U.S. Department of Transportation
Federal Highway Administration

LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection

Section 063042

Lodi, California

Report No. FHWA-06-3042

May 1997

Notice

LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection
Section 063042, Lodi, California

Report No. FHWA-06-3042

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May 1997

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-06-3042	N/A	N/A

4. Title and Subtitle	5. Report Date
LTPP Seasonal Monitoring Program Site Installation and Initial Data Collection Section 063042, Lodi, California.	November 1996.
	6. Performing Organization Code
7. Author(s) Srikanth S. Holikatti, Sirous H. Alavi, Douglas J. Frith and Mark A. Potter	8. Performing organization Report No.
9. Performing Agency Name and Address **Nichols Consulting Engineers, Chtd.** 1885 S. Arlington Avenue, Suite 111 Reno, Nevada 89503	10. Work Unit No. (TRAIS) N/A
	11. Contract or Grant No. DTFH61-96-C-00010
12. Sponsoring Agency Name and Address Federal Highway Administration LTPP-Division, HNR-40 Turner Fairbanks Highway Research Center 6300 Georgetown Pike McLean, Virginia 22101	13. Type of Report and Period Covered. Final Report, July 1995.
	14. Sponsoring Agency Code.

15. Supplementary Notes

Contracting Officer's Technical Representative (COTR) - Monte Symons, HNR-30

16. Abstract

This report contains a description of the instrumentation installation activities and initial data collection for test section 063042 which is a part of the LTPP Core Seasonal Monitoring Program. This is a Jointed Portland Cement Concrete (JPCP) surfaced pavement test section, located on southbound outside lane of Interstate Route 5, near Lodi, California. The section was instrumented on July 12, 1995. The instruments installed included TDR probes for moisture content, thermistor probes for pavement and subsurface temperature, tipping bucket rain gauge for precipitation, piezometer to monitor ground water table, and a CR10 datalogger. Initial data was collected on July 13, 1995. This included FWD and precipitation data, elevation , air and subsurface temperature, TDR measurements, joint opening and faulting measurements. This report also contains a description of site location, characteristics of installed equipment, the location of installed equipment within the test section and a summary of initial data collection.

17. Key Words: Seasonal Monitoring, TDR Probes, Thermistor Probes, CR10 Datalogger, Temperature Gauge, Initial Data.		18. Distribution Statement No restrictions	
19. Security Classification. (of this report) Unclassified	20. Security Classification. (Of this page) Unclassified	21. No. Of Pages	22. Price

Form DOT F 1700.7(8-72)

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3

NOTE: Volumes greater than 1000 l shall be shown in m^3.

Symbol	When You Know	Multiply By	To Find	Symbol
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

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SITE INSTALLATION AND INITIAL DATA COLLECTION CALIFORNIA SECTION 063042

INTRODUCTION

This report describes the equipment installation activities and initial data collection for test section 063042 near Lodi, California, which is a part of the Federal Highway Administration (FHWA) Long Term Pavement Performance (LTPP) Seasonal Monitoring Program (SMP). The equipment installation activities were carried out on July 12, 1995 and initial data was collected on July 13, 1995.

Section Location

Section 063042 is a General Pavement Studies (GPS) section selected for SMP. This section is located on the outside lane of southbound Interstate Route 5, a multi-lane highway facility in the State of California. The closest city to the section is Lodi, California. The beginning of the section is at milepost 48.6, 1.2 miles south of Mokelumne Bridge and San Joaquin/ Sacramento county line and 0.95 miles north of Thornton-Walnut Grove underpass. This is a GPS-3, "General Pavement Study of Jointed Plain Concrete Pavements" (JPCP) section meeting the requirements of SMP seasonal cell #17. Figure A1 in appendix A contains a map showing the location of the section.

Section Details

The pavement section consists of 225mm of JPCP with 122mm cement treated base (CTB) on 122mm lime treated fine grained (LTFG) soil underlain by sandy silt subgrade. The test section has 3.20m wide asphalt shoulder. Additional details are summarized in table 1.

Table 1. Details of section 063042 in California.

Functional Classification of Roadway	Rural Interstate Highway
Number of Lanes/Direction	Two
Pavement Type	Jointed Plain Concrete
Estimated Annual ESAL Applications on the Test Lane	1762 KESALs
Climatic Classification	Dry, No-Freeze, SMP Cell #17
Dowels	None

Pre-installation FWD testing was carried out on the test section. FWD data was analyzed using FWDCheck program and the results are presented in figures A2 through A6 in appendix A. Figures A7 and A8 present the material boring log and the instrumentation hole boring log of the section. The material properties of pavement layers are presented in table 2.

Table 2. Material properties.

Description	Surface Layer	Base Layer	Subbase	Subgrade
Material	PCC	CTB	LTFG	Sandy Silt
Thickness (mm)	225*	122*	122*	----
Proctor Dry Density (kg/m^3)	----	N/A	N/A	1020**
Proctor Moisture Content (%)	----	N/A	N/A	100**
Lab Max Dry Density (kg/m^3)	----	----	1678@20%MC	1726@20%MC
Field Density	N/A	N/A	N/A	N/A
Liquid Limit	----	----	29	29
Plastic Limit	----	----	27	21
Plastic Index	----	----	2	8
Percent passing #200	----	----	49.0	58.3

NP - Non Plastic
MC - Moisture Content
* - Thickness as per the drilling records closest to the installation
** - Proctor density and moisture content as on the day of instrumentation installation at 2.20m depth from pavement surface. These values are not realistic values, refer to the text.

PCC - Portland Cement Concrete
CTB - Cement Treated Base
LTFG - Lime Treated Fine Grained

According to LTPP weather database, the following climatic conditions exist in the region:

Freezing Index	:	1	No. of Days Above 32° C	:	60
Precipitation	:	457.2 mm	No. of Freeze Thaw Cycles	:	22
No. of Days Below 0° C	:	17	No. of Wet Days Per Year	:	68

Installation of instrumentation was carried out on July 12, 1995 and initial data collection was performed on July 13, 1995. The installation was a cooperative effort between California Department of Transportation (CALTRANS) and Nichols Consulting Engineers (NCE) LTPP Western Region Coordination Office staff. The following personnel participated in the installation.

Douglas J. Frith	:	NCE	Haiping Zhou	:	NCE
Mark A. Potter	:	NCE	Michael A. Esposito	:	NCE
Philip Friedman	:	NCE	Larry Burroughs	:	Caltrans
Muts Fukumoto	:	Caltrans	Dennis Smith	:	Caltrans
Robert Songe	:	Caltrans	Steve Stolp	:	Caltrans
Rick Holoway	:	Caltrans	Carl Enloe	:	Caltrans-Drilling
Tom Mirza	:	Caltrans-Drilling			

INSTRUMENT INSTALLATION

Meeting With Highway Agency

A planning meeting between NCE and CALTRANS was held in Sacramento, California on June 21, 1995 to discuss SMP instrumentation, required equipment, the installation schedule, and installation team responsibilities. CALTRANS provided traffic control, equipment and personnel to achieve pavement sawing, instrument and piezometer hole auguring and also to carry out post installation patching and repair of the instrumentation hole. NCE staff performed all the SMP equipment installation. The site was inspected on March 30, 1995 by Michael Esposito, deflection testing of the section was also carried out on this day.

SMP Equipment Installed

Type and quantity of instruments installed at the section are listed in table 3. These included instrumentation to measure air and subsurface temperature, subsurface moisture content, rainfall, ground water table depth, and an equipment cabinet to house the cable ends and the CR10 datalogger. The rain gauge and the air temperature probe were mounted on a 51mm diameter steel pole near the equipment cabinet. The resistivity probe was not installed as the site is in a "Dry, No-Freeze" zone.

Table 3. Instruments installed.

Equipment	Quantity	Serial No.
Instrument Hole		
MRC Thermistor Probe	1	06A#5
TDR Sensors	10	06A01-06A10
13mm dia. Internal Snap Rings	15	N/A
Equipment Cabinet		
Campbell Scientific CR10 Datalogger	1	N/A
Battery Package	1	N/A
Weather Station		
TO525 Tipping Bucket Rain Gauge	1	12100-693
Air Temperature Probe	1	N/A
Radiation Shield	1	N/A
Observation Well/Bench Mark	1	None

Pre-Installation Equipment Check and Calibration

Prior to installation, all equipment used in the installation were checked for functionality, accuracy, and calibrated whenever necessary. The air temperature probe, thermistor probe, and the rain gauge were connected to the CR10 Datalogger to check that they were functioning properly. The rain gauge was calibrated by recording the number of tips to drain 473 ml of water in at least 45 minutes. This was found to be within the range of 99 - 101 tips, which is within the specified limits. The air temperature probe and the thermistor probe were checked for proper functioning by placing them in an ice bath and in direct sunlight and comparing the measured temperatures. The results indicated that both were functioning properly. The spacing of thermistors within the clear plastic tube were measured and recorded. Descriptions of MRC thermistor probe and sensor are presented in table 4. The CR10 Datalogger and battery unit were also checked. They were found to be in working order.

Table 4. Description of MRC thermistor probe and sensor spacing.

Unit No.	Channel No.	Distance from Top of Unit (m)	Remarks
1	1	0.000	Installed in PCC
	2	0.152	
	3	0.305	
2	4	0.022	Installed in Subgrade
	5	0.098	
	6	0.174	
	7	0.250	
	8	0.325	
	9	0.477	
	10	0.629	
	11	0.783	
	12	0.937	
	13	1.087	
	14	1.239	
	15	1.392	
	16	1.544	
	17	1.698	
	18	1.846	

Calibration of TDR probes was completed by performing two measurements in air, one with the prongs shorted at the beginning of the sensor and the other not shorted. An additional measurement was made with the TDR probe submerged in water. The TDR measured dielectric constants were within the specified limits, and the sensors produced the expected traces and were functioning properly. Individual TDR probe traces obtained during calibration are presented in figures B1 through B10 in appendix B. Serial numbers of all equipment to be installed were noted, with the exception of radiation shield and air temperature probe. The benchmark did not have serial numbers and the battery pack serial number was not recorded because the batteries get frequently changed.

Instrument Installation

Analysis of FWD data indicated an almost uniform section, thus the leave end of the section was selected for instrumentation. The equipment installation generally followed the schedule given below.

0715	:	Depart from Sacramento.
0800	:	Arrive at site, start unpacking equipment in preparation for installation.
0830	:	Traffic Control in Place, instrumentation hole and piezometer located and marked, drill piezometer,
0900-1000	:	FWD testing of instrumentation hole. saw cutting of thermistor unit 1 slot, conduit trench and instrument hole.
0845- 1030	:	Installation of piezometer, drill weather station pole hole, place pole and concrete the base.
0930-1000	:	Install equipment cabinet.
1030-1130	:	Excavation of instrumentation cable trench
1030-1200	:	Layout the cables, run the cables through the conduit, drill instrument hole.
1200-1500	:	Installation of thermistor unit #2, TDR probes, collection of moisture samples from each TDR location, proctor test, testing of each TDR probe, etc.
1515-1545	:	Installation of thermistor probe unit #1, into the groove previously cut in the pavement, check all equipment for proper functioning.
1545-1630	:	Patch and repair instrumentation hole and conduit trench, seal all saw cuts with silicone sealant.
1630-1730	:	Clean up site, pack all equipment, place instrument cabinet cover and lock.
1730-1745	:	Depart from site.

Pavement and subsurface instrumentation was installed at the leave end of the section at a distance of 160.14m (station 5+25'3") from section beginning, in a 0.30m diameter hole bored using a 252mm diameter stem auger after sawing a 0.50m square hole in the PCC layer. The pavement temperature sensors (thermistor unit #1) were installed in the PCC layer as per LTPP guidelines. TDR moisture probes and subsurface temperature sensors (thermistor unit #2) were installed in the instrumentation hole. The instrumentation hole was 2.38m deep.

TDR probes were placed in an offset fan pattern such that the lead wires were on the hole side closest to the pavement edge. All the TDR probe lead wires had the "S" shaped stress relief loop made in them. Each TDR probe was connected to the function generator while the soil around it was being compacted and manual traces were generated. This was done to ensure that none of the TDR sensors were damaged during the backfilling and compaction of the instrumentation hole. TDR and thermistor probe lead wires were bundled and put through a 51mm diameter flexible electrical conduit buried in a 76mm wide trench, leading to the equipment cabinet. The equipment cabinet was located 8.20m away from the instrumentation hole on gently sloping ground. The installed depths of TDR are presented in table 5.

Table 5. Installed depths of TDR sensors.

TDR Sensor #	Depth from Pavement Surface (m)	Layer
06A01	0.660	Subgrade
06A02	0.825	
06A03	0.976	
06A04	1.130	
06A05	1.280	
06A06	1.420	
06A07	1.590	
06A08	1.740	
06A09	2.035	
06A10	2.350	

Moisture samples were collected at each TDR probe location. The TDR traces generated during installation are presented in appendix C. These traces were later used to determine in-situ moisture content at each TDR probe depth. From the individual trace, apparent probe length was determined and used in the moisture determination equations provided in the FHWA LTPP SMP Guidelines, April 1994. Comparison of moisture contents determined from TDR traces obtained during installation with field measured moisture contents are presented in table 6 and figure C2, in appendix C.

Table 6. Measured moisture contents during installation.

Sensor No.	Sensor Depth (m)	Layer	Moisture Content (% by wt)	
			Field Measured[1]	TDR Installation[2]
06A01	0.660	Subgrade	14.7	31.3
06A02	0.825		30.7	38.0
06A03	0.076		24.0	29.2
06A04	1.130		17.2	39.3
06A05	1.280		21.2	39.3
06A06	1.420		24.6	39.3
06A07	1.590		17.5	35.5
06A08	1.740		17.9	39.3
06A09	2.035		21.2	41.6
06A10	2.350		104.1	39.3

*Ground water encountered at a depth of 2.65m.

[1]Moisture contents determined in field from the material sampled at each TDR probe depth.

[2]The moisture contents were determined from TDR traces obtained during TDR probe installation. From the individual trace, apparent length was determined and used in the moisture determination equations given in FHWA LTPP SMP Guidelines, April 1994.

A representative Proctor sample was taken at a depth of 2.20m from pavement surface. The Proctor density and the moisture content determined in the field listed in table 2 were quite unrealistic. Thermistor unit #2 was installed in the base, subbase, and subgrade layers. The installed depths of thermistor sensor 4 through 18 are listed in table 7.

A 152 mm diameter stem auger was used to bore the observation piezometer/benchmark at the edge of the pavement shoulder at a distance of 121.95m (section station 4+00), 4.50m to the right of lane edge. Upon completion of instrumentation installation, all wiring to the equipment cabinet were checked carefully for continuity and proper contacts. The "ON SITE" computer program was downloaded to the CR10 datalogger located in the equipment cabinet. The datalogger was left on overnight to collect data so that the results could be evaluated the next day.

Site Repair

The instrumentation hole and the conduit trench were patched and repaired by CALTRANS personnel with quick setting ready-mix concrete. Care was exercised to prevent damage to all of the equipment installed or the wires leading to the equipment cabinet. Subsequent tests confirmed that all installed equipment functioned properly. The repair patch placed performed quite well during the monitoring period. Towards the end of the monitoring period low severity cracks and some spalling were observed. These cracks were sealed June 25, 1996.

Table 7. Installed locations of MRC thermistor sensors.

Unit No.	Channel No.	Depth from Pavement Surface (m)	Remarks
1	1	0.015	Installed in PCC Layer
	2	0.109	
	3	0.204	
2	4	0.549	Installed in Subgrade
	5	0.625	
	6	0.701	
	7	0.777	
	8	0.852	
	9	1.004	
	10	1.156	
	11	1.310	
	12	1.464	
	13	1.614	
	14	1.766	
	15	1.919	
	16	2.071	
	17	2.225	
	18	2.373	

INITIAL DATA COLLECTION

The second day (July 13, 1995) was spent checking the functionality of installed equipment, collecting initial data, elevation surveys of the section, examination of the overnight data collected by the onsite datalogger, and TDR and thermistor data collection using the mobile data acquisition system.

Air temperature, rainfall, pavement, and subsurface temperature data, monitored and stored by the onsite datalogger, were examined. The equipment and datalogger were functioning correctly. The battery voltage was checked and found acceptable. Onsite raw data collected are presented in appendix D. TDR data was collected using the mobile data acquisition system. The mobile system contains a CR10 datalogger, a battery pack, two multiplexers, and a resistance multiplexer circuit board. Figures D3 through D12 in appendix D show the TDR waveform traces collected with the mobile data acquisition system for the ten TDR sensors. It can be seen from the above data that field measured moisture contents in some cases substantially differed from the moisture contents determined from the TDR traces obtained right after installation. Some of these moisture contents appear unreasonable. The significant variation in moisture content observed can be attributed to soil type and the moisture determination method used in the field.

One set of elevation surveys were carried out following the LTPP guidelines. The elevation of observation well top was assumed 1 meter. The elevations are presented in table D2 in appendix D. A set of joint opening measurements and joint faulting measurements were not made due to the time constraints.

SUMMARY

This report describes the SMP equipment installation activities on Section 063042 located in the State of California. The section is located on the southbound outside lane of Interstate Route 5 near the City of Lodi. The beginning of the section is 1.20 miles south of Mokelumne Bridge and San Juaquin/Sacramento county line and 0.95 miles north of Thornton-Walnut Grove underpass. This is a GPS-3 section in "Dry, No Freeze" climatic zone.

A planning meeting with CALTRANS representatives was held in Sacramento on June 25, 1995 to discuss SMP equipment installation and work responsibilities. Accordingly, successful installation of SMP equipment and initial data collection was carried out on July 12 and 13, respectively, in accordance with the LTPP SMP guidelines. Pre-installation deflection testing and inspection of the site was carried out by Michael Esposito on March 30, 1995. Equipment to measure and record the following data were installed at site:

- Ambient temperature and daily rainfall
- Pavement surface and subsurface depth-temperature profile
- Pavement depth-moisture profile
- Ground water measurements
- Joint opening measurements

The equipment installation hole is located at the leave end of the section, the equipment cabinet is located 7.80m to the right of the lane edge on almost level ground. All equipment were installed in accordance with LTPP SMP guidelines, April 1994. Some moisture contents measured in the field and form TDR installation traces are unrealistic and non representative. The pavement joint width and joint faulting were not recorded because the snap rings were placed on the second day, and the sealant below the snap rings was not set and because of time constraints. However the joint widths and faulting were recorded in the subsequent visits. Other than this there were no exceptional conditions. Post installation checks indicated proper functioning of all installed equipment.

APPENDIX A

Test Section Background Information

Appendix A includes the following supporting information:

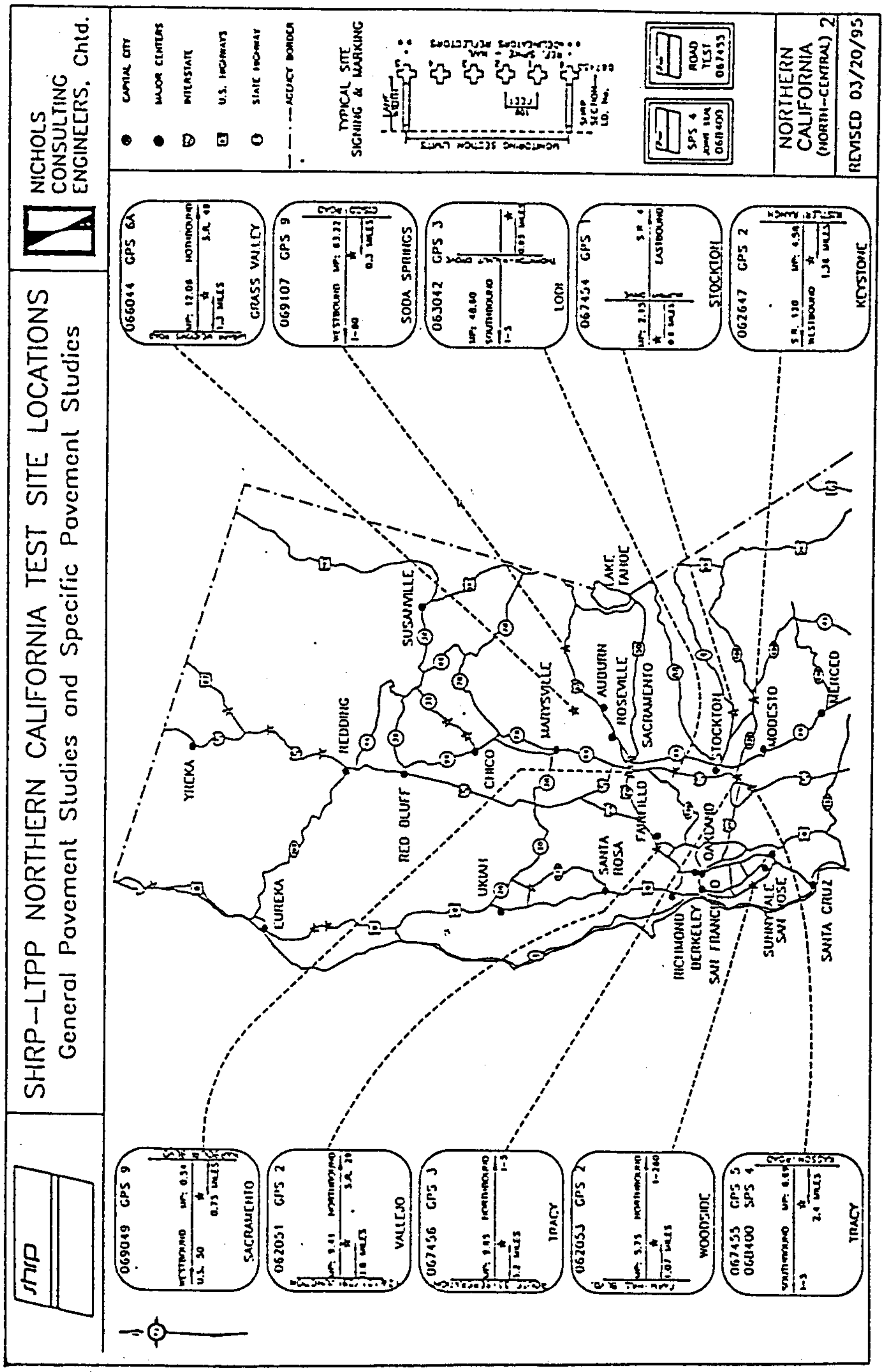


Figure A1. Site location map.

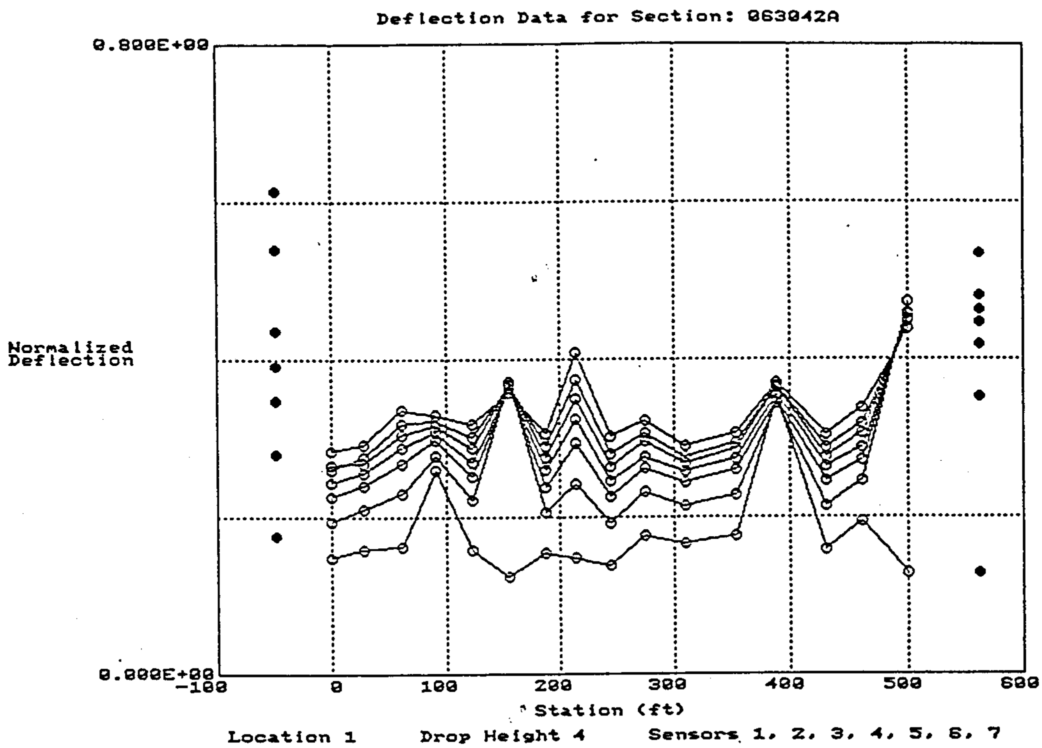


Figure A2. Normalized deflection profile from FWDCheck.

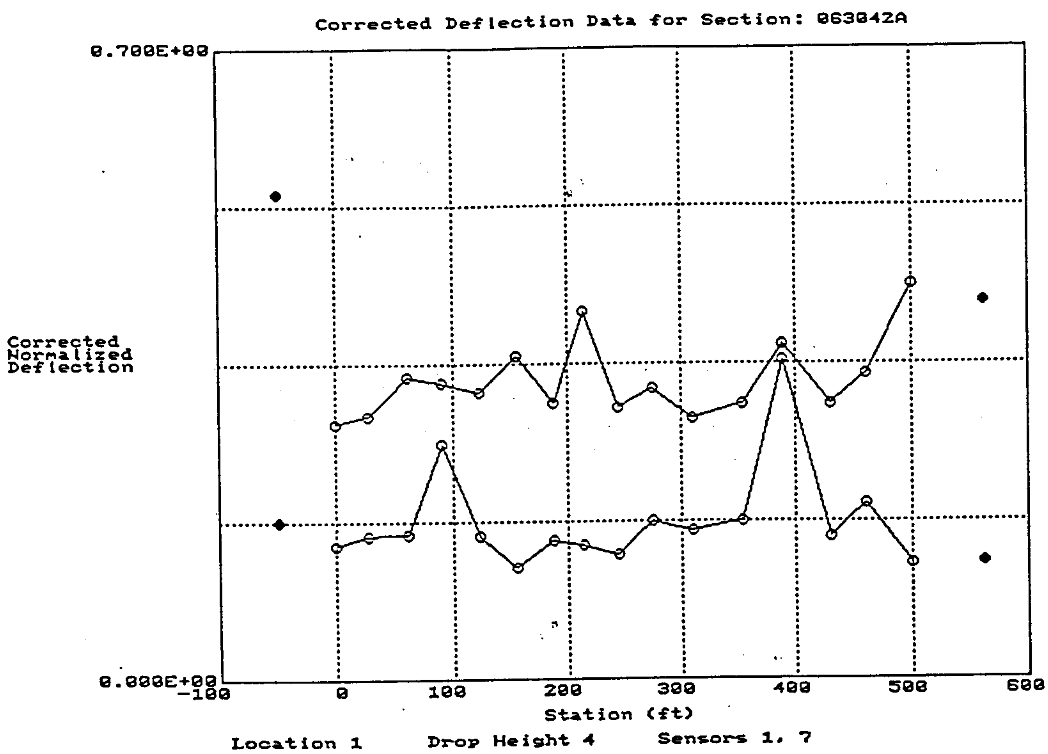


Figure A3. Corrected normalized deflection from FWDCheck.

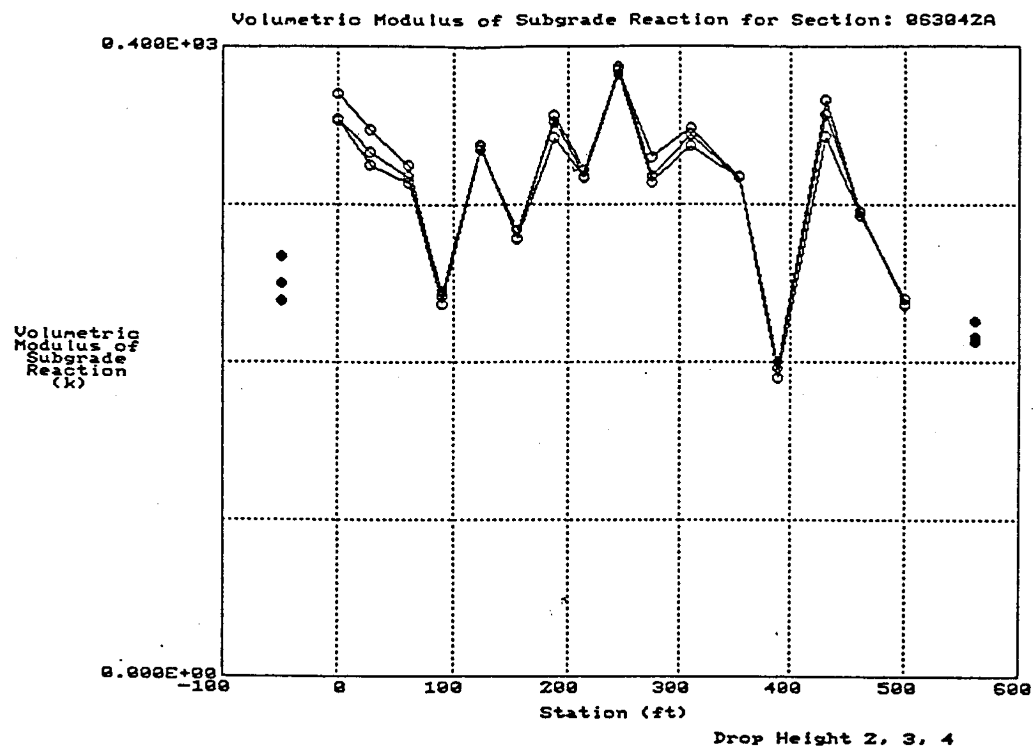


Figure A4. Volumetric modulus of subgrade reaction.

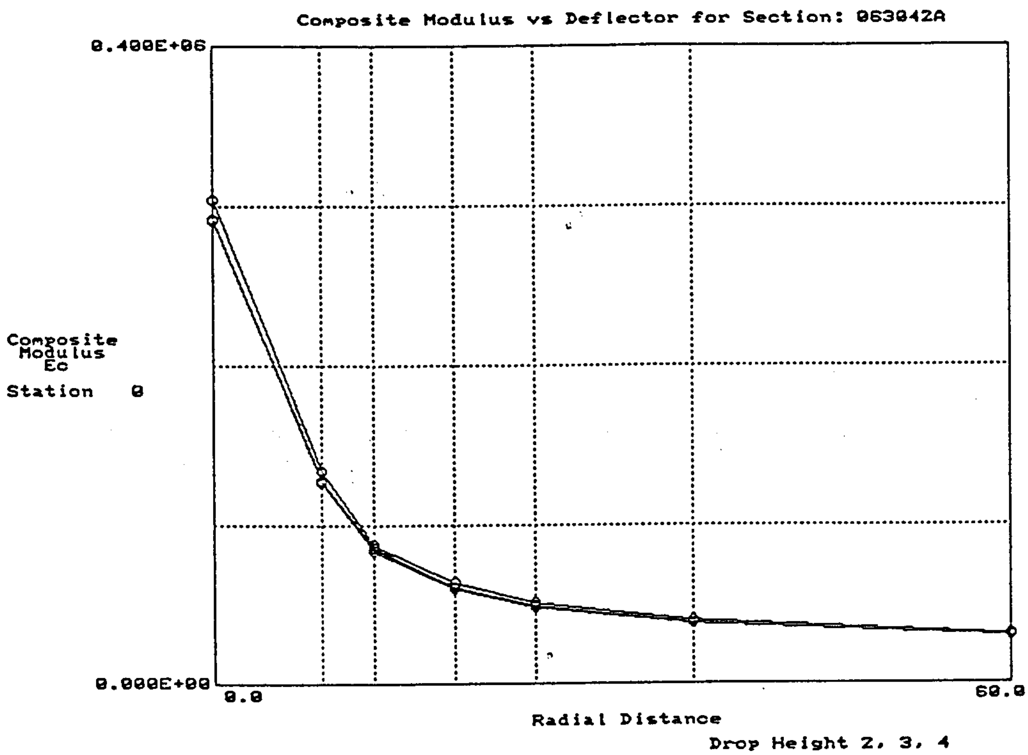


Figure A5. Composite modulus for the section.

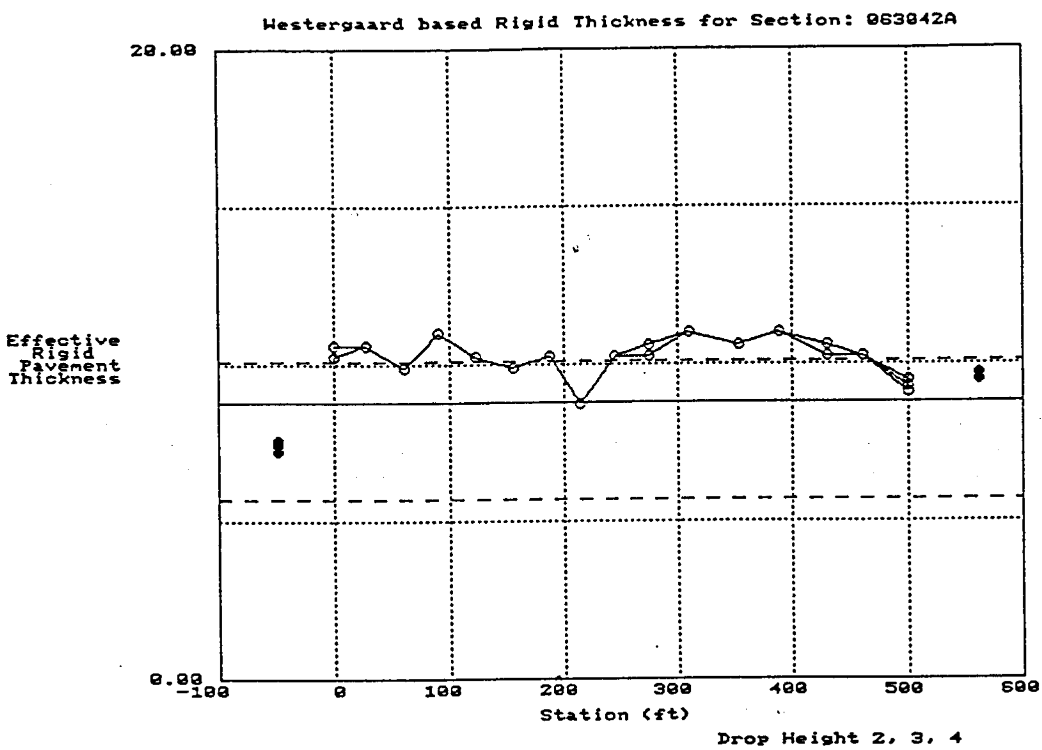
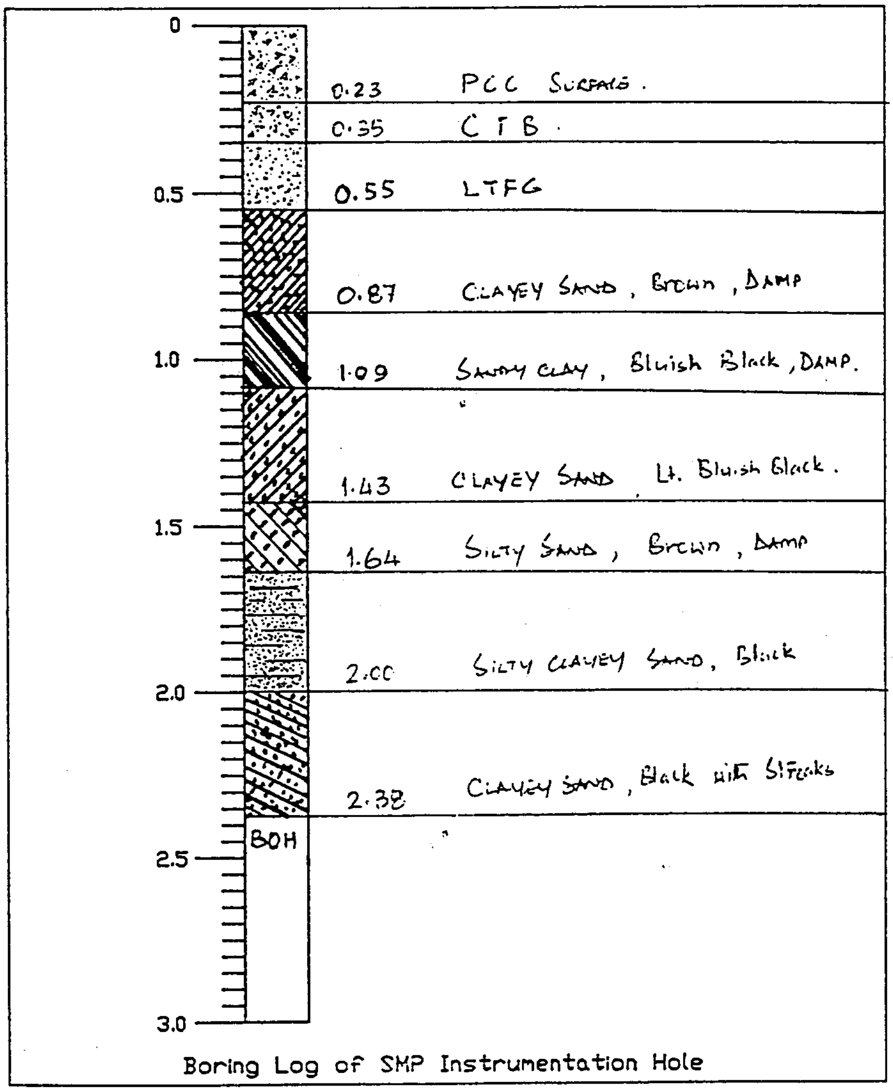


Figure A6. Westergaard based rigid thickness.

State ID. 06 SHRP ID. 3042

Station 160.14 (500+25) Date(dd/mm/yy) 12/07/95



Start Time NA End Time NA

Prepared By D. Frith Employed By NCE

Figure A7. Boring log of the instrument hole.

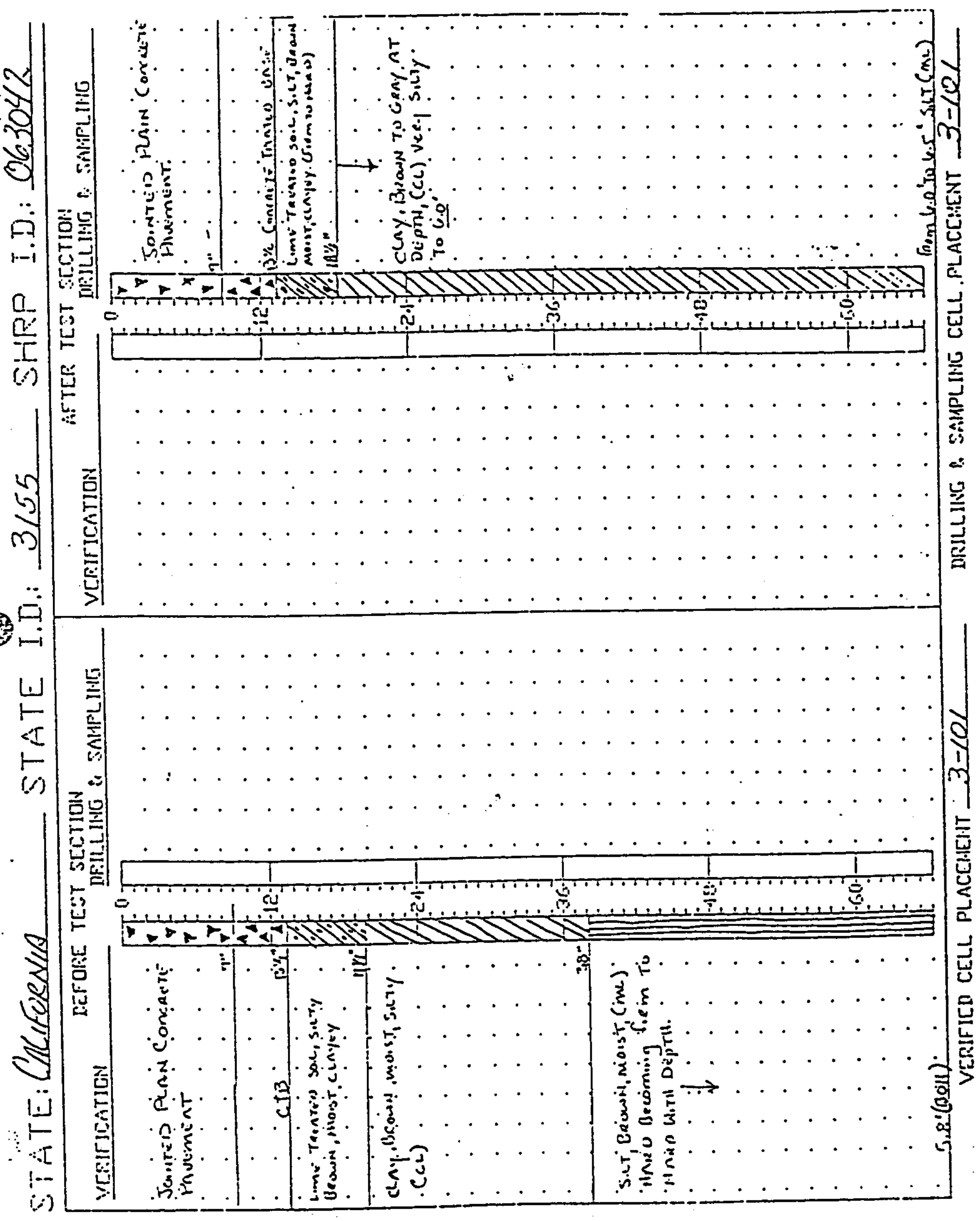


Figure A8. Profile of test section.

Revised May 29, 1992

STATE ASSIGNED ID _ _ _ _

SHEET 4

DISTRESS SURVEY

LTPP PROGRAM

STATE CODE 05

SHRP SECTION ID 3042

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 03/30/95

SURVEYORS: ME_, _ _ _, _ _ _
PAVEMENT SURFACE TEMP - BEFORE _ _ _ _°C; AFTER _ _ _ _°C
PHOTOS, VIDEO, OR BOTH WITH SURVEY (P, V, B) _

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
CRACKING			
1. CORNER BREAKS (Number)	1	0	0
2. DURABILITY "D" CRACKING (Number of Affected Slabs)	0	0	6
AREA AFFECTED (Square Meters)	.0	.0	2.1
3. LONGITUDINAL CRACKING (Meters)	.0	.0	.0
Length Sealed (Meters)	.0	.0	.0
4. TRANSVERSE CRACKING (Number of Cracks)	0	0	0
(Meters)	.0	.0	.0
Length Sealed (Meters)	.6	.0	.0
JOINT DEFICIENCIES			
5a. TRANSVERSE JOINT SEAL DAMAGE Sealed? (Y, N)			0
If "Y" Number of Joints	0	0	0
5b. LONGITUDINAL JOINT SEAL DAMAGE Number of Longitudinal Joints that have been sealed (0, 1, or 2)			0
Length of Damaged Sealant (Meters)			.0
6. SPALLING OF LONGITUDINAL JOINTS (Meters)	.6	.0	.0
7. SPALLING OF TRANSVERSE JOINTS Number of Affected Joints	1	1	0
Length Spalled (Meters)	.3	1.	.0

Revised May 29, 1992

SHEET 5

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID ___ ___ ___ ___

STATE CODE 0 6

SHRP SECTION ID 3 0 4 2

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 3 / 3 0 / 9 5
SURVEYORS: ME ___, ___ ___ ___

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
SURFACE DEFORMATION			
8a. MAP CRACKING (Number)			0
(Square Meters)			.0
8b. SCALING (Number)			0
(Square Meters)			.0
9. POLISHED AGGREGATE (Square Meters)			.0
10. POPOUTS (Number per Square Meter)			0
MISCELLANEOUS DISTRESSES			
11. BLOWUPS (Number)			0
12. FAULTING OF TRANSVERSE JOINTS AND CRACKS - REFER TO SHEET 6			
13. LANE-TO-SHOULDER DROPOFF - REFER TO SHEET 7			
14. LANE-TO-SHOULDER SEPARATION - REFER TO SHEET 7			
15. PATCH/PATCH DETERIORATION			
Flexible			
(Number)	0	0	0
(Square Meters)	.0	.0	.0
Rigid			
(Number)	0	0	0
(Square Meters)	.0	.0	.0
16. WATER BLEEDING AND PUMPING (Number of Occurrences)			0
Length Affected (Meters)			.0
17. OTHER (Describe) ___________			

Revised April 23, 1993

SHEET 6

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 0 5

SHRP SECTION ID 3 0 4 2

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 3 / 3 0 / 9 5
SURVEYORS: ME, _ _ _

3.6 ENTERED MAY 17 1995 By

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

12. FAULTING OF TRANSVERSE JOINTS AND CRACKS

Page 1 of 2

Point[1] Distance (Meters)	Joint or Crack (J/C)	Crack Length (Meters)	Well Sealed (Y/N)	Length of Joint Spalling, m L	M	H	Faulting[2], mm 0.3m	0.75m
3.1	J	3.7	N	.0	.0	.0	0	01
7.2	|	|	|	|	|	|	02	01
10.2	|	|	|	|	|	|	01	02
16.2	|	|	|	|	|	|	01	00
22.2	|	|	|	.0	|	|	02	00
26.6	|	|	|	1.	|	|	01	00
29.8	|	|	|	.0	|	|	03	00
35.2	|	|	|	|	|	|	0	00
41.1	|	|	|	|	|	|	02	00
45.2	|	|	|	|	|	|	02	01
48.9	|	|	|	|	|	|	0	01
54.3	|	|	|	|	|	|	01	01
60.1	|	|	|	|	|	|	02	01
64.2	|	|	|	|	|	|	0	0
67.7	|	|	|	.0	|	|	0	01
73.2	|	|	|	.4	|	|	-02	01
79.1	|	|	|	.0	|	|	0	00
83.0	|	|	|	|	|	|	0	0
86.7	|	|	|	.0	|	|	02	0
92.2	|	|	|	.1	.0	|	02	01
98.1	|	|	|	.0	.1	|	01	0
10[illegible].1	|	|	|	|	.0	|	0	0
105.7	|	|	|	|	|	|	0	01
111.2	|	|	|	.0	|	|	01	00
117.1	|	|	|	.3	|	|	0	0
121.1	|	|	|	.0	|	|	0	0
124.8	J	3.7	N	.0	.0	.0	0	01

Note 1. Point Distance is from the start of the test section to the measurement location.

Note 2. If the "approach" slab is higher than the "departure" slab, faulting is recorded as positive (+ or 0); if the "approach" slab is lower, record faulting as negative (-) and the minus sign must be used.

Revised April 23, 1993

SHEET 6

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID __ __ __ __

STATE CODE 0 5

SHRP SECTION ID 3 0 4 2

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 3 / 3 0 / 9 5

SURVEYORS: NE __ __, __ __ __

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

12. FAULTING OF TRANSVERSE JOINTS AND CRACKS

Point[1] Distance (Meters)	Joint or Crack (J/C)	Crack Length (Meters)	Well Sealed (Y/N)	Length of Joint Spalling, m L	M	H	Faulting[2], mm 0.3m	0.75m
130.2	J	3.7	N	.0	.0	.0	-02	00
136.1							0	0
140.1							01	00
143.6					.0		0	01
149.2	J	3.7	N	.0	.2	.0	0	0

ENTERED
MAY 10 1995
By

Note 1. Point Distance is from the start of the test section to the measurement location.

Note 2. If the "approach" slab is higher than the "departure" slab, faulting is recorded as positive (+ or 0); if the "approach" slab is lower, record faulting as negative (-) and the minus sign must be used.

Revised May 29, 1992

SHEET 7

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID ____

STATE CODE 06

SHRP SECTION ID 3042

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 03/30/95
SURVEYORS: mE, ___

ENTERED
MAY 10 1995
By

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

13. LANE-TO-SHOULDER DROPOFF

14. LANE-TO-SHOULDER SEPARATION

Point No.	Point[1] Distance (meters)	Lane-to-shoulder[2] Dropoff (mm)	Lane-to-shoulder Separation (mm)	Well Sealed (Y/N)
1.	0.	_01.	001.	N
2.	15.25 50	-_03.	002.	
3.	30.5 100	-_06.	001.	
4.	45.75 150	-_03.	001_.	
5.	61. 200	-___.	_19.	
6.	76.25 250	_02.	001.	
7.	91.5 300	-_18.	_21.	
8.	106.75 350	-_04.	010.	
9.	122. 400	-_02.	_18.	
10.	137.25 450	-_02.	009.	
11.	152.5 500	_00.	007.	N

Note 1. Point Distance is from the start of the test section to the measurement location. The values shown are SI equivalents of the 50 ft spacing used in previous surveys.

Note 2. If heave of the shoulder occurs (upward movement), record as a negative (-) value. Do not record (+) signs, positive values are assumed.

APPENDIX B

Installed Instrument Information

Appendix B Includes the following supporting information:

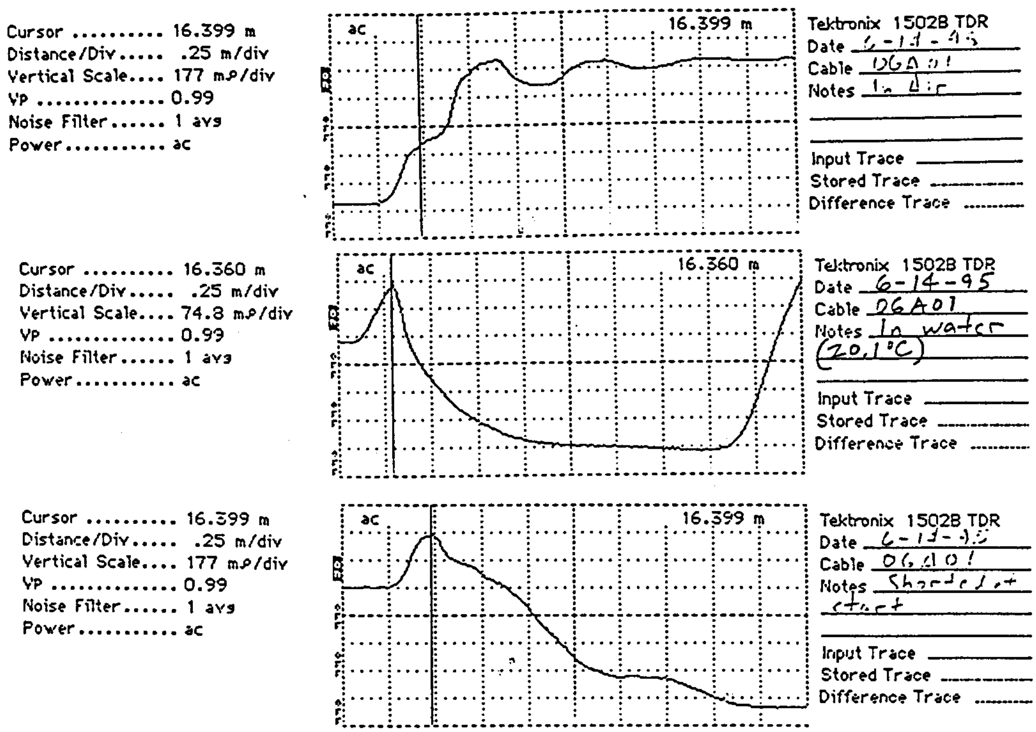


Figure B1. TDR traces obtained during calibration for sensor 06A01.

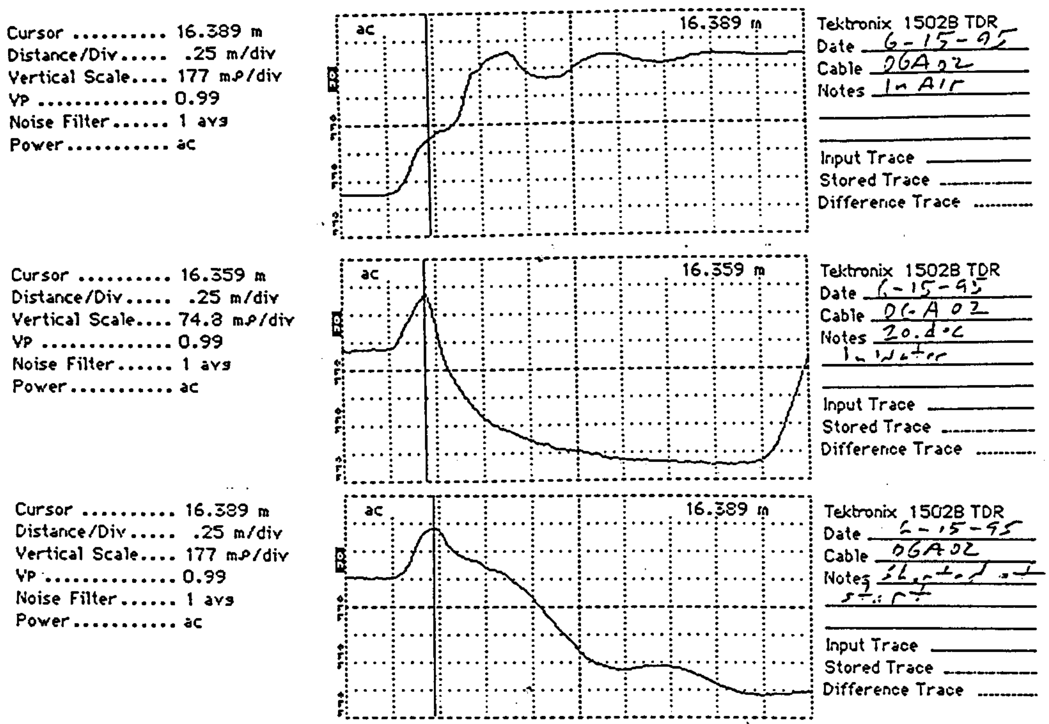


Figure B2. TDR traces obtained during calibration for sensor 06A02.

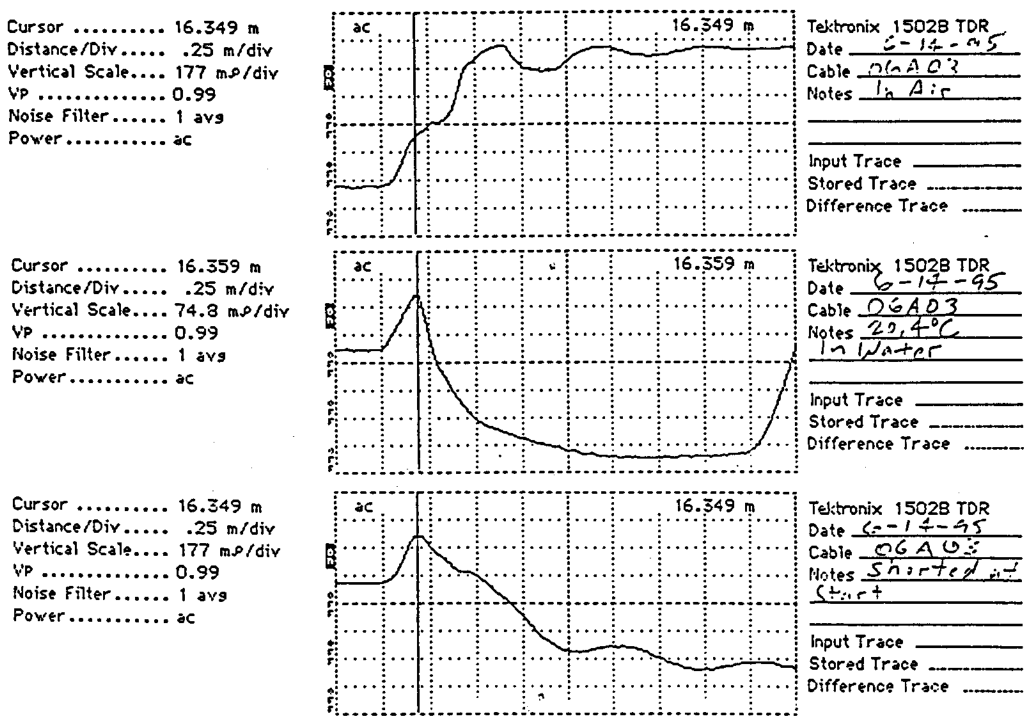


Figure B3. TDR traces obtained during calibration for sensor 06A03.

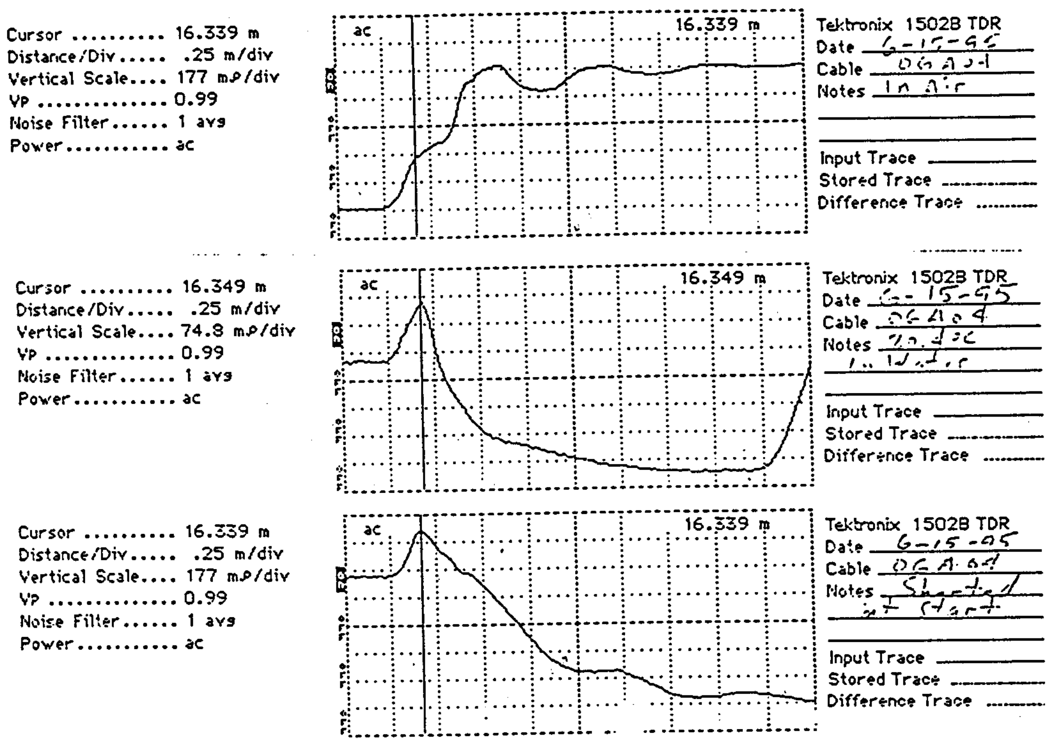


Figure B4. TDR traces obtained during calibration for sensor 06A04.

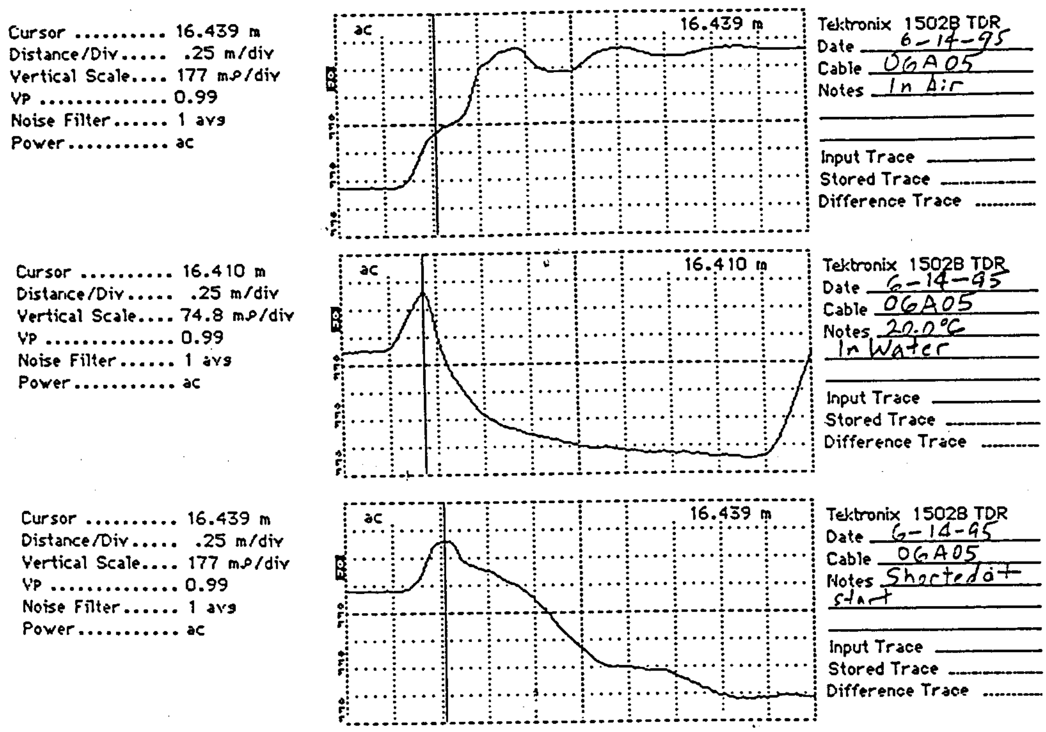


Figure B5. TDR traces obtained during calibration for sensor 06A05.

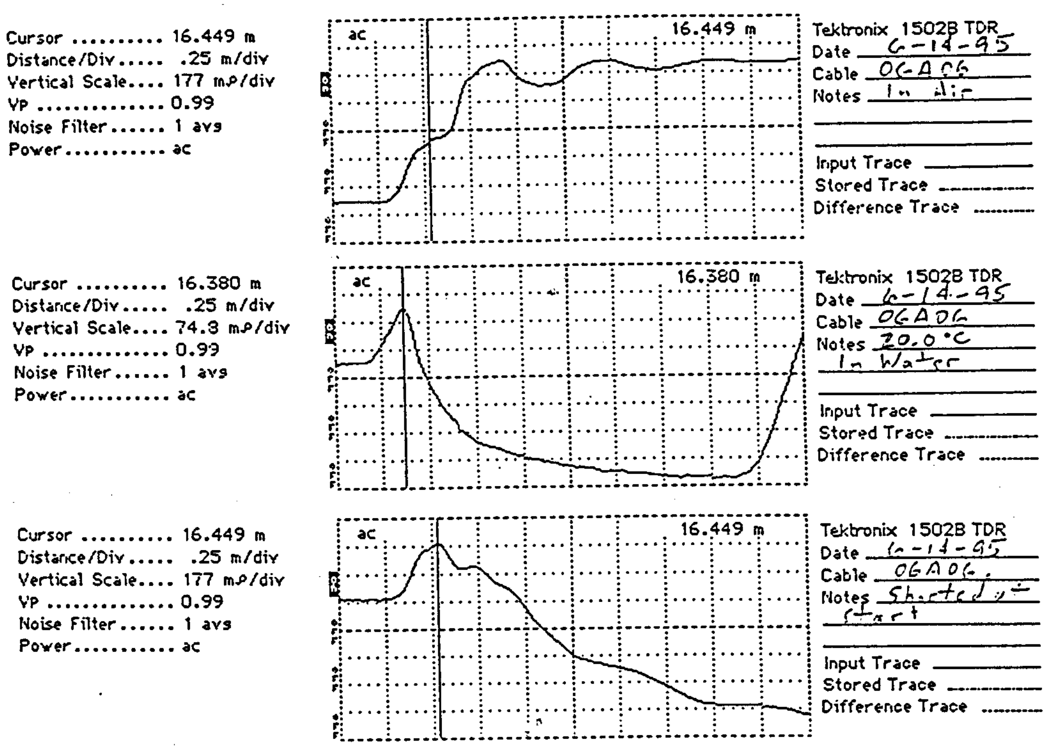


Figure B6. TDR traces obtained during calibration for sensor 06A06.

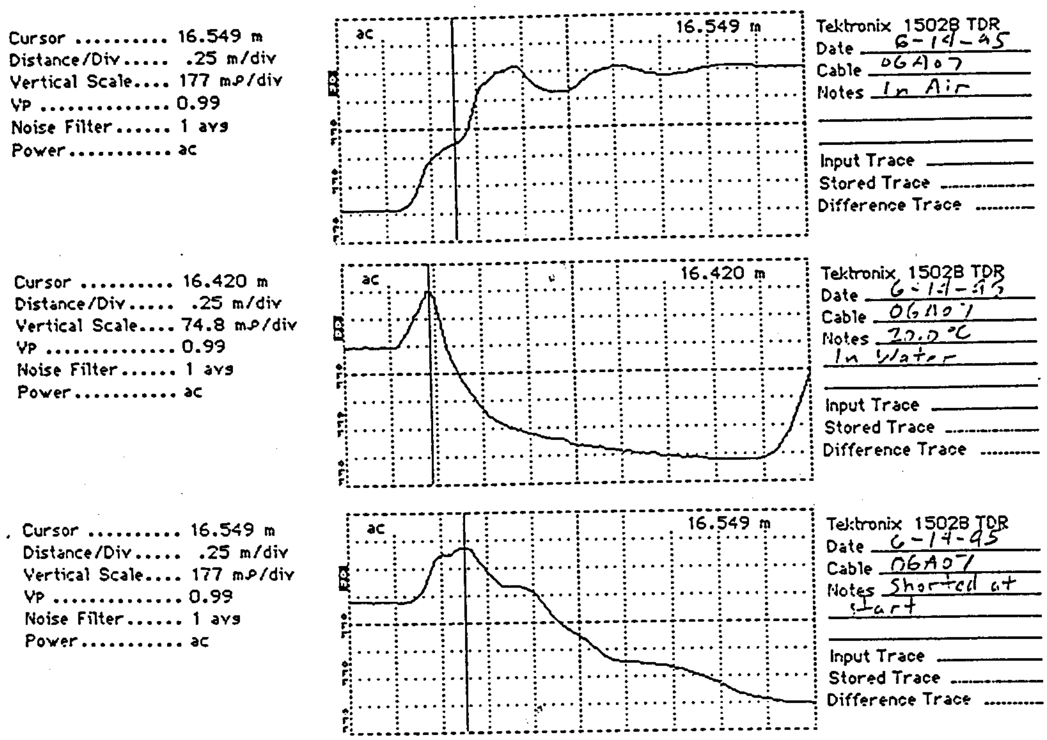


Figure B7. TDR traces obtained during calibration for sensor 06A07.

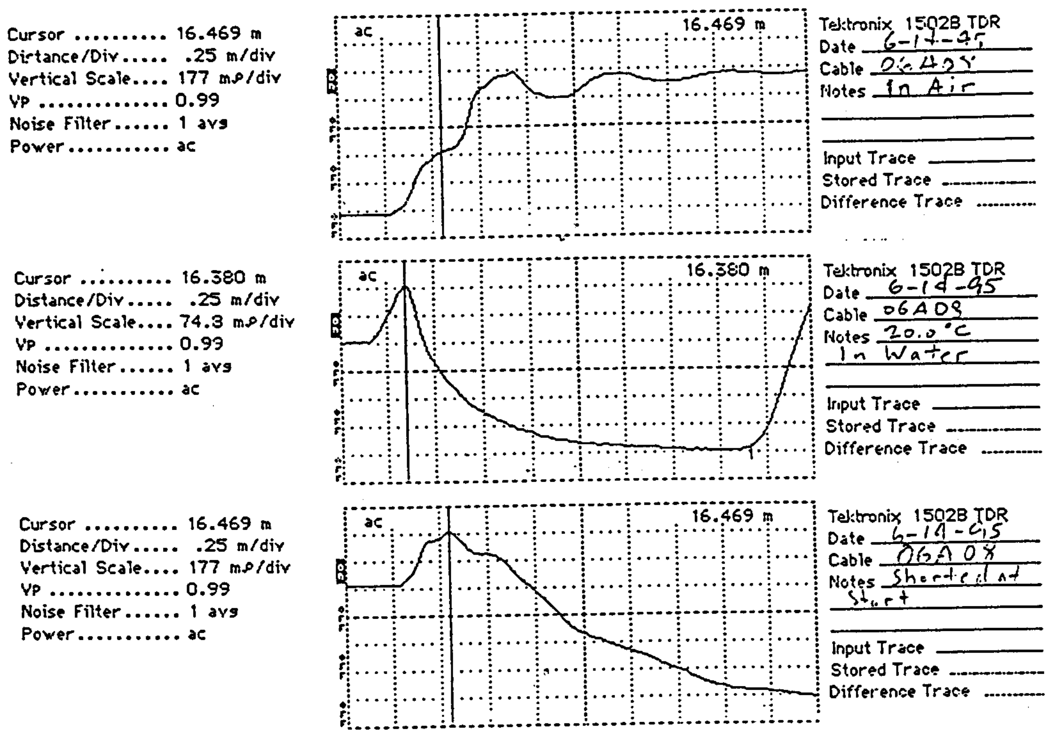


Figure B8. TDR traces obtained during calibration for sensor 06A08.

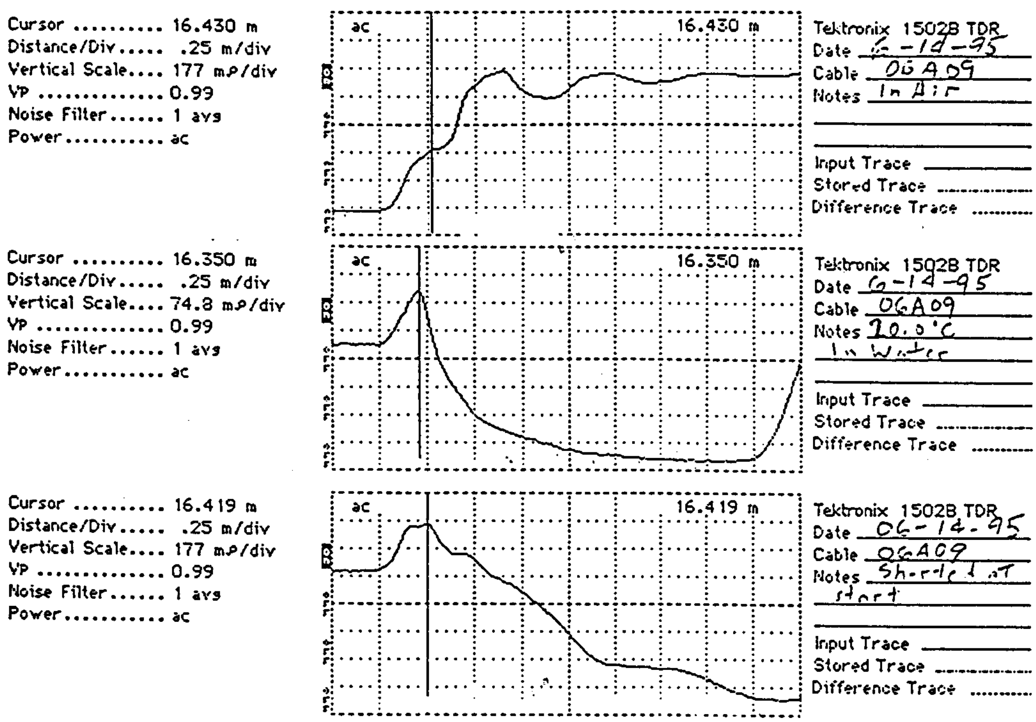


Figure B9. TDR traces obtained during calibration for sensor 06A09.

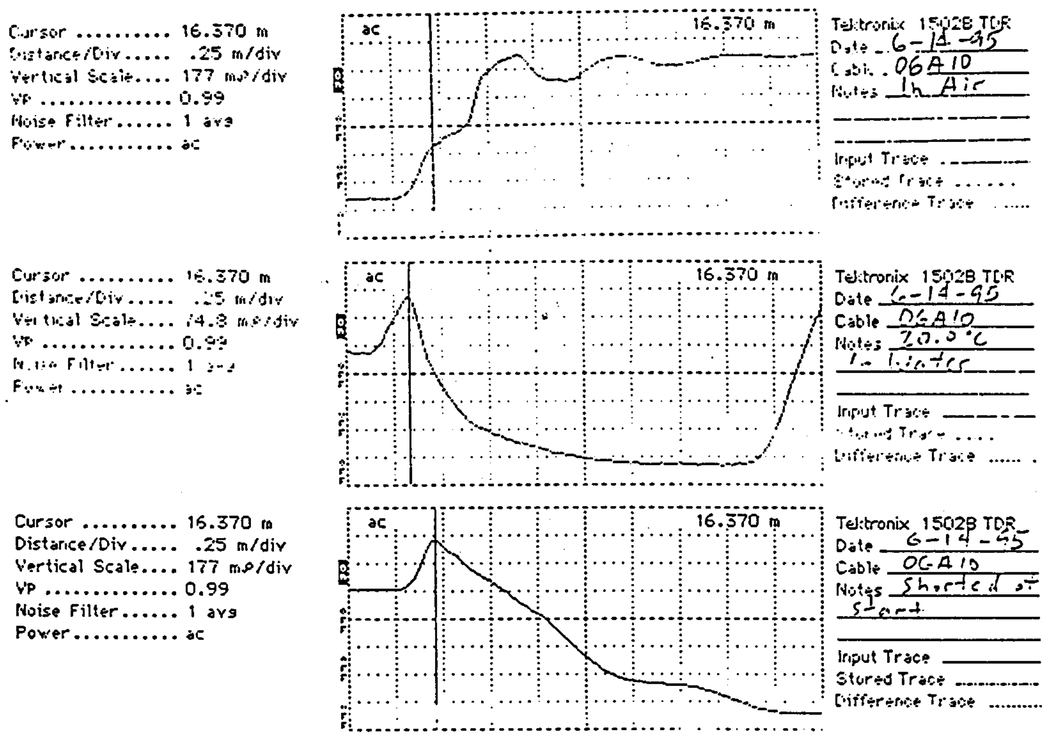


Figure B10. TDR traces obtained during calibration for sensor 06A010.

APPENDIX C

Installed Instrument Information

Appendix C includes the following supporting information:

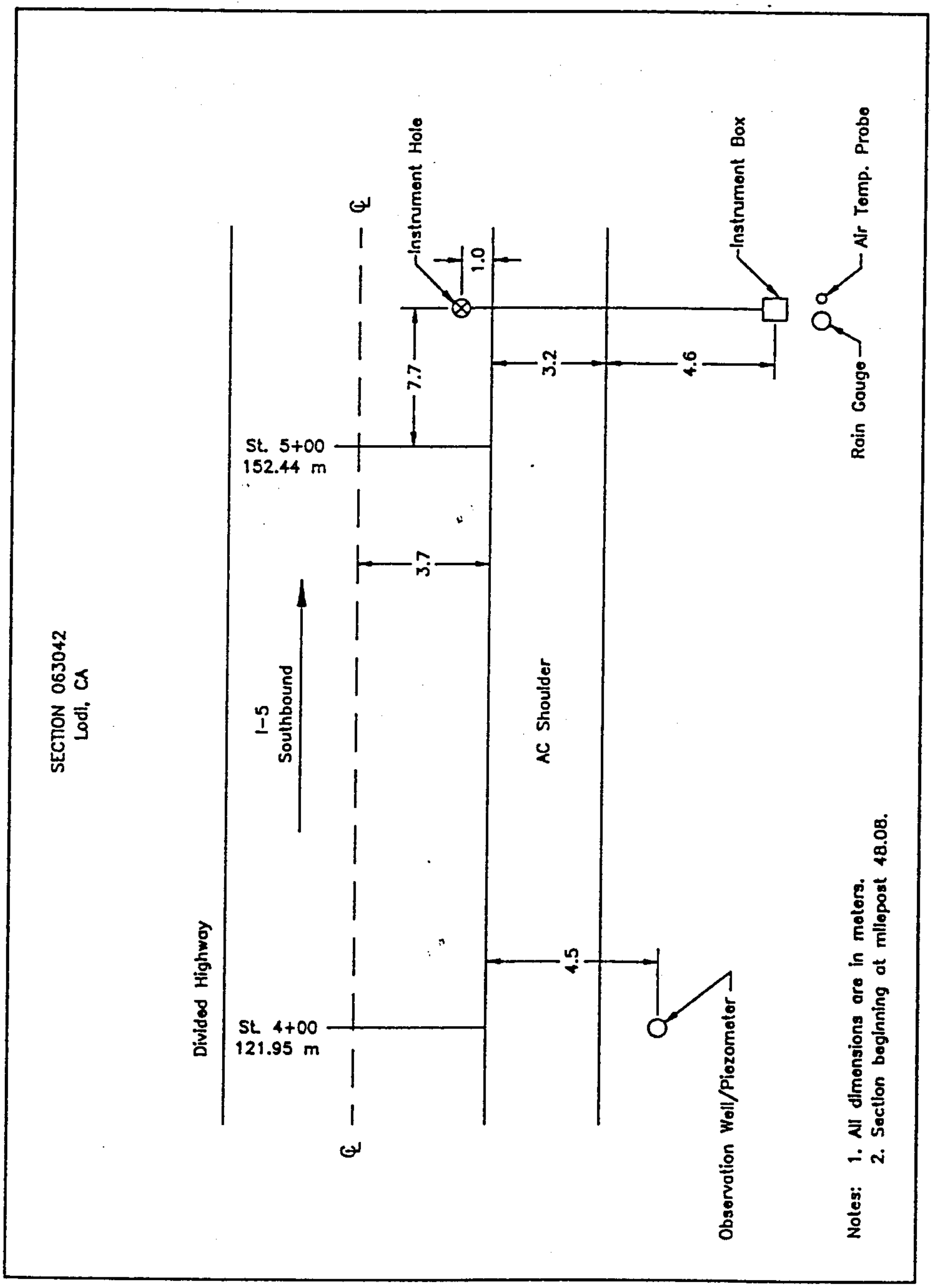


Figure C1. Location of SMP instrumentation on the site.

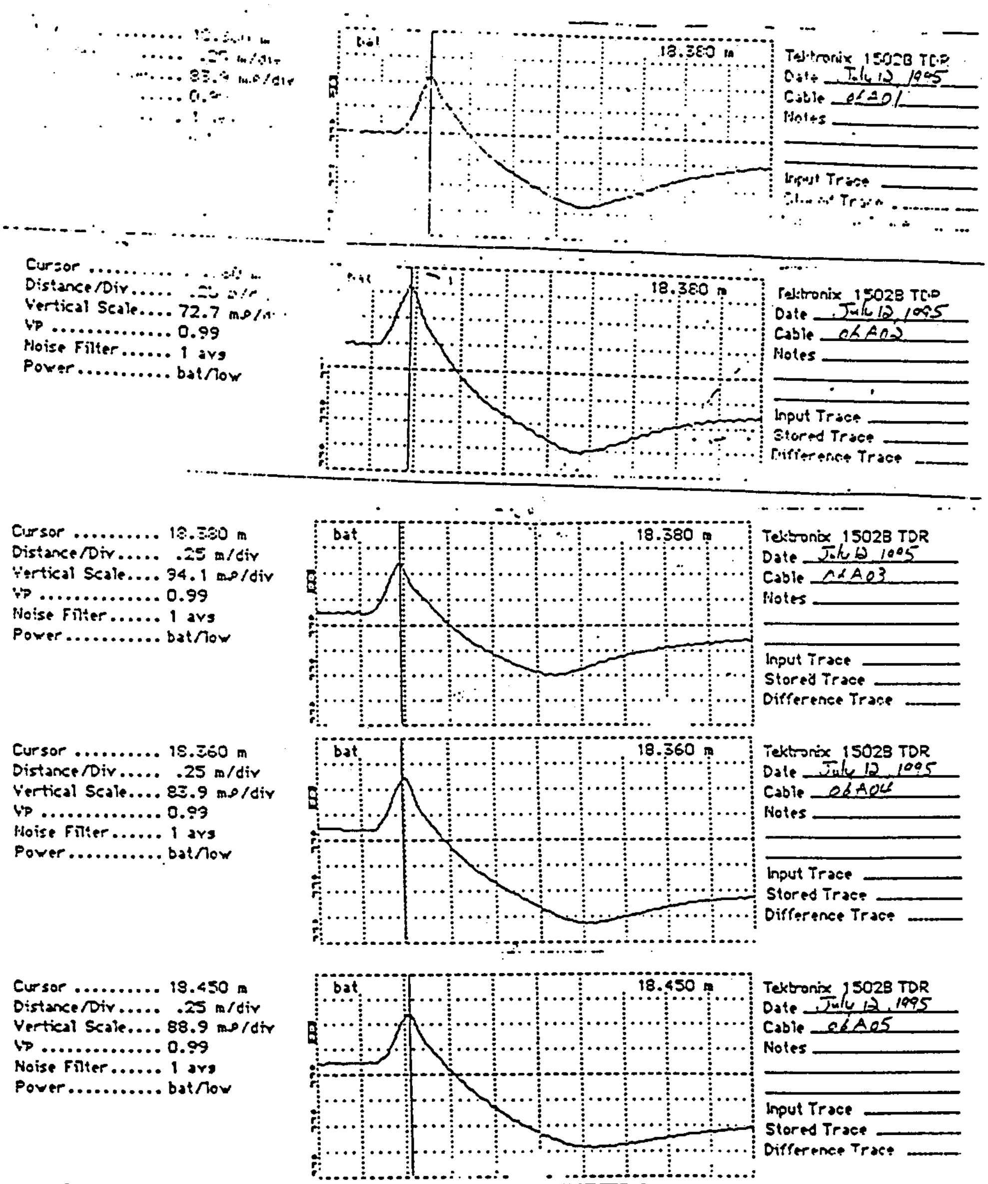
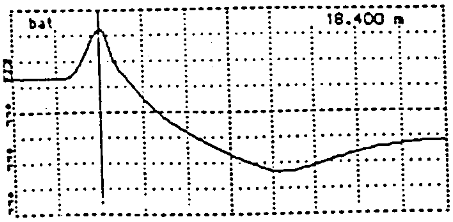


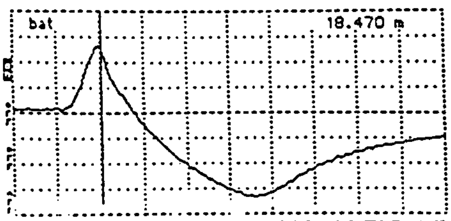
Figure C2. TDR traces obtained during installation for sensors 06A01 through 06A05.

Cursor .... 18.400 m
Distance/Div..... .25 m/div
Vertical Scale.... 81.6 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... bat/low



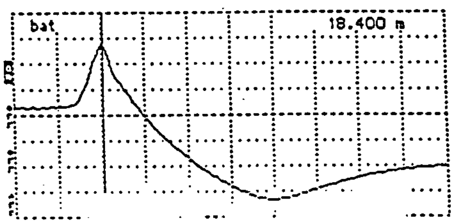
Tektronix 1502B TDR
Date July 12, 1995
Cable 06A06
Notes
Input Trace
Stored Trace
Difference Trace

Cursor .... 18.470 m
Distance/Div..... .25 m/div
Vertical Scale.... 68.6 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... bat



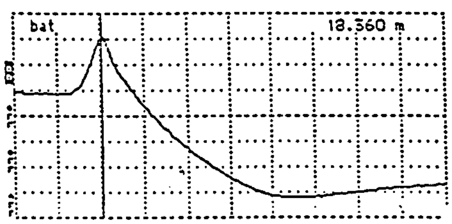
Tektronix 1502B TDR
Date July 12, 1995
Cable 06A07
Notes
Input Trace
Stored Trace
Difference Trace

Cursor .... 18.400 m
Distance/Div..... .25 m/div
Vertical Scale.... 77.0 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... bat



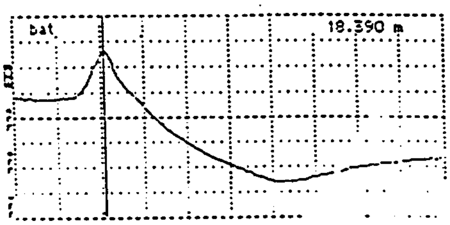
Tektronix 1502B TDR
Date July 12, 1995
Cable 06A08
Notes
Input Trace
Stored Trace
Difference Trace

Cursor .... 18.360 m
Distance/Div..... .25 m/div
Vertical Scale.... 83.9 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... bat



Tektronix 1502B TDR
Date July 12, 1995
Cable 06A09
Notes
Input Trace
Stored Trace
Difference Trace

Cursor .... 18.390 m
Distance/Div..... .25 m/div
Vertical Scale.... 94.1 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... bat



Tektronix 1502B TDR
Date July 12, 1995
Cable 06A10
Notes
Input Trace
Stored Trace
Difference Trace

Figure C3. TDR traces obtained during installation for sensors 06A06 through 06A10.

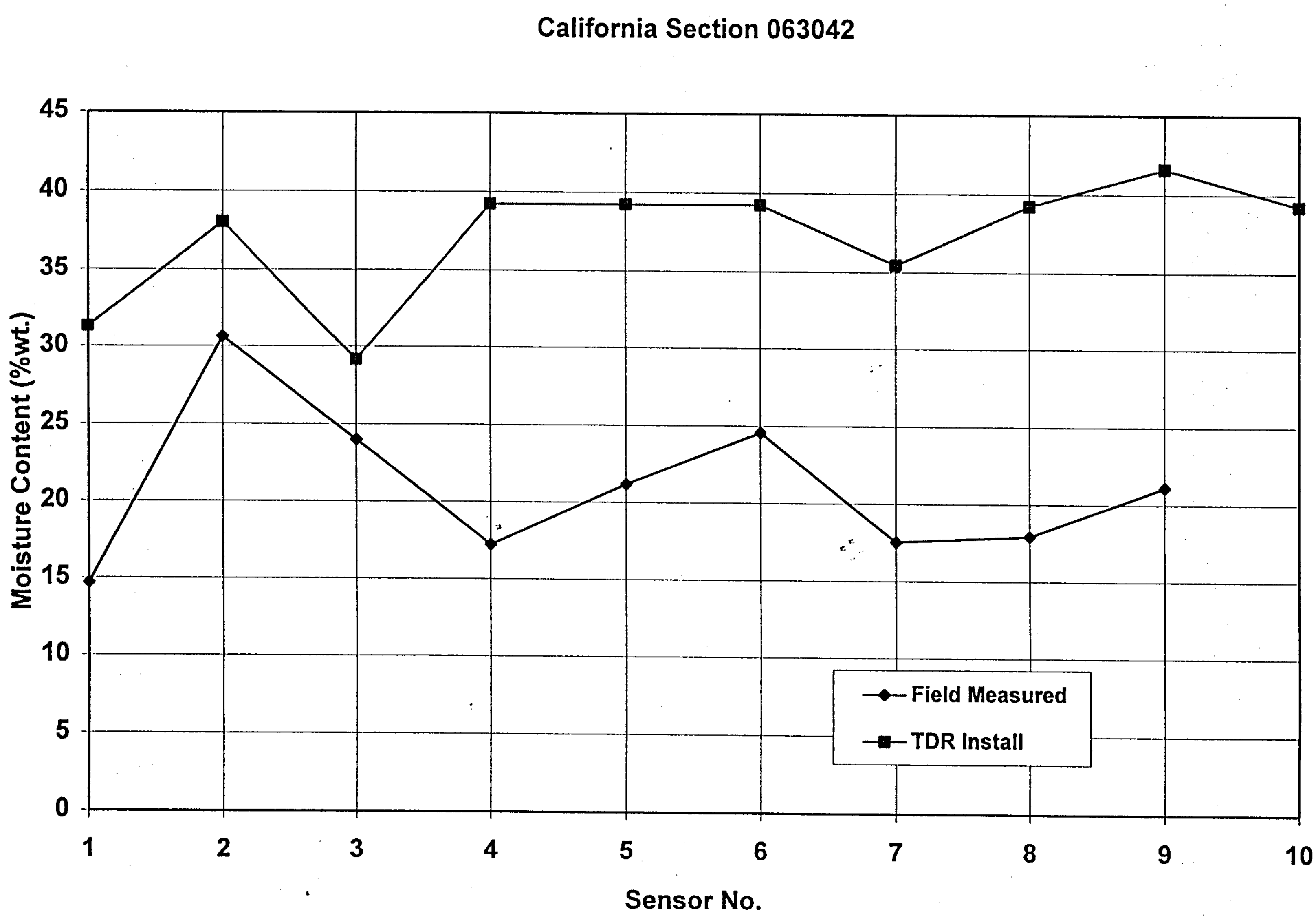


Figure C4. Moisture contents measured during installation.

Figure C5. Installation of TDR and thermistor sensors in progress.

Figure C6. Cable trench and the climatic equipment pole.

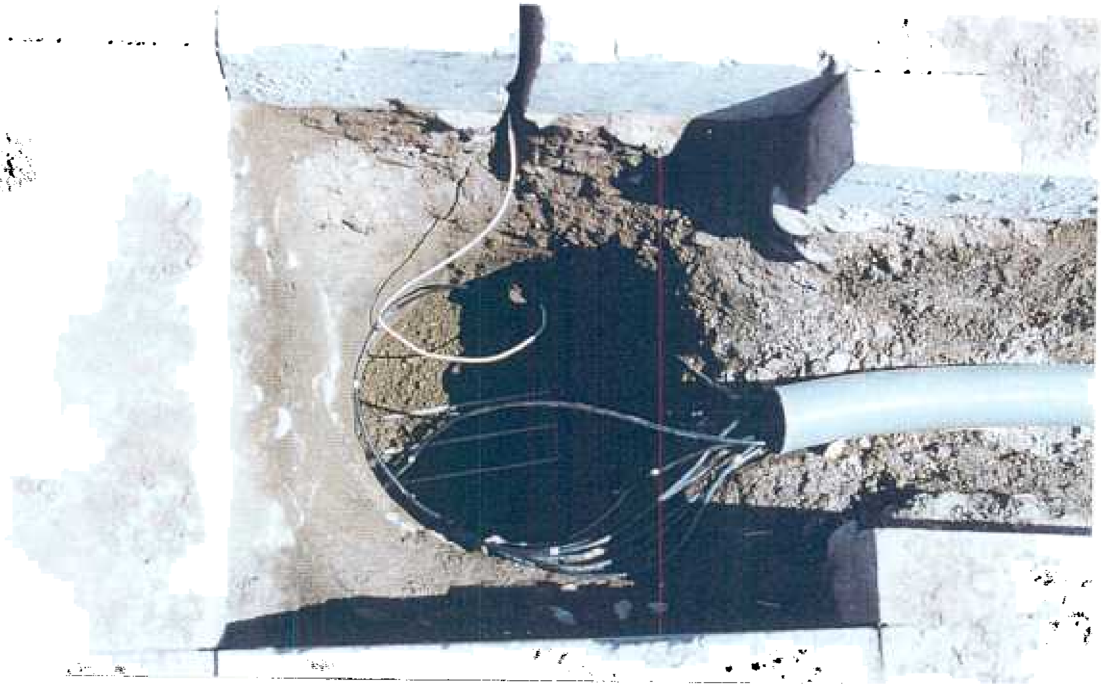


Figure C7. Instrumentation hole with the TDR and temperature sensors.

Figure C8. Equipment cabinet and climatic sensors.

Table C1. Field measured moisture contents at different depths.

LTPP Seasonal Monitoring Study Field Measured Moisture Contents	* State Code [06] * Test Section Number [3042]

Personnel : Michael Esposito
Date : 7/12/95
Start Time : NA
Finish Time : NA
Surface Type : Portland Cement Concrete
Weather Conditions : Clear.
Unusual Conditions : None

TDR Sensor Number	Field Measured Moisture Content %
10	104.1
9	21.2
8	17.9
7	17.5
6	24.6
5	21.2
4	17.2
3	24.0
2	30.7
1	14.7

* The moisture content calculated at this depth was quite unrealistic, therefore, not reported.

APPENDIX D

Initial Data Collection

Appendix D includes the following supporting information:

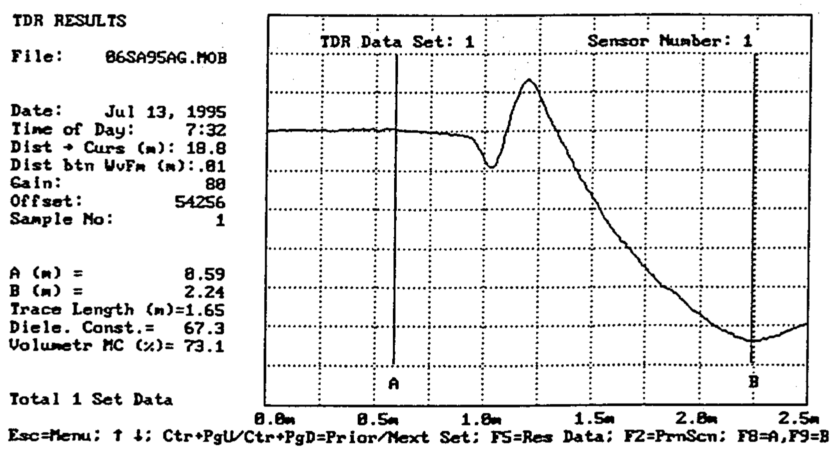


Figure D1. TDR trace for sensor 06A01 obtained during initial data collection.

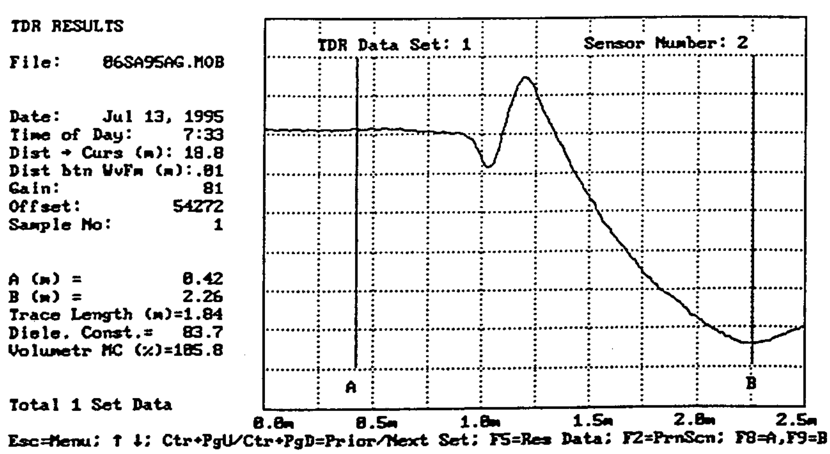


Figure D2. TDR trace for sensor 06A02 obtained during initial data collection.

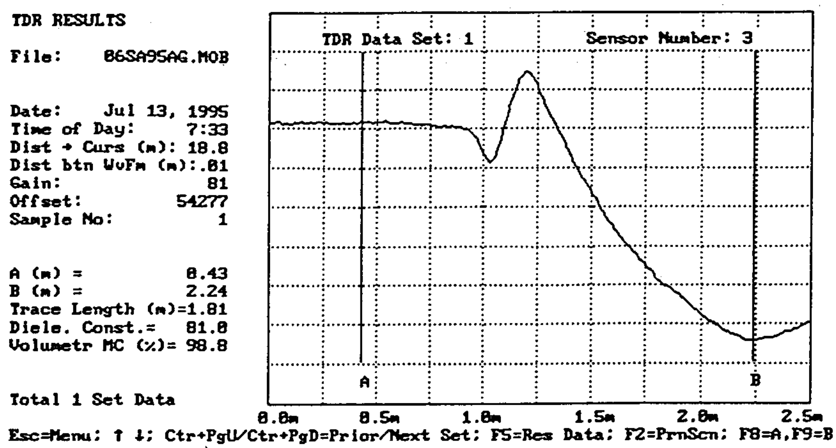


Figure D3. TDR trace for sensor 06A03 obtained during initial data collection.

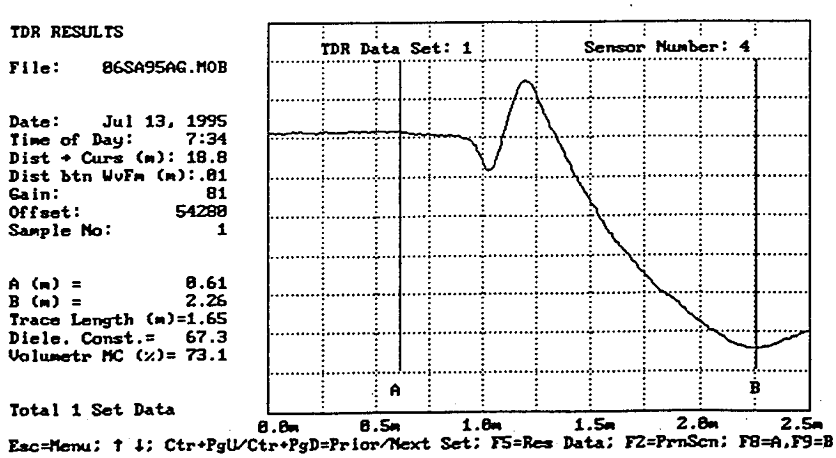


Figure D4. TDR trace for sensor 06A04 obtained during initial data collection.

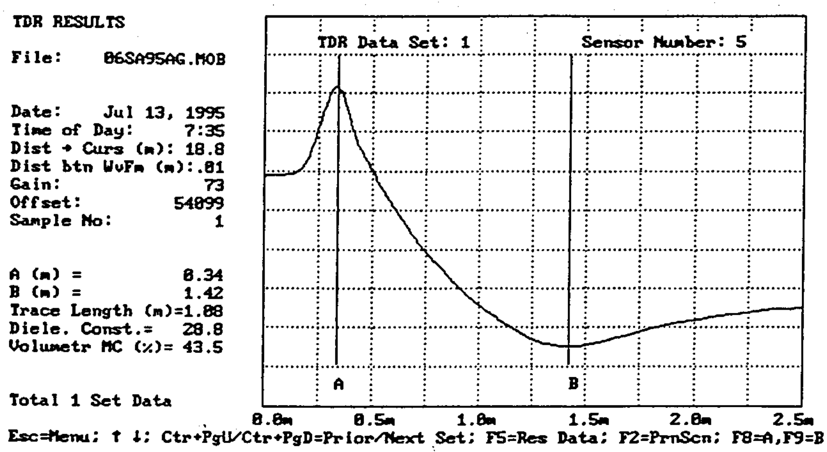


Figure D5. TDR trace for sensor 06A05 obtained during initial data collection.

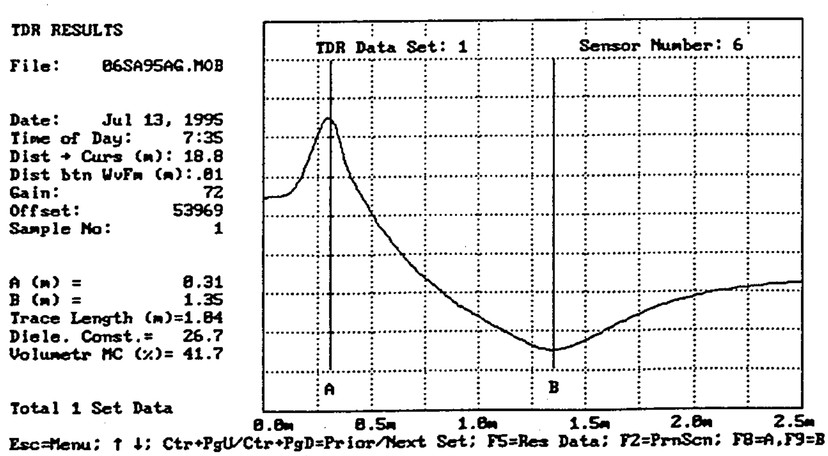


Figure D6. TDR trace for sensor 06A06 obtained during initial data collection.

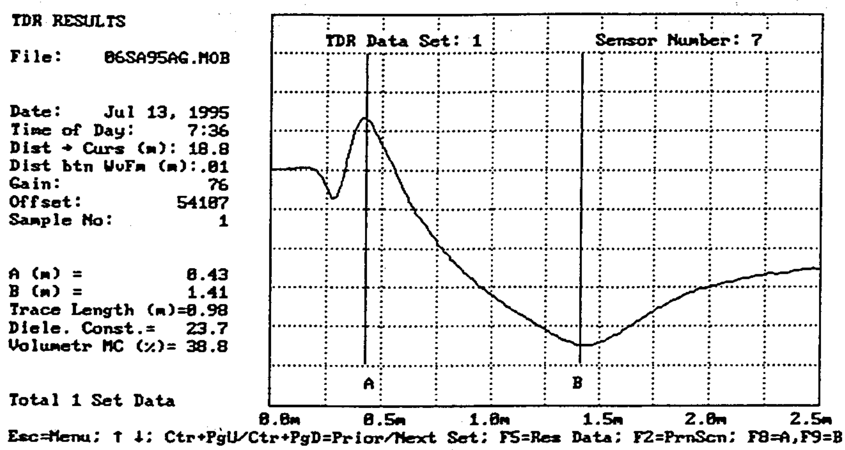


Figure D7. TDR trace for sensor 06A07 obtained during initial data collection.

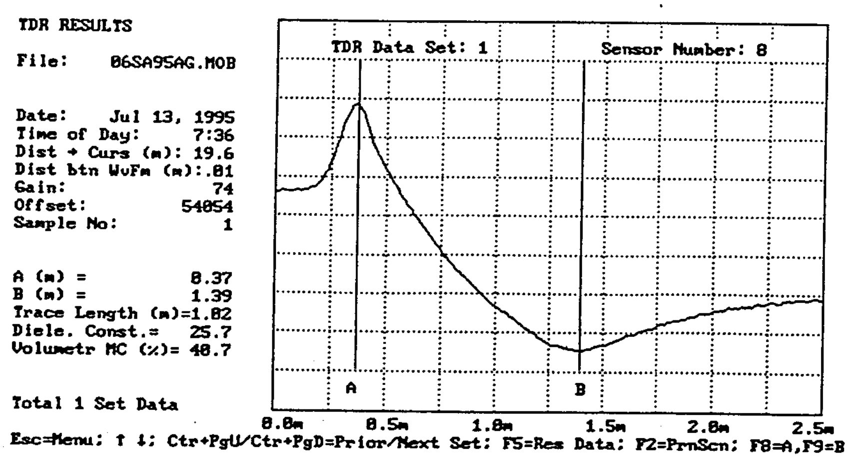


Figure D8. TDR trace for sensor 06A08 obtained during initial data collection.

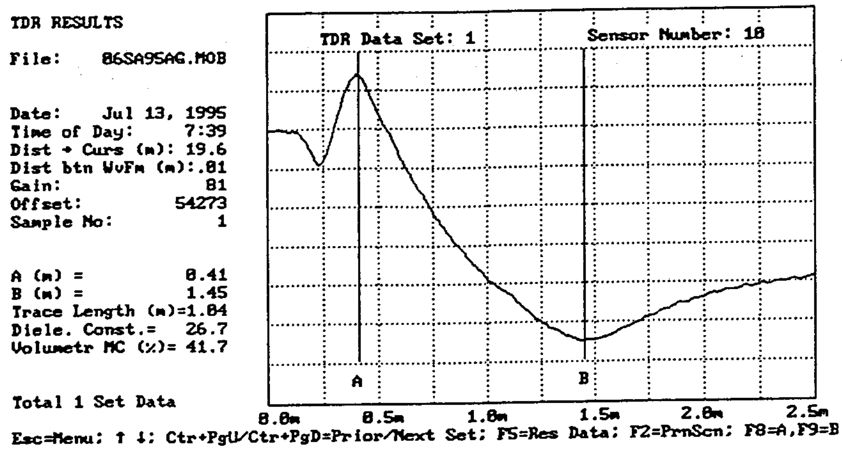


Figure D9. TDR trace for sensor 06A09 obtained during initial data collection.

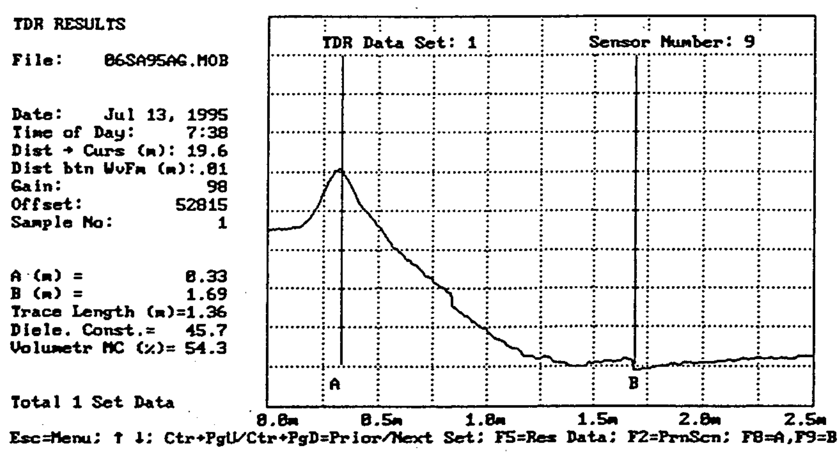


Figure D10. TDR trace for sensor 06A010 obtained during initial data collection.

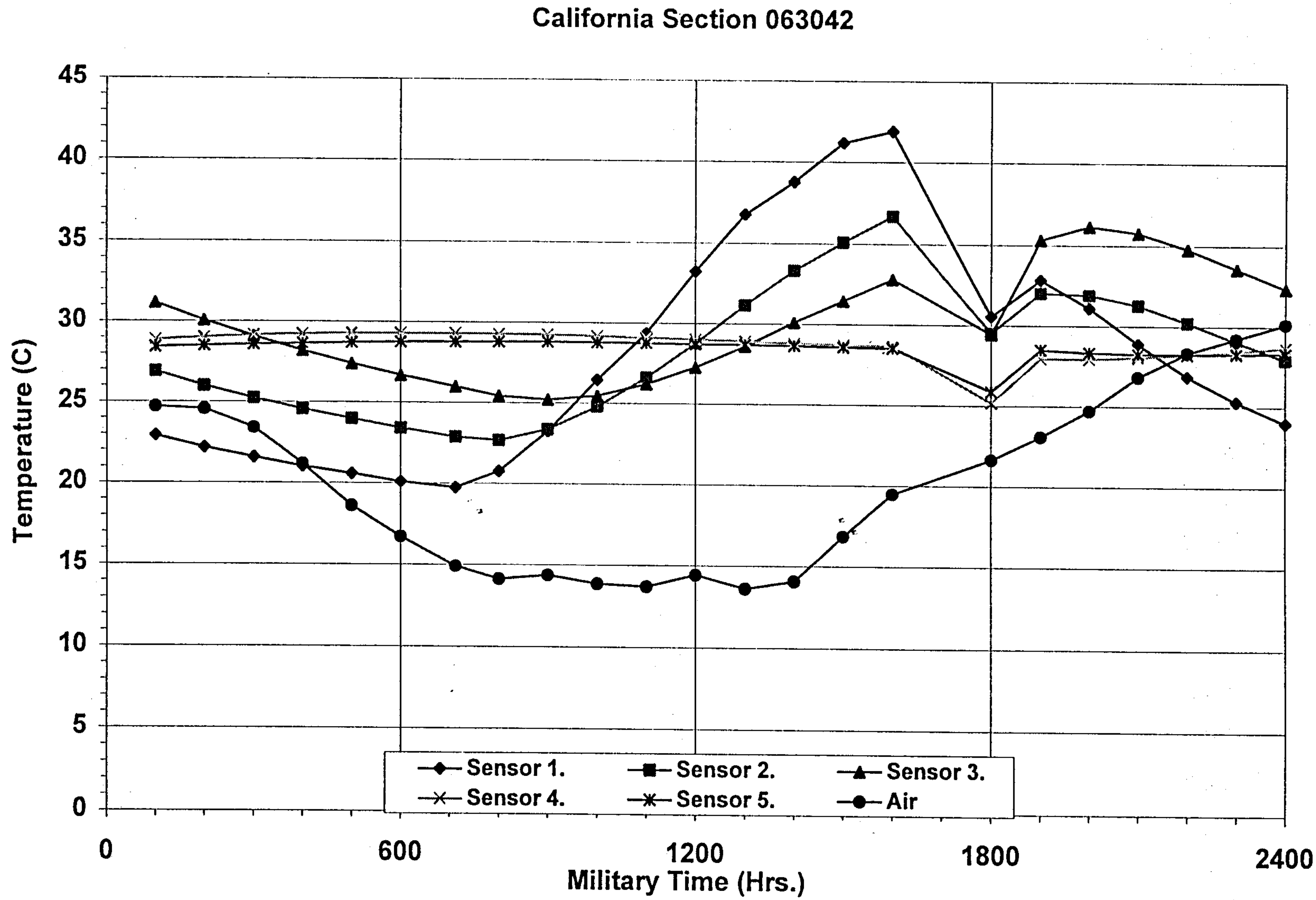


Figure D11. Hourly average air temperature and subsurface temperature at the top five sensors during initial data collection.

Table D1. Onsite raw data collected by the CR10 datalogger during initial data collection.

5	1995	193	1800	11.72	24.71	0																				
6	1995	193	1800	30.57	29.54	29	25.19	25.88																		
5	1995	193	1900	11.72	24.57	0																				
6	1995	193	1900	32.87	32.04	35	27.96	28.5																		
5	1995	193	2000	11.72	23.41	0																				
6	1995	193	2000	31.13	31.93	36	27.94	28.33																		
5	1995	193	2100	11.72	21.19	0																				
6	1995	193	2100	28.9	31.3	36	28.06	28.28																		
5	1995	193	2200	11.71	18.62	0																				
6	1995	193	2200	26.87	30.22	35	28.24	28.25																		
5	1995	193	2300	11.7	16.74	0																				
6	1995	193	2300	25.31	29.06	34	28.46	28.29																		
1	1995	193	2400	11.71	11.73	###	11.69	2351	20.39	25.56	1743	14.29	2359	0	4067											
2	1995	193	2400	28.41	30.33	34	27.92	28.09	28.27	28.35	28.31	27.84	26.82	26.3	25.74	25.22	24.65	24.16	23.73	23.04	22.25					
3	1995	193	2400	34.62	1721	33	1721	36.22	1953	28.77	2359	28.75	1721	29.03	1721	29.03	1732	29.01	1722	28.62	1721	27.21	1732	26.76	1724	26.45
4	1995	193	2400	20.56	1733	20	1734	19.06	1725	16.79	1730	17.52	1733	17.55	1734	17.96	1725	17.92	1726	17.66	1727	19.24	1725	19	1726	5.493
5	1995	193	2400	11.69	14.92	0																				
6	1995	193	2400	23.97	27.93	32	28.68	28.34																		
5	1995	194	100	11.69	14.14	0																				
6	1995	194	100	22.91	26.89	31	28.87	28.42																		
5	1995	194	200	11.69	14.39	0																				
6	1995	194	200	22.18	25.99	30	29.03	28.5																		
5	1995	194	300	11.69	13.88	0																				
6	1995	194	300	21.58	25.24	29	29.15	28.58																		
5	1995	194	400	11.69	13.73	0																				
6	1995	194	400	21.04	24.57	28	29.24	28.65																		
5	1995	194	500	11.68	14.45	0																				
6	1995	194	500	20.6	23.97	27	29.3	28.71																		
5	1995	194	600	11.68	13.63	0																				
6	1995	194	600	20.11	23.41	27	29.31	28.76																		
5	1995	194	700	11.68	14.09	0																				
6	1995	194	700	19.76	22.86	26	29.31	28.78																		
5	1995	194	800	11.68	16.89	0																				
6	1995	194	800	20.77	22.67	25	29.28	28.79																		
5	1995	194	900	11.69	19.5	0																				
6	1995	194	900	23.23	23.36	25	29.25	28.81																		
5	1995	194	1000	11.7	21.64	0																				
6	1995	194	1000	26.46	24.79	25	29.17	28.78																		
5	1995	194	1100	11.71	23.07	0																				
6	1995	194	1100	29.38	26.61	26	29.1	28.77																		
5	1995	194	1200	11.71	24.71	0																				
6	1995	194	1200	33.27	28.77	27	29.02	28.72																		
5	1995	194	1300	11.71	26.82	0																				
6	1995	194	1300	36.78	31.17	29	28.91	28.7																		
5	1995	194	1400	11.71	28.34	0																				