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Delaware

LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection
Section 100102, Ellendale Delaware

Report No. FHWA-TS-96-10-02

June 1996

Notice

LTPP Seasonal Monitoring Program

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15. Supplementary Notes

The report is a cooperative effort between Commonwealth of Delaware Department of Transportation (DEL DOT), Long Term Pavement Performance (LTPP) Division Federal Highway Administration, and Pavement Management Systems Limited LTPP North Atlantic Region Coordination Office.

16. Abstract

This report provides a description of the installation of seasonal monitoring instrumentation and initial data collection for the seasonal experimental study conducted as part of the Long Term Pavement Performance (LTPP) program at the Specific Pavement Study (SPS-1) section 100102 on US 113 in Ellendale, Delaware. This asphalt concrete surface pavement test section was instrumented on October 04, 1995. The instrumentation installed included time domain reflectometry probes for moisture content, thermistor probes for temperature, tipping bucket rain gauge, piezometer to monitor the ground water table, and an on-site datalogger. Initial data collection was performed on October 05, 1995 which consisted of deflection measurements with a Falling Weight Deflectometer, elevation, temperature, TDR, and water table measurements. Longitudinal profile data is collected during scheduled visits with the LTPP profiler. 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.

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I. Introduction

The installation of the LTPP instrumentation on seasonal site 100102 near Ellendale, Delaware was performed on October 04 - October 05, 1995. The test section is a SPS-1 experiment, located on Southbound US 113 approximately 2 kilometers South of State Highway 16. A map indicating the location detail of the site is presented in Figure A-1 of Appendix A. The highway consists of two 3.7 m wide lanes in each direction, with a 3.0 m wide paved outside shoulder and a 1.2 m paved inside shoulder. A grassed median divides the traffic in each direction.

This road was constructed during the 1995 construction season. The Northbound lanes were used during the construction period for traffic in both directions. During the period of the preparation of this report the Southbound lanes were being used for traffic in both directions because the construction activity switched to the Northbound lanes. The site history data available for this site is minimal because it is a new road. There is no FWD history, profile history, distress rating, traffic data, and weather data specific to this site. No verification drilling, except for core samples taken on the asphalt, was conducted and no laboratory data was available when this report was being prepared.

The pavement, which is built on a slightly elevated fill area, consists of 95 mm of asphalt concrete on a 365 mm dense graded aggregate base. The design 25 mm thick Open Graded Surface Coarse (OGSC)of hot mix has not been placed yet. It is scheduled to be placed during the Summer of 1996. The addition of the OGSC will increase all the depth values in this report. For example, the depth of all instrumentation from the top of the surface will be increased by the depth of the surface coarse. The embankment fill material and the subgrade under the road base are highly variable in content and thickness throughout the section. The embankment fill is made up of a silty sand soil. The subgrade predominantly consists of silty sand with a layer of silty clay. Bedrock was not encountered during pre-construction drilling in the top 6 m. It is reported to be much deeper than 6 m. The design depths for all the experimental sections are presented in Figure A-2. Pavement structure information taken from the SPS material drilling logs are presented in Appendix A, Figure A-3. Properties determined from field tests and logs are shown in Table 1. The uniformity survey results are summarized in Table A-2 and the deflection values and analysis results from the FWDCHECK are also presented in Appendix A.

The site is in a wet-freeze zone and resides in cell 8 (thin AC on coarse subgrade) of the Seasonal Monitoring Program. Below is a summary from the LTPP climate database based on eleven years of data:

- Freezing Index (C-Days) 124
- Precipitation (mm) 1092
- No. of Freeze/Thaw Cycles 76
- Days Above 32°C 25
- Days Below 0°C 80
- Wet Days 110

The climatic data listed above was taken from site 105005, since there was no climatic data available for site 100102. Site 105005 is approximately 5 kilometers East of 100102, and is the closest LTPP site that could be used for climatic data.

In addition to the seasonal monitoring site an Automated Weather Station (AWS) is installed on Delaware Department of Agriculture property (Ellendale State Forest) at the junction of Route 113 and Road 224. The AWS will collect continuos air temperature, humidity, wind direction/speed, solar radiation, and rainfall for the SPS-1 and SPS-2 projects on route 113.

Traffic data for this site is to be provided by a permanent WIM installed between route 16 and section 100102 in the Southbound lanes. The WIM has been installed and is expected to be operational in the summer of 1996.

Installation of the instrumentation was a cooperative effort between Delaware Department of Transportation (DEL DOT), Federal Highway Administration (FHWA) Long Term Pavement Performance (LTPP) Division, and Pavement Management Systems Limited (PMSL) LTPP North Atlantic Region Coordination Office (NARCO) staff. The following personnel participated in the instrumentation installation:

Harry Banks	DEL DOT - District 1, Georgetown
Garry Glanden	DEL DOT - Materials and Research (core unit)
John Graves	DEL DOT - Materials and Research (auger unit)
Bob Radish	DEL DOT - Materials and Research
Mike Cohan	DEL DOT - Ellendale area 3 Maintenance
Sinath Sam	DEL DOT - Ellendale area 3 Maintenance
Gabe Cimini	PMSL NARCO
Scott Comstock	PMSL NARCO
Tim Comstock	PMSL NARCO
Brandt Henderson	PMSL NARCO
Dilan Singaraja	PMSL NARCO

Table 1. Material Properties

Description	Surface	Base	Embankment* (Fill)	Subgrade**
Material (Code)	HMAC (01)	Dense Graded Mixture (308)	Silty Sand Fill (214)	Silty Sand with Clay (200)
Thickness (mm)	95	365	800	
In-Situ Density Dry (kg/m^3)	2346	2427	1896	1924
In-Situ Moisture Content (%)		5.7	7.1	9.8

* Note: Depth of fill varies throughout the site

** Note: Highly variable subgrade conditions

II. Instrumentation Installation

Site Inspection and Meeting with Highway Agency

A preliminary planning meeting was held at the Dover, Delaware office on September 22, 1995. The attendees at the meeting were:

• Paul Smith	DEL DOT - Planning - Dover
• Jim Pappas	DEL DOT - Materials and Research - Dover
• Bob Raddish	DEL DOT - Materials and Research - Georgetown
• Brandt Henderson	PMSL - NARCO
• Bill Phang	PMSL - NARCO

A presentation on the installation of seasonal monitoring instrumentation and monitoring requirements was provided by Bill Phang and Brandt Henderson of Pavement Management Systems. Reasons for picking this site for the seasonal monitoring program were discussed along with the details and the frequency of scheduled testing. Brandt Henderson then gave a more detailed description of roles and responsibilities of the agencies and the personnel involved with the installation. The list of materials required by DEL DOT was presented. Correspondence regarding the installation are presented in Appendix B.

A pre-installation meeting was arranged and conducted on October 03, 1995 at the site on US113. Bob Radish and Harry Banks of DEL DOT and Brandt Henderson and Dilan Singaraja of PMSL were present at the meeting. Final details of the installation were discussed with DEL DOT members. Rain was forecasted for October 04. It was decided that the final decision whether to proceed with the installation or not would be made on October 4th morning, depending on the weather condition. The decision to place the cabinet and the weather pole on the inside of the ditch line was made because cable extensions would have been necessary to place them on the outside of the ditch. FWD testing, to pick the most uniform end for the installation, was conducted on October 03, 1995. This section of pavement was fairly uniform with two obvious changes in pavement response. For monitoring purposes either end could have been selected. The 5+00 end was picked because it was slightly more uniform than the 0+00 end and provided longer distance from any intersecting roads, which would be beneficial in layout and setup of traffic control.

Equipment Installed

The equipment installed at the test site included instrumentation for measuring air, pavement, and subsurface temperatures, precipitation, subsurface moisture content, and water table. An equipment cabinet was installed to hold the datalogger, battery pack, and all electrical connections for the instrumentation. The equipment cabinet installation and wiring of the panel was completed on October 04, 1995. The equipment installed are shown in Table 2.

Table 2. Equipment Installed

Equipment	Quantity	Serial Number
Instrumentation Hole		
MRC Thermistor Probe	1	10AT
CRREL Resistivity Probe	N/A	N/A
TDR Probes	10	10A01-10A10
Equipment Cabinet		
Campbell Scientific CR10 Datalogger	1	16510
Campbell Scientific PS12 Power Supply	1	5656
Weather Station		
TE525MM Tipping Bucket Rain Gage	1	12057
Campbell Scientific 107-L Air Temperature Probe	1	10AAT
Observation Well/Bench Mark	1	N/A

Equipment Check/Calibration

Prior to installation, each measurement instrument was checked or calibrated. The tipping bucket rain gauge was connected to the CR10 datalogger for calibration. A plastic container with 473 ml of water was placed in the tipping bucket. The container had a small hole in the bottom, which allowed all the water to be drained out in 45 minutes. For the 473 ml of water, the tipping bucket should measure 100 tips $\pm$ 3 tips. The results were 99 tips, which was within specification.

The air temperature and thermistor probes were connected to the CR10 datalogger simultaneously. They were checked by placing the probes in ice, room temperature, and hot water. In order for the probes to pass this check, the temperatures for each probe needed to correspond to the water temperature. The check indicated that the air temperature and thermistor probes were working properly. A second check was done where the air temperature and thermistor probes were connected to the datalogger and run, in air, for 24 hours. The minimum, maximum, and mean temperature for each sensor were checked. All 18 thermistors were similar in their minimum, maximum, and mean readings respectively, therefore the probes were considered to be functioning correctly. The results from the calibration of the air temperature and the thermistor probes along with the spacing between the thermistors are presented in Appendix B.

The TDR probes used at this site were manufactured by Campbell Scientific. These probes were of the FHWA three prong design. The 6 mm stainless steel probes are 203 mm in length, mounted to a printed circuit board encased in a 15 mm epoxy coating with burial type coaxial cable used to transmit signals between the Mobile unit and the TDR probe. This probe is more rugged than the FHWA probe but it is more difficult to maneuver around the instrument hole because it is bulkier.

The function of the TDR probes was checked by performing measurements in air, water, methyl alcohol, and with the prongs shorted at the circuit board and the end of the probe. The traces were taken and the dielectric constant was calculated for the water, air, and methyl alcohol. These values were checked against expected dielectric constants for each medium. The tests indicated that all probes were functioning properly. Results of the TDR measurements are presented in Appendix B.

Equipment Installation

The installation took place at 0800 hours on October 04, 1995. The rain came as predicted at approximately 1200 hours. Traffic control was not required because the section was not open to the public. During the data collection period the traffic control is scheduled to be provided by the DEL DOT Ellendale area 3 maintenance facility. The contact is Jeff Read. The pavement surface drilling and augering of the piezometer and instrumentation hole were done by agency equipment and drilling crew. The sawing of the trench was done by DEL DOT personnel. The installation of the measurement equipment, the observation piezometer, weather station pole, and cabinet was performed by PMSL staff. Assistance was provided by DEL DOT's Robert Radish, Materials and Research division.

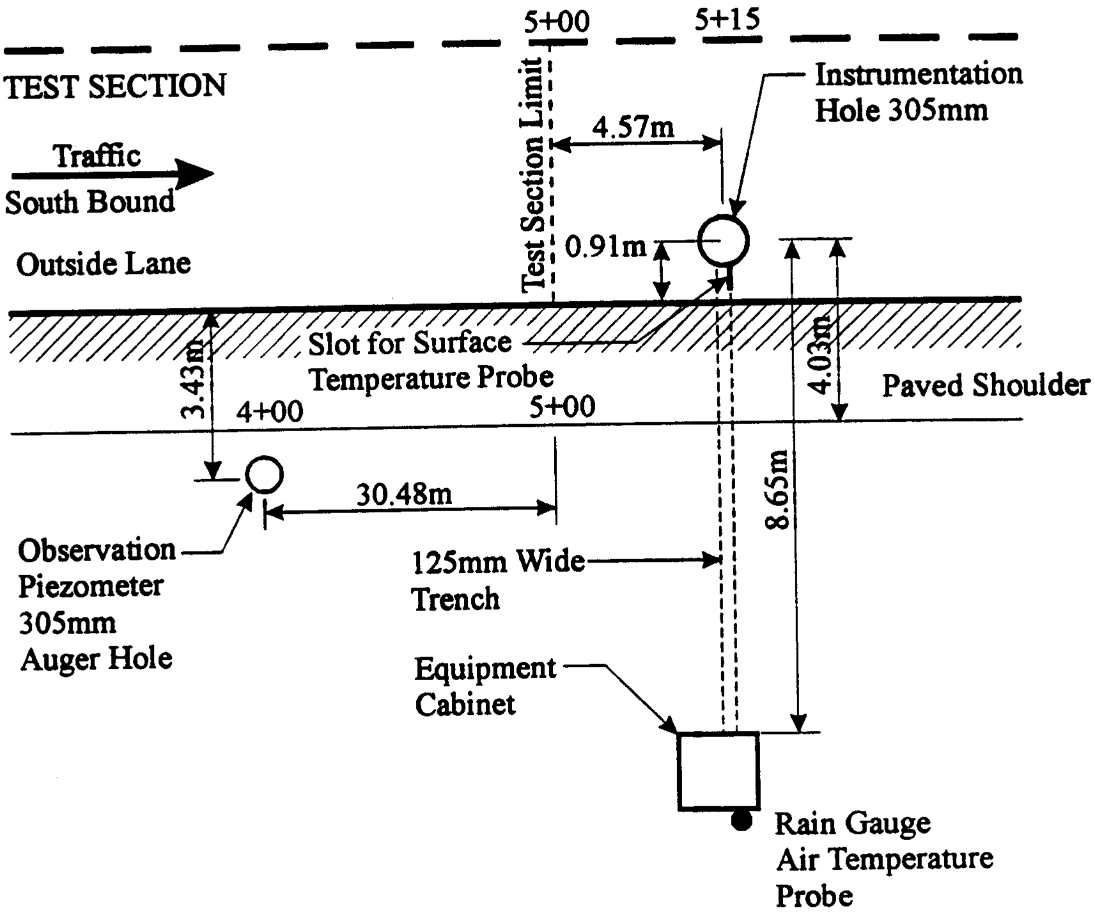
The instrumentation was installed on the South end of SPS 100102, in the Southbound lane of Route 113, approximately 2.0 km South of the S.R16 in Ellendale, Delaware. The combination piezometer/bench mark was placed in the shoulder at station 4+00. The in-pavement instrumentation was installed in the outer wheel path at station 5+15. The cabling from the instrumentation was placed in two 50 mm flexible conduit and buried in a trench running from the instrument hole to the proposed equipment cabinet. The cabinet was located on the road embankment adjacent to the shoulder, 8.65 m from the centre of the instrumentation hole. The weather pole was installed 0.25 m behind the equipment cabinet. Figure 1 provides the location and distances for the various instrumentation and equipment installed.

The installation generally followed the procedures described in the "LTPP Seasonal Monitoring Program: Instrumentation Installation and Data Collection Guidelines". The combination bench mark/piezometer was installed 3.43 m from the edge of pavement to a depth of 4.31 m. Water was encountered at approximately 4 m depth during the drilling. The metal access cover was seated firmly in concrete at the completion of the piezometer installation.

A core hole was drilled in the pavement surface, located in the outside wheel path 0.91 m from the edge of the travel lane at station 5+15, using a 305 mm thin wall diamond core barrel attached to a trailer mounted drilling unit. A 150 mm wide by 225 mm deep trench was saw cut between the core hole and the edge of the pavement using a heavy duty pavement sawing machine. The asphalt concrete portion of the trench was removed with picks and shovels.

The instrumentation hole was excavated using a truck mounted single ram hydraulic drilling unit with a 300 mm diameter, 0.91 m long solid stem auger. The material was loosened in 0.3 to 0.4 m lifts and removed by hand and scoop for the surface layers, and with a hand held post hole digger at deeper depths. Distinct layers were separated during the removal from the instrumentation hole. Care was taken to ensure that the excavated material was stored in the order that it was removed. The forecasted rain arrived at approximately 1200 hours. The instrument hole was prepared for refilling when the rain arrived. A tent was set up over the instrument hole such that water could not enter the instrument hole. A standard proctor test of sample subgrade soil was conducted at a depth of 0.88 m in the field. The coarse sandy material yielded a dry density of 1890 kg/m^3 (as shown in Table C-3. of Appendix C). The drilling was stopped 2.05 m below the surface of the pavement. The findings from the excavation of the instrumentation hole at station 5+15 are presented in Figure 2. All the material excavated from the instrument hole was placed and hand compacted in the order of removal with the TDR probes, and the thermistor probe placed at the specified locations. The top of the stainless steel probe of the thermistor probe was kept as close to the surface as possible to allow for the 25 mm surface coarse that is planned for this site. During the placement of TDR probe number 1, the larger stones were picked out of the soil, so as to attain maximum soil contact with the probes. Once the probe was surrounded by soil the stones were placed above it. The location and elevation information of the instrumentation is presented in figure 2. Samples of the material placed around the TDR probes were retrieved for the field determination of the gravimetric moisture. The accuracy of the DEL DOT field procedure for determining moisture was such that no laboratory testing was required.

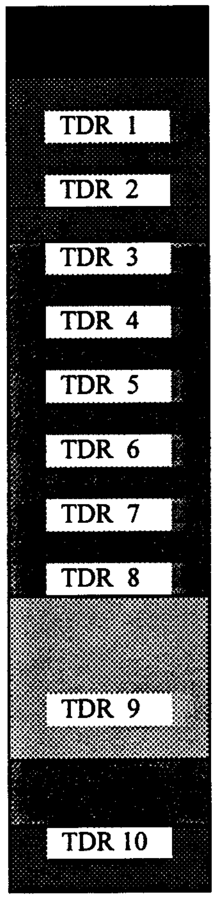
The pole for the rain gauge and air temperature probe were installed as per manual guidelines. The equipment cabinet installation and the wiring of the panel was completed on October 05, 1995.



- Height of Air Temperature Probe: 2.77m
- Height of Tipping Bucket Rain Gauge: 2.77m
- Depth of Piezometer: 4.31m

Figure 1. Location of Seasonal Monitoring Instrumentation Installed at SPS 100102

Material	Depth (mm)
HMAC	114
Dense Graded Aggregate Base	450
Sand trace Stone	510
Coarse Brown Sand (Fill Material)	1320
Fine light Reddish Brown Sand and Silt	1725
White Sandy Clayey Silt (Firm)	1850
White Coarse Sand (Wet)	2045



TDR depth (mm)	Comments
	Average Core Depth 114 mm
270	Thermistor Probe Depth 133mm
430	
580	Dry Density 1890 kg/m^3
730	
880	
1040	
1190	
1380	
1660	
1940	

Figure 2. Profile of Pavement Structure and Probe Depths, Station 5+15

To check for breakage of the TDR probes during installation, each probe was connected to the cable tester and it's wave form monitored during compaction of the material around it. The TDR traces are included in Appendix C. The cables coming from the TDR probes were staggered along the perimeter of the instrument hole to prevent water from migrating along a bundle of cables. The top TDR probe was placed with the printed circuit board and the cable facing downward to avoid any contact with the asphalt concrete pavement surface. The top of the thermistor probe was 0.133 m below the pavement surface. The cables from all instrumentation installed converged at the opening of the flexible conduit pipe which was placed about 50 mm from the edge of the core hole. The cables were then tie wrapped in two bundles and passed through the conduits to the equipment cabinet. The ends of the conduits were plugged with a mastic pipe sealant.

Tables 3, and 4 present the installed depths of the TDR probes, and thermistor sensors respectively. Table 5 gives TDR, and field measured moisture content collected during the installation. A comparison of the moisture content from the TDR traces, and the field determination indicate some discrepancies. The wet weather conditions might have had an impact on the moisture measurements. It should be noted that the calculation of moisture is dependent on the calibration inputs to the TDR model. Differences of moisture content in the range of 1 to 2% are not uncommon.

Table 3. Installed Depths of TDR Sensors

Sensor #	Depth from Pavement Surface (m)	Layer
10A01	0.27	Base
10A02	0.43	
10A03	0.58	Embankment Fill Material
10A04	0.73	
10A05	0.88	
10A06	1.04	
10A07	1.19	
10A08	1.38	
10A09	1.66	Subgrade
10A10	1.94	

Table 4. Installed Location of MRC Thermistor Sensor

Unit	Channel Number	Depth from Pavement Surface (m)	Remarks
1	1	0.006*	This unit was installed in the AC layer.
	2	0.045	
	3	0.083	
2	4	0.154	This unit was installed below the AC layer into the subgrade.
	5	0.229	
	6	0.303	
	7	0.380	
	8	0.455	
	9	0.606	
	10	0.761	
	11	0.913	
	12	1.066	
	13	1.217	
	14	1.371	
	15	1.523	
	16	1.674	
	17	1.827	
	18	1.983	

* Note: MRC #1 was placed this close to the surface to allow for the 25 mm surface coarse that will be placed at a later date.

Table 5. TDR, and Field Moisture Content During Installation

Sensor Number	Sensor Depth (m)	Layer	TDR Moisture Content (by wt)*	Field Moisture Content (by wt)*
10A01	0.27	Base	6.8%	4.8%
10A02	0.43		6.8%	4.2%
10A03	0.58	Embankment Fill Material	7.1%	6.7%
10A04	0.73		7.1%	7.4%
10A05	0.88		8.7%	8.8%
10A06	1.04		8.7%	8.0%
10A07	1.19		8.7%	8.6%
10A08	1.38		10.3%	12.3%
10A09	1.66	Subgrade	15.1%	24.0%
10A10	1.94		16.7%	11.7%

* Note: Raw data given in Appendix C

Site Repair and Cleanup

The instrumentation hole and trench were repaired by placing and compacting hot mix asphalt concrete. The contractor, Greggo and Ferrara, filled and compacted the hot-mix after completion of the installation. There was not enough asphalt concrete to complete the trench. Arrangements were made for DEL DOT to complete the filling of the trench and remove all the chunks of asphalt material removed from the pavement. A vibratory compactor was used to compact the asphalt concrete. Soil cover of at least 50 mm was maintained over the conduit for the extent of the paved trench. The road base material removed from the trench was used to bring it up to grade.

The wiring panel in the equipment cabinet was installed on October 05, 1995. All equipment checks and initial data collection was completed by October 05, 1995.

Patch/Repair Area Assessment

All indications until the site visit on May 09, 1996, were that the instrument hole and trench were in good condition. An instrument hole distress survey has not been conducted at the site since the installation because traffic control will not close the lane off until the entire road is open to traffic. Currently the two Southbound lanes are being used to service traffic in both directions. After the Southbound lanes were opened to bi-directional traffic, slight fatigue cracking was noticed in the wheel paths, especially for the Northbound travel portion.

III. Initial Data Collection

Initial data collection on the site and checks on functioning of installed equipment were conducted on October 05, 1995. This consisted of examination of the data collected over the day by the onsite datalogger, data collection and check of the mobile CR10 datalogger, check of the tipping bucket, deflection testing, water table measurement, and elevation survey. A sample of the data collected by the onsite datalogger is presented in Appendix D (Table D-1).

Air Temperature, Subsurface Temperature, Rain-fall Data

The air temperature, pavement subsurface temperature profile, and rainfall data, collected on October 05 by the CR10 datalogger, were examined. All equipment and the datalogger appeared to be functioning properly. The battery voltages were checked and found to be acceptable. The plots of the temperature profiles are presented in Appendix D (figures D-1 and D-2).

The tipping bucket rain gauge was checked by determining the number of tips recorded from 473 ml of water discharged into the gauge over a 1 hour time period. The rain gauge was found to be operating properly.

TDR Measurements

TDR data was collected using the mobile system provided by FHWA. The mobile system contains a CR10 datalogger, battery pack, two TDR multiplexers, and a resistance multiplexer circuit board. Version 2.2 of the MOBILE program was used to collect and record the TDR wave form traced for each sensor.

Figure D-3 shows the initial TDR traces collected with the MOBILE data acquisition system for all 10 sensors. The figures indicate that the multiplexers of the mobile system and TDR sensors were working properly.

Deflection Measurement Data

Deflection measurements followed procedures described in the "LTPP Seasonal Monitoring Program: Instrumentation Installation and Data Collection Guidelines". The analysis results from the FWDCHECK program from the day of installation and the following day are presented in Appendix D. Since then no tests have been conducted because no lane closures are allowed for the construction period.

Longitudinal Profile Data

According to the guidelines, since this is in a frost area, the survey should be performed on five different occasions; one survey during the middle of each season and one survey during the late winter period (fully frozen condition). There was one survey conducted at this site on February 24, 1996. The average IRI value for the entire site was 57.42 inches/mile, which is indicative of a new pavement.

Elevation Surveys

One set of the surface elevation survey was performed following the guidelines. The elevation at the top of the piezometer pipe was assumed to be 1.000 meters. There are three other bench-marks that will be used to monitor the stability of the combination piezometer/bench mark that was installed. The first two are nails in trees at different locations and the third is a concrete monument that was placed for checking the stability of the piezometer/bench mark. These bench marks will be used to monitor the piezometer/bench mark. The survey was conducted on October 05, 1995 and the results are presented in Appendix D.

Water Depth

The water level on October 05, 1995 was 2.81 m below the ground level. Since then one other water table reading of 1.67 m was taken on January 16, 1996.

IV. Summary

The installation of the seasonal monitoring instrumentation at the SPS site 100102 near Ellendale, DE was completed on October 04, 1995. A check of the equipment and initial data collection was completed on October 05, 1995. The instrumentation, permanently installed at the site, were:

- Time domain reflectometer probes for moisture measurements,
- Thermistor probes for pavement and soil gradient temperature measurements,
- Air temperature, thermistor probe, and tipping bucket rain gauge to record local climatic conditions, and
- Combination piezometer (well) and bench mark to determine changes in water level and pavement elevations.

The pavement gradient temperature and local climatic data are to have continuous data collection stored in an on-site datalogger. The moisture measurement is to be collected during each site visit (14 times per year) using a mobile datalogger system. The water level, and elevation data are to be collected manually during site visits.

The test section is on Southbound Route 113, 2.0 km South of the S.R. 16. The site is located in a predominantly fill area. The road embankment on the either side of the road slopes gently toward a ditch. The tree line is approximately 11 m West of the edge of pavement. The pavement consists of two 3.7 m wide lane in each direction with a 3.0 m wide paved outside shoulder and a 1.2 m wide paved inside shoulder. The traffic in either direction is separated by a grassed median. The pavement structure consists of 95 mm of asphalt concrete over 365 mm dense graded aggregate base which lies on silty sand fill material. The subgrade material consists of silty sand with clay. The top 25 mm of Open Graded Surface Coarse (OGSC) hot mix has not been placed yet. It is scheduled to be placed in the summer of 1996.

During the construction of the Northbound lanes the Southbound lanes are being used for traffic in both directions. DEL DOT can not close lanes in the Southbound direction because of the construction. As a direct result of this there was no FWD data, or manual data collected. Onsite and Mobile data has been collected regularly.

All instrumentation was checked prior to installation at the PMSL facility in Amherst, NY. These initial checks indicated that the instrumentation was within specifications, as required for the seasonal monitoring program. Operational checks during the installation and the following day indicated that all instrumentation were functioning properly. The air temperature and gradient temperatures measured in the pavement surface compared favourably with the hand held Omega temperature gauge. The temperature profile for the pavement soils appeared reasonable with no outlying sensors except for sensor number one as mentioned above. A check of the tipping bucket indicated it was functioning correctly with tips corresponding to the amount of water supplied.

Moisture content of the soil was determined by TDR method, and field moisture determination at time of installation by soil drying. There were slight differences between the moisture content determined by the TDR method and gravimetric moisture content determined in the field.

The installation generally proceeded as expected with only a few minor problems. The rain came as forecasted on the day of installation. A tent was set up over the instrument hole as soon as the truck mounted drilling unit was removed from the instrument hole area. The installation proceeded as usual from this point on. The removal/replacement of the material from the instrumentation hole was successful, with the hot-mix being well compacted and level with the existing pavement surface at completion. The top of the stainless steel probe of the thermistor probe was placed very close to the surface in order that it be approximately 25 mm below the surface once the surface coarse is added to the pavement structure.

Monitoring of this section has been hampered by the fact that traffic control could not be provided to collect the FWD response and elevation data. Some minor distress has started to show on this section, which may put this and the SPS experiment in jeopardy if construction is required in the near future.

APPENDIX A

Test Section Background Information

Appendix A contains the following supporting information:

Figure A-1	Site Location Map
Figure A-2	SPS-1 Design Schematic
Figure A-3	Profile of Pavement Structure
Table A-1	Uniformity Survey Results
Figure A-4	Deflection Profiles from FWDCHECK (Test Date October 03, 1995)
Table A-2	Subgrade Modulus and Structural Number from FWDCHECK (Test Date October 03, 1995)

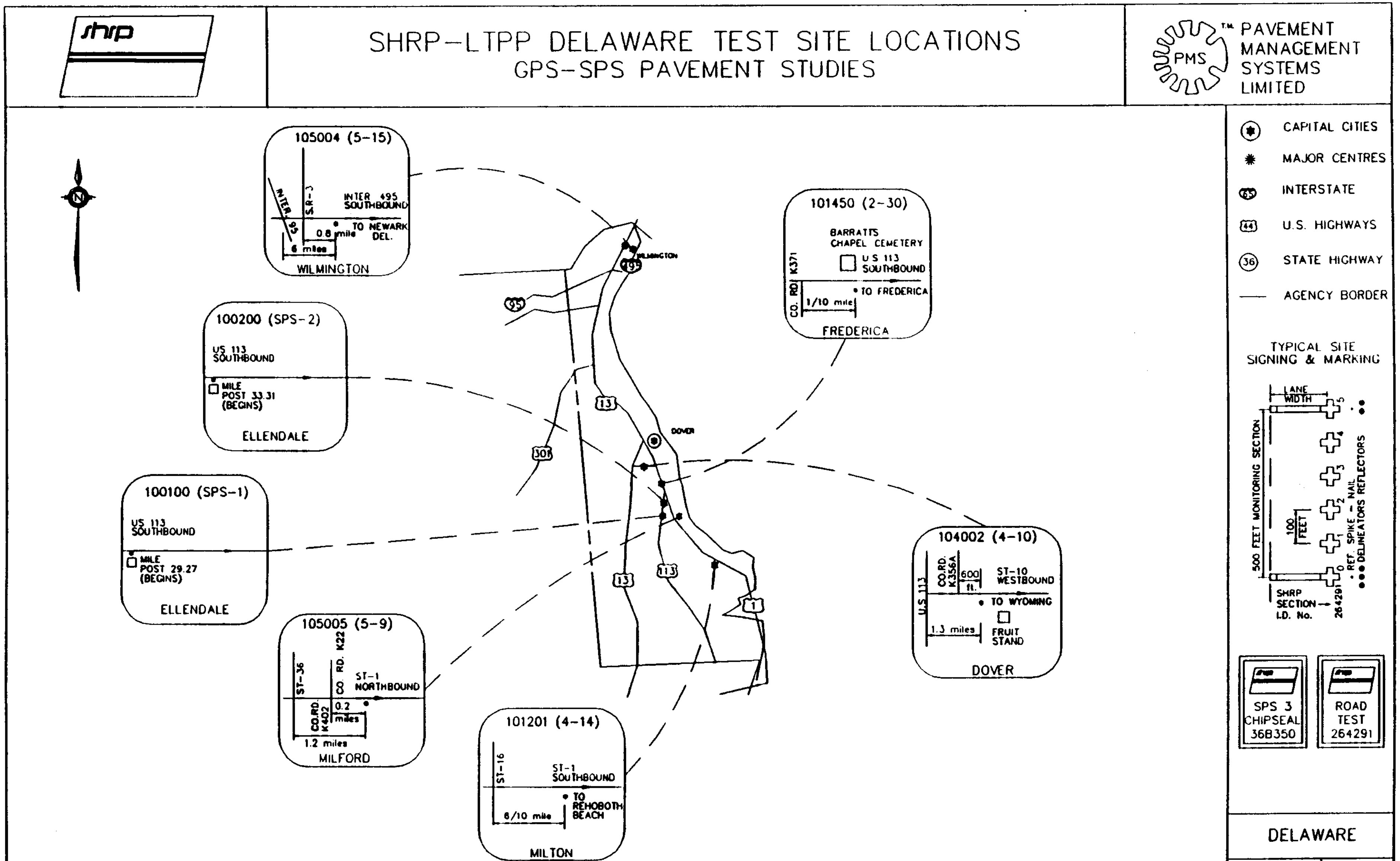


FIGURE A-1 SITE LOCATION MAP - SECTION 100102

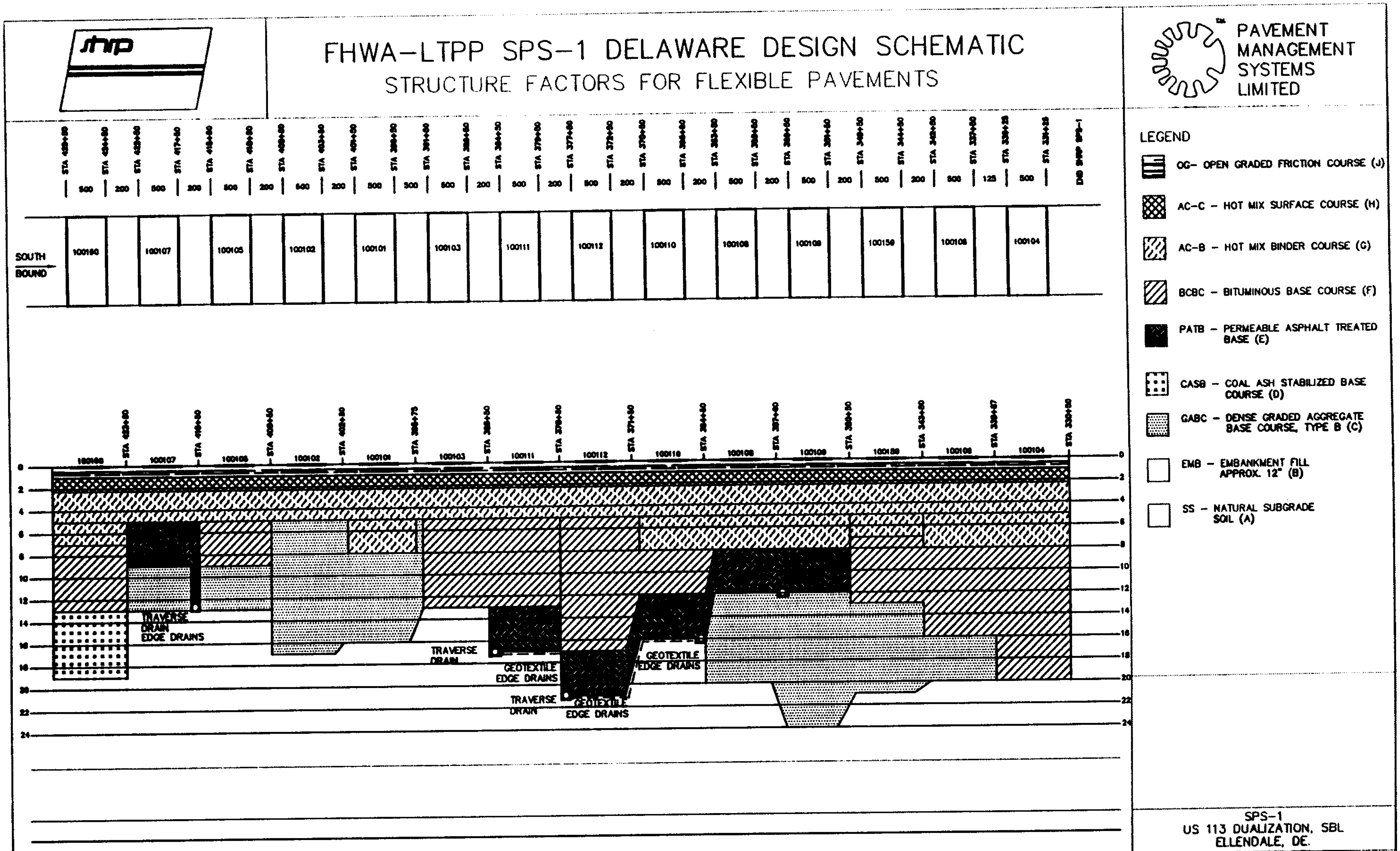
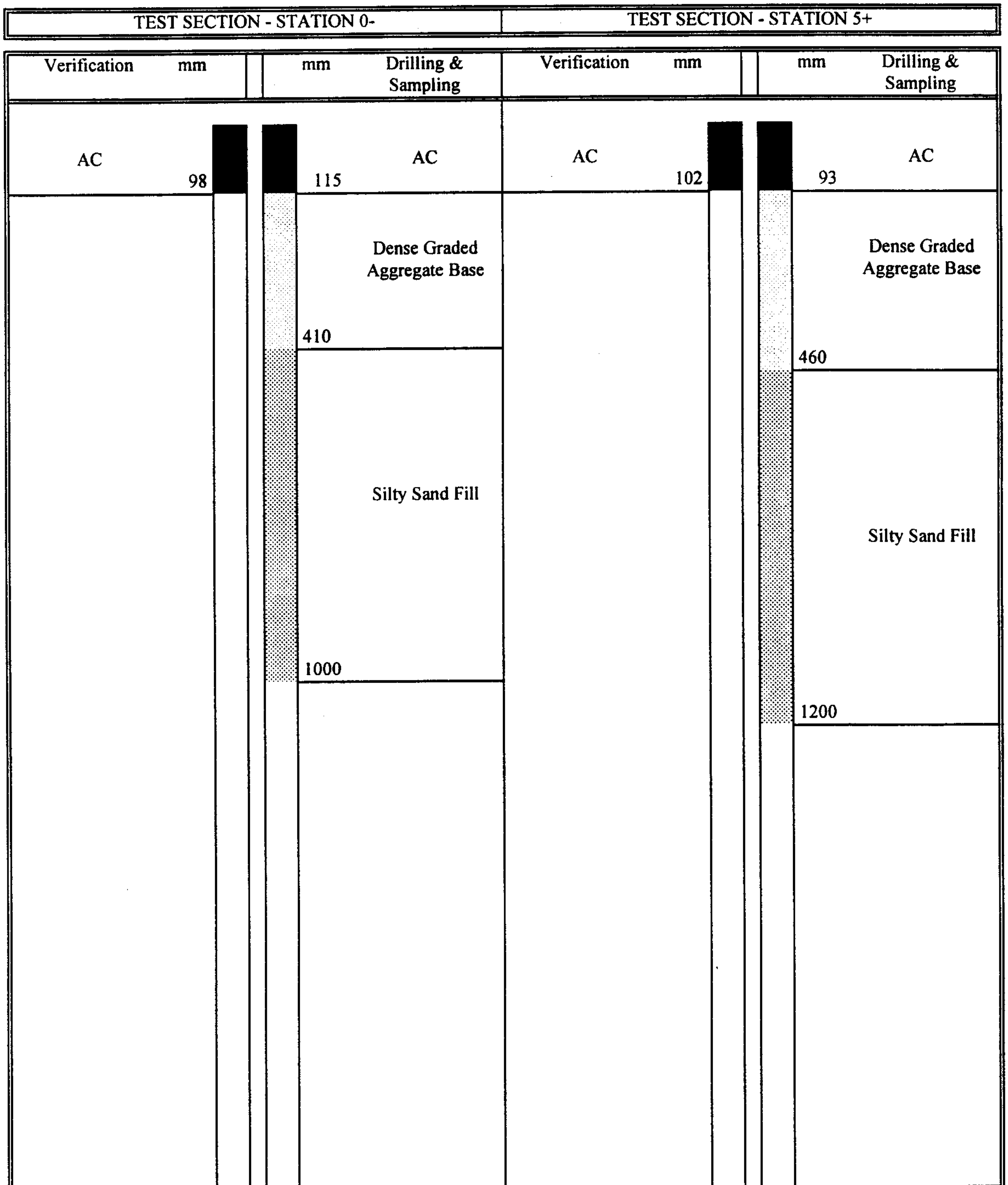


FIGURE A-2. DELAWARE SPS-1 DESIGN SCHEMATIC



* Drilling and sampling data was taken from levels and field logs. Verification data was taken from the coring logs. There is no laboratory data available at this time.

Figure A-3. Profile of Pavement Structure

Table A-1. Uniformity Survey Results

Seasonal Uniformity Survey	Falling Weight Deflectometer Data Collection and Processing Summary
Site Number: 100102	
Date Surveyed: October 03, 1995	

Section Interval (ft)	Mean Deflection Values for HT 2 (mils) - Corrected							
	Sensor 1	Sensor 1 std dev	Sensor 7	Sensor 7 std dev	Subg modulus (psi)	Subg modulus std dev	Effective SN	SN std dev
-100 - 200	10.90	0.98	1.36	0.14	27617	2520	3.94	0.31
200 - 600	12.47	0.79	1.76	0.14	21438	1869	3.86	0.19

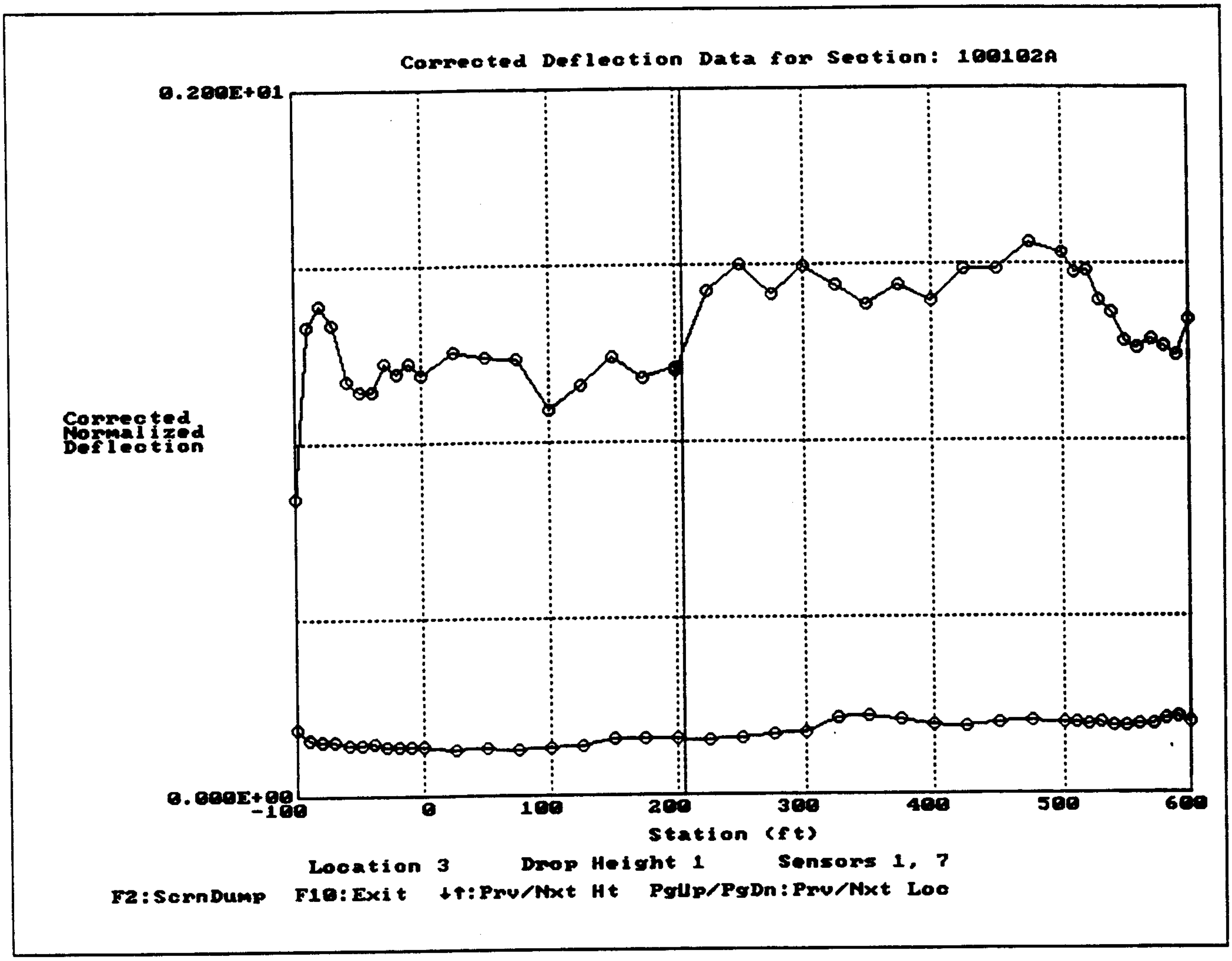


Figure A-3. Deflection Profile from FWDCHECK
(Test Date October 03, 1995)

Table A-2. Subgrade Modulus and Structural Number from FWDCHECK
(Test Date October 03, 1995)

Flexible Pavement Thickness Statistics - 100102A - Drop Height 2			
Subsection	Station	Subgrade Modulus	Effective SN
1	-100	21607	5.15
	-90	24556	3.80
	-80	25270	3.70
	-70	26392	3.75
	-60	28030	3.95
	-50	27107	4.00
	-40	28097	3.95
	-30	29824	3.80
	-20	29055	3.85
	-10	28292	3.85
	0	28909	3.85
	25	30806	3.70
	50	30209	3.75
	75	30969	3.75
	100	30020	4.05
	125	29739	3.95
	150	25389	3.95
	175	24954	4.05
	200	25770	3.95
2	225	26735	3.60
	250	25207	3.55
	275	24288	3.70
	300	23319	3.65
	325	19185	3.90
	350	19003	4.00
	375	20030	3.85
	400	21170	3.85
	425	21078	3.75
	450	20668	3.75
	475	20412	3.70
	500	20441	3.75
	510	20841	3.75
	520	21072	3.75
	530	20860	3.90
	540	21792	3.90
	550	21718	4.05
	560	21006	4.15
	570	21020	4.10
	580	20345	4.15
	590	20677	4.20
	600	20762	4.00
Subsection 1	Overall Mean	27617	3..94
	Standard Deviation	2520	0.31
	Coeff of Variation	9.13%	7.99%
Subsection 2	Overall Mean	21438	3.86
	Standard Deviation	1869	0.19
	Coeff of Variation	8.72%	4.86%

APPENDIX B

Supporting Site Visit and Installed Instrument Information

Appendix B contains the following supporting information:

Correspondence from the Site Inspection and the Planning Meeting

Table B-1. Air Temperature Thermistor Calibration

Table B-2. MRC Probe Calibration

Table B-3. Description of MRC Thermistor Probe and Sensor Spacing

Table B-4. TDR Probes Calibration

Figure B-1. TDR Traces Obtained During Calibration

FAX TRANSMITTAL

		Date:	September 27, 1995
To:	Bob Radish	**Fax No.:**	(302) 856-5728
Sender:	Brandt Henderson	**Project No.:**	5-045-11-25
		File No.:	
Reference:	Seasonal Site Installation	Includes cover sheet plus 3 page	
		☑ Original will follow by mail	

MESSAGE:

To follow up the site visit of September 22, 1995, please find enclosed a site plan view and diagram of projected instrument placement for SPS 100102. The installation is scheduled for Wednesday October 04, 1995. We would like to have a pre-installation meeting at the site on Tuesday October 03, 1995, at 8:30 a.m. to identify the location of the test section since the section has no paint markings on it now. We will contact you to confirm this meeting.

The uniformity survey will be conducted on Tuesday October 03, 1995. The location for the installation will be finalised after the uniformity test. The location of the piezometer, instrumentation, equipment cabinet and instrument weather pole are identified in the plan view diagram. Utility clearances will be required at these locations. If there are any problems with clearances we can review and adjust the locations as part of the pre-installation meeting.

From our discussion, it seems that preparation for the installation are progressing well. We will bring a 12" core barrel for coring the instrument hole. This core barrel produces a hole approximately 12.25" in diameter. We will require an auger that is compatible with this size. The augers minimum size is 9" (outside diameter).

The following summarises the supply items requested from the agency.

Asphalt concrete hot or cold mix to patch shoulder
Filter sand - 1 bag 80 to 100 lbs
* Bentonite - 1/2 bag 20 to 40 lbs
Concrete Mix (Sacrete) - 2 bags 160 to 200 lbs
* Surface access cover for piezometer

* We will bring extra supplies of these items to the installation

The loan of a standard 4"(102mm) Proctor mould, 5.5 lb. (2.5 kg) hammer and balance with a capacity of 25 lb (11.5 kg) readable to .01 lbs. (5 gm) for density determination of the subgrade material is required. As

If you have not received a complete message, please call sender at:

Pavement Management Systems Limited

415 Lawrence Bell Drive, Unit 3, AMHERST, New York 14221 Ph: (716) 632-0804, Fax: (716) 632-4808

PMS T.M.

FAX TRANSMITTAL

verification of the field moisture we are also requesting the agency provide laboratory moisture values for soil samples taken at each TDR installation location (10 in total).

The Pavement Management Systems employees coming for the installation are:

Gabe Cimini	FWD Operator
Scott Comstock	Instrumentation Technician
Tim Comstock	Installation Technician
Brandt Henderson	Team Leader
Dilan Singaraja	Engineering Assistant

If you have any questions or need further information do not hesitate to call. I will be out of the office most of this week. If you leave a message with the secretary (716-632-0804) I will return your call.

We look forward to seeing you and your co-workers on October 04.

Copies: Aramis Lopez, (w/o attachments)
Wayne Kling, (w/o attachments)

ORIGINAL 10-08-1

ITX Technologies

FAX TRANSMITTAL

PMS T.M.

To: Wayne Kling
DEL DOT

Fax No.: (302) 739-6119

Date: September 12, 1995

Project No.: 50451125

Sender: Bill Phang *Bill Phang.*

Includes cover sheet plus 1 page

Reference: Seasonal Monitoring Site Installation - SPS Section 100102

❑ Original will follow by mail

MESSAGE:

Brandt Henderson and myself, would like to hold a planning meeting for the installation of seasonal monitoring instrumentation at Section 100102 of the SPS-1 project on US 113 SB, at 10:00am on Friday, September 22, 1995. (Instead of Monday September 18, 1995), in your offices in Dover.

A sample agenda for the meeting taken from the "Seasonal Monitoring Program Guidelines": Version 2.1, April 1994 is attached.

Please confirm that date, time, and place are convenient and acceptable. It would be appropriate to have representation from traffic control, coring and auguring field crews, materials testing, survey (leveling), and pavement maintenance.

C.C. I.J. Pecnik
B. Henderson

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ITX Technologies • **Pavement Management Systems**

415 Lawrence Bell Drive, Unit 3, AMHERST, New York 14221 Ph: (716) 632-0804, Fax: (716) 632-4808

FAX TRANSMITTAL

		Date:	September 8, 1995
To:	Wayne Kling	**Fax No.:**	(302) 739-6119
Sender:	Brandt Henderson Bill Phang	**Project No.:**	5-045-11-25
		File No.:	16.03
Reference:	Seasonal SPS 100102 - Installation Planning Meeting	Includes cover sheet plus page	
		☐ Original will follow by mail	

MESSAGE:

Dear Mr. Kling,

We would like to conduct the Installation Planning Meeting on Monday September 18, 1995 at your offices. Arrangements for the installation such as the dates, traffic control, coring and auguring equipment, supplies, and personnel have to be made. We will be sending you further detail on the site information, instrumentation layout, installation scheduling, installation team, and supplies needed as the information becomes available to us.

We will contact you to confirm the date and time of the meeting. We would appreciate it if those attending the meeting are notified once the date and time have been fixed. Thank you for your cooperation.

If you have not received a complete message, please call sender at:

Pavement Management Systems Limited

415 Lawrence Bell Drive, Unit 3, AMHERST, New York 14221 Ph: (716) 632-0804, Fax: (716) 632-4808

PAVEMENT
MANAGEMENT
SYSTEMS

March 21, 1995
50451025-13.08.1

Mr. C. Wayne Kling
Chief of Materials and Research
Delaware Department of Transportation
P.O. Box 778
Dover, Delaware 19903

RE: Nomination of SPS-1 Test Section 100102 for Seasonal Monitoring

Dear Mr. Kling:

Test section 100102 of the SPS-1 Project on US 113 SB, Ellendale, Delaware, with its 4" AC on 12" GABC and a 1" OG friction course falls into Experimental Cell 8 of the LTPP Seasonal Monitoring Program (SMP). The North Atlantic Regional Coordination Office (NARO) would like to include this test section in the second SMP circuit in this Region and requests your consideration and participation.

The activities for SMP monitoring includes installation of moisture, temperature, and frost penetration sensors as is described in the enclosed "LTPP Seasonal Monitoring Program: Instrumentation Installation and Data Collection Guidelines", FHWA-RD-94-110, April 1994. Monitoring activities include once monthly measurements with the FWD (twice monthly in March and April) which will require traffic control, beginning in November 1995 and ending in October 1996.

Installation and instrumentation can be scheduled upon completion of construction of the SPS-1 project and prior to opening to traffic.

Should you agree to participate, NARO is prepared to make a presentation to your offices to establish contacts and schedule the activities.

415 LAWRENCE BELL DRIVE
UNIT #3
AMHERST, N.Y. 14221
TEL. (716) 632-0804
FAX (716) 632-4808

Your continued participation in the LTPP project is very much appreciated.

Yours Sincerely,

for William A. Phang
Program Manager
Pavement Management Systems Limited

WAP/tf

enclosure

C.C. I.J. Pecnik, w/o enclosure
B. Henderson, w/o enclosure

LTPP DATA DEMONSTRATION PROGRAM

SECTION DETAILED REPORT - DATA AS OF 9/27/93

-NTIFICATION SUMMARY DATA:

RP ID Number	105005.1	County Code	1
State	DE	Functional Class	Rural Pr Art
LTPP Region	1	Route Number	1
periment	5	Milepost	.
-nstruct. Date (D/M/Yr)	010671	Elevation (ft)	25
LTPP Participation Date	310571	Latitude	38.925
PP Deassign date	.	Longitude	75.417

CLIMATIC/INVENTORY SUMMARY DATA:

Freezing Index (F-Days)	223	Seasonal Section	NO
ecipitation (Inches)	43	Inside Shoulder Type	Surf Treat
No. of Freeze/Thaw Cycles	76	Outside Shoulder Type	Surf Treat
Days Above 90 F	25	Drainage Type	None
-ys Below 32 F	80	Joint Spacing (ft)	.
-t days	110	Load Transfer Type	.
Years of Climatic Data	11	Long. Steel Content (%)	0.60

AFFIC SUMMARY DATA:

Average ESAL Per Year (K)	74	Latest ESAL (KESAL)	94
Years included in ESAL	19	Latest ESAL Year	89

-NITORING SUMMARY DATA:

Year->	89	90	91	92
IRI	.	67	68	64
SKID	49	.	34	36
FAULT	.	.	.	.

LAYER SUMMARY DATA:

Layer	Thick	Layer Description	Layer Material Code

Layer data is available but has not passed QA/QC Checks

Table B-1. Air Temperature Thermistor Calibration

LTPP Seasonal Monitoring Study	State Code	[10]
Air Temperature Thermistor Calibration	Test Section Number	[0102]

Before Operation Checks	Calibration Date (dd-mm-yy)	02-10-95
	Probe S/N	10AAT
	Operator	SC/TC

Mobile Datalogger (24 hour)			Water Room Temperature		Ice Bath 0° C (+/- 1° C)		Hot Water 50° C (+/-)		ok
Mean	Min.	Max.	Reading	Time	Reading	Time	Reading	Time	y/n
	21.7	23.48	24.7	915	0.010	1211			y

Probe Accepted	S.C.	(Initials)

Note: Cannot fill blank cells because of missing data

Table B-2. MRC Probe Calibration

LTPP Seasonal Monitoring Study		State Code	[10]
MRC Probe Calibration		Test Section Number	[0102]

Before Operation Checks	Calibration Date (dd-mm-yy)	02-10-95
	Probe S/N	10AT
	Operator	SC/TC

	Mobile Datalogger (24 hour)			Water Room Temp Time 915	Ice Bath 0 °C (+/- 1 °C) Time 1050	Hot Water 50 °C (+/-) Time 1210	ok
No.	Mean	Min.	Max.	Reading	Reading	Reading	y/n
1		21.27	22.90	24.5	0.25		y
2		21.29	22.99	24.5	0.21		y
3		21.28	23.11	24.4	0.51		y
4		21.30	23.25	24.0	0.98		y
5		21.37	23.31	24.3	1.31		y
6		21.37	23.35	24.3	1.27		y
7		21.24	23.16	24.2	1.09		y
8		21.31	23.19	24.4	1.01		y
9		21.32	23.22	24.4	1.95		y
10		21.31	23.18	24.5	2.06		y
11		21.25	23.03	24.5	1.77		y
12		21.28	22.94	24.5	2.27		y
13		21.31	22.96	24.4	2.06		y
14		21.24	22.77	24.0	2.52		y
15		21.20	22.66	24.0	1.59		y
16		21.16	22.50	23.9	1.27		y
17		21.03	22.23	23.9	0.76		y
18		20.93	21.92	24.0	0.58		y

Probe Accepted:	S.C.	(Initials)
Probe Length:	1.860	(meters)

Thermistor distance from top of probe: (meters)									
4	0.021	7	0.247	10	0.628	13	1.084	16	1.541
5	0.096	8	0.322	11	0.780	14	1.238	17	1.694
6	0.170	9	0.473	12	0.933	15	1.390	18	1.850

Note: Cannot fill blank cells because of missing data

Table B-3. Description of MRC Thermistor Probe and Sensor Spacing

Unit	Channel No.	Distance from Top of Unit(m)	Remarks
1	1	0.025	0.3302 m long by 6.35 mm stainless steel probe installed in the AC layer.
	2	0.177	
	3	0.327	
2	4	0.021	1.860 m long by 25.4 mm PVC tube installed in the base and subgrade.
	5	0.096	
	6	0.170	
	7	0.247	
	8	0.322	
	9	0.473	
	10	0.628	
	11	0.780	
	12	0.933	
	13	1.084	
	14	1.238	
	15	1.390	
	16	1.541	
	17	1.694	
	18	1.850	

Table B-4. TDR Probes Calibration

LTPP Seasonal Monitoring Study		State Code	[10]
TDR Probes		Test Section Number	[0102]

Before Operation Checks	AL/SC	Initial	Calibration Date (dd-mm-yy)	29-09-95
			Seasonal Site	10SA

No.	Probe (S/N)	Resistance (ohms) Core	Resistance (ohms) Shield	Probe Shorted Begin Length	Probe Shorted End Length	Air Begin Length	Alcohol Begin Length	Water Begin Length
1	10A01	0.4	0.4	15.12	15.32	15.12	15.11	15.11
2	10A02	0.3	0.4	15.12	15.29	15.12	15.11	15.11
3	10A03	0.3	0.3	15.10	15.31	15.10	15.10	15.11
4	10A04	0.3	0.4	15.15	15.32	15.15	15.16	15.16
5	10A05	0.4	0.4	15.15	15.29	15.15	15.15	15.14
6	10A06	0.3	0.3	15.13	15.32	15.13	15.13	15.13
7	10A07	0.3	0.3	15.11	15.25	15.11	15.11	15.11
8	10A08	0.3	0.3	15.06	15.23	15.06	15.06	15.08
9	10A09	0.3	0.3	15.09	15.28	15.09	15.08	15.07
10	10A10	0.4	0.4	15.06	15.23	15.06	15.06	15.07

NOTE: Record lengths from TDR

Calculation of Dielectric Constant

Probe Length 0.203 m

V_p Setting 0.99 V_p

$$\varepsilon = \left[\frac{TDRL}{(PL)\,(V_p)} \right]^2$$

No.	Air TDR Length	Air Dielectric Constant	Air In Spec. (?)	Alcohol TDR Length	Alcohol Dielectric Constant	Alcohol In Spec. (?)	Water TDR Length	Water Dielectric Constant	Water In Spec. (?)
1	0.20	0.97	y	0.97	22.83	y	1.77	76.02	y
2	0.17	0.70	y	0.96	22.36	y	1.76	75.17	y
3	0.21	1.07	y	1.00	24.27	y	1.78	76.89	y
4	0.17	0.70	y	0.97	22.83	y	1.78	76.89	y
5	0.18	0.79	y	0.99	23.78	y	1.77	76.02	y
6	0.19	0.88	y	0.98	23.31	y	1.78	76.89	y
7	0.20	0.97	y	0.97	22.83	y	1.77	76.02	y
8	0.17	0.70	y	0.99	23.78	y	1.77	76.02	y
9	0.19	0.88	y	0.97	22.83	y	1.78	76.89	y
10	0.17	0.70	y	0.98	23.31	y	1.79	77.75	y

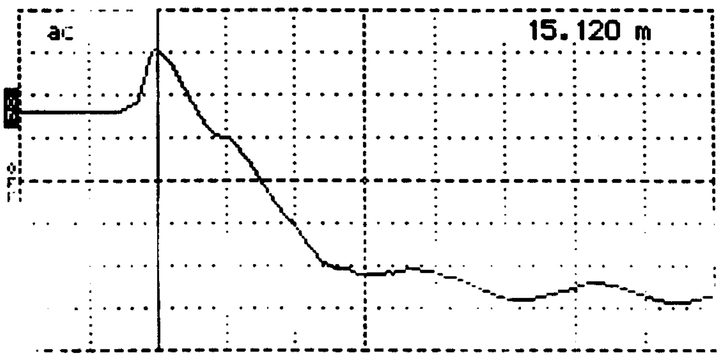
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0102]

Probe Serial Number: 10A01 **Date (dd/mm/yy):** 29/09/95

Probe Number 01

Trace 1 - Probe Shorted at Start

Cursor .... 15.120 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac

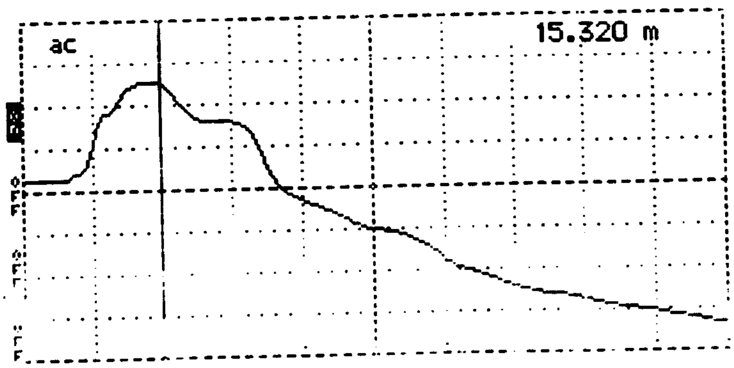


Tektronix 1502B TDR
Date 9-29-95
Cable 10A01
Notes short

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

Cursor .... 15.320 m
Distance/Div ..... .25 m/div
Vertical Scale.... 211 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A01
Notes short-end

Input Trace
Stored Trace
Difference Trace

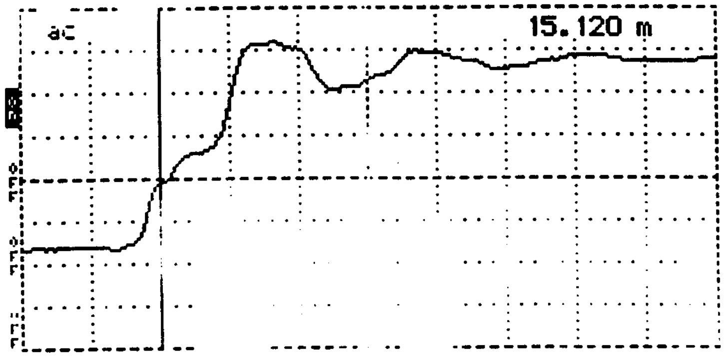
Figure B-1. TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [01 02]

Probe Number 01

Trace 3 - Probe in Air

Cursor .... 15.120 m
Distance/Div.... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power......... ac

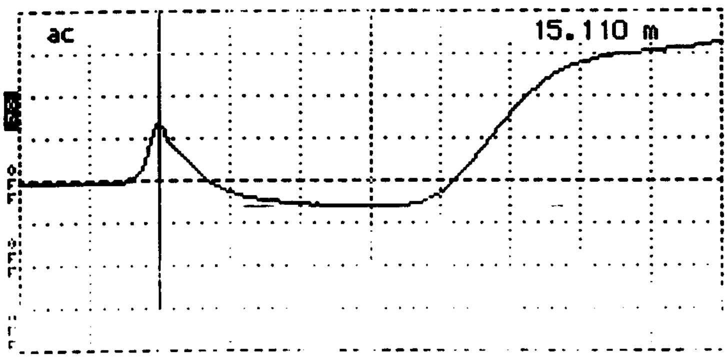


Tektronix 1502B TDR
Date 9-29-95
Cable 10A01
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

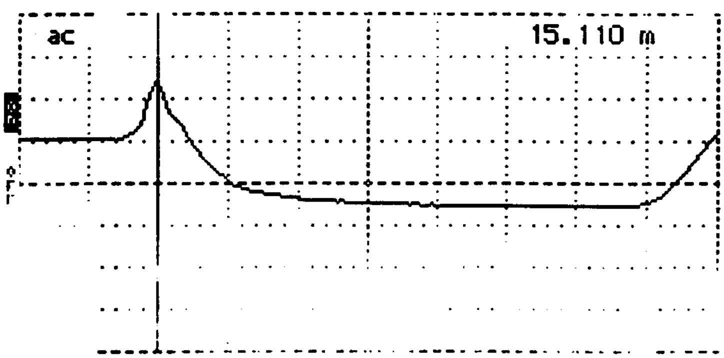


Tektronix 1502B TDR
Date 9-29-95
Cable 10A01
Notes alcohol 25

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A01
Notes water 21

Input Trace
Stored Trace
Difference Trace

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

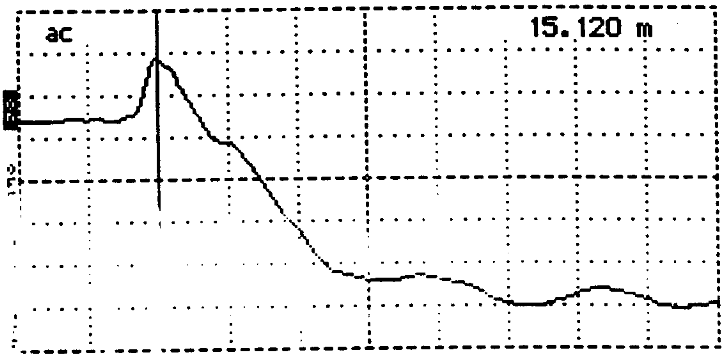
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0102]

Probe Serial Number: 10A02 **Date (dd/mm/yy):** 27/09/95

Probe Number 02

Trace 1 - Probe Shorted at Start

Cursor .... 15.120 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

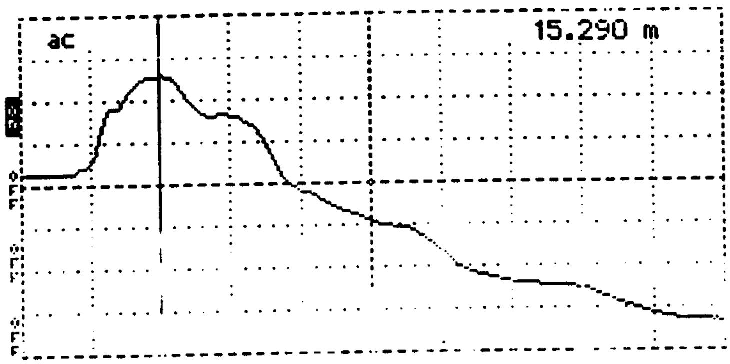


Tektronix 1502B TDR
Date 9-29-95
Cable 10A02
Notes Short

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

Cursor .... 15.290 m
Distance/Div..... .25 m/div
Vertical Scale.... 211 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A02
Notes short end

Input Trace
Stored Trace
Difference Trace

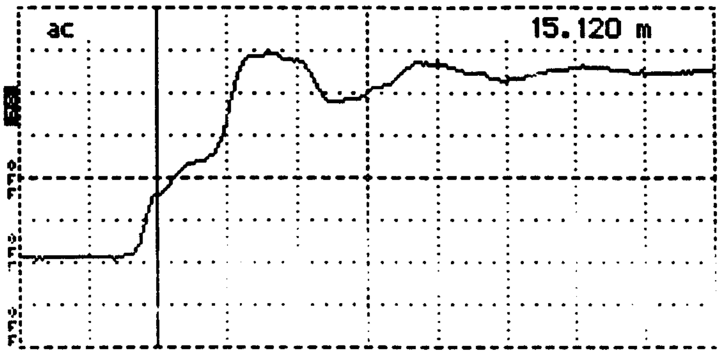
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0104]

Probe Number 02

Trace 3 - Probe in Air

Cursor .... 15.120 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

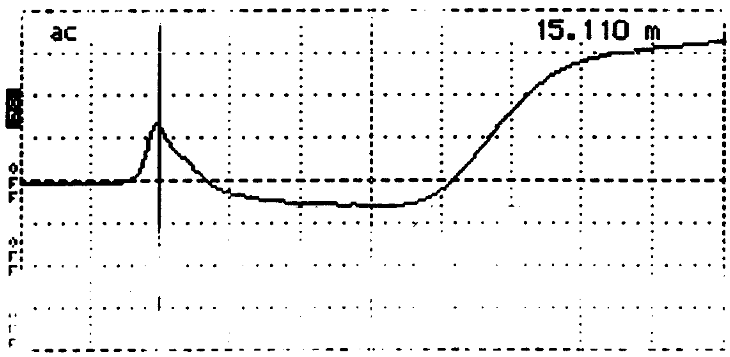


Tektronix 1502B TDR
Date 9-29-95
Cable 10A02
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

Cursor .... 1:.110 m
Distance/Div..... .25 m/div
'ertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

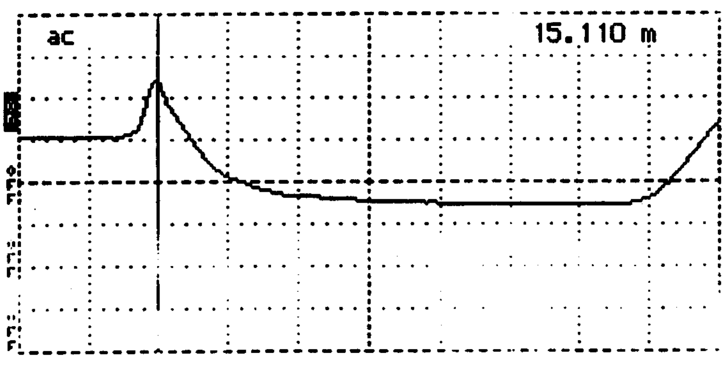


Tektronix 1502B TDR
Date 9-29-95
Cable 10A02
Notes alcohol 25.

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A02
Notes water 22.8

Input Trace
Stored Trace
Difference Trace

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

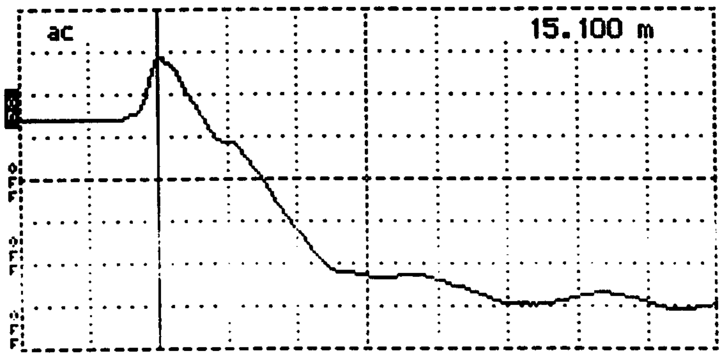
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0104]

Probe Serial Number: 10A03 Date (dd/mm/yy): 29/09/95

Probe Number 03

Trace 1 - Probe Shorted at Start

Cursor .... 15.100 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac

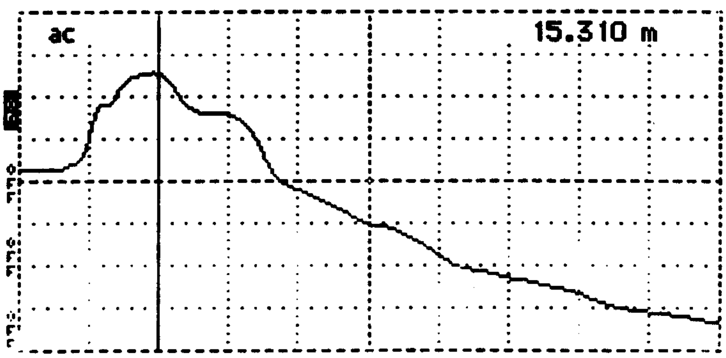


Tektronix 1502B TDR
Date 9-29-95
Cable 10A03
Notes short

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

Cursor .... 15.310 m
Distance/Div ..... .25 m/div
Vertical Scale.... 211 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A03
Notes short end

Input Trace
Stored Trace
Difference Trace

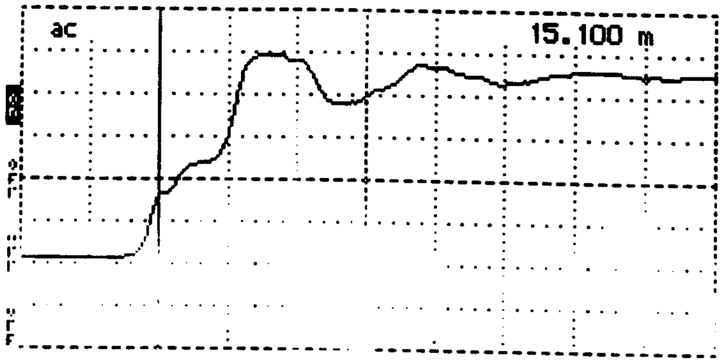
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0104]

Probe Number 35

Trace 3 - Probe in Air

Cursor .... 15.100 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac

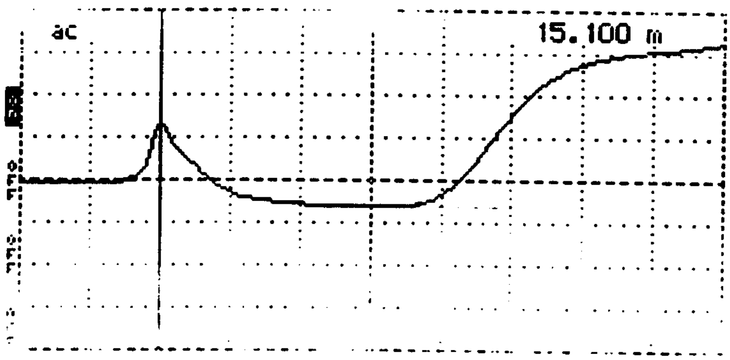


Tektronix 1502B TDR
Date 9-29-95
Cable 10A03
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

ursor .... 15.100 m
istance/Div ..... .25 m/div
rtical Scale.... 217 mρ/div
ρ 0.99
oise Filter ...... 1 avg
ower .... ac

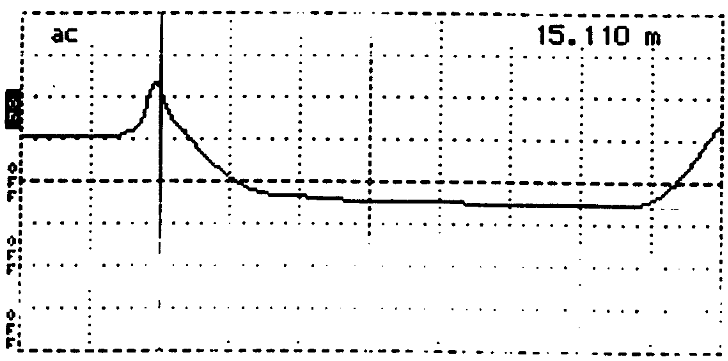


Tektronix 1502B TDR
Date 9-29-95
Cable 10A03
Notes alcohol 25.6

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

rsc .... 15.110 m
istar e/Div ..... .25 m/div
tical Scale.... 217 mρ/div
.... 0.99
ise Filter ...... 1 avg
wer .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A03
Notes water 22.2

Input Trace
Stored Trace
Difference Trace

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

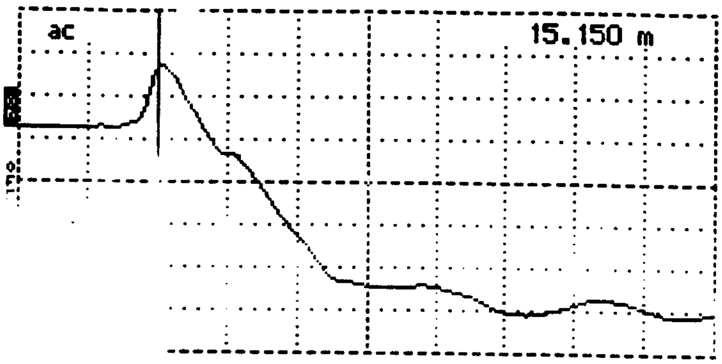
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0102]

Probe Serial Number: 10A04 **Date (dd/mm/yy):** 29/09/95

Probe Number 04

Trace 1 - Probe Shorted at Start

Cursor .... 15.150 m
istance/Div..... .25 m/div
ertical Scale.... 217 mρ/div
Vp 0.99
oise Filter...... 1 avg
er........... ac

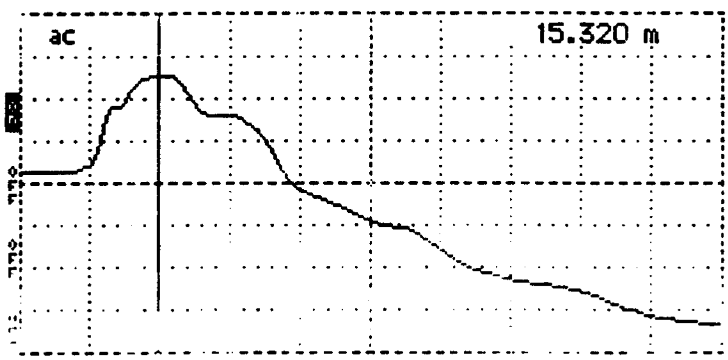


Tektronix 1502B TDR
Date 9-29-95
Cable 10A04
Notes Short

Input Trace
Stored Trac
Difference Trac

Trace 2 - Probe Shorted at End

Cursor .... 15.320 m
Distance/Div..... .25 m/div
Vertical Scale.... 211 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-9
Cable 10A04
Notes short en

Input Trace
Stored Trace
Difference Trace

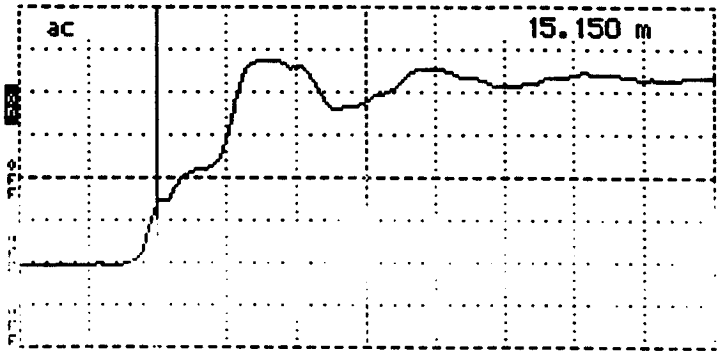
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0102]

Probe Number 04

Trace 3 - Probe in Air

Cursor .... 15.150 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac

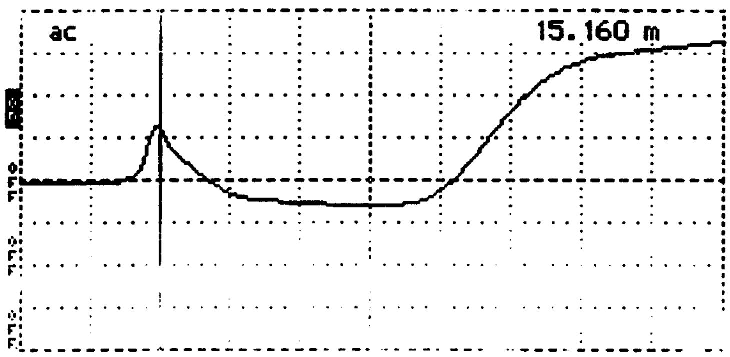


Tektronix 1502B TDR
Date 9-29-95
Cable 10A04
Notes 91F

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

Cursor .... 15.160 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac

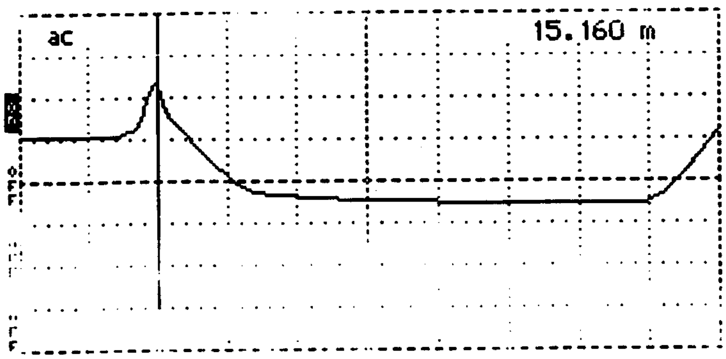


Tektronix 1502B TDR
Date 9-29-95
Cable 10A04
Notes alcohol 25

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.160 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A04
Notes water 22.5°

Input Trace
Stored Trace
Difference Trace

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

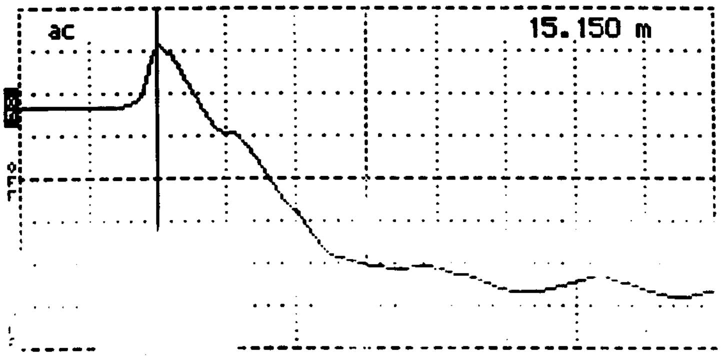
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0102]

Probe Serial Number: 10A05 **Date (dd/mm/yy):** 29/09/95

Probe Number 05

Trace 1 - Probe Shorted at Start

Cur sor .... 15.150 m
is ance/Div..... .25 m/div
'er tical Scale.... 217 mρ/div
VP 0.99
lc e Filter...... 1 avg
er... .... ac

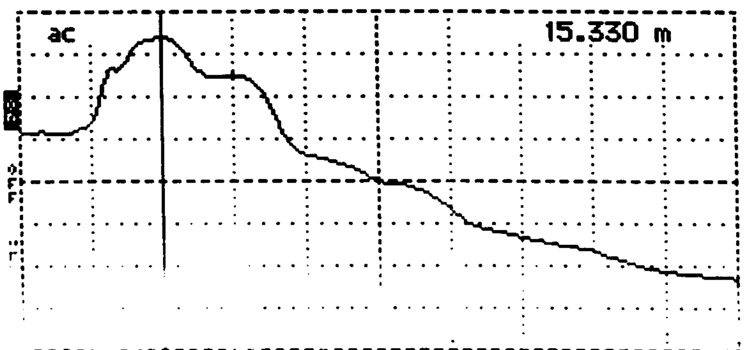


Tektronix 1502B TDR
Date 9-29-95
Cable 10A05
Notes short

Input Trace
Stored Trace
Difference rac

Trace 2 - Probe Shorted at End

sor .... 15.330 m
stance/Div..... .25 m/div
tical Scale.... 217 mρ/div
.... 0.99
ise Filter...... 1 avg
wer........... ac



Tektronix 1502B TDR
Date 10-3-95
Cable 10A05
Notes short end

Input Trace
Stored Trace
Difference Trace

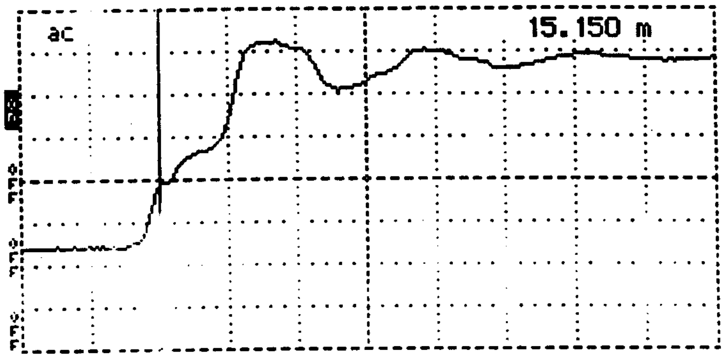
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: LTPP Section ID:	[_10_] [_6_1_0_4_]

Probe Number 05

Trace 3 - Probe in Air

Cursor . ... 15.150 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power.. .... ac

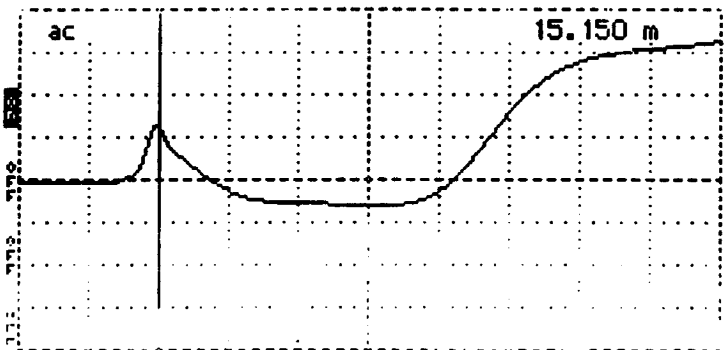


Tektronix 1502B TDR
Date 9-29-95
Cable 10A05
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

Cursor .... 15.150 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power.......... ac

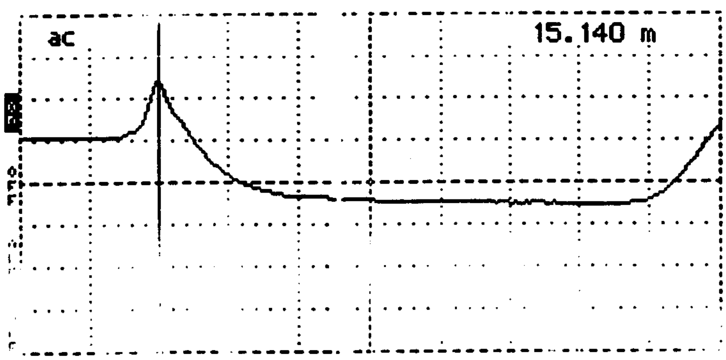


Tektronix 1502B TDR
Date 9-29-95
Cable 10A05
Notes alcohol 25.9

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.140 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power.......... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A05
Notes water 22.9

Input Trace
Stored Trace
Difference Trace

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

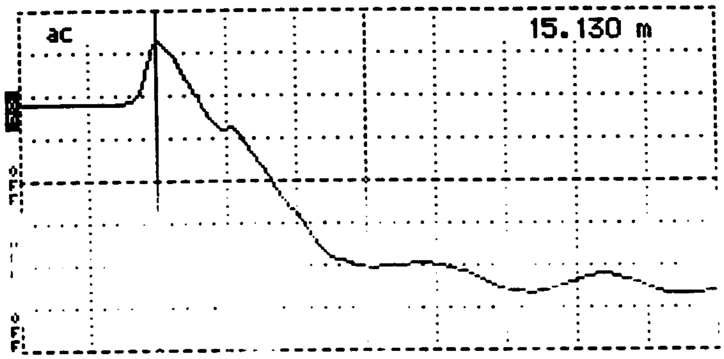
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: LTPP Section ID:	[10] [0102]

Probe Serial Number: 10A06 **Date (dd/mm/yy):** 29/09/95

Probe Number 06

Trace 1 - Probe Shorted at Start

Cursor .... 15.130 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

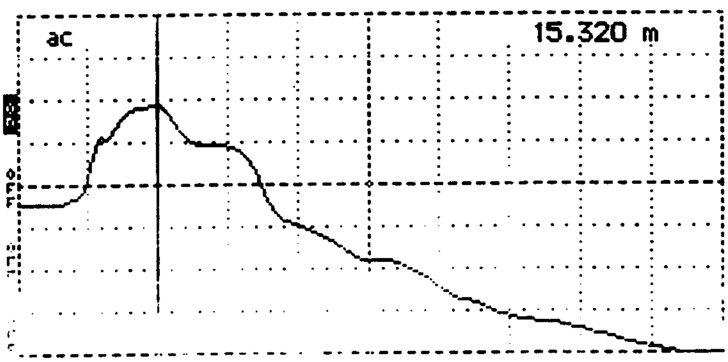


Tektronix 1502B TDR
Date 9-29-95
Cable 10A06
Notes short

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

Cursor .... 15.320 m
Distance/Div..... .25 m/div
Vertical Scale.... 211 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A06
Notes short end

Input Trace
Stored Trace
Difference Trace

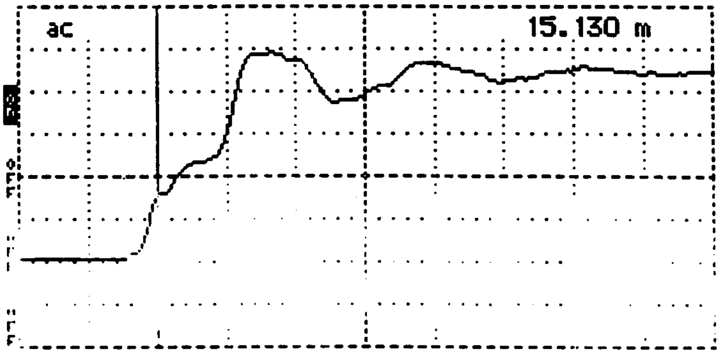
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0][02]

Probe Number 06

Trace 3 - Probe in Air

Cursor .... 15.130 m
Distance/Div ..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac

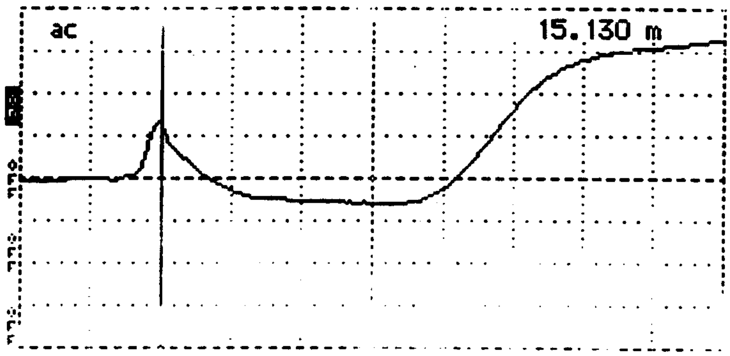


Tektronix 1502B TDR
Date 9-29-95
Cable 10A06
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

ursor .... 15.130 m
istance/Div ..... .25 m/div
rtical Scale.... 217 mρ/div
.... 0.99
oise Filter ...... 1 avg
ower .... ac

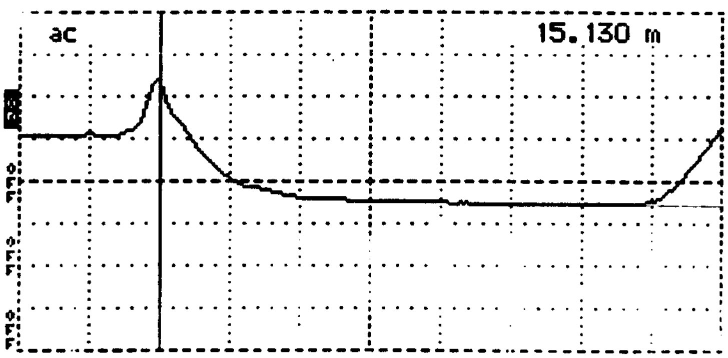


Tektronix 1502B TDR
Date 9-29-95
Cable 10A06
Notes alcohol 25.

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

ursor .... 15.130 m
istance/Div ..... .25 m/div
ertical Scale.... 217 mρ/div
.... 0.99
oise Filter ...... 1 avg
ower .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A06
Notes water 23.

Input Trace
Stored Trace
Difference Trace

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

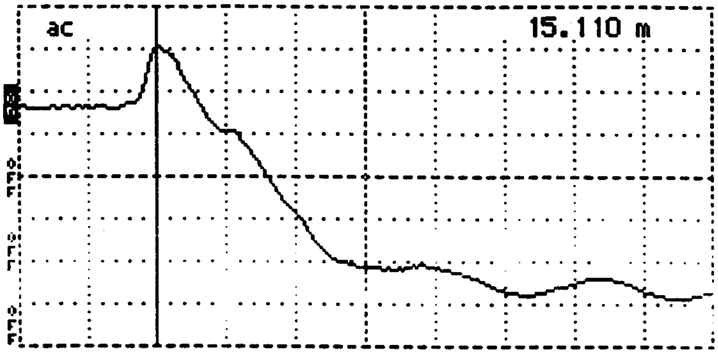
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0104]

Probe Serial Number: 10A07 **Date (dd/mm/yy):** 29/09/95

Probe Number 07

Trace 1 - Probe Shorted at Start

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

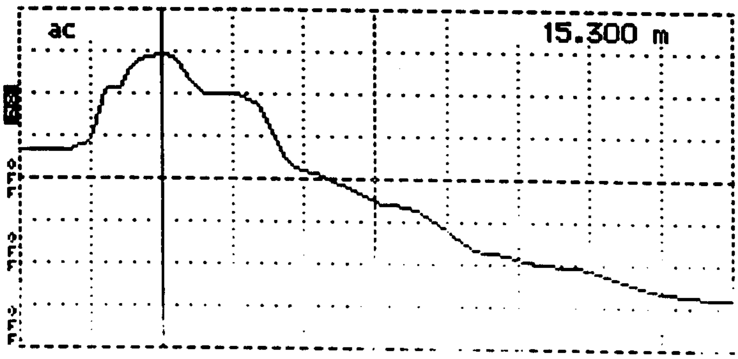


Tektronix 1502B TDR
Date 9-29-95
Cable 10A07
Notes short

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

rsor .... 15.300 m
istance/Div..... .25 m/div
rtical Scale.... 217 mρ/div
.... 0.99
oise Filter...... 1 avg
ower........... ac



Tektronix 1502B TDR
Date 10-3-95
Cable 10A07
Notes short-end

Input Trace
Stored Trace
Difference Trace

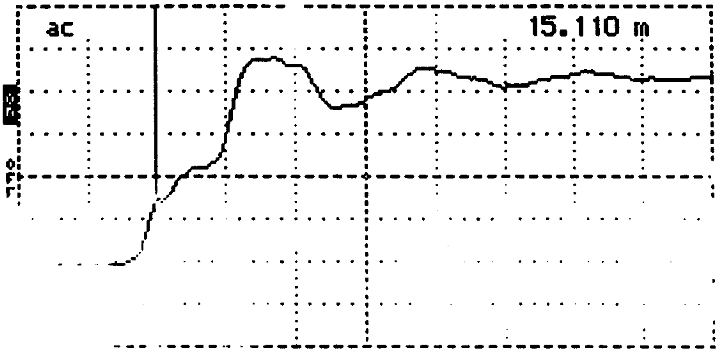
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [3102]

Probe Number 07

Trace 3 - Probe in Air

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power...... .... ac

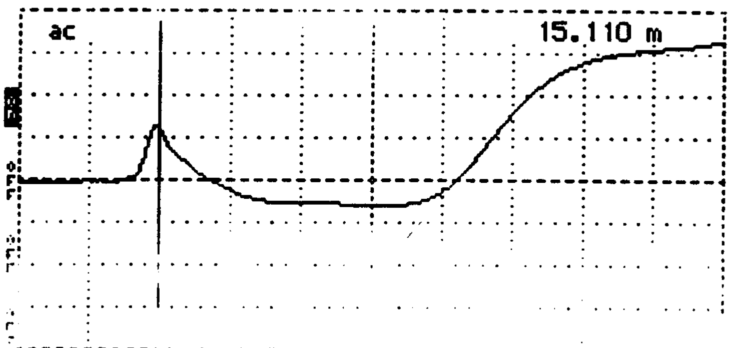


Tektronix 1502B TDR
Date 9-29-95
Cable 10A07
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

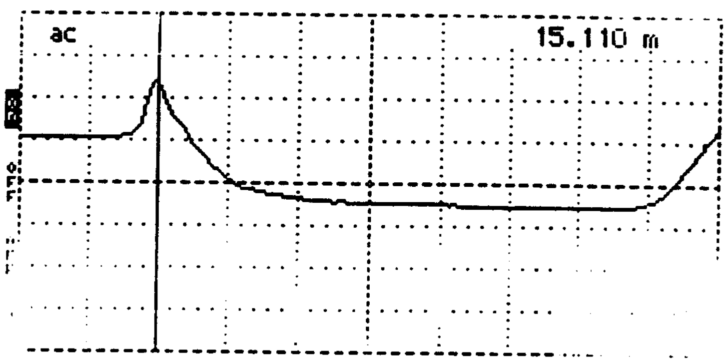


Tektronix 1502B TDR
Date 9-29-95
Cable 10A07
Notes alcohol 25

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.110 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A07
Notes water 23.c

Input Trace
Stored Trace
Difference Trace

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

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [_10] LTPP Section ID: [0102]

Probe Serial Number: 10A08 **Date (dd/mm/yy):** 29/09/95

Probe Number 08

Trace 1 - Probe Shorted at Start

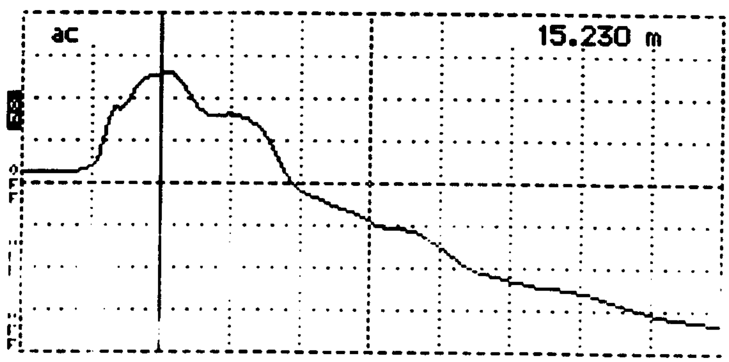
Cursor .... 15.060 m
Distance/Div..... .25 m/div
Vertical Scale.... 182 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

Tektronix 1502B TDR
Date 9-29-95
Cable 10A08
Notes Shorted

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

Cursor .... 5.230 m
Distance/Div..... .25 m/div
Vertical Scale.... 211 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A08
Notes short end

Input Trace
Stored Trace
Difference Trace

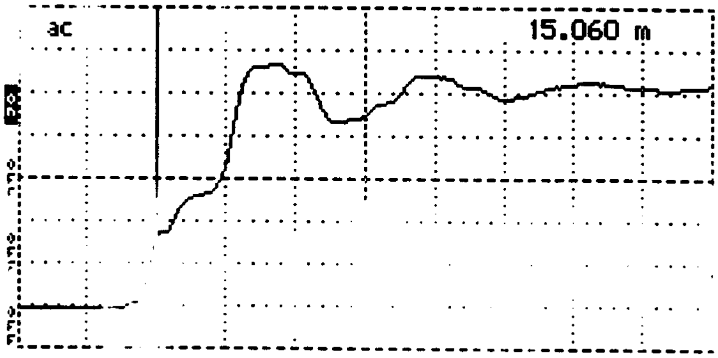
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [81 04]

Probe Number 08

Trace 3 - Probe in Air

ursor .... 15.060 m
istance/Div..... .25 m/div
ertical Scale.... 182 mρ/div
 .... 0.99
oise Filter...... 1 avg
ower .... ac

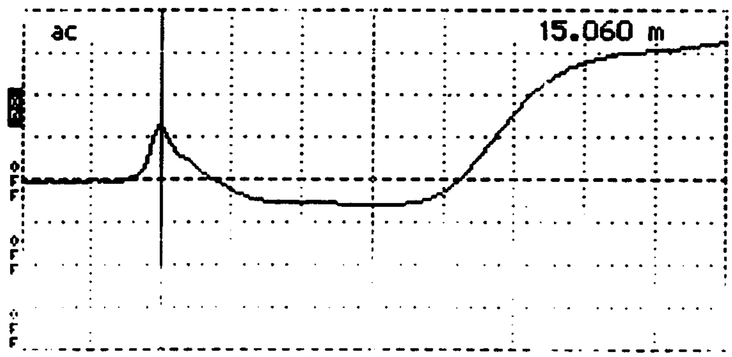


Tektronix 1502B TDR
Date 9-29-95
Cable 10A08
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

Cursor .... 15.060 m
istance/Div..... .25 m/div
ertical Scale.... 217 mρ/div
VP 0.99
oise Filter...... 1 avg
ower .... ac

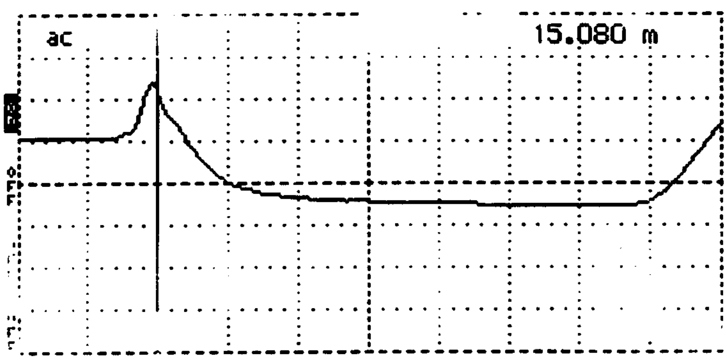


Tektronix 1502B TDR
Date 9-29-95
Cable 10A08
Notes alcohol 25.9

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.080 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A08
Notes water 23.3

Input Trace
Stored Trace
Difference Trace

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

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0102]

Probe Serial Number: 10A09 **Date (dd/mm/yy):** 29/09/95

Probe Number 09

Trace 1 - Probe Shorted at Start

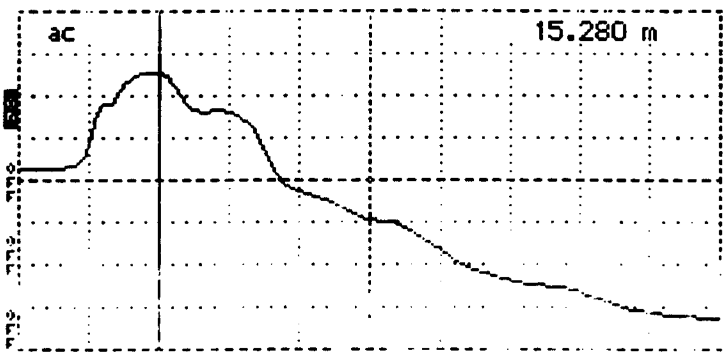
Cursor .... 15.090 m
Distance/Div..... .25 m/div
Vertical Scale.... 217 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

Tektronix 1502B TDR
Date 9-29-95
Cable 10A09
Notes shorted

Input Trace
Stored Trace
Difference Trace

Trace 2 - Probe Shorted at End

Cursor .... 15.280 m
Distance/Div..... .25 m/div
Vertical Scale.... 211 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A09
Notes Short-end

Input Trace
Stored Trace
Difference Trace

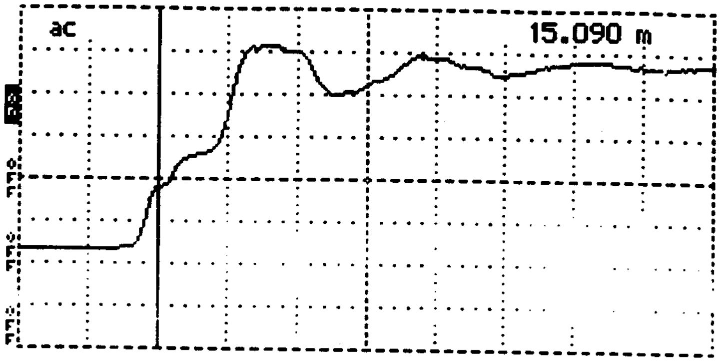
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: LTPP Section ID:	[10] [. 1 0 4]

Probe Number 21

Trace 3 - Probe in Air

sor .... 15.090 m
tance/Div ..... .25 m/div
tical Scale .... 217 mρ/div
.... 0.99
e Filter ...... 1 avg
wer .... ac

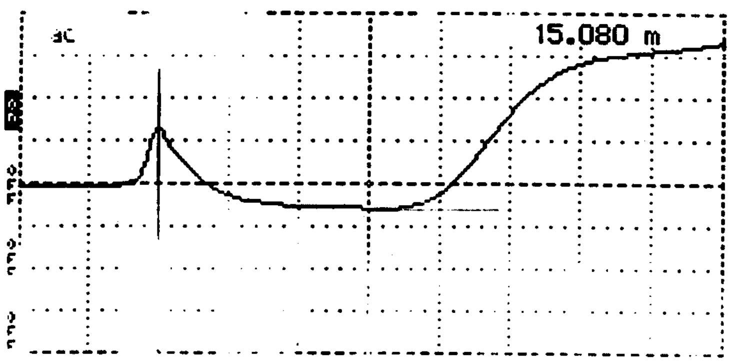


Tektronix 1502B TDR
Date 9-29-95
Cable 10A09
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

ursor .... 15.0 m
stance/Div ..... .25 m/div
rtical Scale .... 217 mρ/div
.... 0.99
ise Filter ...... 1 avg
wer .... ac

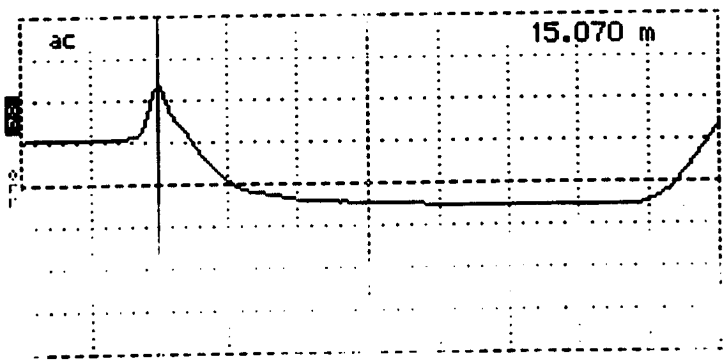


Tektronix 1502B TDR
Date 9-29-95
Cable 10A09
Notes alcohol 25

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

Cursor .... 15.070 m
Distance/Div ..... .25 m/div
Vertical Scale .... 217 mρ/div
VP 0.99
Noise Filter ...... 1 avg



Tektronix 1502B TDR
Date 9-29-95
Cable 10A09
Notes water 21

Input Trace
Stored Trace
Difference Trace

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

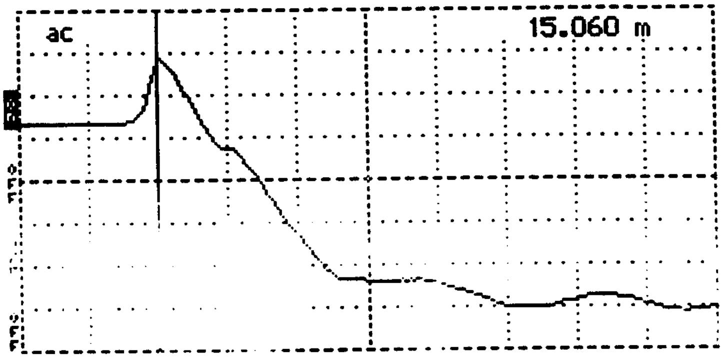
LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: [10] LTPP Section ID: [0101]

Probe Serial Number: 10A10 **Date (dd/mm/yy):** 29/09/95

Probe Number 10

Trace 1 - Probe Shorted at Start

rsor .... 15.060 m
istance/Div ..... .25 m/div
ertical Scale.... 217 mρ/div
.... 0.99
.ise Filter...... 1 avg
'ower........... ac

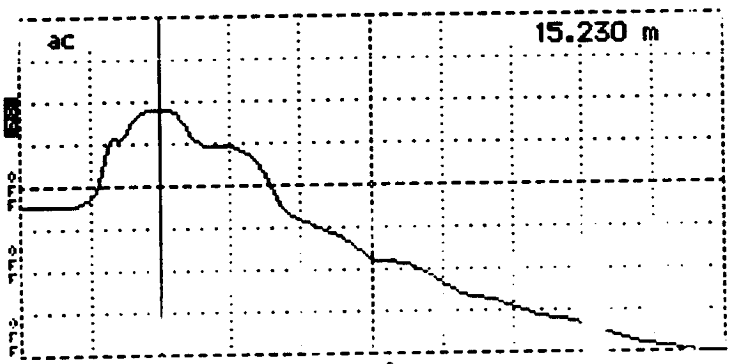


Tektronix 1502B TDR
Date 9-29-95
Cable 10A10
Notes Short

Inp t Trace
Stc ed Trace
Dif rence Trace

Trace 2 - Probe Shorted at End

rsor .... 15.230 m
stance/Div ..... .25 m/div
'ertical Scale.... 211 mρ/div
'' 0.99
)ise Filter...... 1 avg
'ower........... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A10
Notes Short end

Input Trace
Stored Trace
Difference Trace

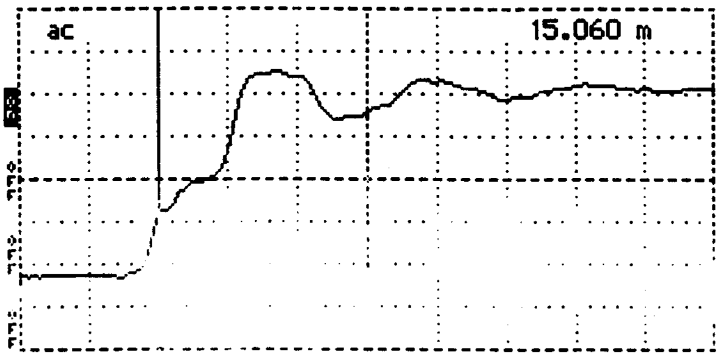
Figure B-1(cont.). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program TDR Probe Calibration	Agency Code: LTPP Section ID:	[10] [0104]

Probe Number 10

Trace 3 - Probe in Air

rsor .... 15.060 m
stance/Div ..... .25 m/div
ertical Scale .... 217 mρ/div
 .... 0.99
ise Filter ...... 1 avg
ower .... ac

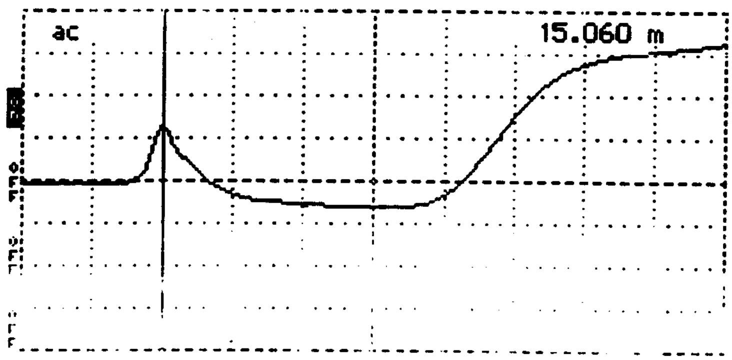


Tektronix 1502B TDR
Date 9-29-95
Cable 10A10
Notes air

Input Trace
Stored Trace
Difference Trace

Trace 4 - Probe in Alcohol

sor .... 15.060 m
ance/Div ..... .25 m/div
tical Scale .... 217 mρ/div
 .... 0.99
e Filter ...... 1 avg
er .... ac

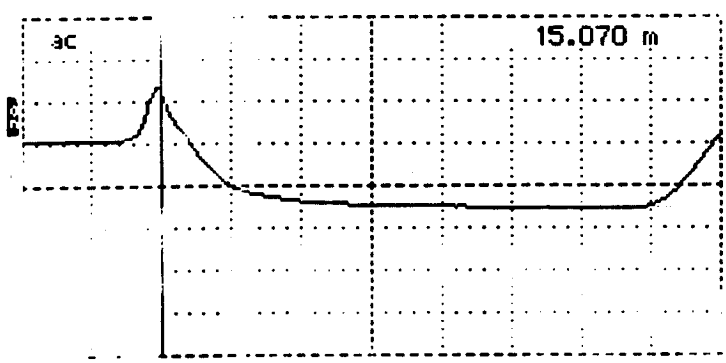


Tektronix 1502B TDR
Date 9-29-95
Cable 10A10
Notes alcohol 25

Input Trace
Stored Trace
Difference Trace

Trace 5 - Probe in Water

ur or .... 15.070 m
istance/Div ..... .25 m/div
Vertical Scale .... 217 mρ/div
 .... 0.99
ise Filter ...... 1 avg
 .... ac



Tektronix 1502B TDR
Date 9-29-95
Cable 10A10
Notes water 23.1°

Input Trace
Stored Trace
Difference Trace

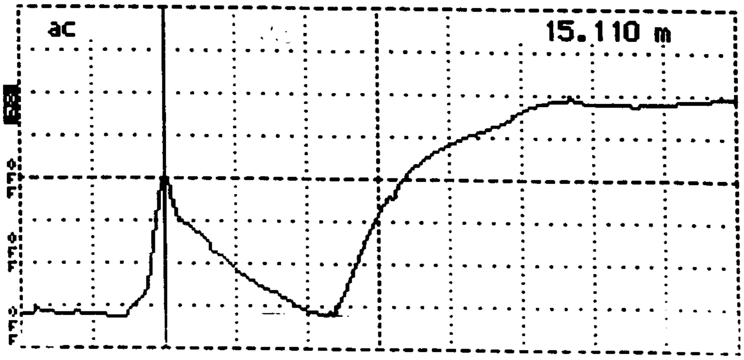
Figure B-1(cont.). TDR Traces Obtained During Calibration

APPENDIX C

Supporting Instrumentation Installation Information

Appendix C contains the following supporting information:

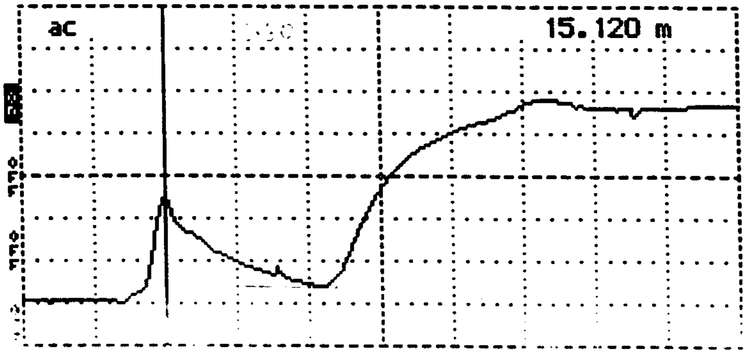
· .... 15.110 m
ıce/Div..... .25 m/div
cal Scale.... 96.9 mρ/div
.... 0.99
Filter...... 1 avg
·.......... ac



Tektronix 1502B TDR
Date 10/04/95 13:2
Cable 10A 01
Notes @ INSTALLATI
SITE 100102

Input Trace
Stored Trace
Difference Trace

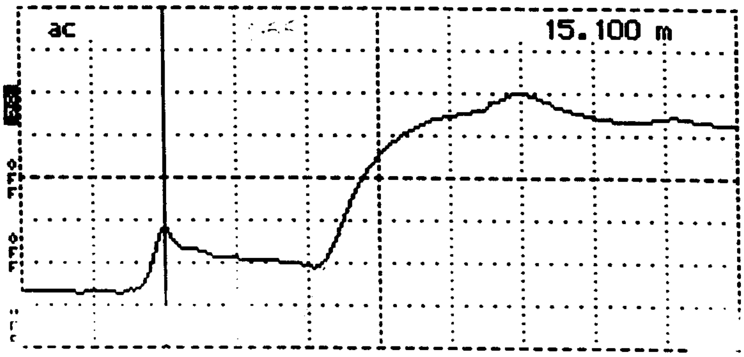
r .... 15.120 m
ce/Div..... .25 m/div
al Scale.... 129 mρ/div
.... 0.99
Filter...... 1 avg
.... ac



Tektronix 1502B TDR
Date 10/04/95 13:05
Cable 10A 02
Notes @ INSTALLATI
SITE 100102

Input Trace
Stored Trace
Difference Trace

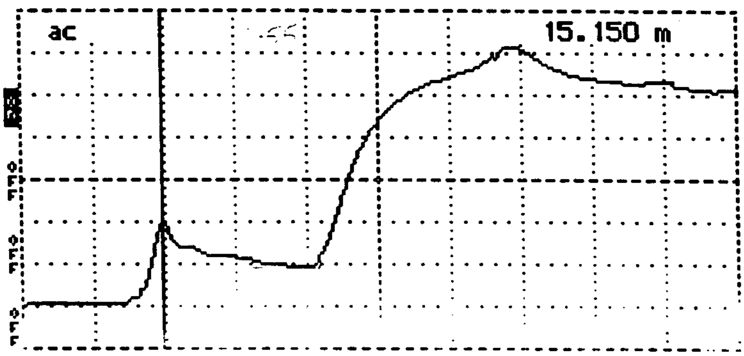
r .... 15.100 m
nce/Div..... .25 m/div
ical Scale.... 205 mρ/div
.... 0.99
Filter...... 1 avg
er.......... ac



Tektronix 1502B TDR
Date 10/04/95 12:
Cable 10A 03
Notes @ INSTALLATION
SITE 100102

Input Trace
Stored Trace
Difference Trace

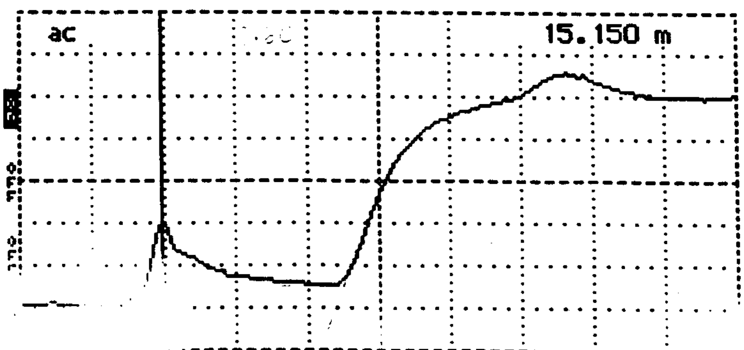
or .... 15.150 m
ıce/Div..... .25 m/div
al Scale.... 163 mρ/div
.... 0.99
Filter...... 1 avg
·.......... ac



Tektronix 1502B TDR
Date 10/04/95 12:
Cable 10A 04
Notes @ INSTALLATIO
SITE 100102

Input Trace
Stored Trace
Difference Trace

· .... 15.150 m
nce/Div..... .25 m/div
al Scale.... 163 mρ/div
.... 0.99
Filter...... 1 avg
r.......... ac

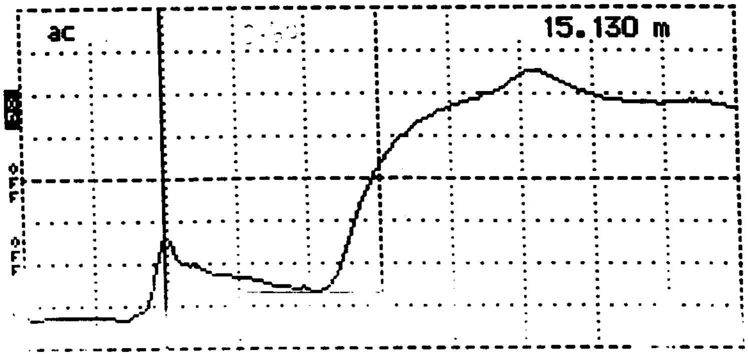


Tektronix 1502B TDR
Date 10/04/95 12:15
Cable 10A 05
Notes @ INSTALLATIO
SITE 100102

Input Trace
Stored Trace
Difference Trace

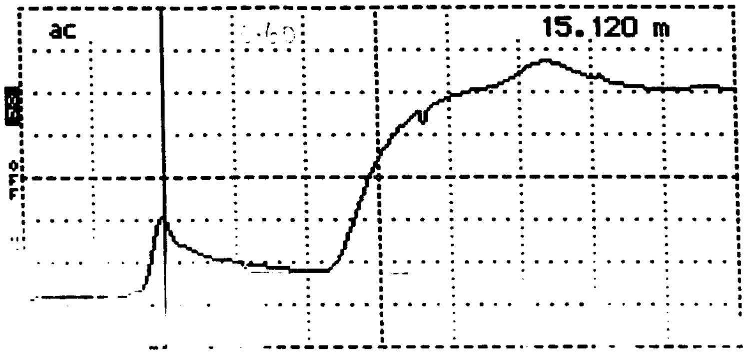
Figure C-1. TDR Traces Measured Manually During Installation

sor .... 15.130 m
tance/Div..... .25 m/div
tical Scale.... 163 mρ/div
.... 0.99
ise Filter...... 1 avg
rer........... ac



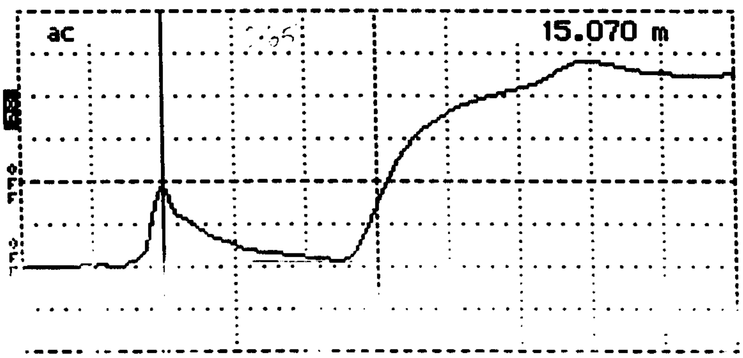
Tektronix 1502B TDR
Date 10/04/95 12:
Cable 10A 06
Notes @ INSTALLATIO
SITE 100102
Input Trace
Stored Trace
Difference Trace

sor .... 15.120 m
ance/Div..... .25 m/div
tical Scale.... 163 mρ/div
.... 0.99
se Filter...... 1 avg
wer........... ac



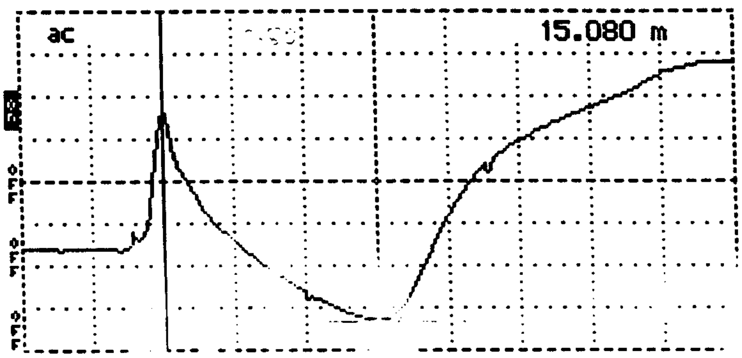
Tektronix 1502B TDR
Date 10/04/95 12:
Cable 10A 07
Notes @ INSTALLATION
SITE 100102
Input Trace
Stored Trace
Difference Trace

sor .... 15.070 m
tance/Div..... .25 m/div
tical Scale.... 163 mρ/div
.... 0.99
ise Filter...... 1 avg
rer........... ac



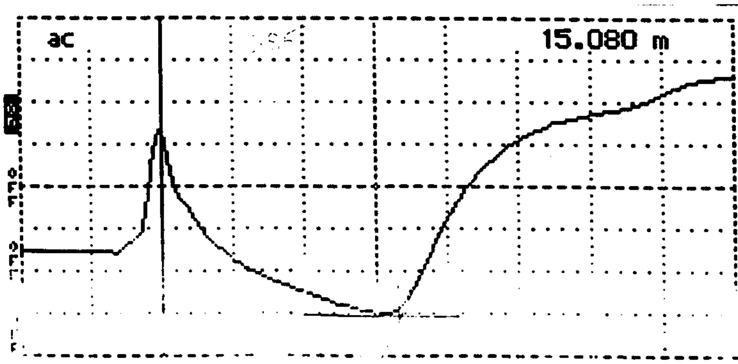
Tektronix 1502B TDR
Date 10/04/95 12
Cable 10A 08
Notes
@ INSTALLATION
SITE 100102
Input Trace
Stored Trace
Difference Trace

sor .... 15.080 m
ance/Div..... .25 m/div
rtical Scale.... 94.1 mρ/div
.... 0.99
se Filter...... 1 avg
wer........... ac



Tektronix 1502B TDR
Date 10/04/95 1145
Cable 10A 09
Notes @ INSTALLATI
SITE 100102
Input Trace
Stored Trace
Difference Trace

sor .... 15.080 m
stance/Div..... .25 m/div
tical Scale.... 103 mρ/div
.... 0.99
ise Filter...... 1 avg
wer........... ac



Tektronix 1502B TDR
Date 10-4-95
Cable 10A10
Notes 1132
@ installation
SITE 100102
Input Trace
Stored Trace
Difference Trace

Figure C-1(cont.). TDR Traces Measured Manually During Installation

Table C-1. TDR Moisture Content

TDR No.	Depth (m)	TDR Length (m)	Dielectric Constant (ε)	Volumetric Moisture Content (%)	In-Situ Dry Density (kg/m^3)	Gravimetric Moisture Content (%)
10A01	0.27	0.60	8.74	16.39	2427	6.8
10A02	0.43	0.60	8.74	16.39	2427	6.8
10A03	0.58	0.55	7.34	13.41	1890	7.1
10A04	0.73	0.55	7.34	13.41	1890	7.1
10A05	0.88	0.60	8.74	16.39	1890	8.7
10A06	1.04	0.60	8.74	16.39	1890	8.7
10A07	1.19	0.60	8.74	16.39	1890	8.7
10A08	1.38	0.65	10.25	19.42	1890	10.3
10A09	1.66	0.80	15.53	28.55	1890	15.1
10A10	1.94	0.85	17.53	31.48	1890	16.7

Table C-2. Field Measured Moisture Content

LTPP Seasonal Monitoring Study	State Code	[10]
In-Situ Moisture Tests	Test Section Number	[0102]

Weight (gm)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5
Weight of Pan + Wet Soil					
Weight of Pan + Dry Soil					
Weight of Pan					
Weight of Dry Soil	417.1	367.2	361.9	335.9	321.8
Weight of Wet Soil	437.3	382.6	386.2	360.8	350.0
Weight of Moisture	20.2	15.4	24.3	24.9	28.2
Wt of Moisture/Dry Wt x 100	4.8	4.2	6.7	7.4	8.8

Weight (gm)	Probe 6	Probe 7	Probe 8	Probe 9	Probe 10
Weight of Pan + Wet Soil					
Weight of Pan + Dry Soil					
Weight of Pan					
Weight of Dry Soil	425.9	287.7	342.2	288.2	268.5
Weight of Wet Soil	460.0	312.5	384.3	357.5	300.0
Weight of Moisture	34.1	24.8	42.1	69.3	31.5
Wt of Moisture/Dry Wt x 100	8.0	8.6	12.3	24.0	11.7

Prepared by:	BR	Employer:	DEL DOT
Date (dd/mm/yy):	04/10/95		

Note: Data not available to fill blank fields.

Table C-3. Field Measured Dry Density

LTPP Seasonal Monitoring Program Data Sheet SMP-I07 Representative Dry Density	Agency Code [10] LTPP Section ID [0102]

Depth of Representative Sample (from pavement surface): 0.88 m

Dry Density Determination:

a.	Tare Weight of Empty Mold:	2037g	(4.49 lb)
b.	Weight of Mold and Compacted Soil:	3983 g	(8.78 lb)
c.	Weight of Compacted Soil (b-a):	1946 g	(4.29 lb)
d.	Unit Weight of Compacted Soil = (c/943.0) =		2.06 g/cm^3
	= [c/(1/30)] =		(128.7 lb/ft^3)
e.	Dry Density of Compacted Soil = [d/(1+r/100)] =		1.89 g/cm^3
			(118.3 lb/ft^3)

Moisture Content Determination:

m	Tare Weight of Pan:	g
n.	Weight of Pan and Moisture Sample:	g
o.	Weight of Pan and Dry Sample:	g
p.	Weight of Moisture (n -o):	g
q.	Weight of Dry Sample (o - m):	g
r.	Moisture Content by Weight = [(p/q)*100] =	8.8 %

Prepared by:	BR	Employer:	DEL DOT
Date (dd/mm/yy):	04/10/95		

Note: Data not available to fill blank fields.

APPENDIX D

Initial Data Collection

Appendix D contains the following supporting information:

Table D-1. Sample Data from the Onsite Datalogger During Initial Data Collection, November 19, 1995


```
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6,1995,323,100,8.18,8.08,8.35,8.84,9.33
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6,1995,323,300,7.92,7.89,8.17,8.73,9.26
5,1995,323,400,11.98,5.571,0
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6,1995,323,800,4.859,5.921,6.689,7.97,8.85
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,2323,11.89,2339,12.48,3,13.16,1,13.85,1,14.45,7,15,1,15.7,18,16.25,10,16.75,44
4,1995,323,2400,4.599,759,5.495,831,6.18,902,7.41,951,8.36,1050,9.15,1120,9.75,1241,10.35,1311,11.14,1504,11.7
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Section: 100102

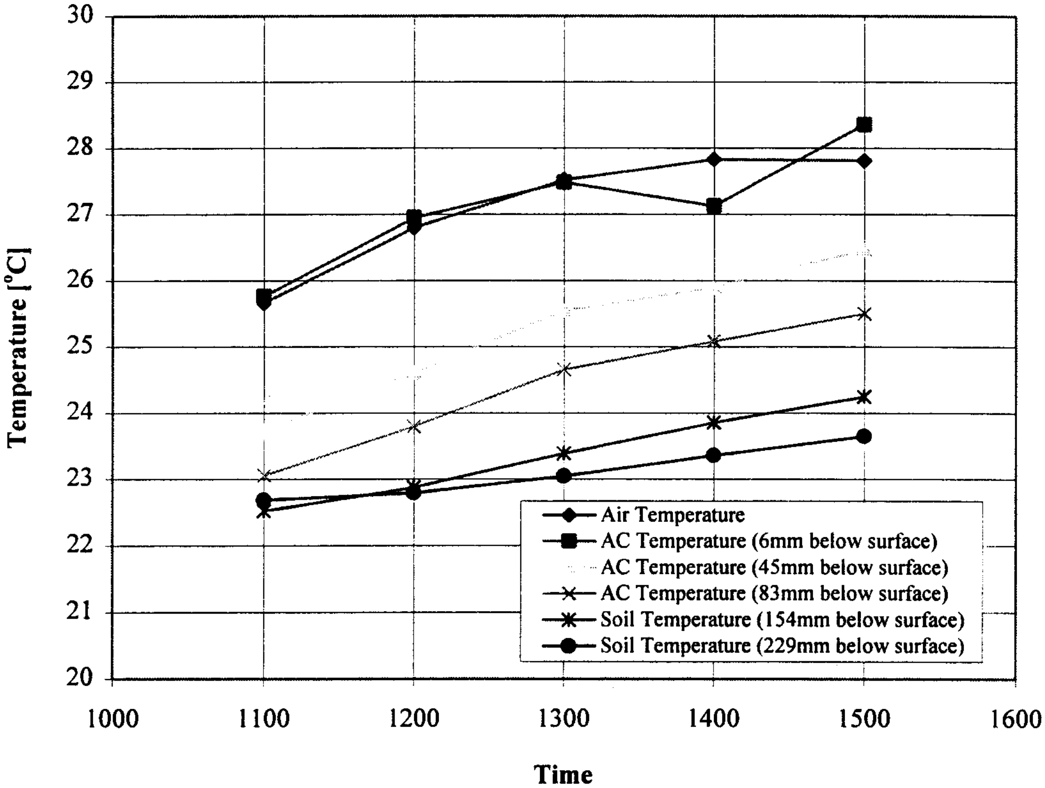

Figure D-1. Air Temperature and First Five Sub-Surface Temperatures From Initial Data Collection, October 05, 1995

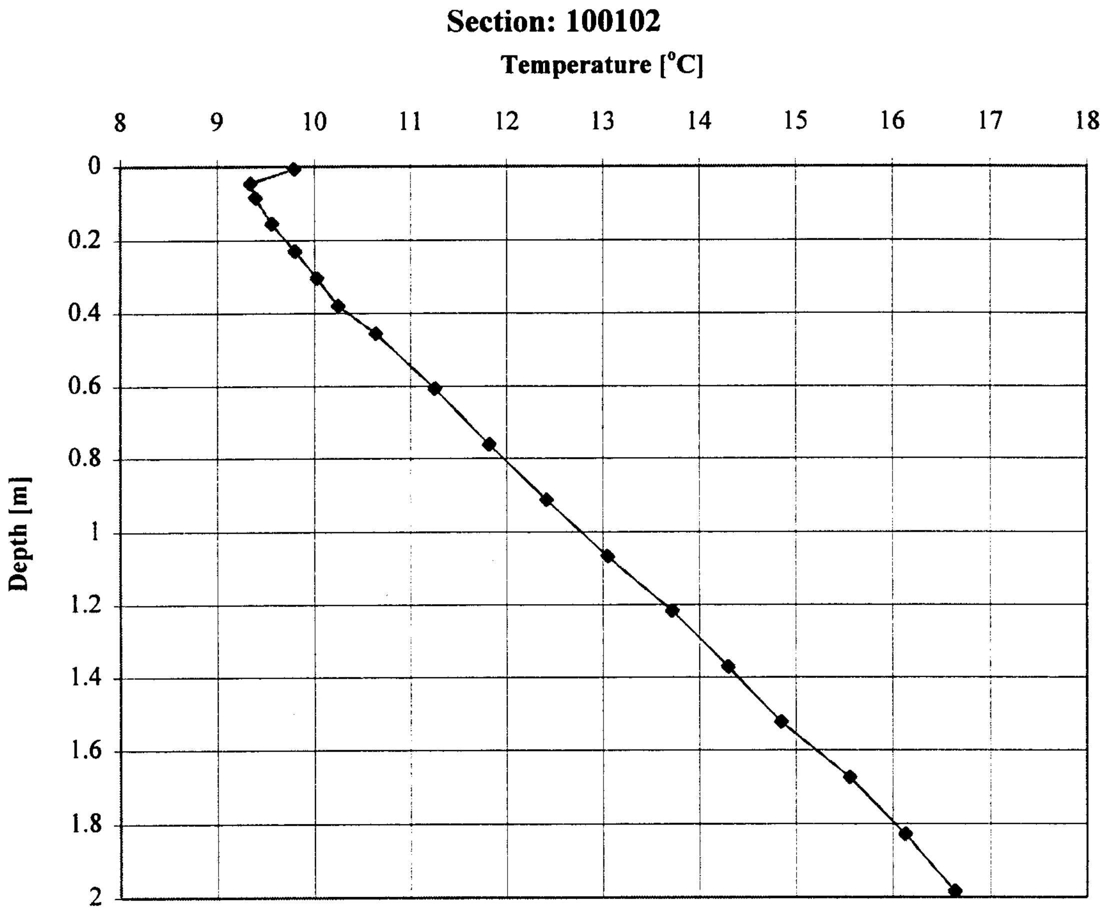

Figure D-2. Average Subsurface Temperature for all 18 Sensors on November 19, 1995

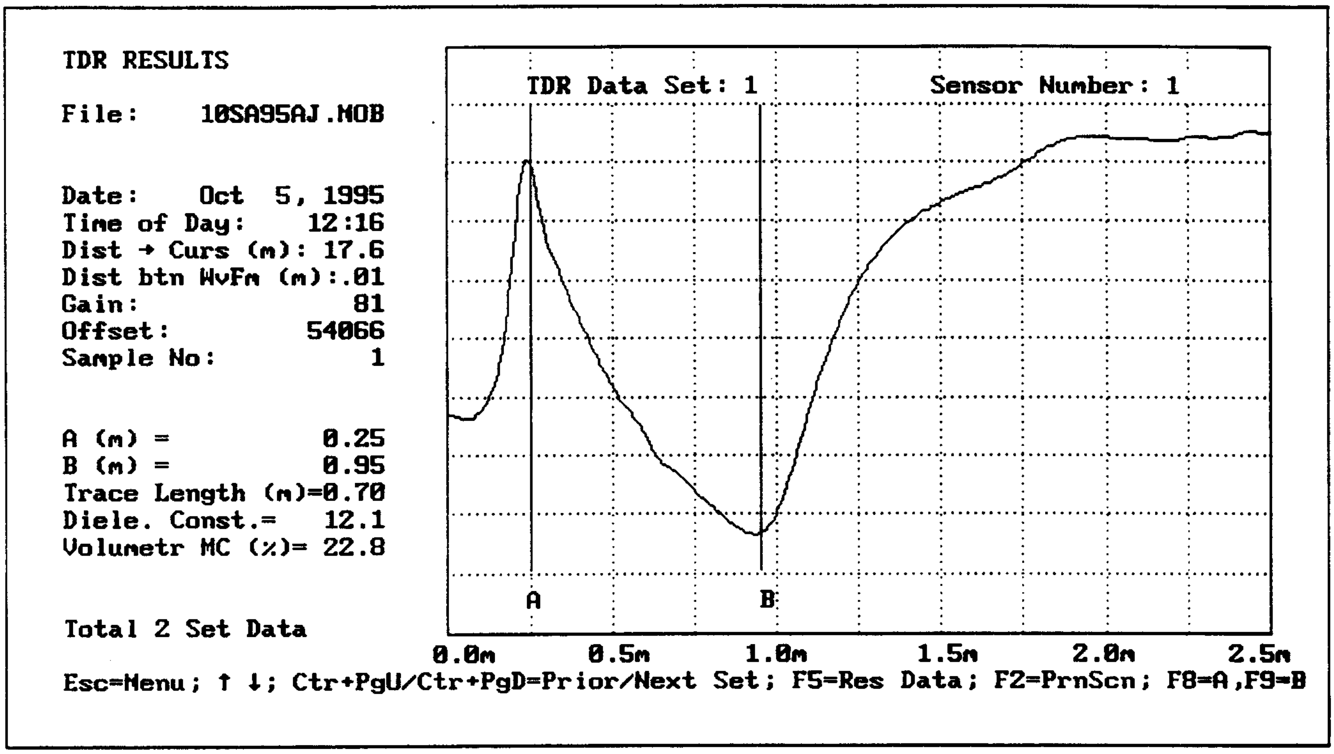

Figure D-3. Initial First Set of TDR Traces Measured with the Mobile Unit

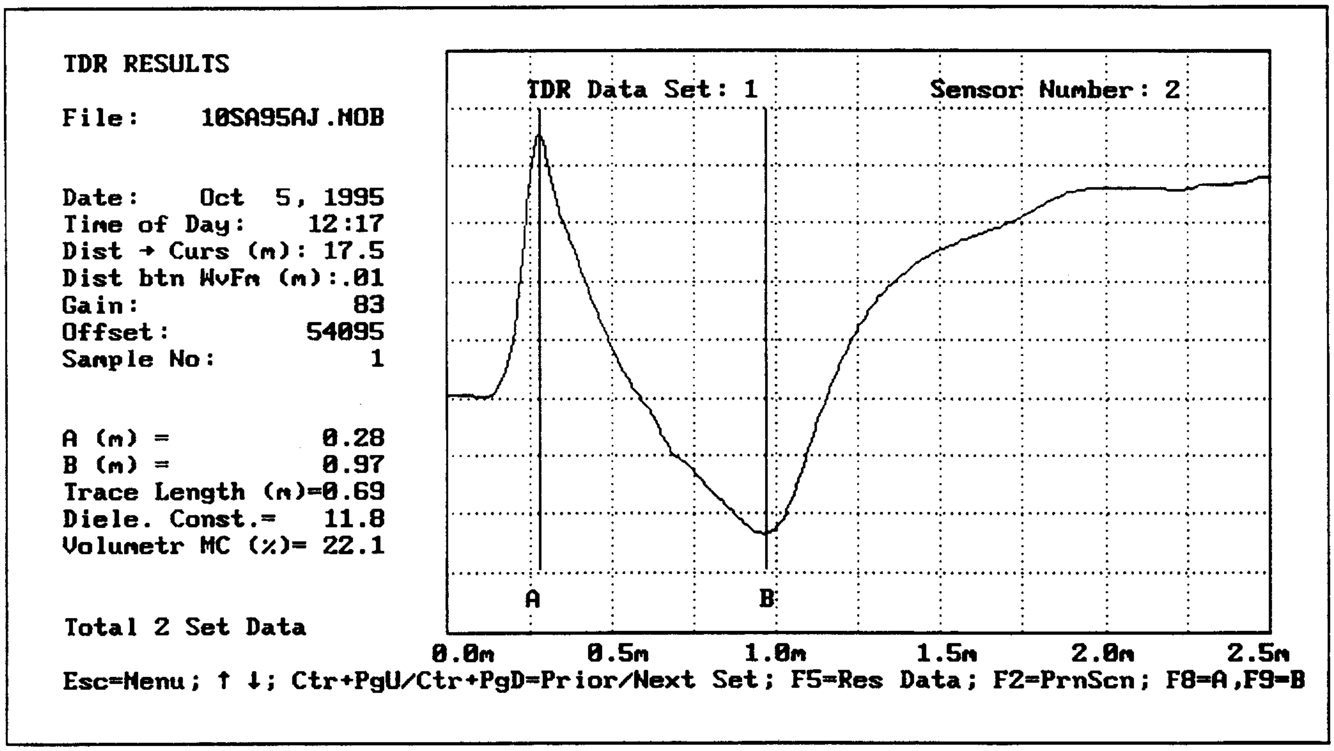

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

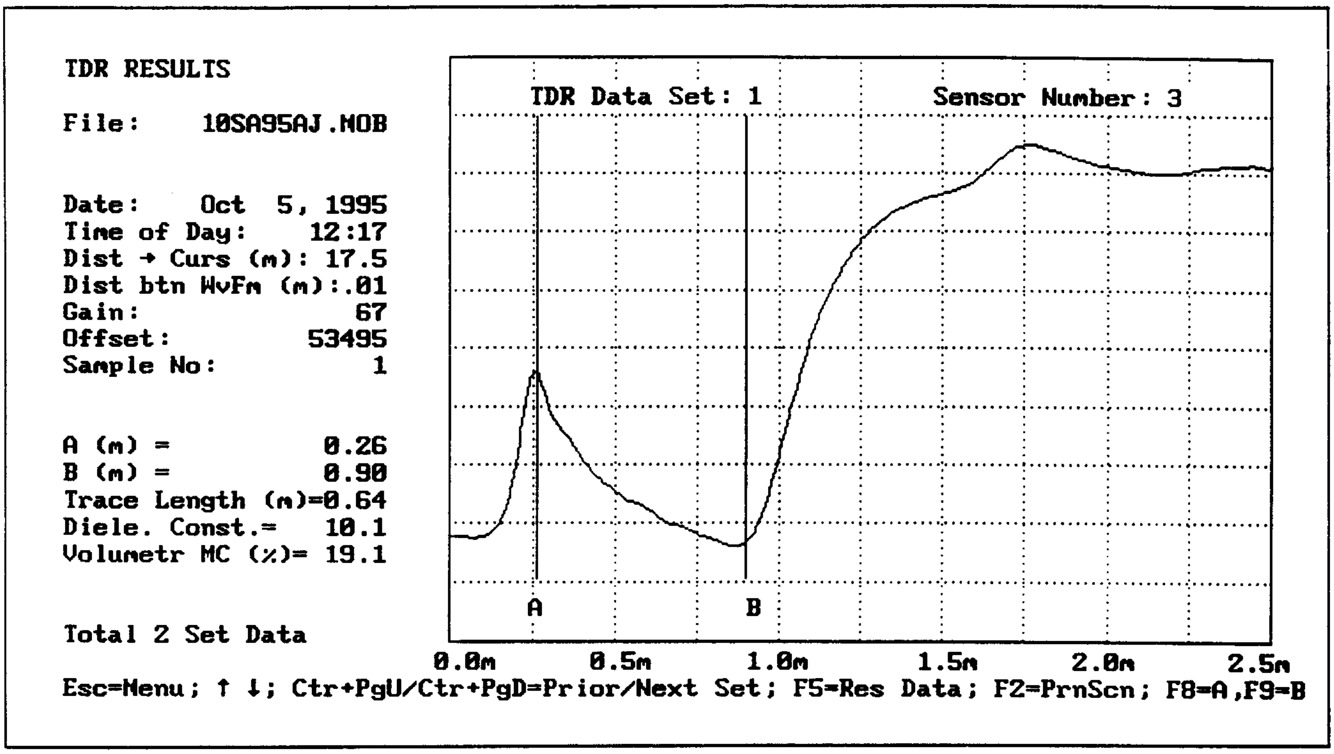

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

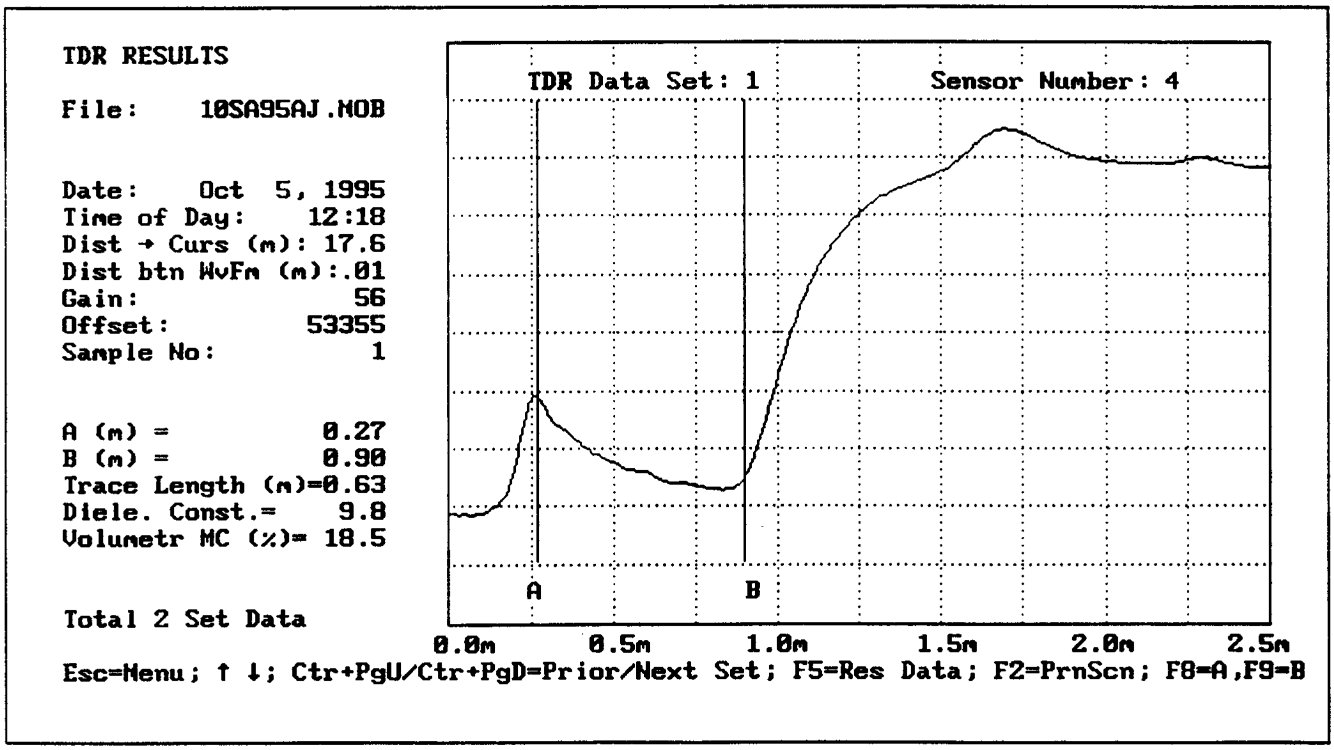

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

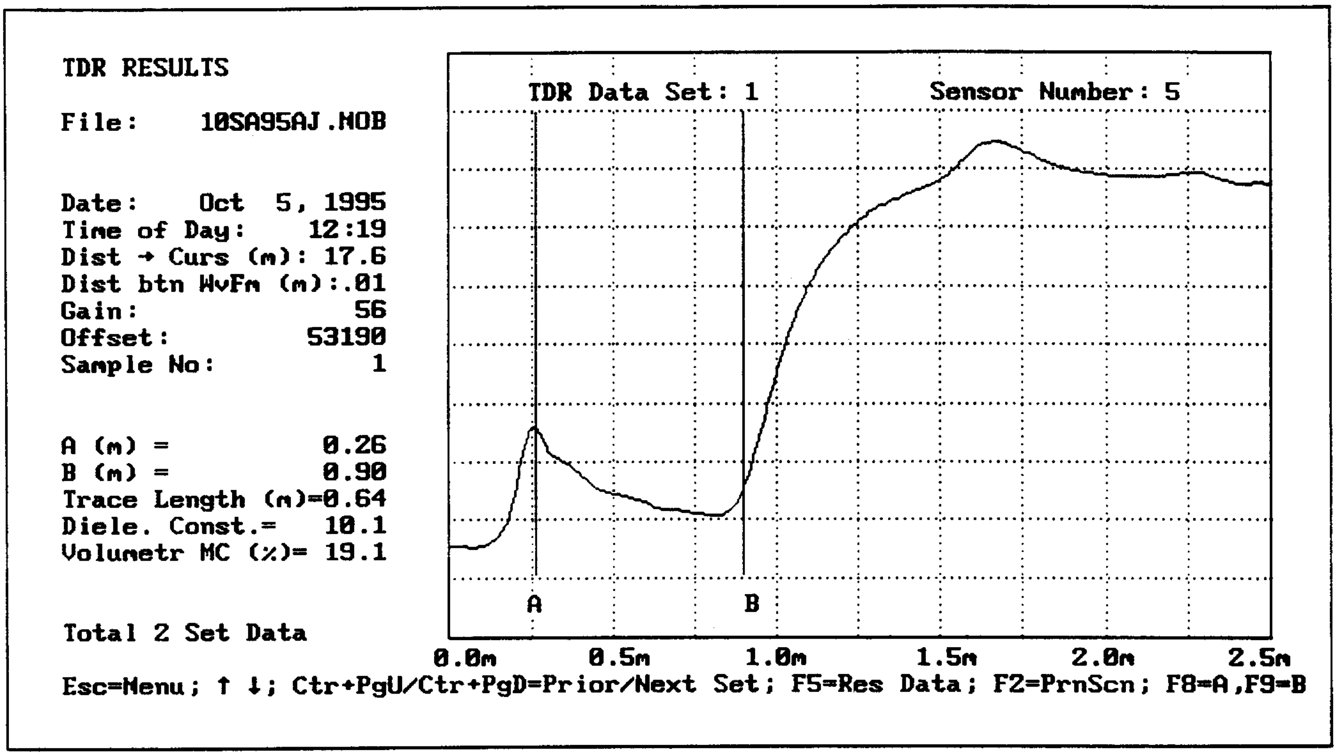

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

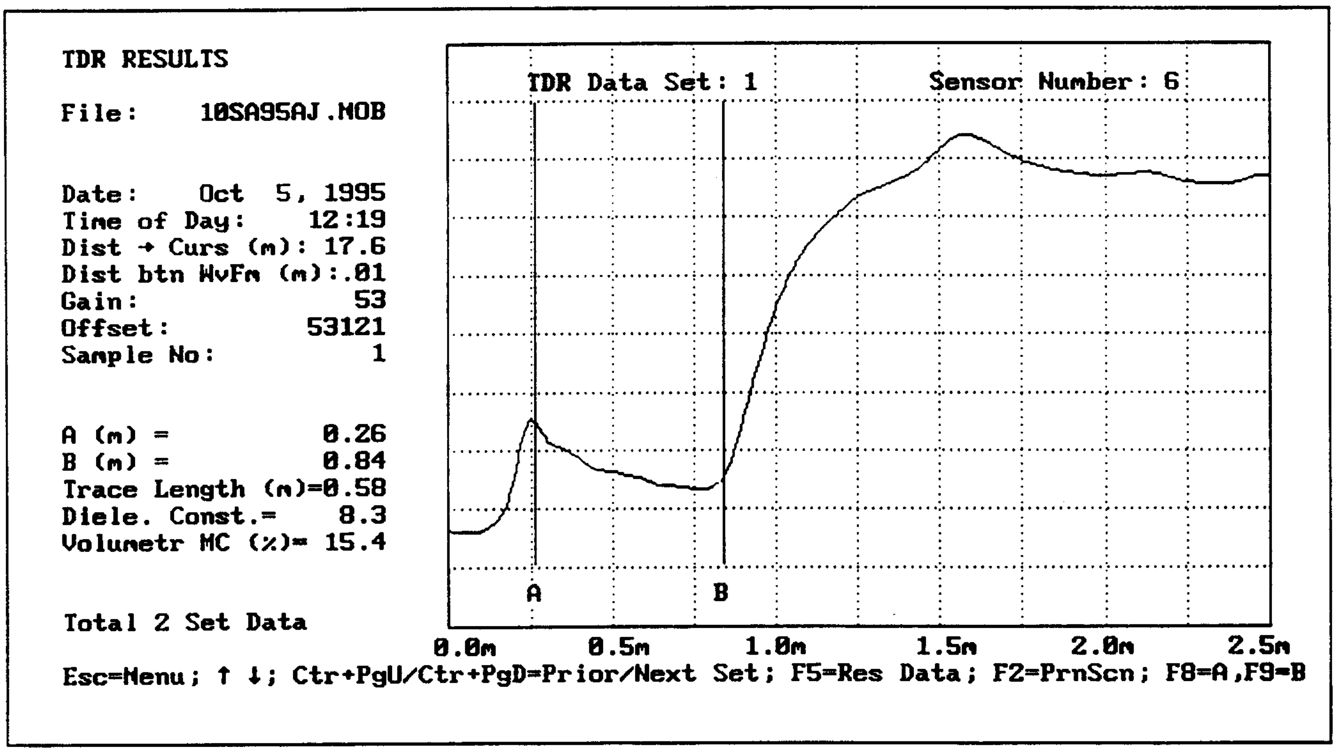

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

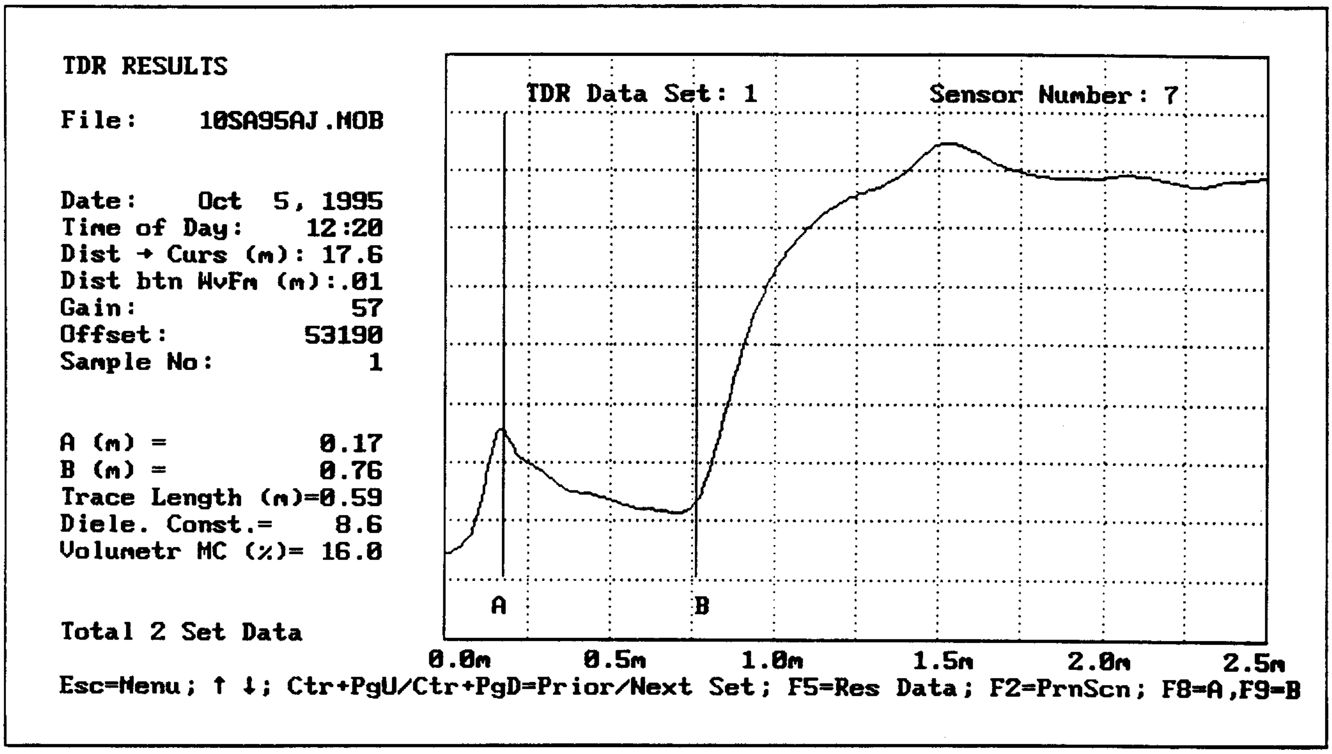

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

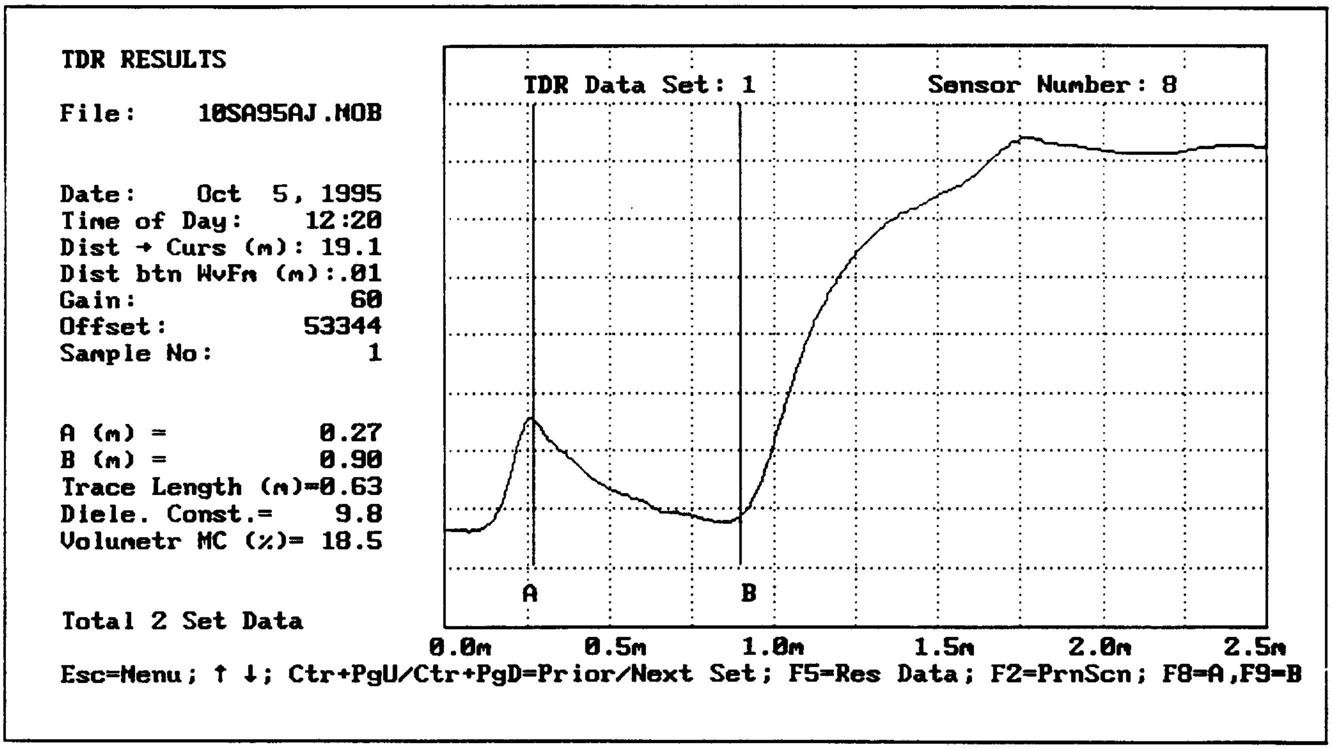

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

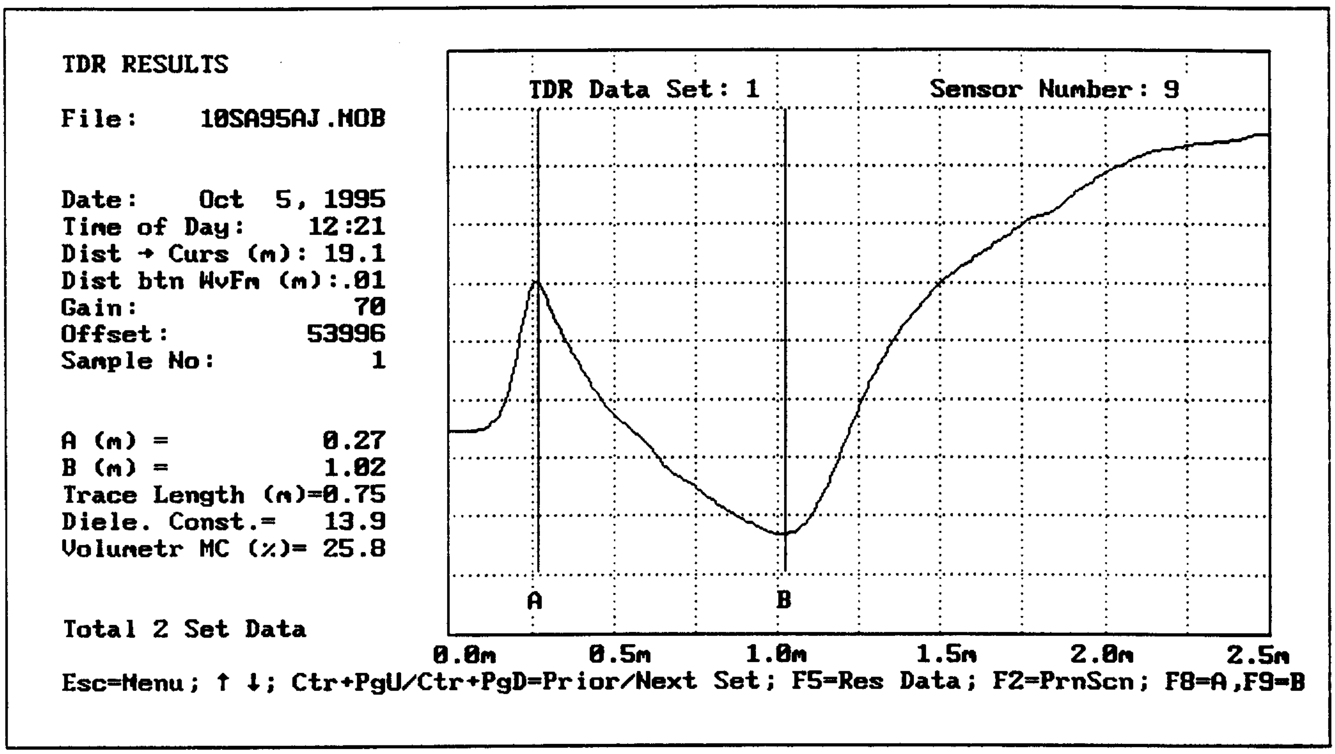

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

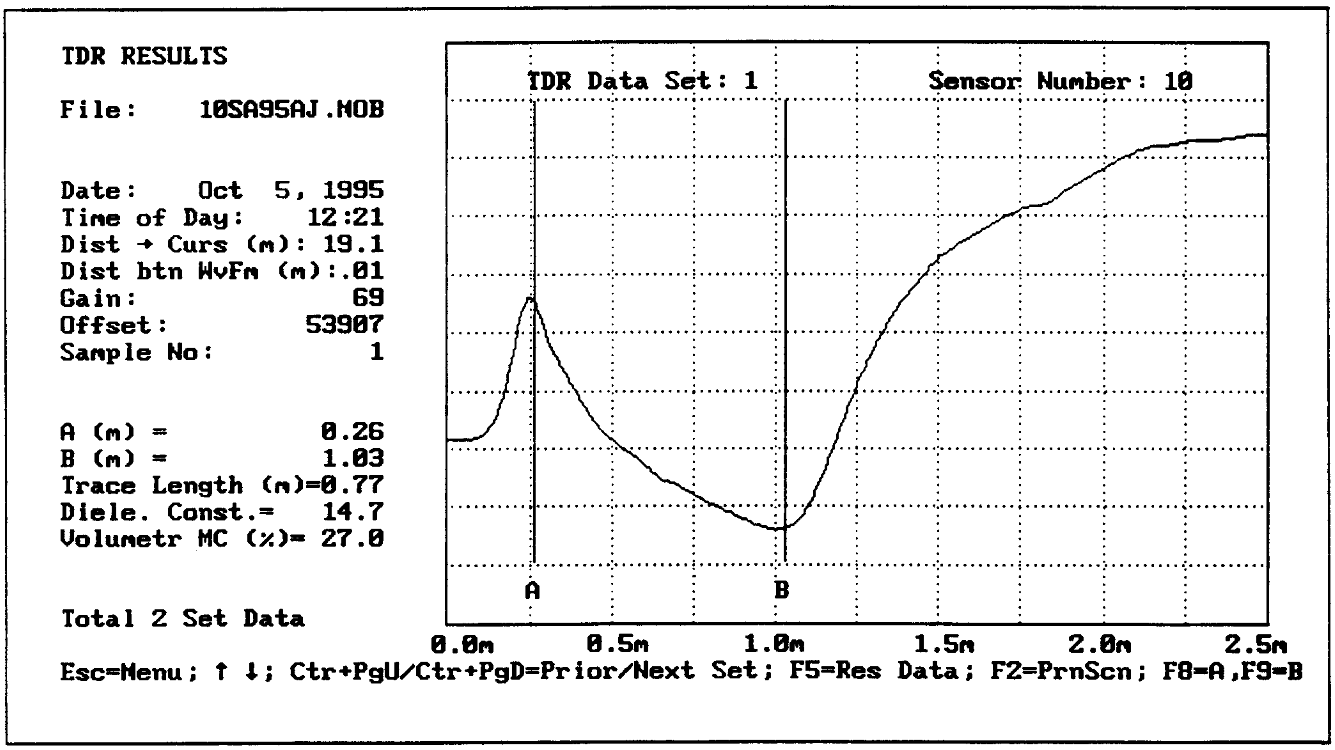

Figure D-3(cont.). Initial First Set of TDR Traces Measured with the Mobile Unit

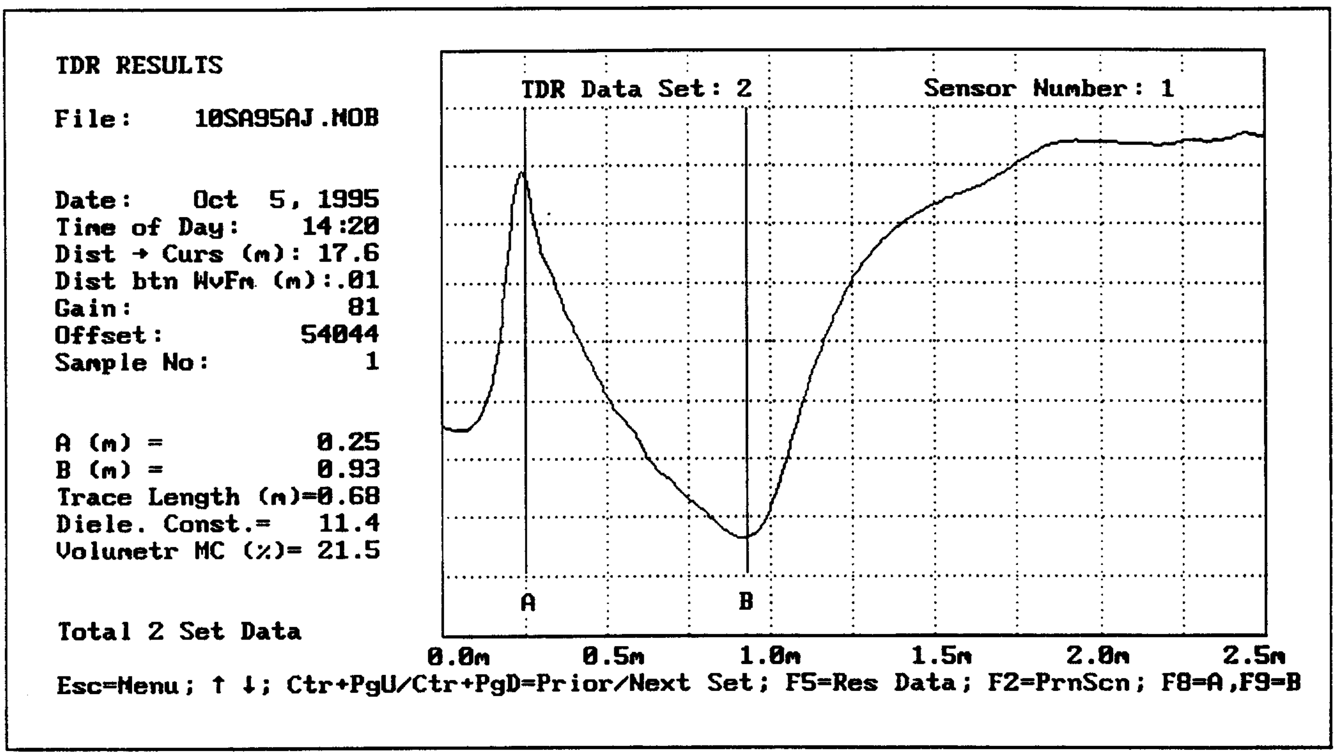

Figure D-3. Initial Second Set of TDR Traces Measured with the Mobile Unit

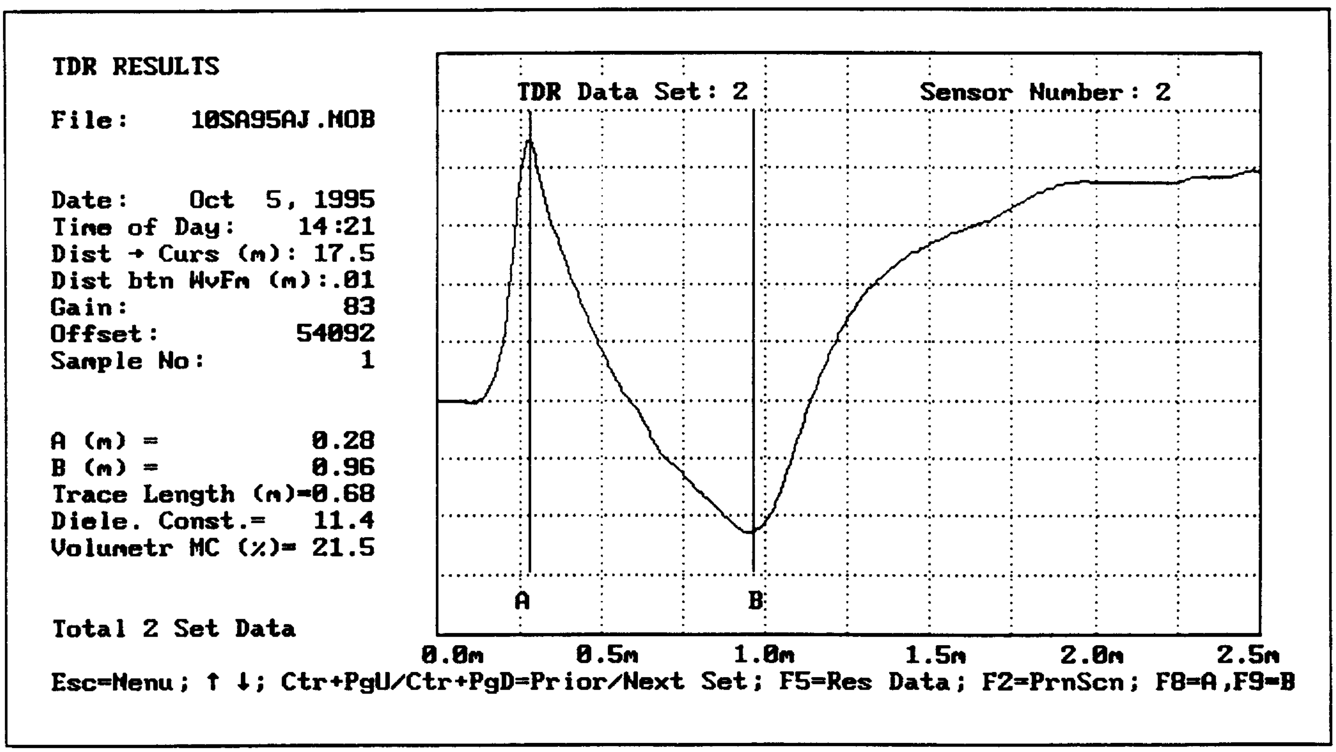

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

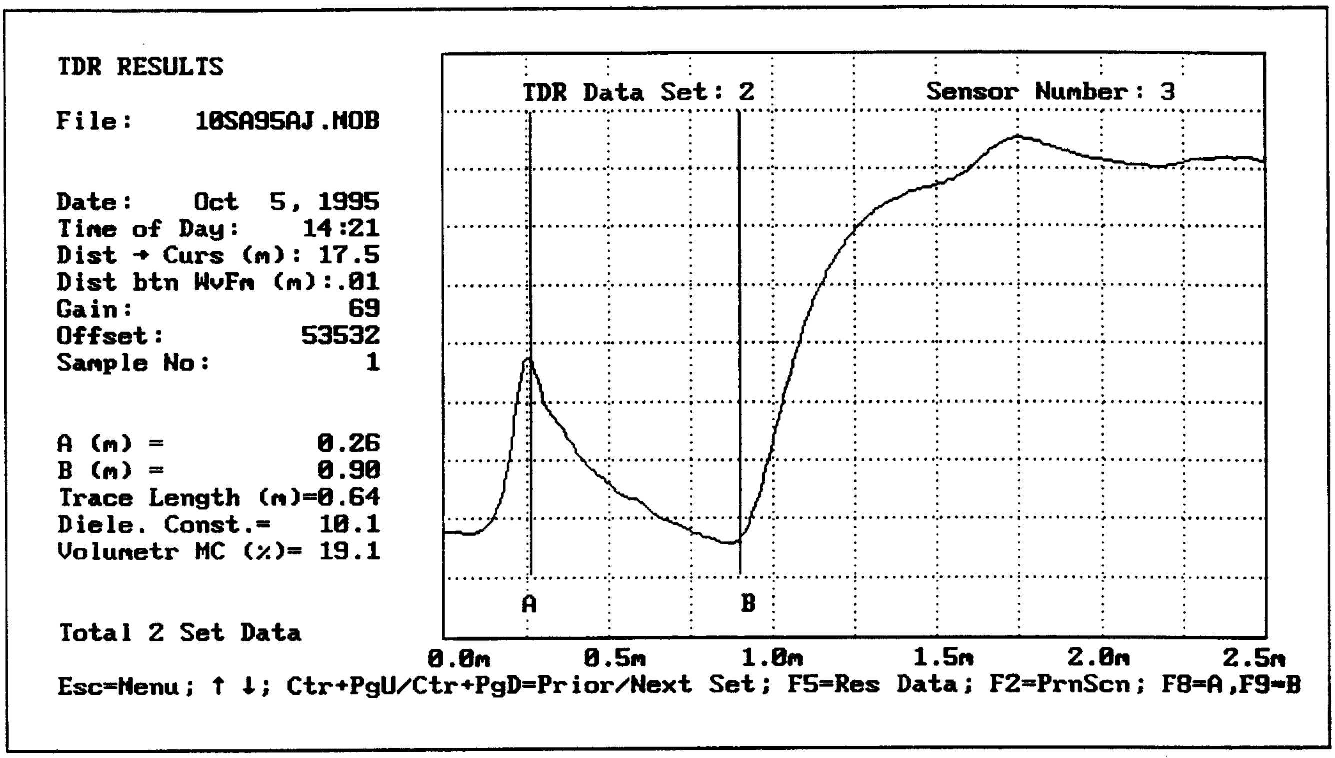

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

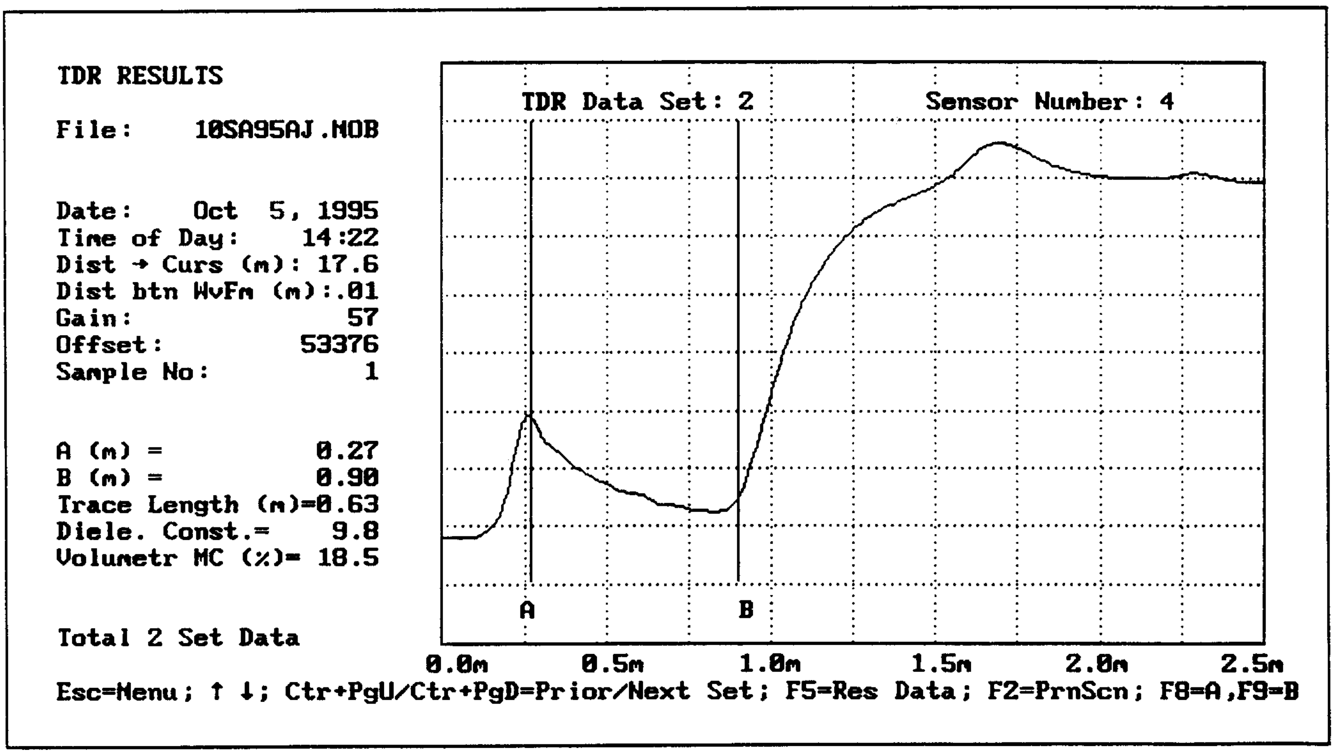

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

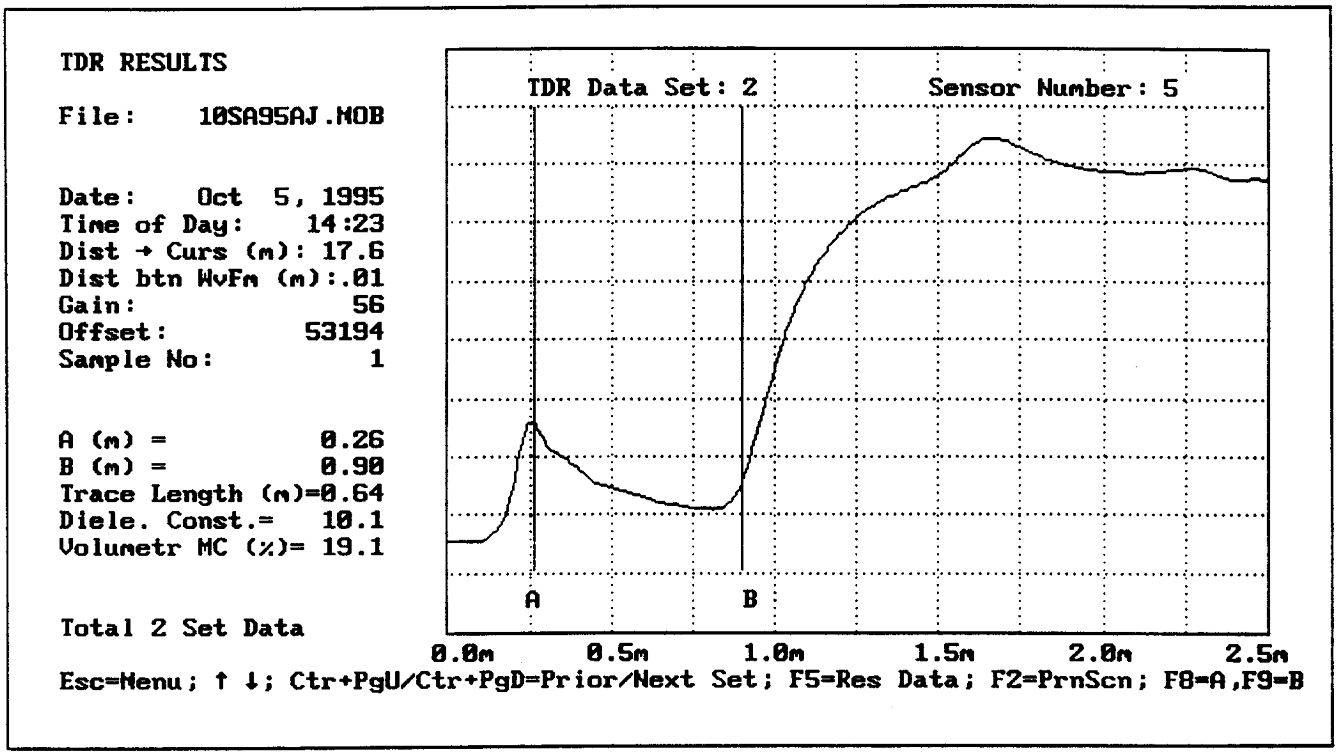

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

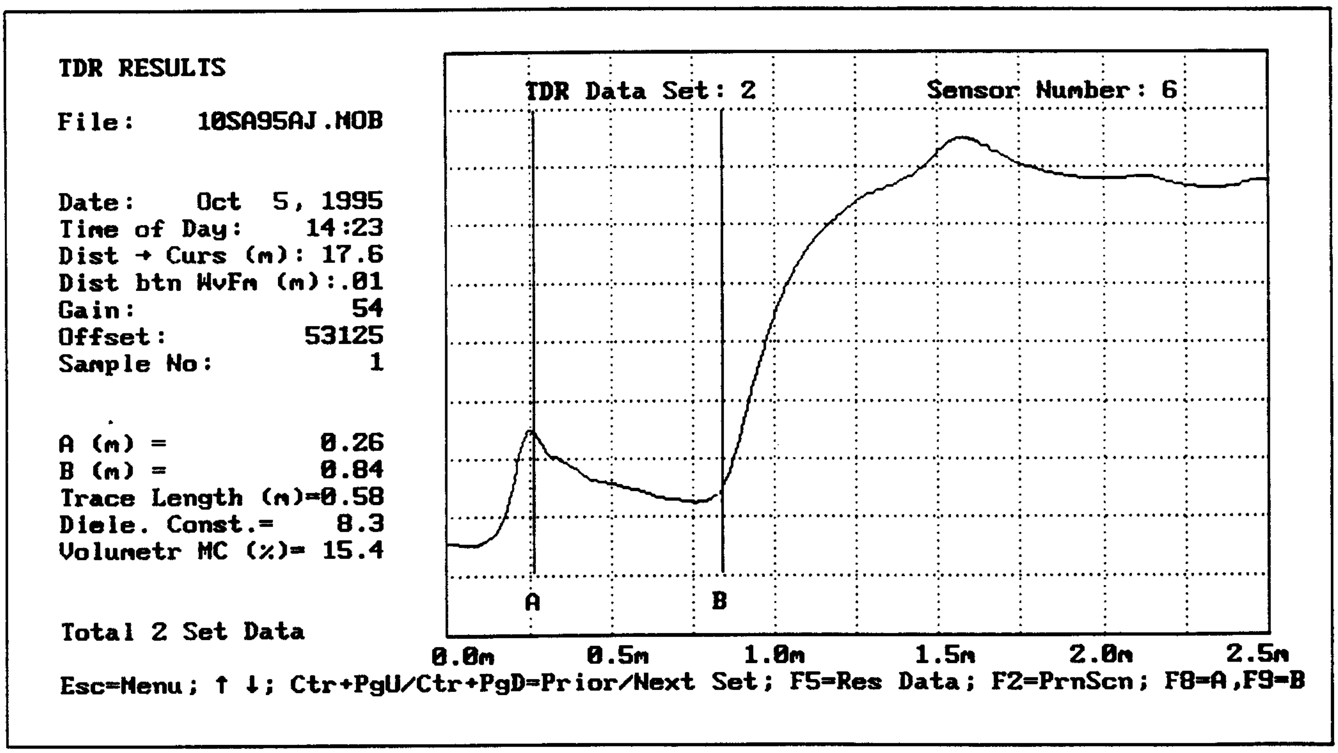

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

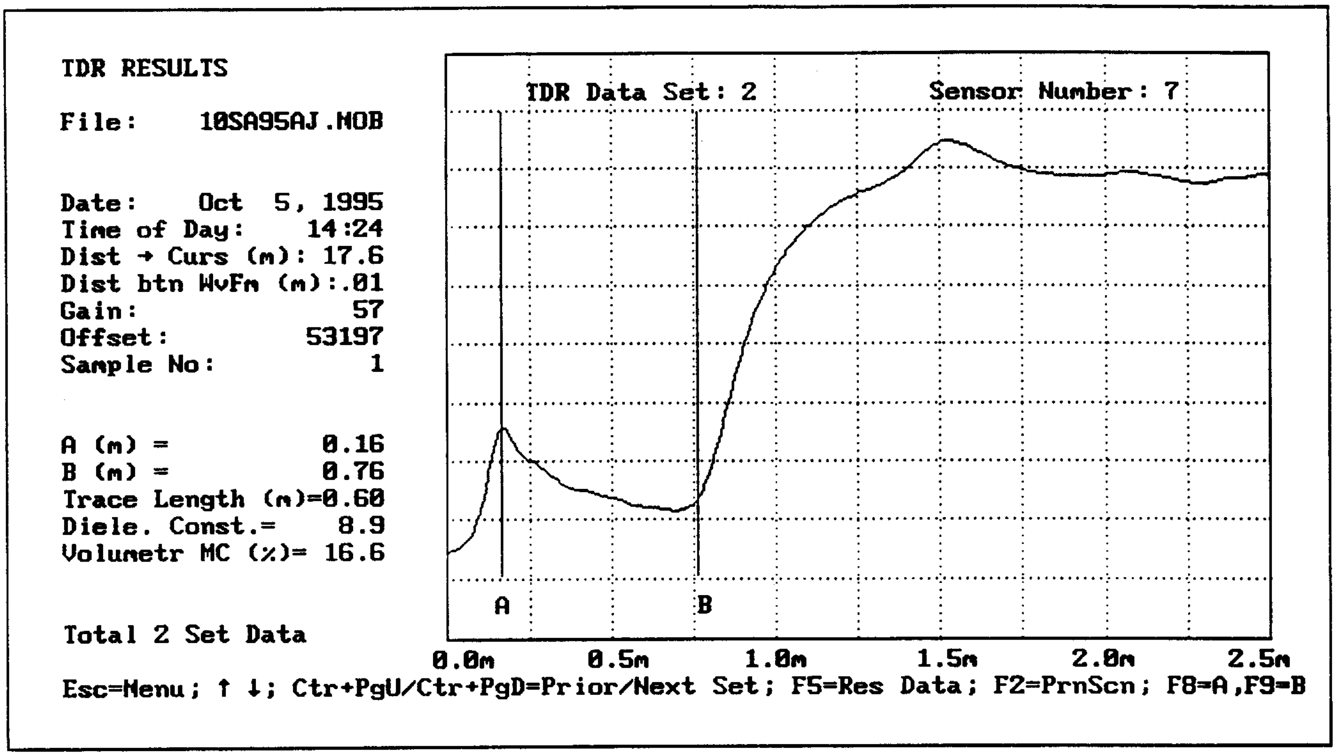

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

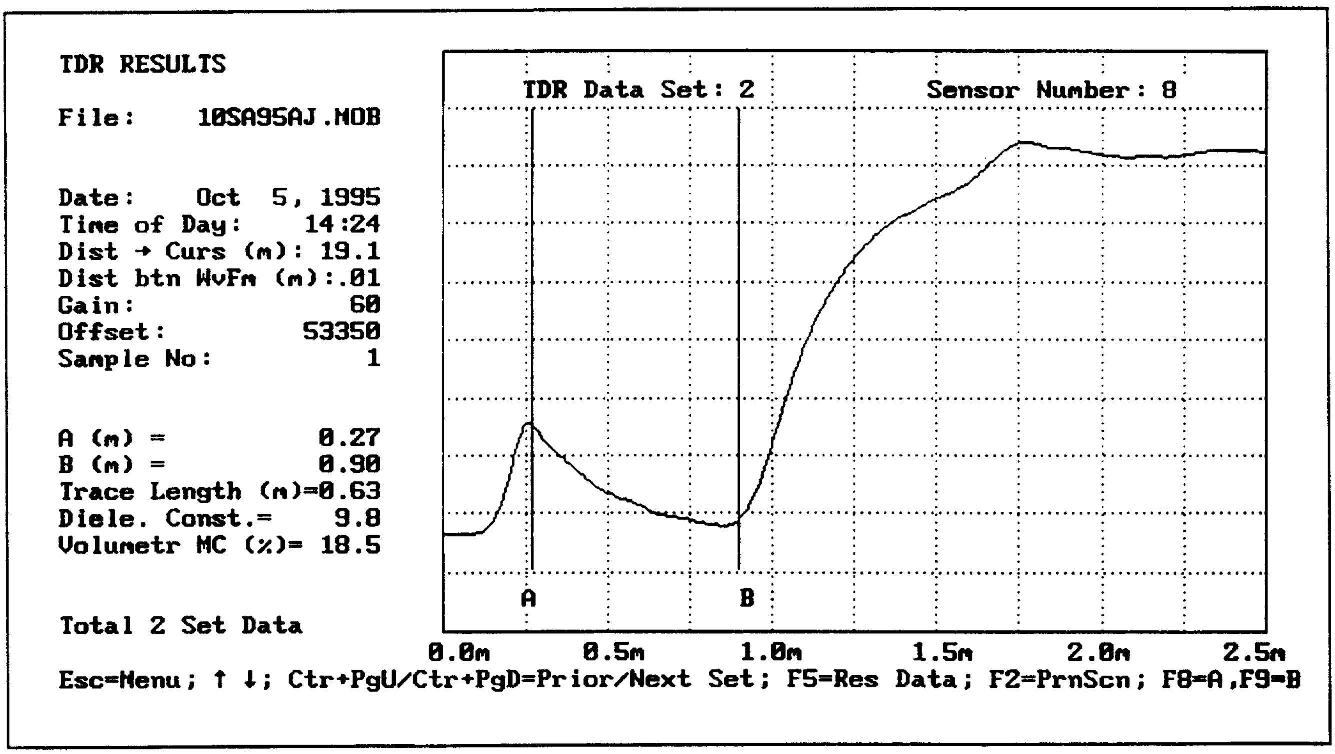

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

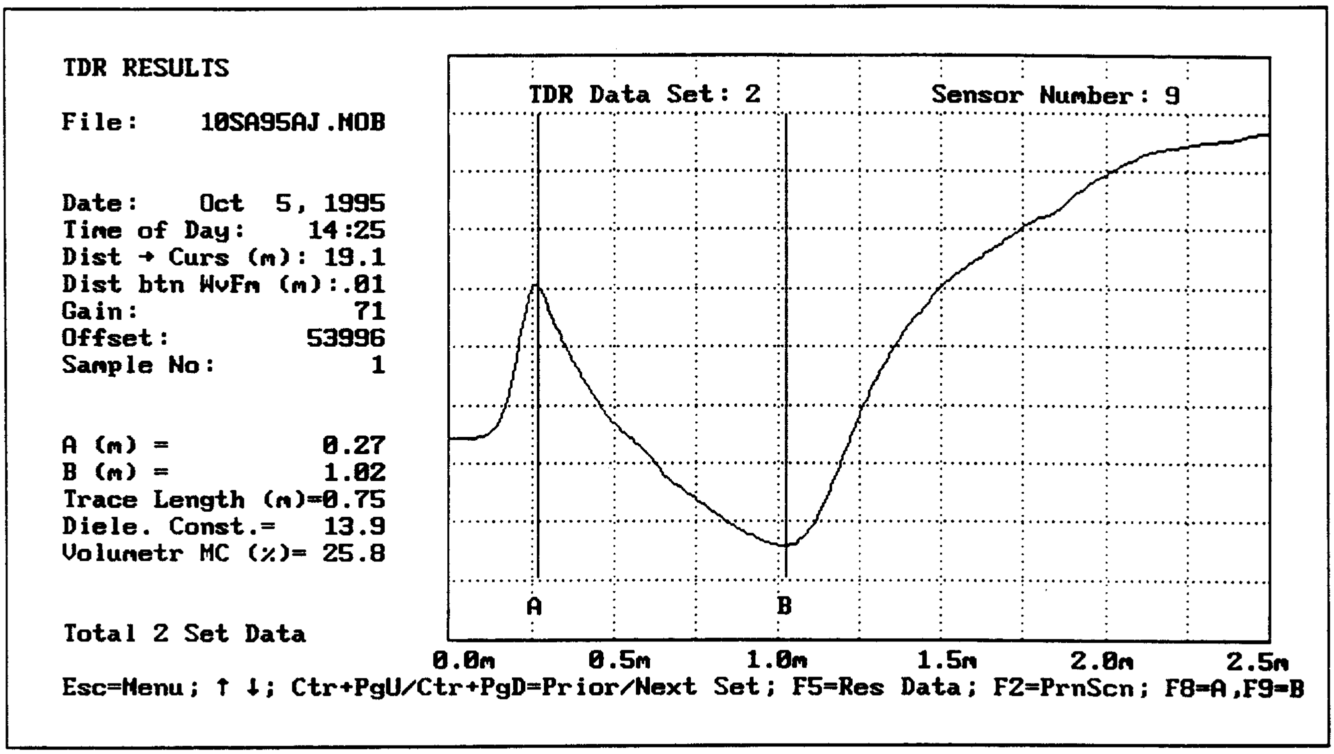

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

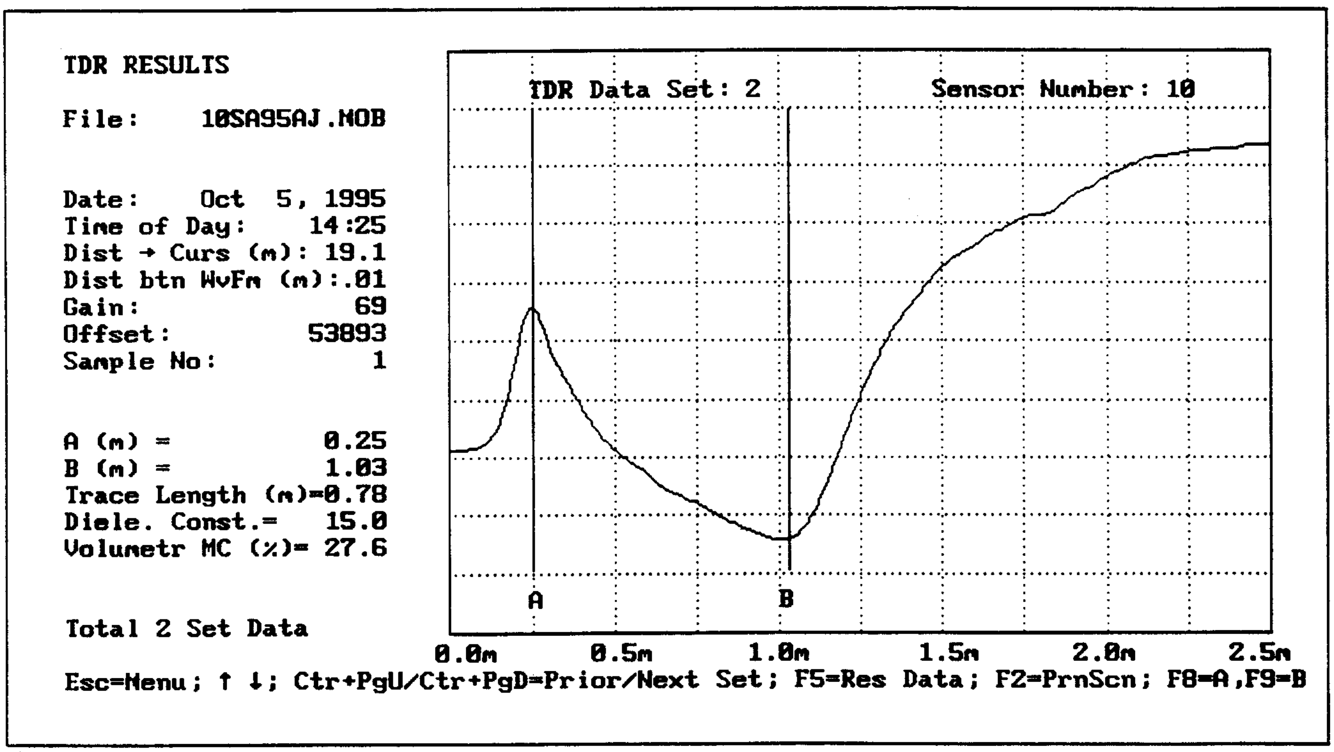

Figure D-3(cont.). Initial Second Set of TDR Traces Measured with the Mobile Unit

Table D-2. Uniformity Survey Results Before and After Installation

Seasonal Uniformity Survey	Falling Weight Deflectometer
Site Number: 100102	Data Collection and
Date Surveyed: October 04 - October 05, 1995	Processing Summary

Section Interval (ft)	Mean Deflection Values for HT 2 (mils) Corrected								Mean Temp D1 (F)
	Sensor 1	Sensor 1 std dev	Sensor 7	Sensor 7 std dev	Subg modulus (psi)	Subg modulus std dev	Effective SN	SN std dev	
300 to 521 **October 04** @ 0936	12.59	0.38	1.76	0.11	21460	1357	3.82	0.11	74.5
300 to 521 **October 05** @ 1158	12.58	0.36	1.82	0.12	20751	1356	3.87	0.13	79.7

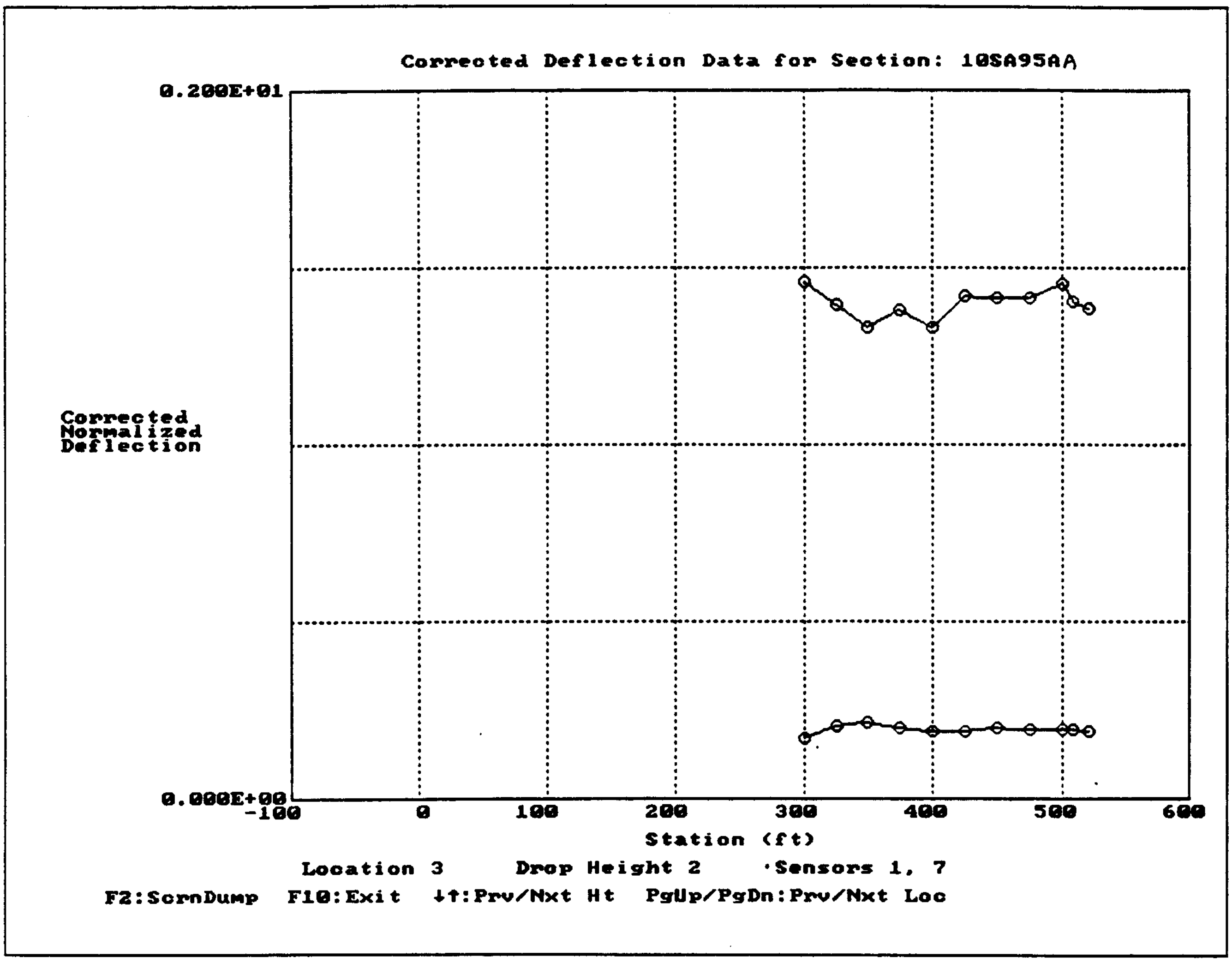

Figure D-4. Deflection Profiles from FWDCHECK
(Test Date and Time October 04, 1995 @ 0936)

Table D-3. Subgrade Modulus and Structural Number from FWDCHECK
(Test Date and Time October 04, 1995 @ 0936)

Flexible Pavement Thickness Statistics - 51SA95AA - Drop Height 2			
Subsection	Station	Subgrade Modulus	Effective SN
1	300	24719	3.60
	325	20199	3.90
	350	19396	4.05
	375	20689	3.90
	400	22013	3.90
	425	21953	3.75
	450	20944	3.80
	475	21234	3.80
	500	21317	3.75
	509	21452	3.80
	521	22146	3.80
Subsection 1	Overall Mean	21460	3.82
	Standard Deviation	1357	0.11
	Coeff of Variation	6.32%	3.00%

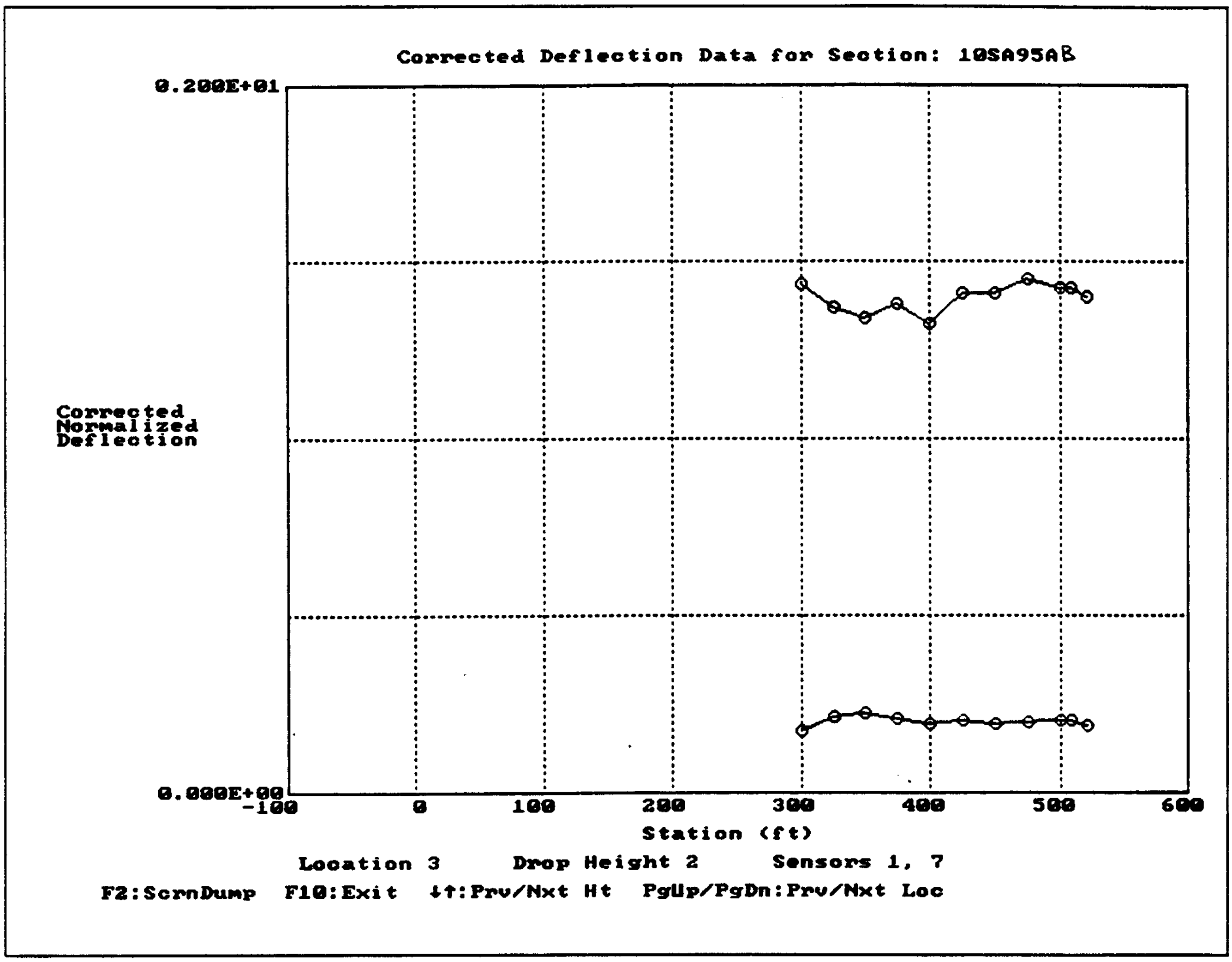

Figure D-5. Deflection Profiles from FWDCHECK
(Test Date and Time October 05, 1995 @ 1158)

Table D-4. Subgrade Modulus and Structural Number from FWDCHECK
(Test Date and Time October 05, 1995 @ 1158)

Flexible Pavement Thickness Statistics - 51SA95AB - Drop Height 2			
Subsection	Station	Subgrade Modulus	Effective SN
1	300	23756	3.65
	325	19594	4.00
	350	18517	4.10
	375	20067	3.95
	400	21175	3.95
	425	20392	3.85
	450	21179	3.80
	475	20912	3.75
	500	20483	3.85
	509	20160	3.85
	521	22026	3.80
Subsection 1	Overall Mean	20751	3.87
	Standard Deviation	1356	0.13
	Coeff of Variation	6.54%	3.23%

Table D-5. Surface Elevation Measurements

LTPP Seasonal Monitoring Study	State Code	[10]
Surface Elevation Measurements	Test Section Number	[0102]

Survey Date	October 05, 1995
Surveyed By	DS/GC
Surface Type	A/C
Benchmark	Observation Piezometer - 1.000 meters - assumed
	Nail at Station 1+78 - 0.9275 meters
	Concrete Monument at Station 5+15 - 0.5000 meters

STATION	PE m offset 0.30m	OWP m offset 0.91m	ML m offset [illegible]	IWP m offset [illegible]	ILE m offset [illegible]
3+00	1.2025	1.2175	1.2375	1.2525	1.2650
3+25	1.2150	1.2300	1.2475	1.2675	1.2750
3+50	1.2275	1.2400	1.2600	1.2825	1.2875
3+75	1.2475	1.2575	1.2750	1.2925	1.3000
4+00	1.2600	1.2750	1.2925	1.3125	1.3200
4+25	1.2750	1.2875	1.3050	1.3225	1.3275
4+50	1.2800	1.2975	1.3125	1.3325	1.3425
4+75	1.2900	1.3025	1.3200	1.3425	1.3525
5+00	1.3050	1.3175	1.3350	1.3525	1.3600
5+09	1.3050	1.3200	1.3400	1.3550	1.3650
5+15	1.3100	1.3200	1.3400	1.3575	1.3675
5+21	1.3100	1.3250	1.3450	1.3625	1.3725

PE	Pavement Edge
OWP	Outer Wheel Path
ML	Mid Lane
IWP	Inner Wheel Path
ILE	Inner Lane Edge

APPENDIX E

Photographs

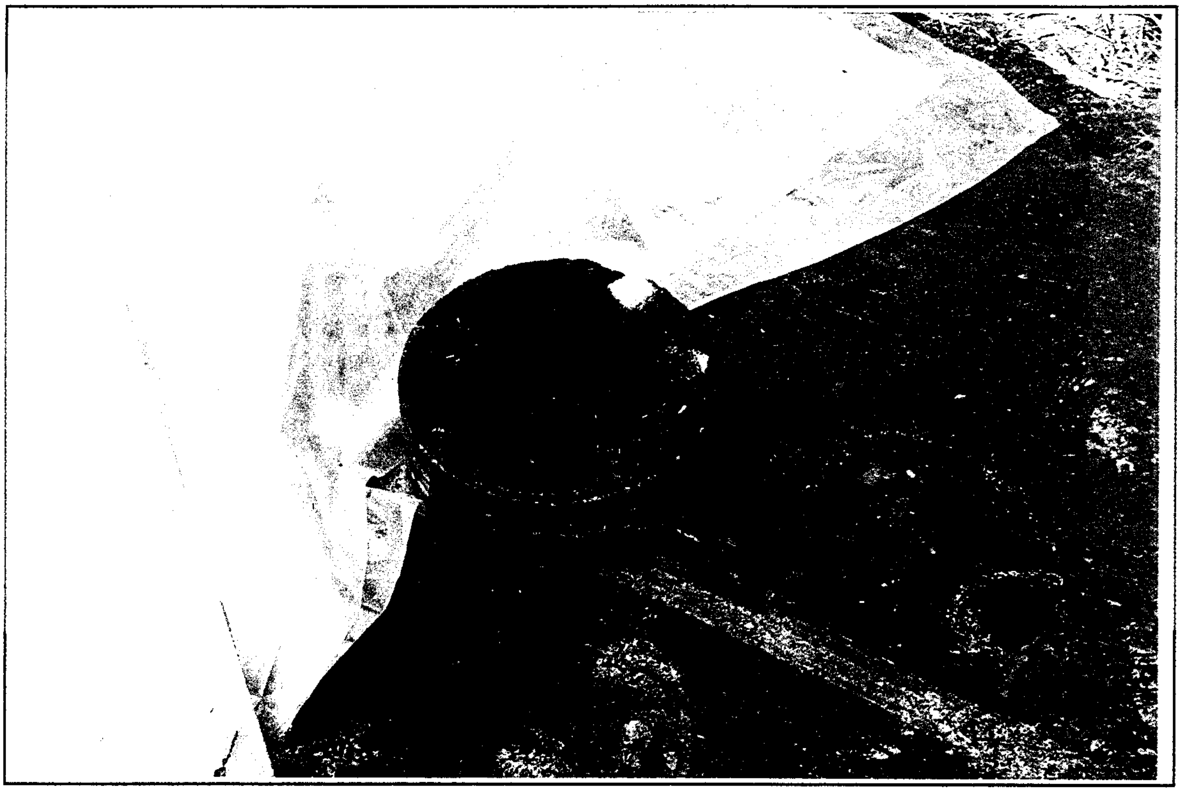

Figure E-1. Asphalt Core Removed from the Instrument Hole

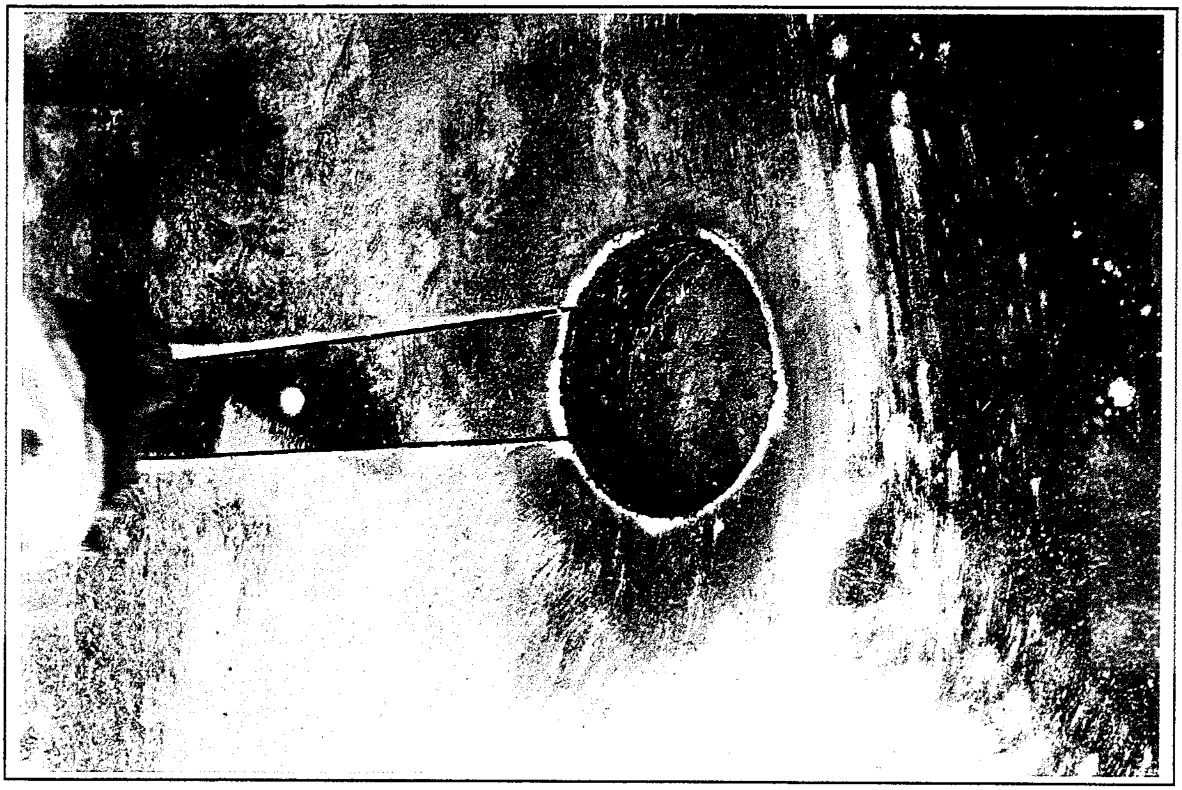

Figure E-2. Instrument Hole before Augering

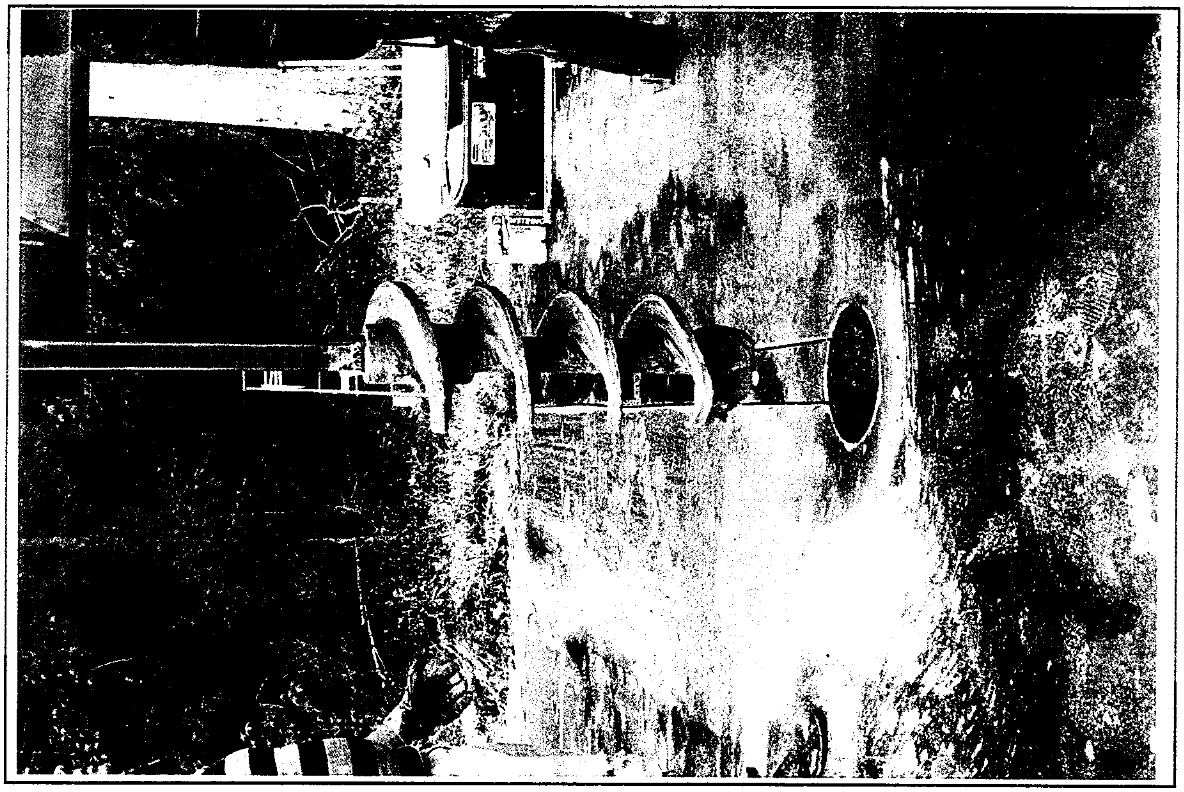

Figure E-3. Augering the Instrument Hole

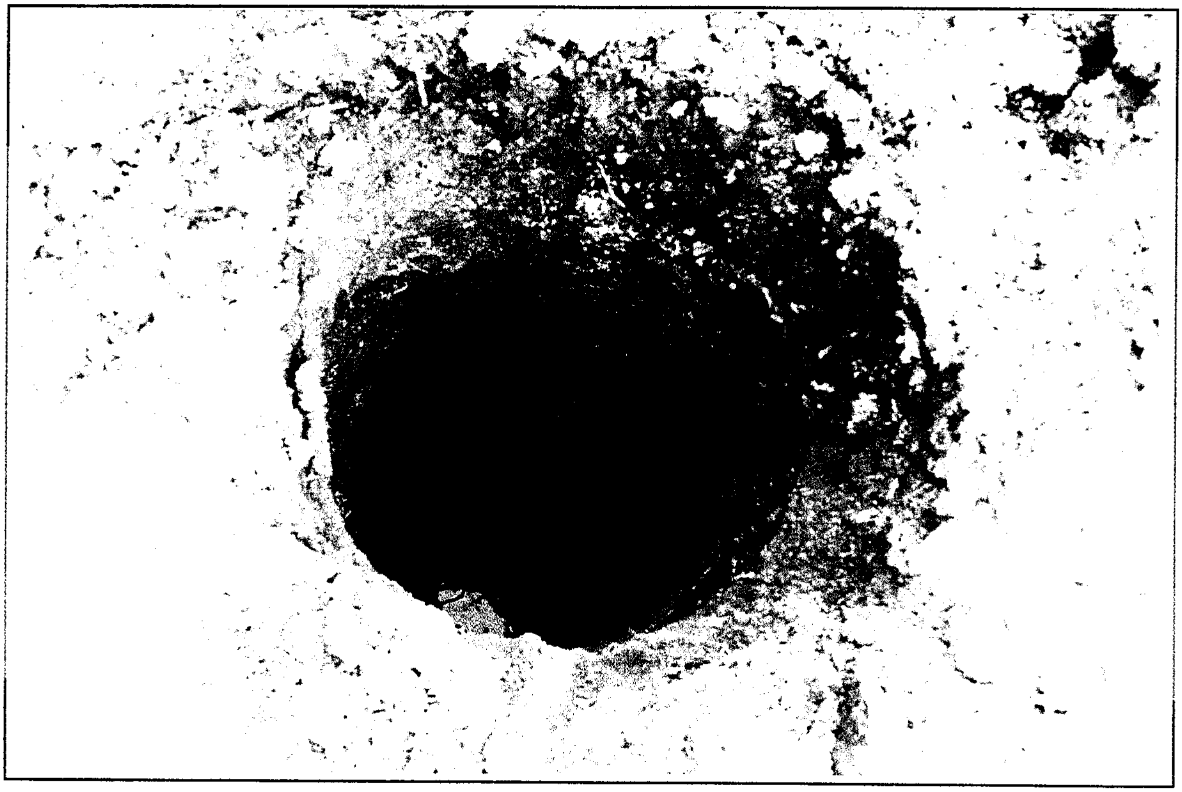

Figure E-4. Piezometer Hole after Augering

Figure E-5. Instrument Hole after Augering

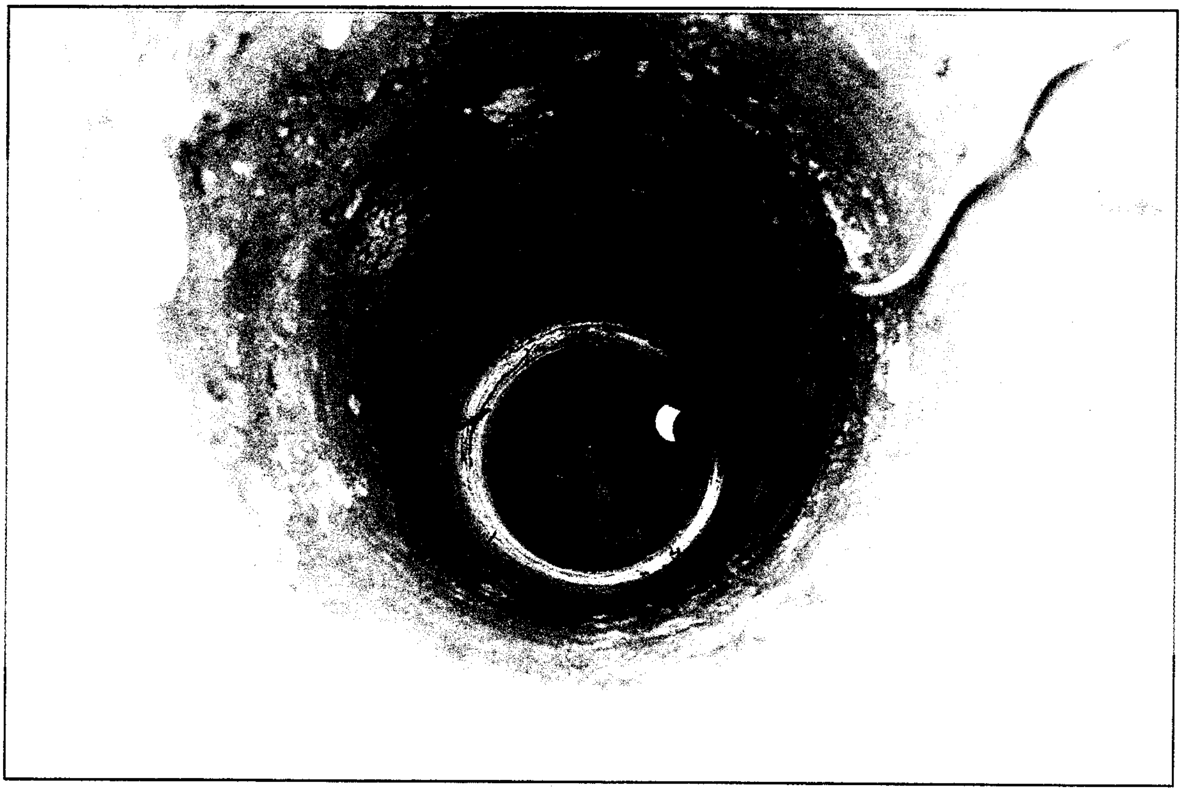

Figure E-6. Bottom of Instrument Hole before Backfilling

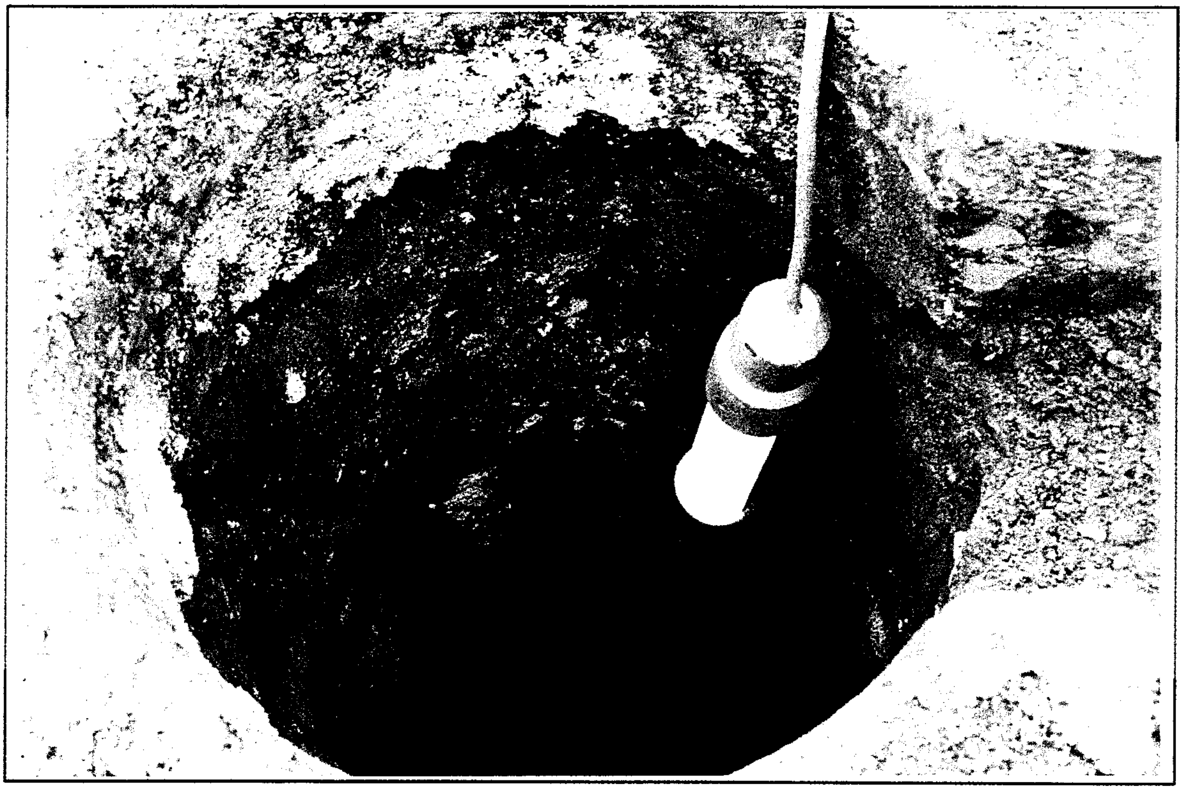

Figure E-7. Top of Instrument Hole before Backfilling

Figure E-8. TDR Probe Number Ten in the Instrument Hole

Figure E-9. Backfilling and Compacting the Instrument Hole

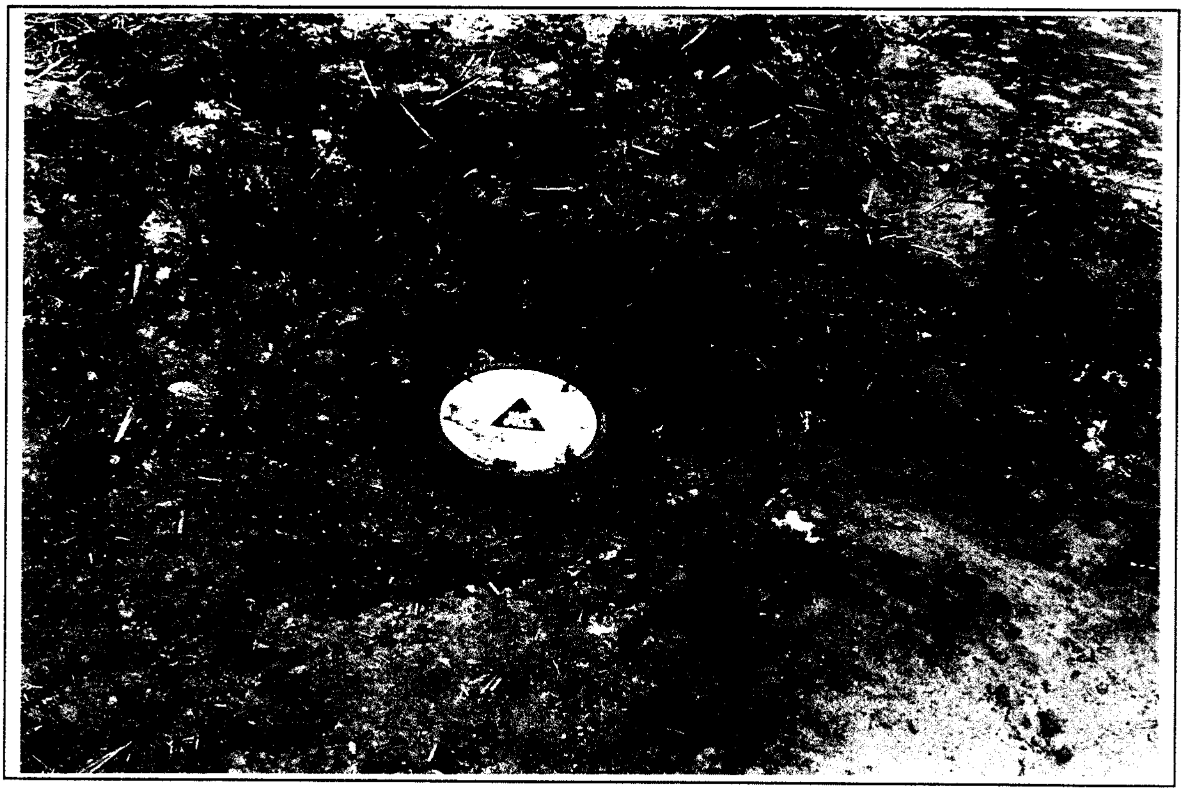

Figure E-10. Completed Piezometer

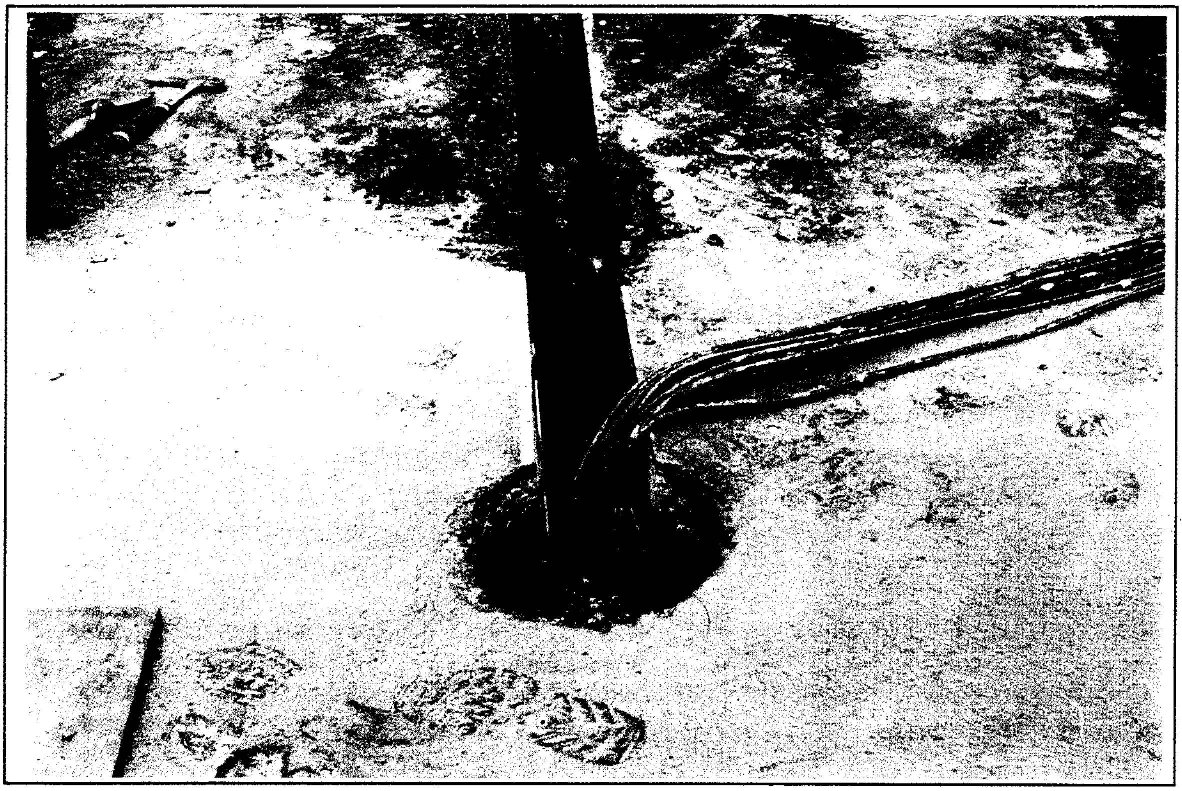

Figure E-11. Compacted Instrument Hole and Trench

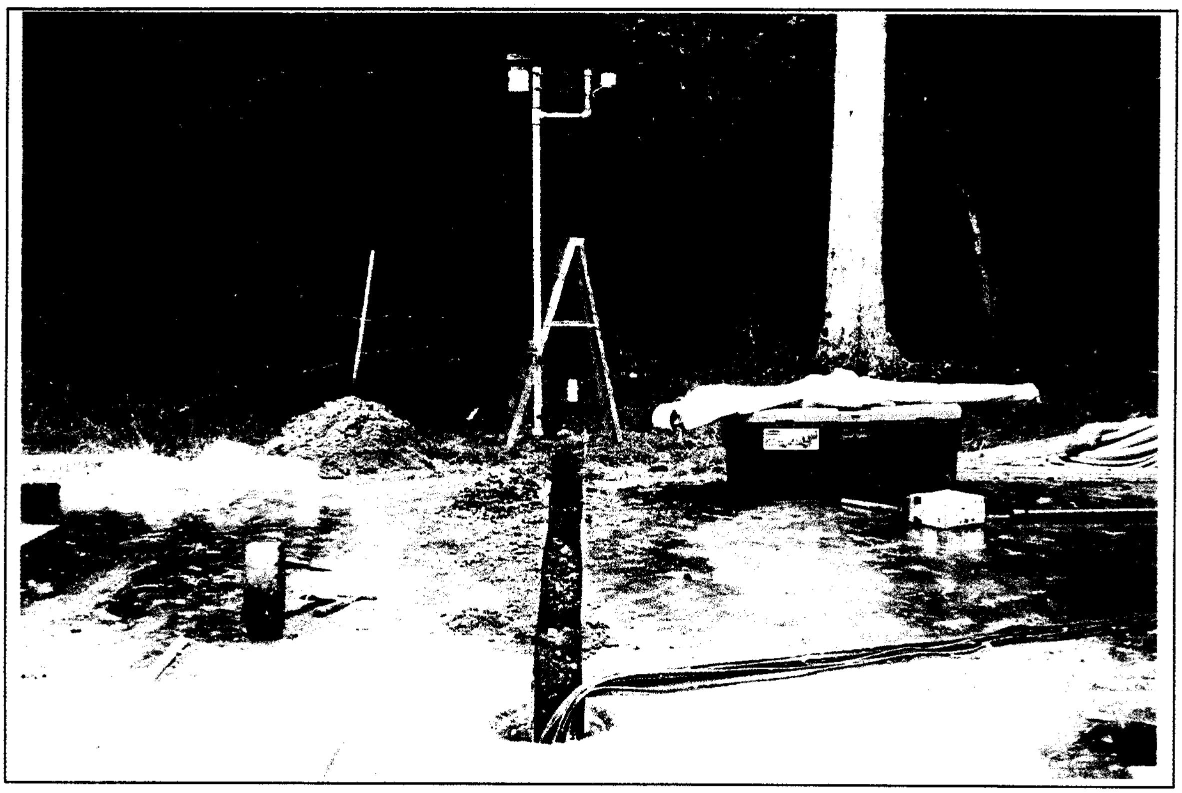

Figure E-12. Instrument Hole, Trench, and Weather Station

Figure E-13. Cabling Conduits in the Trench

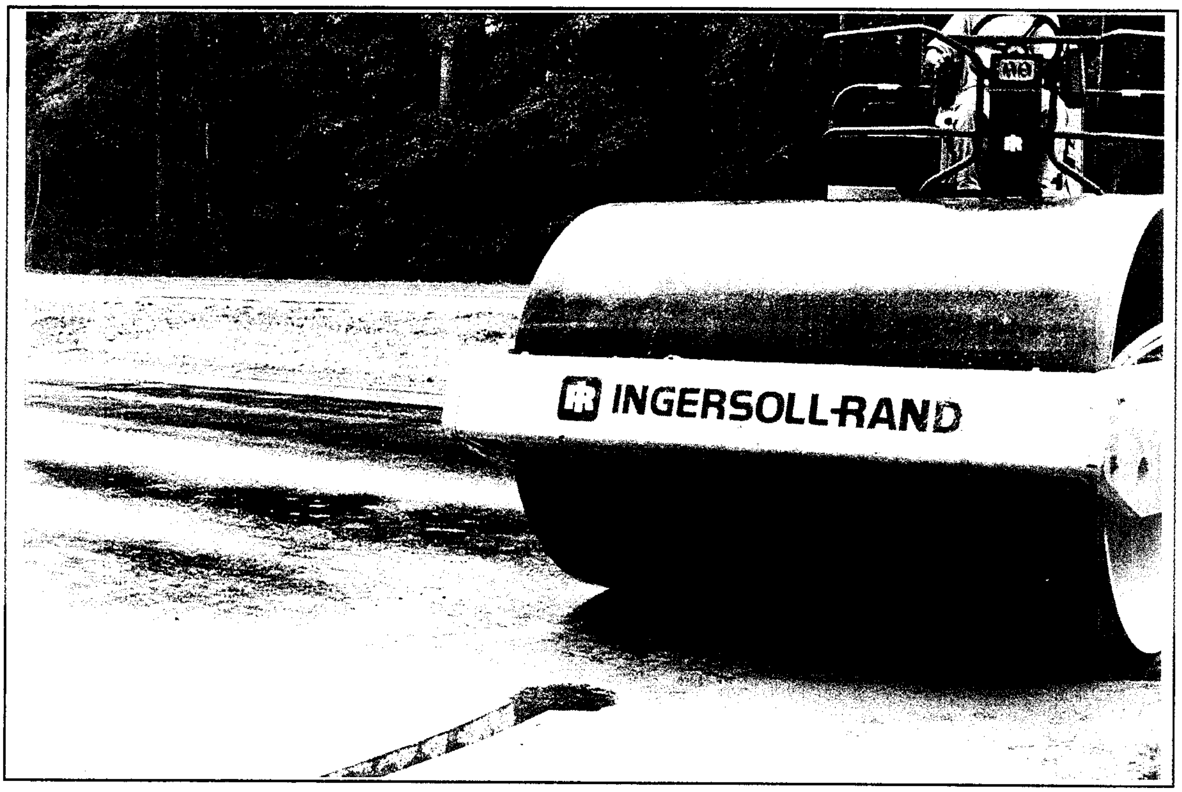

Figure E-14. Vibratory Compaction of the Instrument Hole

Figure E-15. Placing Asphalt in Trench

Figure E-16. Checking Top of MRC Probe

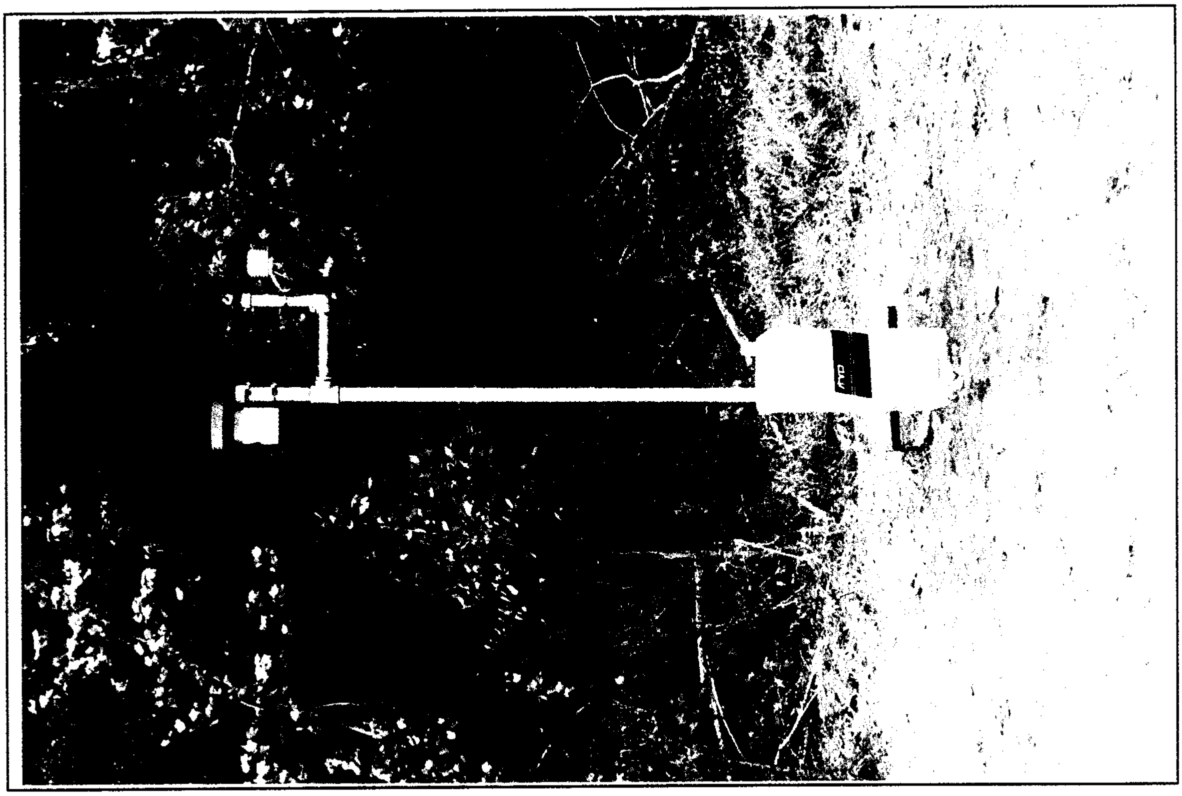

Figure E-17. Completed Equipment Cabinet and Weather Station

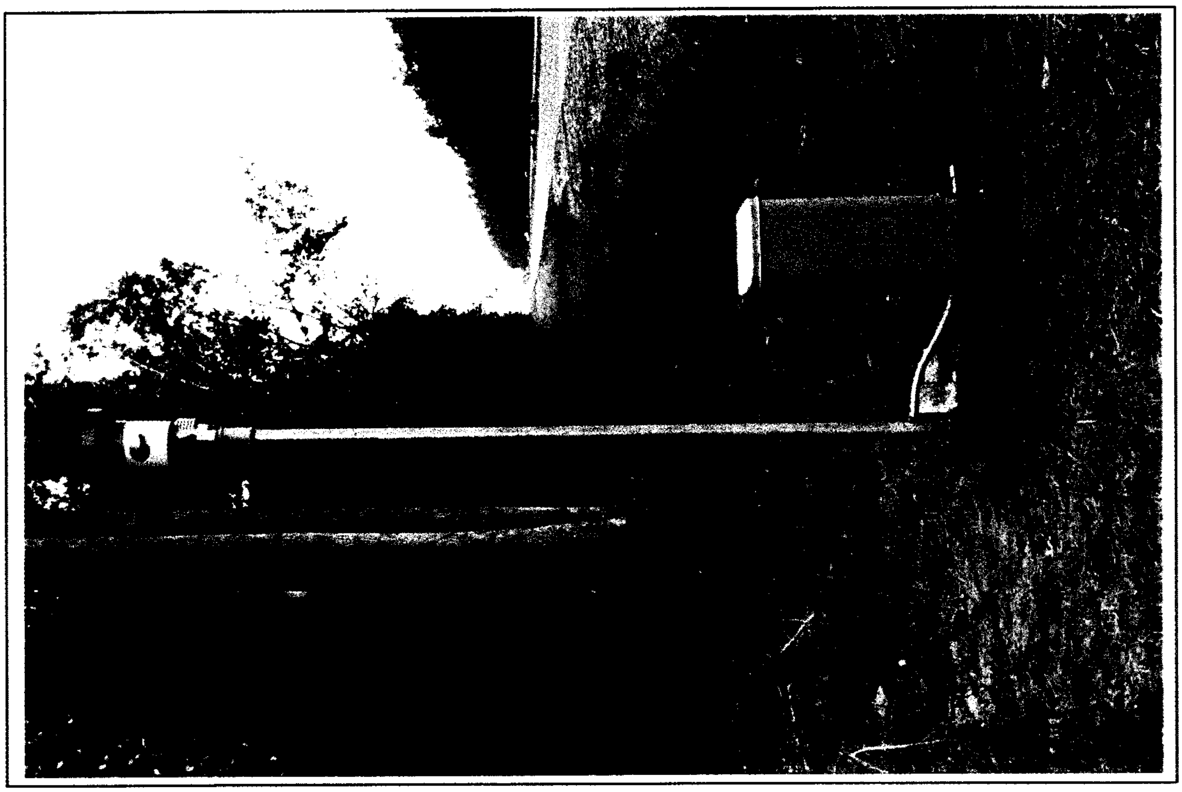

Figure E-18. Equipment Cabinet and Weather Station - Facing North

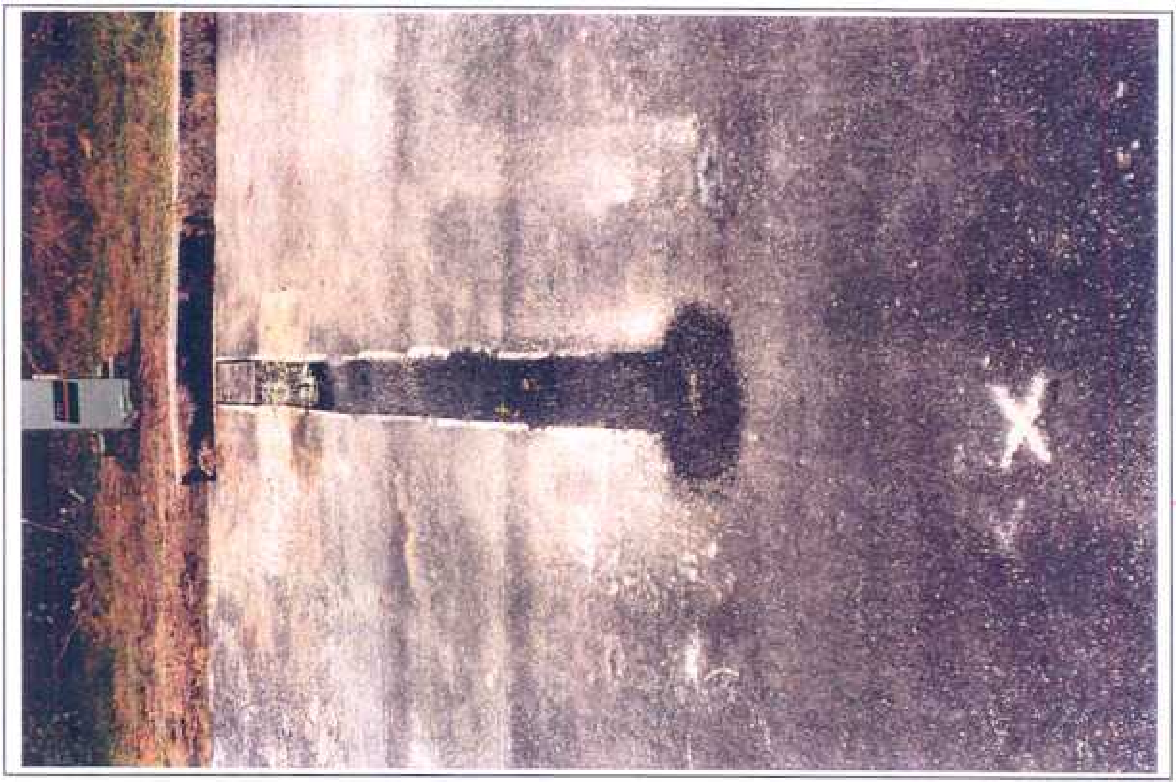

Figure E-19. Instrument Hole and Trench area near Completion

Figure E-20. Instrument Hole Area - Facing North

Figure E-21. Site - Facing North