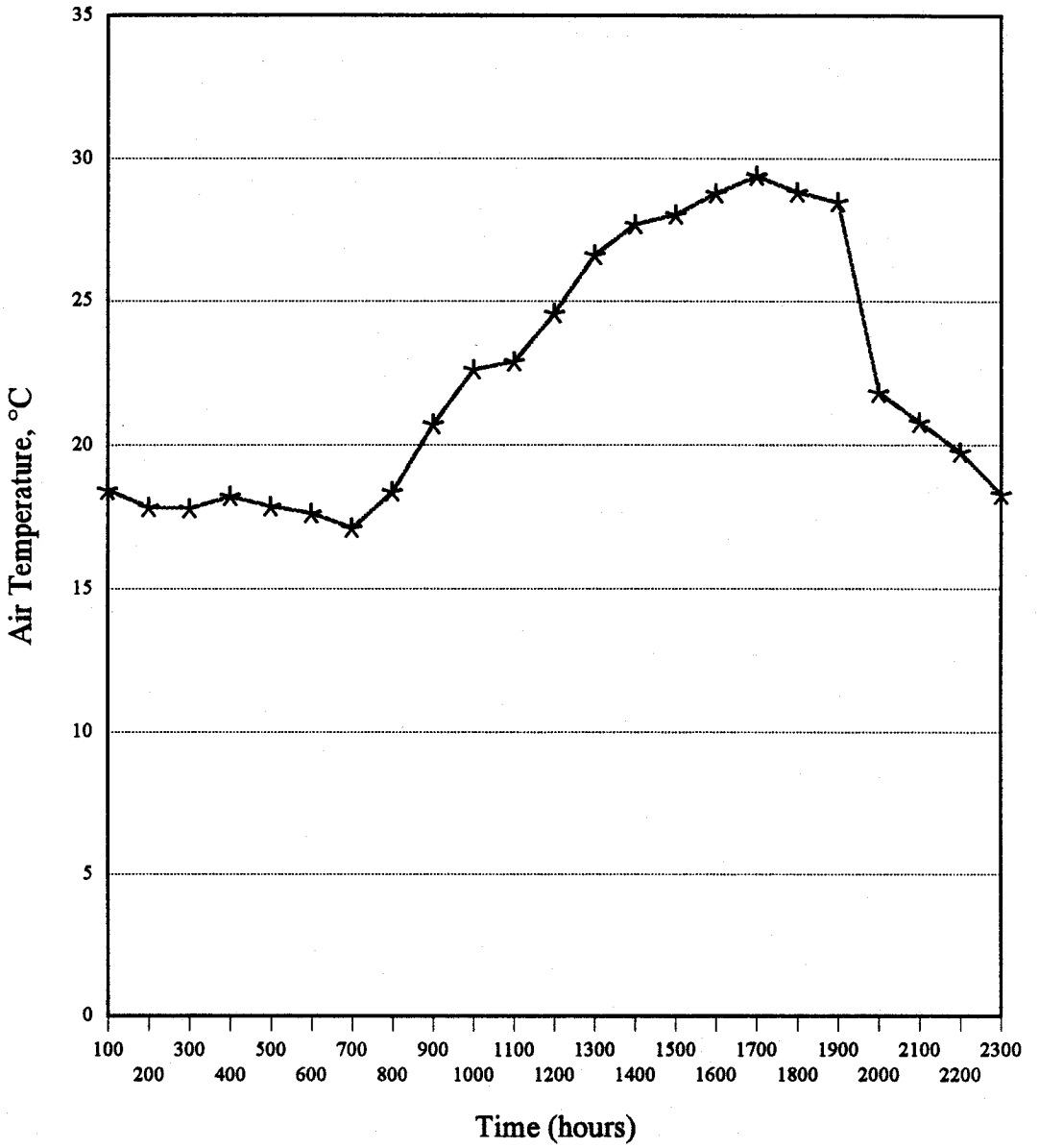


Figure D-1. Measured Air Temperature During May Data Collection.

Site 404165

May 6, 1994

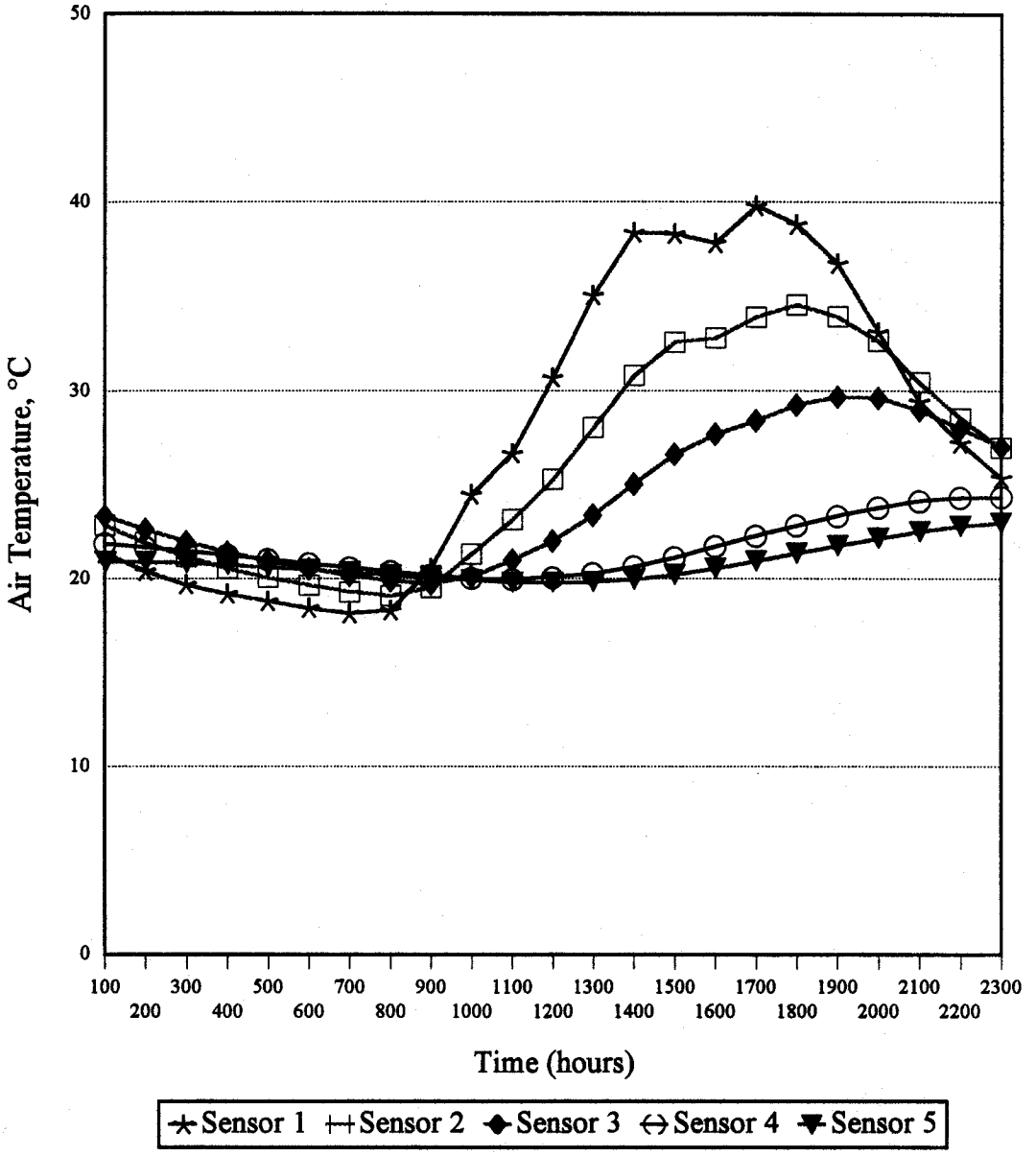


Figure D-2. Measured Average Subsurface Temperature for the First 5 Sensors During May Data Collection.

Site 404165

May 6, 1994

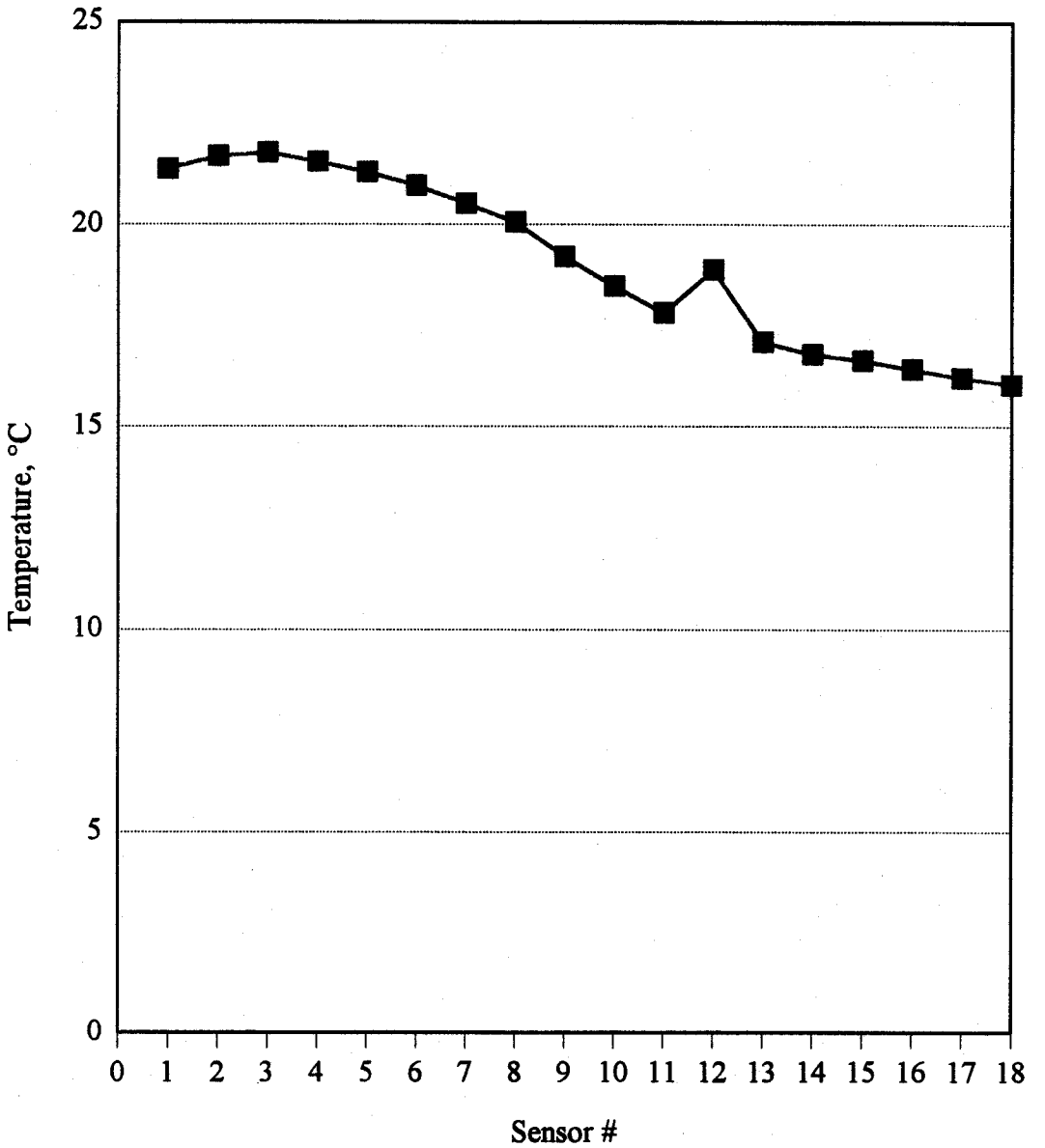


Figure D-3. Measured Average Subsurface Temperature for all 18 Sensors During May Data Collection.

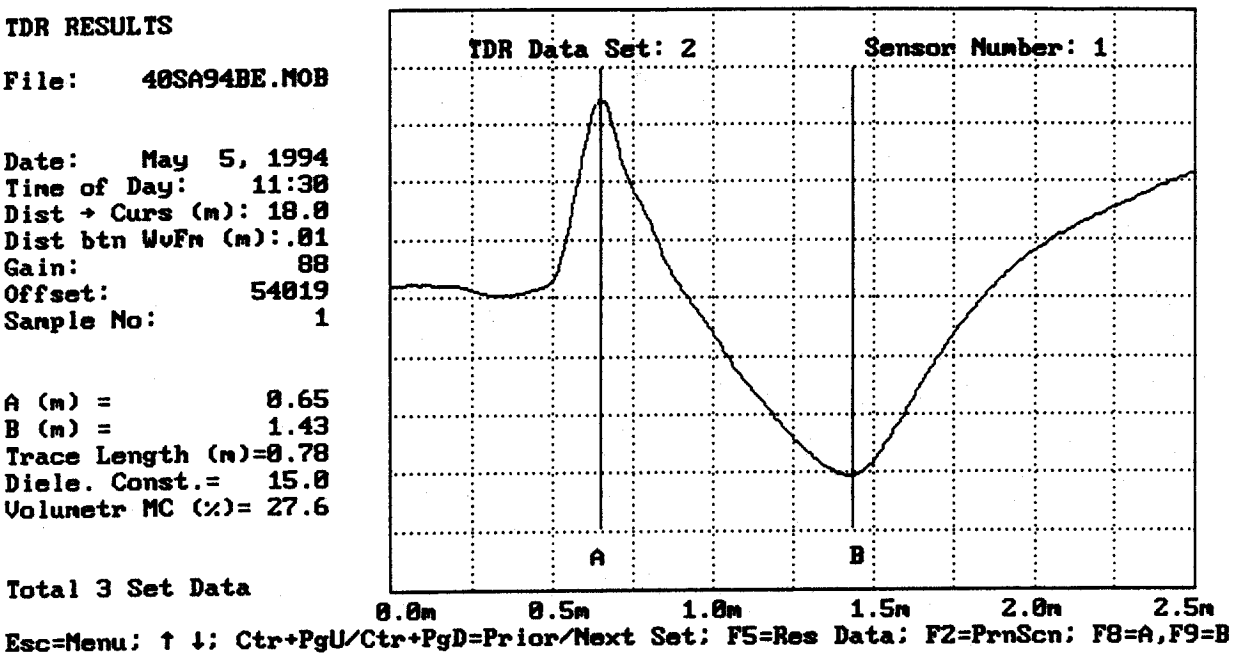


Figure D-4. Trace from TDR Sensor 1

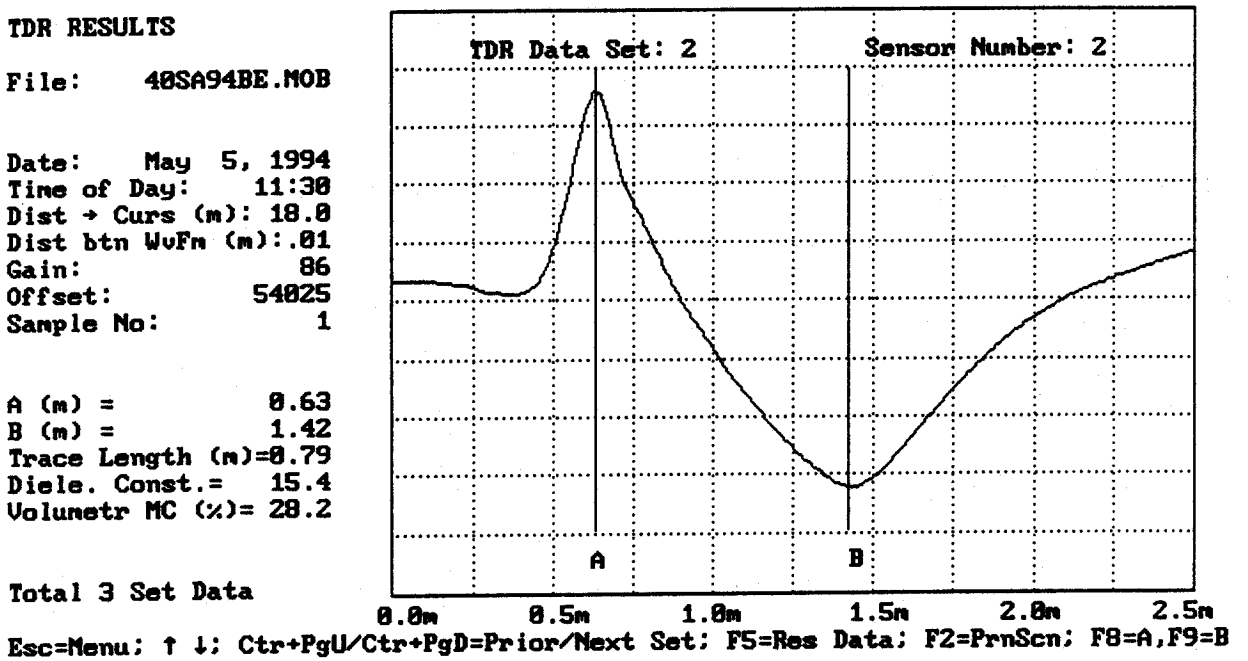


Figure D-5. Trace from TDR Sensor 2

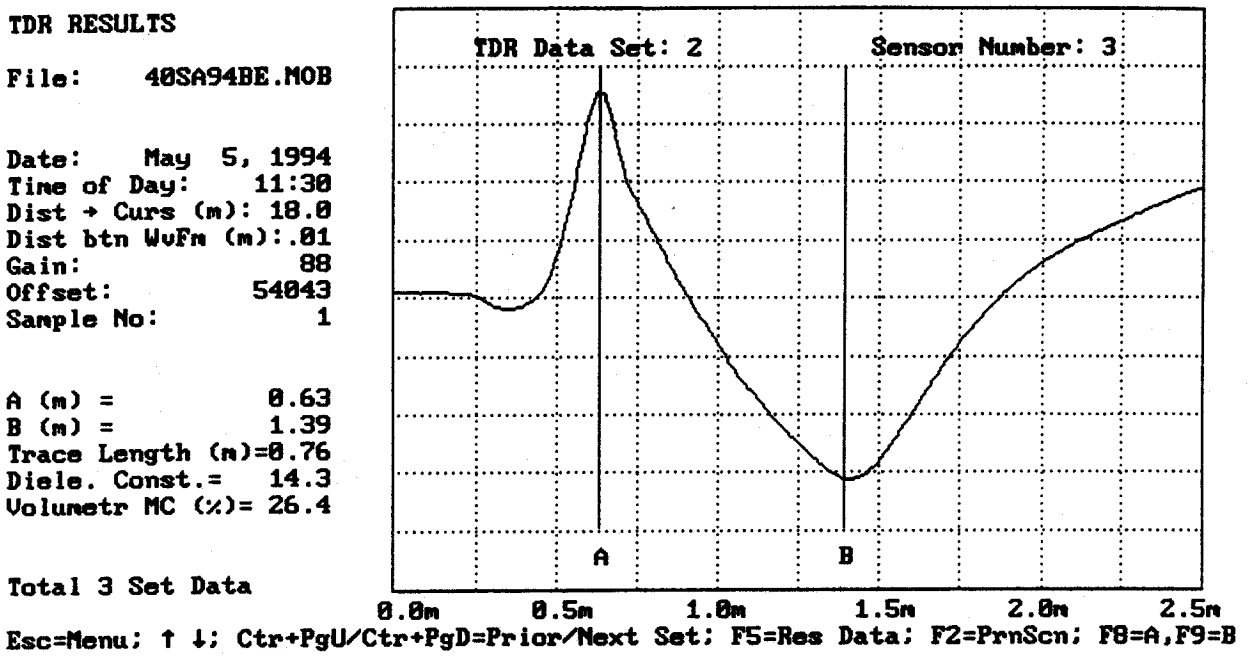


Figure D-6. Trace from TDR Sensor 3

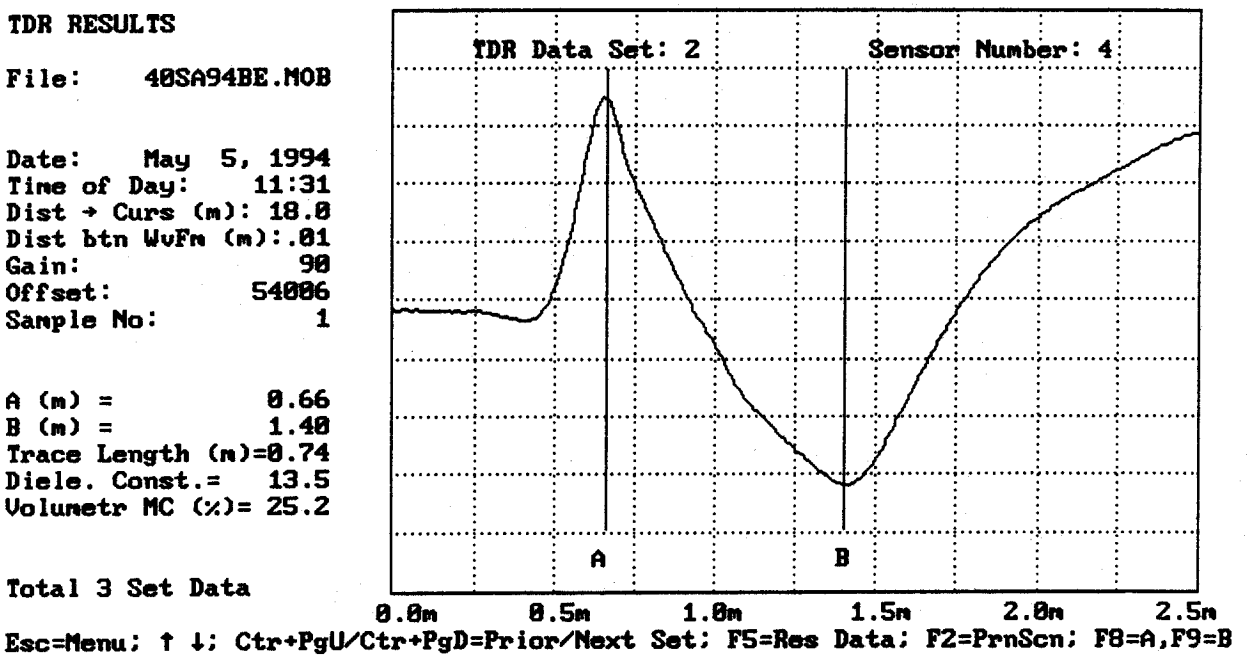


Figure D-7. Trace from TDR Sensor 4

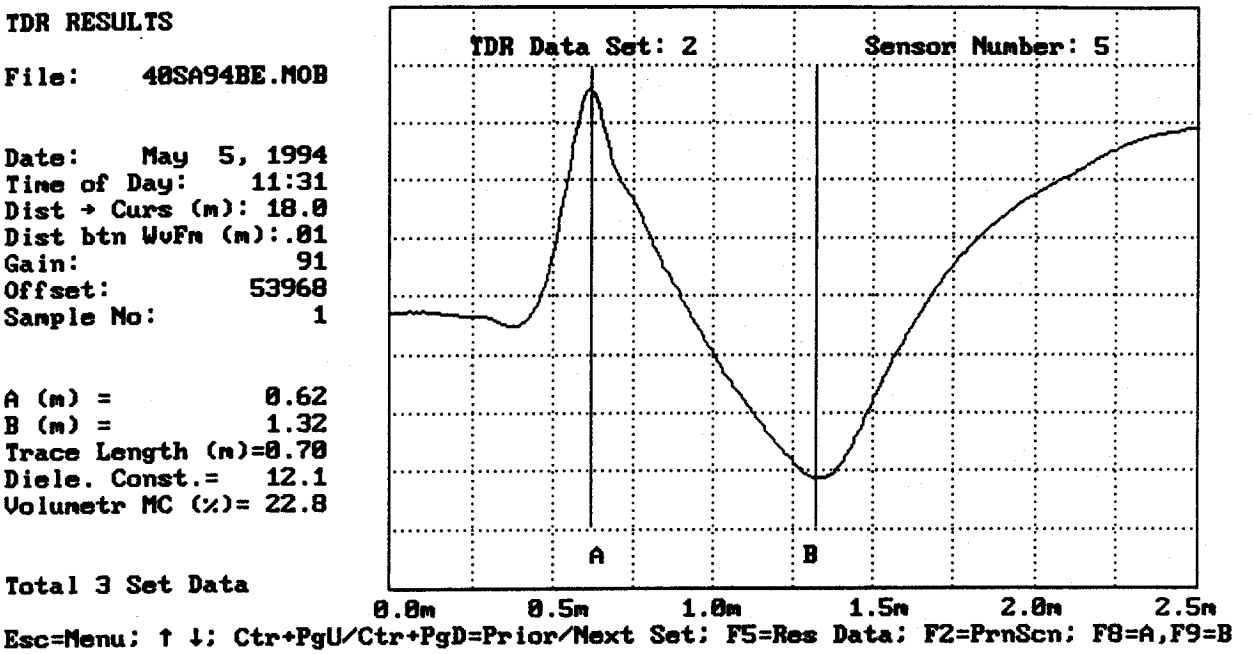


Figure D-8. Trace from TDR Sensor 5

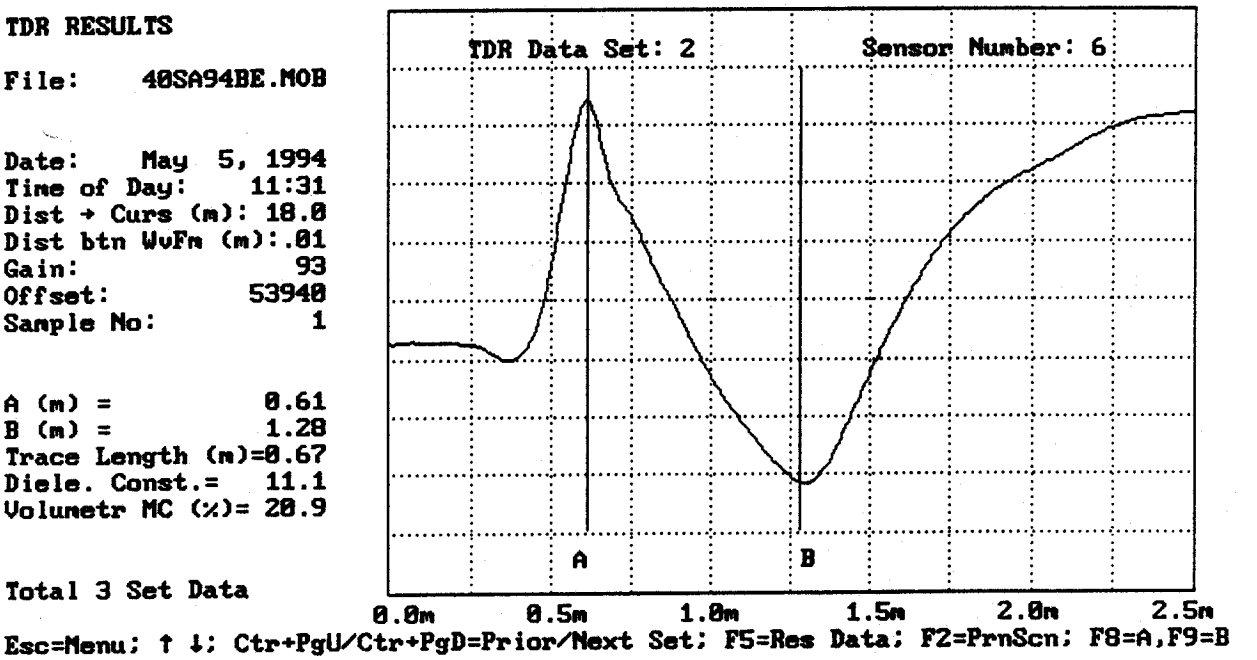


Figure D-9. Trace from TDR Sensor 6

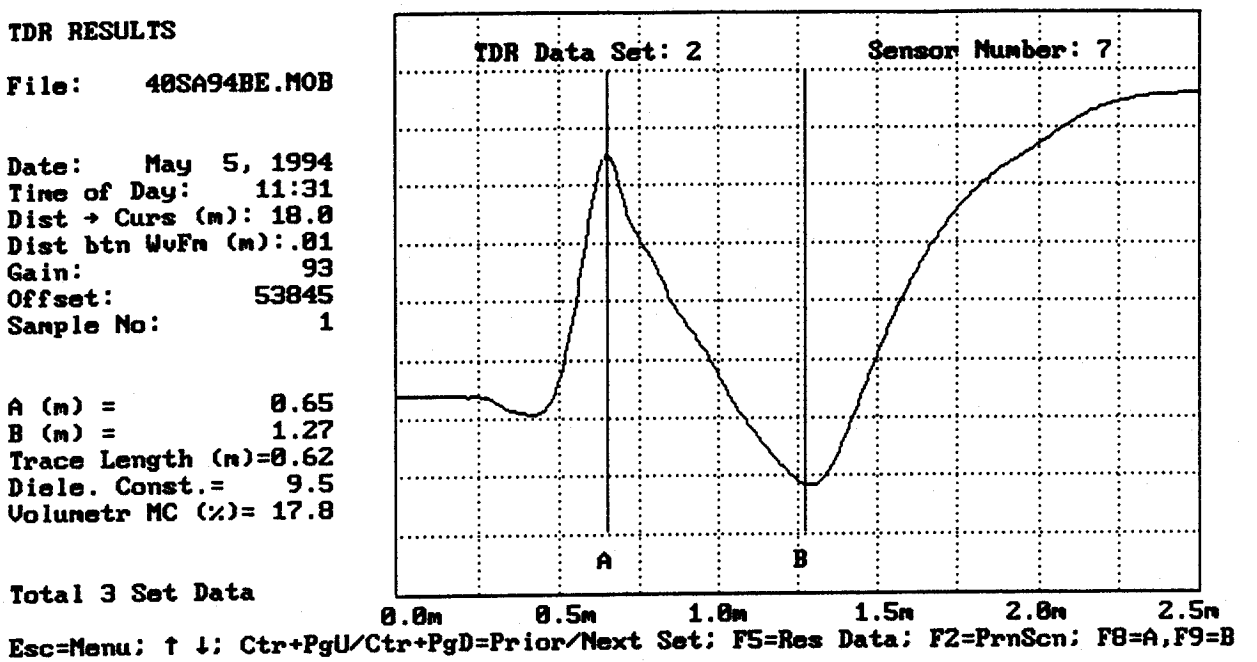


Figure D-10. Trace from TDR Sensor 7

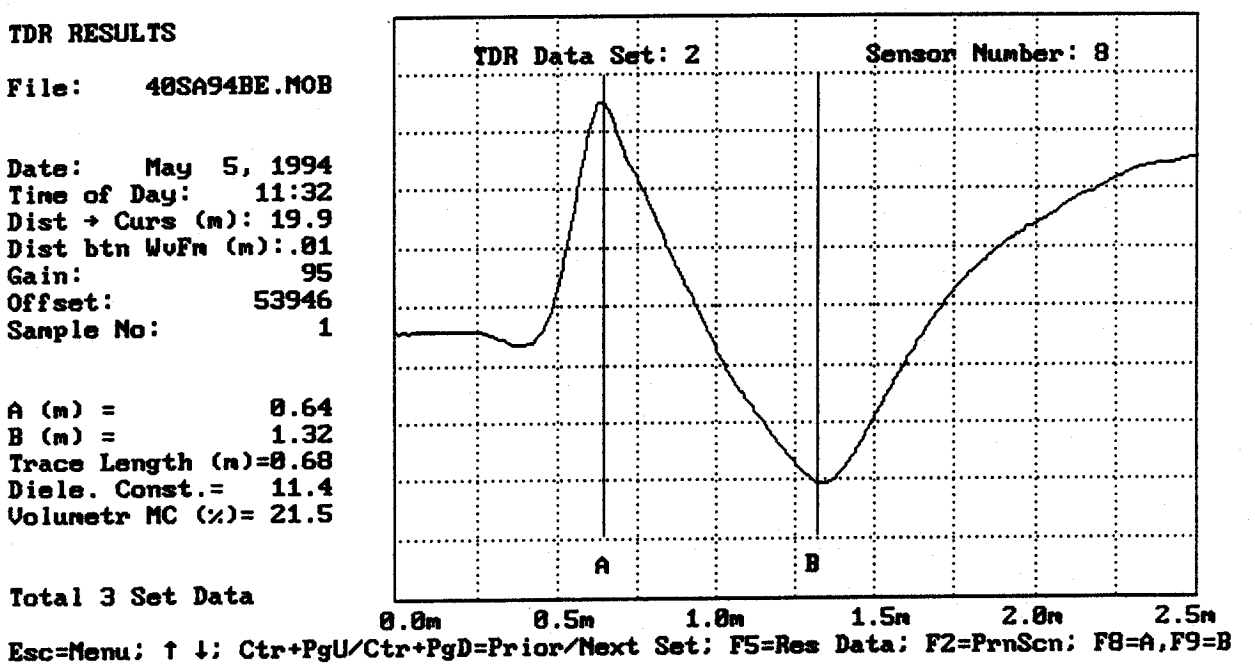


Figure D-11. Trace from TDR Sensor 8

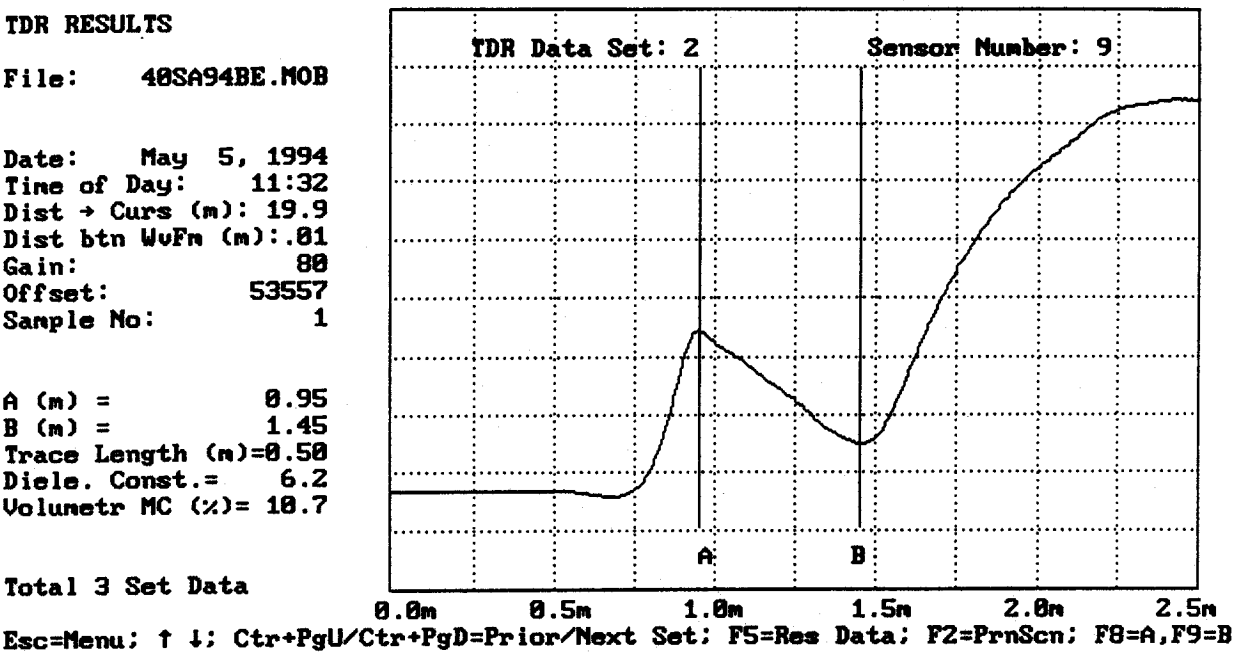


Figure D-12. Trace from TDR Sensor 9

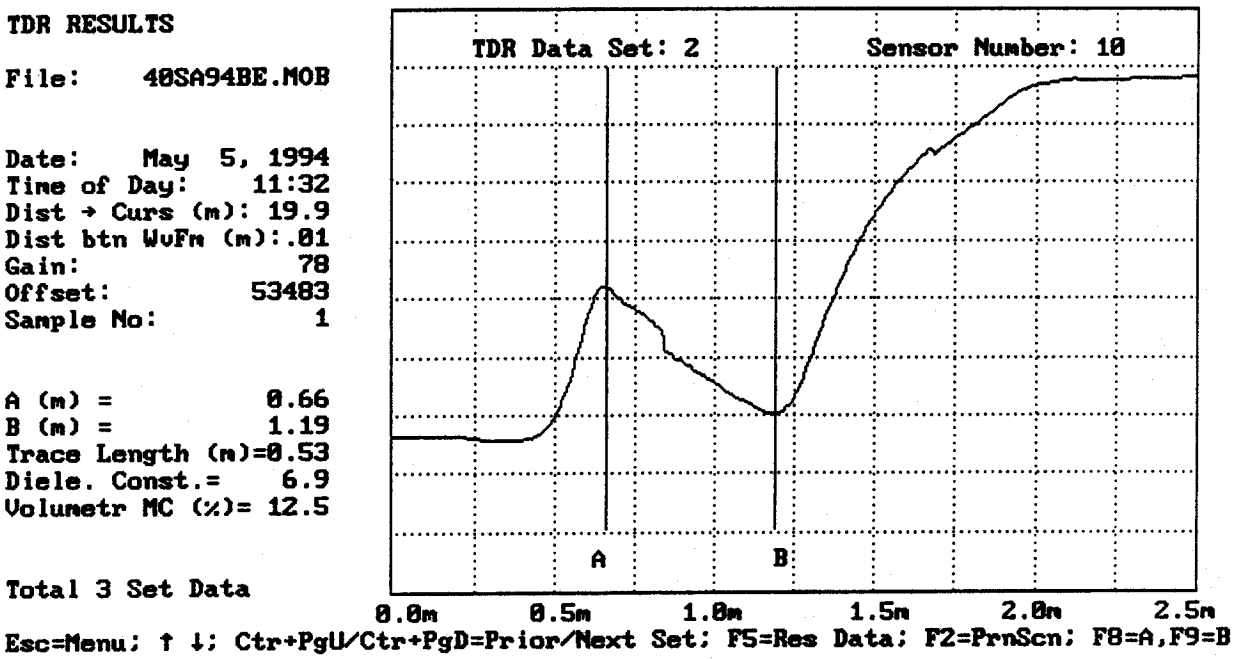


Figure D-13. Trace from TDR Sensor 10

Table D-2. Elevation Measurements from Installation

40SA94AD

SEASONAL MONITORING
"FLEX" TRANSVERSE ELEVATION MEASUREMENTS[1]

Station	Outside Edge		OWP		ML		IWP		Inside Edge	
	O/S	Elev.	O/S	Elev.	O/S	Elev.	O/S	Elev.	O/S	Elev.
3+00	.10m	100.768	.80m	100.770	1.90m	100.794	2.70m	100.798	3.65m	100.815
3+25	"	100.667	"	100.668	"	100.690	"	100.695	"	100.713
3+50	"	100.567	"	100.568	"	100.588	"	100.590	"	100.605
3+75	"	100.453	"	100.457	"	100.483	"	100.488	"	100.508
4+00	"	100.392	"	100.397	"	100.421	"	100.428	"	100.451
4+25	"	100.353	"	100.356	"	100.380	"	100.384	"	100.403
4+50	"	100.303	"	100.304	"	100.328	"	100.334	"	100.355
4+75	"	100.257	"	100.263	"	100.286	"	100.290	"	100.308
5+00	"	100.210	"	100.217	"	100.238	"	100.243	"	100.262
5+10			.80m	100.195	"	100.217				
5+20			INSTRUMENTATION		1.90m	100.188				
5+30			.80m	100.138						

Bench Mark : CHISELED + ON EAST END OF NORTH HEADWALL; SECTION STA. ±7+03
ASSUMED ELEV. 100.00 METERS ±15' RT. OF LN. EDGE

TKINV

Comments: MONITOR WELL NOT SET YET. USED HEADWALL FOR B.M.

Test Section No.	404165	Date	3/30/94
Time	±12:00	Device Used	LASER PLANE LEVEL
Recorded By	JON PEACOCK,	Employer	BRE

[1] OWP and ML readings to be taken at FWD test locations

10/29/93

APPENDIX E

Photographs

Appendix E contains the following photographs:

Photo E-1. Location of Instrumentation Area

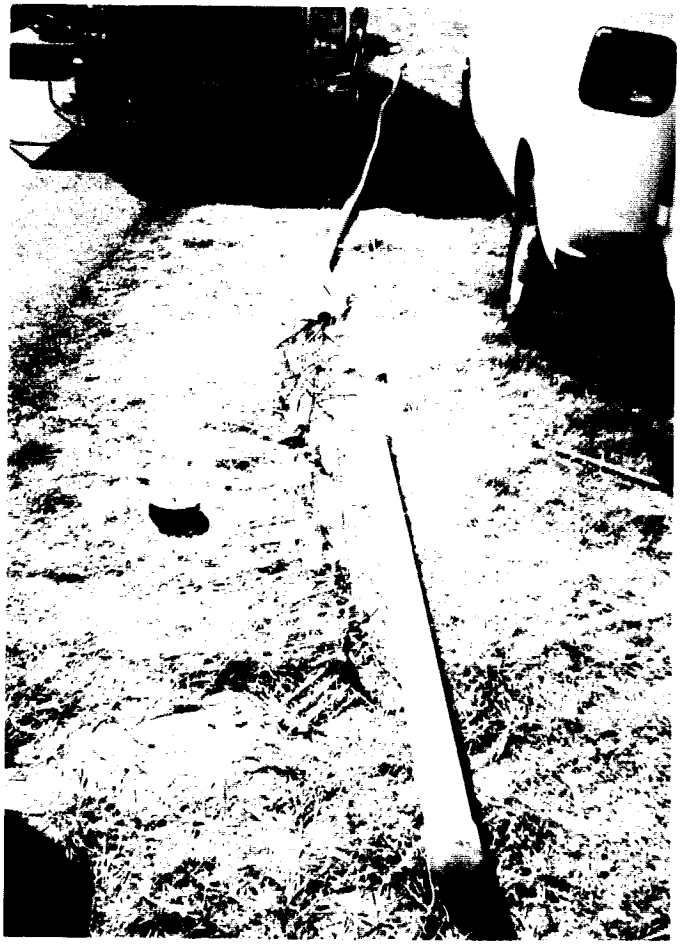


Photo E-2. Preparing for Instrumentation Installation

Photo E-3. Preparing Weather Station for Installation

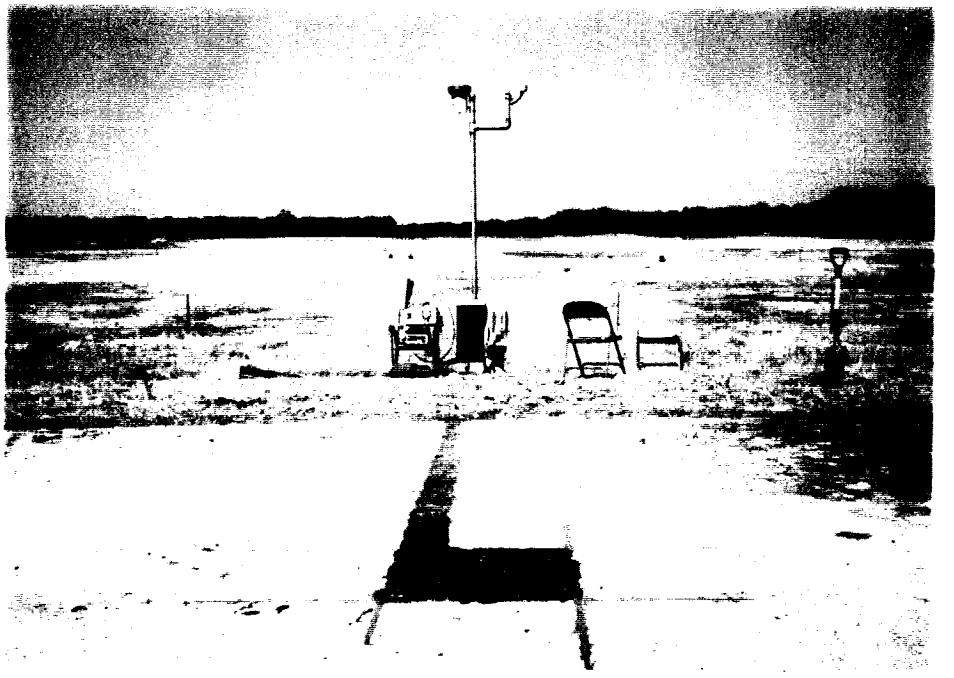


Photo E-4. Patched Instrumentation Area