Determination of Soil Salinity and Soil Water Content Using Electromagnetic Induction

by

Keith R. Sheets
New Mexico Institute of Mining and Technology

May, 1994

H-N-V

Submitted in partial fulfillment of the requirements for the degree of Master of Science in Hydrology

Table of Contents

Acknowledgements

I would like to thank the Special Grants Water Quality Research Program of the United States Department of Agriculture and the New Mexico Tech Research Council for funding this project. I would like to thank the Special Grants Water Quality Research Program of the United States Department of Agriculture and the New Mexico Tech Research Council for funding this project.

I would also like to thank my advisor Jan Hendrickx for his positive support during my stay at New Mexico Tech. His ideas and input were essential for the success of the project.

I wish to thank Rob Bowman for the helpful suggestions on the salinity paper. Thanks to John Taylor for the opportunity to work at the Bosque del Apache National Wildlife Refuge. Special thanks to John Anderson for the countless bits of information on the LTER site and to Alan Guhtjar for the guidance on the statistical methods employed in the soil water content paper. Thanks to Edith, Loretta, Pat and Connie for all the secretarial work and making sure all the bureaucratic paper work was in order over the past two years.

I was very fortunate to come to Tech with a special group of fellow students. I know my time here at Tech would not have been nearly as fun or rewarding without them. Special thanks to my friends Carl Benson, Jeff Chaves, Matt and Ruth Davis, Jesse Dengate, Dan Detmer, Kim Edlund, Madeline Gotkowitz, Chris Grande, Rob Pine, Mitch Plummer, Tom Spijkers, Mike Yao, all the other Hydros and Rock-heads in the department, and all of the members of the Geosox 1993 Championship Softball Team.

List of Figures in Chapter 2

List of Tables in Chapter 2

List of Figures in Chapter 3

List of Tables in Chapter 3

Chapter 1

Introduction

This document is the culmination of an Independent Study for a Master of Science degree in Hydrology. The Independent Study focused on the use of electromagnetic induction for determining soil salinity and soil water content. The objectives of the study were: 1) To investigate the feasibility of soil salinity measurements with electromagnetic induction in riparian areas, and 2) To develop a method to measure soil water content with electromagnetic induction over large areas in arid regions. Two papers on these subjects were written and submitted to peer reviewed journals.

This is a joint study funded by Special Grants Water Quality Research Program of the United States Department of Agriculture and the New Mexico Tech Research Council.

The first journal article is entitled "*Rapid salinity mapping by electromagnetic induction for determining riparian restoration potential*", and has been submitted to the journal Restoration Ecology. The article presents a rapid, accurate, cost-effective method for determining soil salinity in riparian areas using electromagnetic induction. The study was conducted at the Bosque del Apache National Wildlife Refuge, 30 km south of Socorro, New Mexico.

The second journal article is entitled "*Non-invasive soil water content measurement using electromagnetic induction*", and has been submitted to the journal Water Resources Research. This article presents the results of a 16 month study of the relationship of soil water content and soil electrical conductivity. The capability of ground conductivity meters for monitoring the spatial and temporal variability of soil water in the Chihuahuan desert is evaluated. This study area was on the Jornada Experimental Range Site of the Long Term Ecological Research Network of the National Science Foundation near Las Cruces, New Mexico.

Appendices A1, A2 and A3 contain data from the Bosque del Apache Salinity Survey. Appendices A1 and A2 contain the EC_a measurements and converted EC_e measurements, for the EM 38 and EM 31, respectively. Appendix A3 contains the laboratory determined EC_e values and the observed clay contents at each measurement point.

Appendices B1 and B2 contain the data for the 16 month electromagnetic induction/soil water content study performed at the LTER/NSF site. Appendix B1 contains the 16 months of EM 31 measurements taken at 75 stations at 3 heights and two orientations at each height. Appendix B2 contains the soil water content data for each month of the study.

Chapter 2

Rapid Salinity Mapping by Electromagnetic Induction for Determining Riparian Restoration Potential

Keith R. Sheets[1]

John P. Taylor[2]

Jan M. H. Hendrickx[3]

1-CH2M HILL, P.O.Box 12681, Oakland Ca. 94604-2681
2-Bosque del Apache National Wildlife Refuge, P.O. Box 1246, Socorro, N.M. 87801
3-New Mexico Institute of Mining and Technology, Geoscience Department, Socorro, N.M. 87801

Submitted for publication in
Restoration Ecology (in press)

Abstract

The feasibility of measuring soil salinity with electromagnetic induction (EM) for determining riparian restoration potential was investigated on a 28 hectare plot at the Bosque del Apache National Wildlife Refuge in Central New Mexico. The plot was cleared of exotic _Tamarix chinensis_ (saltcedar), surveyed and gridded into 137 0.2 hectare sections. Soil samples and EM measurements were taken at each section. We compared laboratory-determined EC_e values from the soil samples with EC_e values calculated from the EM measurements using a model developed by Rhoades et al. (1990). Direct comparison of EC_e values determined from the two methods yields a low correlation due to sample-size differences but the calculated EC_e was able to accurately predict whether the measured EC_e would lie above or below some threshold value. An assessment of general site suitability for riparian restoration with electromagnetic induction has proven to be a rapid, accurate, and cost-effective alternative to intensive soil sampling.

Key Words: Riparian restoration, cottonwood, black willow, salt cedar, soil salinity, soil electrical conductivity, electromagnetic induction.

Introduction

The value of native riparian ecosystems to wildlife in arid regions of the southwestern United States is widely recognized. However, these habitats, characterized by Populus fremontii (cottonwood), Salix nigra (black willow) and associated understory species have been altered significantly through man-induced factors including flood control developments and the introduction of exotic vegetation (Hink and Ohmart 1984; Szaro 1989).

Structural diversity in riparian flora is important in assuring maximum plant productivity and vertebrate species richness (Ohmart and Anderson, 1986). Exotic Tamarix chinensis (salt cedar) in portions of the Middle Rio Grande Valley has been characterized as generally early successional, occurring in large monotypic tracts with little variation in vegetation structure. To provide structural diversity in this area, a 100-ha T. chinensis tract has been replaced with a native P. fremontii and S. nigra plant community. The mechanics of this conversion were derived from pioneering research on the lower Colorado River (Anderson and Ohmart, 1982) and tree establishment techniques developed in the Middle Rio Grande Valley (Swenson and Mullins, 1985).

Of critical importance in assuring the success of revegetation efforts is the determination of site suitability. For P. fremontii and S. nigra, knowledge regarding soil texture, soil salinity, and depth to water table is essential. Soil salinity is often expressed as EC_e, the electrical conductivity of a soil saturation extract. The current method of determining these parameters, developed by Anderson (1989), requires intensive field sampling using soil augering equipment followed by laboratory determination of salinity from distilled water extracts of collected saturated soil pastes. Further, to obtain the distribution of salinity with depth in a profile, several soil samples at different depths are required at each point of measurement. Although this abbreviated method for determining general site suitability balances data needs and costs, determination of site suitability using this method remains a timely and costly endeavor. For example, using the current method, this investigation required the collection and laboratory analysis of 274 soil samples (137 locations, with one sample from two depths at each location) to determine the EC_e distribution within the study area.

This study compares the current method for determining soil profile salinity with a rapid, accurate and cost-effective alternative using electromagnetic induction sensors (Geonics EM 31 and EM 38) (McNeill 1980a,b; Rhoades and Corwin 1981; Rhoades and Oster 1986) which measure the apparent electrical conductivity (EC_a) of the soil directly in the field. A number of studies have illustrated the effectiveness of the electromagnetic induction sensor for determining soil salinity (Slavich 1990; Slavich and Petterson 1990; Hendrickx et al. 1992). Rhoades et al. (1989), and Rhoades et al. (1990), presented a method to convert the measured EC_a (measured by the electromagnetic induction sensor) to the EC_e (salinity expressed as the electrical conductivity of a soil saturation extract).

Materials and Methods

<u>Study Area.</u>

The study was conducted on a 28-ha plot recently cleared of salt cedar at the Bosque del Apache National Wildlife Refuge, thirty-two kilometers south of Socorro, New Mexico in the Middle Rio Grande Valley. The Middle Rio Grande Valley is 1.5 to 8 km wide between steep mountain ranges on both the east and west. Valley floor elevations average 1,434 m, and include both Chihuahuan desert scrub and semidesert grassland (Brown and Lowe 1980; Brown 1982). Although soil mapping has not been conducted in the area, an extrapolation of the existing soil map in adjacent areas indicates soils are Saneli clays, Gila clay loams, Anthony sandy loams (Typic Ustifluvents) with 0-2 percent slope formed in recent alluvium (Johnson, 1988). Prior to removal, the dominant vegetation over the area was dense monotypic salt cedar maintained in its present state through periodic wildfire. Regional climatic conditions are characterized by high light intensity, low relative humidity, and an average Class A pan evaporation of 250 cm per year. Rainfall is extremely variable; average annual precipitation is 20-25 cm with 50% of the rainfall occurring between July 1 and September 30. The average maximum air temperature is highest in June (36° C) and lowest in January (13° C). (Johnson, 1988).

Survey Methods.

Soil Sampling. The plot was surveyed and gridded into 137, 0.2 hectare sections. Two soil samples were collected in the center of each section, 38 cm below the surface and 38 cm above the water table (depth to water table in this area was between 2.1 meters and 3.3 meters). The percent clay content of the soil and the EC_e, electrical conductivity of the extraction extract were then determined for each of these samples at the Revegetation and Wildlife Management Center, Blythe, California, a laboratory that specializes in riparian restoration.

EM Survey. Electromagnetic induction measurements were also taken at the center of each section with two Geonics ground conductivity meters, the EM 38 and EM 31 (McNeill 1980a,b; 1986)(Pictures 1 & 2). The EM instruments non-invasively measure the EC_a, the apparent bulk soil electrical conductivity. EC_a readings are obtained by simply placing the instrument on the ground. Readings take less than five seconds and are recorded by a data-logger connected to the instrument. The effective depth of the EM 31 is approximately 6 meters in the vertical mode and 3 meters in the horizontal mode. The effective depth for the EM 38 is 1.5 meters in the vertical mode and 0.75 meters in the horizontal mode. One can easily tell if the salinity is increasing or decreasing with depth by simply rotating the instrument and noting which orientation, vertical or horizontal, gives the highest conductivity reading.

Conversions. To convert the EC_a measurements into EC_e values, we used a method developed by Rhoades et al. (1990) to determine soil salinity from soil electrical conductivity. The method uses the following equations:

$$EC_a = \left[\frac{(\theta_s + \theta_{ws})^2 \, EC_{ws} \, EC_s}{(\theta_s) \, EC_{ws} + (\theta_{ws}) \, EC_s} \right] + (\theta_w - \theta_{ws}) \, EC_{wc} \qquad (1)$$

and

$$EC_e = EC_w \left[\frac{\theta_w}{\rho_b} \frac{100}{SP} \right] \qquad (2)$$

where θ_s is the volumetric content of soil, θ_w is the volumetric content of soil water, θ_{ws} is the volumetric content of immobile soil water, θ_{wc} volumetric content of mobile soil water, EC_s is the average electrical conductivity of the soil particles, EC_{ws} and EC_{wc} are the electrical conductivities of the soil water components θ_{ws} and θ_{wc} respectively. EC_w is the average electrical conductivity of the total water ($\theta_w = \theta_{ws} + \theta_{wc}$), ρ_b is the bulk density of the soil, and SP is the gravimetric water content of the saturation paste.

EC_w was obtained from the quadratic expression of Eq. (1), assuming $EC_{ws} = EC_{wc}$ as:

$$EC_w = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A} \qquad (3)$$

where A = $-[(\theta_s)(\theta_w - \theta_{ws})]$, B = $[(\theta_s)(EC_a) - (\theta_s + \theta_{ws})^2(EC_s) - (\theta_w - \theta_{ws})(\theta_{ws})EC_s)]$, and C = $[(\theta_{ws})(EC_s)(EC_a)]$. Previous results show that the assumption $EC_{ws} = EC_{wc}$ is a reasonable one (Rhoades et al. 1989). We used Procedure IV of Rhoades et al. (1990), which determines the unknown soil parameters from measurements or estimates of the water content and clay content of the soil.

Water content was not measured at the time of the survey, but an appropriate range in water content for these soils is between 15 and 30 volume percent (Slik 1993). The conversion from EC_a measurements to EC_e values is not sensitive to changes within this range; therefore, a water content of 20 volume percent was used for all calculations (Table 1). In the following discussion, "measured EC_e" refers to the laboratory determined EC_e; "calculated EC_e" refers to the estimated EC_e obtained from EM data using the procedure of Rhoades et al. (1990).

<u>Comparisons of EC values.</u> To compare measured EC_e taken at single points within the soil profile with calculated EC_e averaged across the soil profile by the EM instruments, we found that for the EM 38, the average of the upper (0.38 m) and lower (3 m) depths of measured EC_e corresponded with the vertical mode measurement (1.5 m), and for the EM 31, the lower measurement of the measured EC_e (3 m) corresponded to the horizontal mode measurement (3 m). To compare the measured EC_e to the calculated EC_e we examined how often both sets of values lie above or below a threshold value of 3.0 dS/m. Salinities above this critical value cause extreme losses in productivity of cottonwoods and willows. Losses in productivity begin at a threshold value of 2.0 dS/m (Anderson 1989). A probability value for the accuracy of each EM instrument's estimation of the salinity is calculated by

noting how often the measured and calculated EC_e's coincide to the same side of the threshold value.

Results and Discussion

Comparison of EC values. A direct comparison of measured EC_e to the calculated EC_e yields a low correlation because at each measurement point the EM instruments obtain a depth averaged measurement of the electrical conductivity for the entire soil profile, up to their effective depths, as opposed to the two point measurements of EC_e taken at the center of each section at the depths specified previously. In contrast, the calculated EC_e was able to predict whether the measured EC_e would lie above or below a given threshold value. Results of the threshold value test for the EM 38 show there was a 0.82 probability that the measured EC_e value and the calculated EC_e value would fall on the same side of the threshold value of 3.0 dS/m. For the EM 31, there was a 0.87 probability that the measured and calculated EC_e values would fall on the same side of the 3.0 dS/m value (Figures 3 and 4). Probabilities based on other threshold values are given in Table 2.

As stated previously, knowledge of clay content and water content of the soil where the EM measurement is taken is requisite for accurate data interpretation. Having determined the conversion of EC_a measurements to EC_e values is not sensitive to changes within the normal range of soil water content, a sensitivity analysis was performed with the mean clay content percentage determined from all soil samples taken in the field. We found that if the mean clay content of the soil for the entire study area (38.7% clay) was used in the conversion, the results of the threshold comparison did not change appreciably (Table 2). Therefore, adequate appraisals of soil salinity can be obtained when knowledge of the soil water content and clay content is limited.

Conclusions

We compared field sampling and laboratory determination of EC_e's with field surveys using EM instruments and appropriate conversions. Our results showed a high probability that data sets for measured EC_e values and calculated EC_e values would coincide above or below the threshold value of 3.0 dS/m, a value generally regarded as the upper limit for the survival and productivity of cottonwood and black willow plantings. Advantages of an EM survey are: 1) measurements can be taken almost as fast as one can move from one measurement location to another, therefore large areas can be surveyed in a fraction of the time it takes to survey an area with the current method; 2) the large volume of soil measured yields a more reliable representation of the electrical conductivity for the entire profile with depth; 3) measurements in relatively dry or stony soils are possible because contact between the soil and the EM sensor is not necessary (Hendrickx et al. 1992); and 4) conversion of EC_a to EC_e using the Rhoades et al. (1990) procedure is relatively simple because the conversion is not very sensitive to water content and clay content.

Literature Cited

Anderson, B.W. 1989. Research as an integral part of revegetation projects. *In:* Proceedings of the California Riparian Systems Conference, Berkeley, California. U.S. Department of Agriculture. U.S. Forest Service General Technical Report PS-110: 413-419.

Anderson, B.W. and R.D. Ohmart. 1982. Revegetation for wildlife enhancement along the Lower Colorado River. Report for U.S. Department of the Interior, Bureau of Reclamation, Contract No. 7-07-30-V0009. 215 pp.

Brown, D.E., editor. 1982. Biotic communities of the American Southwest-United States and Mexico. Desert Plants 4(1-4). 342 pp.

Brown, D.E. and C.H. Lowe. 1980. Biotic communities of the Southwest. Map. U.S. Forest Service General Technical Report RM-78.

Hendrickx, J.M.H., B. Baerends, Z.I. Raza, M. Sadiq, and M. Akram Chaudhry. 1992. Soil salinity assessment by electromagnetic induction on irrigated land. Soil Science Society of America Journal 56:1933-1941.

Hink, V.C. and R.D. Ohmart. 1984. Middle Rio Grande biological survey. Report for U.S. Department of Defense, Army Corps of Engineers, Contract No. DACW47-81-C-0015.

Johnson, W.R. 1988. Soil survey of Socorro County area, New Mexico. U.S. Department of Agriculture, Soil Conservation Service.

McNeill, J.D. 1980a. Electrical conductivity of soils and rocks. Technical Note TN-5. Geonics Ltd., Mississauga, Ontario, Canada.

McNeill, J.D. 1980b. Electromagnetic conductivity terrain measurement at low induction numbers. Technical Note TN-6. Geonics Ltd. Mississauga, Ontario, Canada.

Mcneill, J.D. 1986. Geonics EM 38 Ground Conductivity Meter. Tech. Note TN-21. Geonics Ltd. Mississauga, Ontario, Canada.

Ohmart, R.D. and B.W. Anderson. 1986. Riparian habitat. Pages 169-199 *in*: Inventory and monitoring of wildlife habitat. U.S. Department of the Interior, Bureau of Land Management. Service Center. Denver, Colorado. xviii, 858 pp.

Rhoades, J.D. and D.L. Corwin. 1981. Determining soil electrical conductivity-depth relations using an inductive electromagnetic soil conductivity meter. Soil Science of America Journal 45:255-260.

Rhoades, J.D. and J.D. Oster. 1986. Solute content. Pages 985-1006. *in*: A. Klute (editor). Methods of soil analysis, Part 1, Second edition, Agronomy Monograph 9. American Society of Agronomy and Soil Science Society of America, Madison, WI.

Rhoades, J.D., B.L. Waggoner, P.J. Shouse, and W.J. Alves. 1989. Determining soil salinity from soil and soil-paste electrical conductivities: sensitivity analysis of models. Soil Science of America Journal 53:1368-1374.

Rhoades, J.D., P.J. Shouse, W.J. Alves, Nahid A. Manteghi, and S.M. Lesch. 1990. Determining soil salinity from soil electrical conductivity using different models and estimates. Soil Science Society of America Journal 54:46-54.

Slavich, P.G. 1990. Determining ECa-depth profiles from electromagnetic induction measurements. Australian Journal of Soil Research. 28:443-452.

Slavich, P.G., and G.H. Petterson. 1990. Estimating average root zone salinity from electromagnetic induction (EM 38) measurements. Australian Journal of Soil Research. 28:453-463.

Slik, N. 1993. Time domain reflectometry for measuring bulk soil electrical conductivity and comparison with the EM 38 instrument. Internal Research Report. New Mexico Institute of Mining and Technology, Hydrology Program.

Swenson, E.A. and C.L. Mullins. 1985. Revegetating riparian trees in southwestern floodplains. Pages 135-138. *in*: Proceedings of the first North American riparian conference, April 16-18, 1985, Tucson, Arizona. 521 pp.

Szaro, R.C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants 9:69-138.

Table 1: Effects of varying water contents on EC_a to EC_e conversion:

EC_a reading mS/m	water content cm^3/cm^3	EC_e dS/m
20	0.15	0.89
	0.30	0.79
30	0.15	1.35
	0.30	1.19
40	0.15	1.81
	0.30	1.60
50	0.15	2.27
	0.30	2.00
60	0.15	2.72
	0.30	2.41
70	0.15	3.18
	0.30	2.81
80	0.15	3.64
	0.30	3.22
90	0.15	4.10
	0.30	3.63
100	0.15	4.55
	0.30	4.03
150	0.15	6.84
	0.30	6.06

TABLE 2: Probabilities of Agreement Between Measured and Calculated EC_e for Different Threshold Values:

Bosque del Apache Salinity Survey Probabilities for different threshold values								
EM 31 Horizontal Mode vs. Lower Measurement:								
Threshold value (dS/m)	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0
Actual clay %	0.92	0.90	0.87	0.82	0.79	0.83	0.89	0.93
Average clay %	0.95	0.90	0.88	0.86	0.82	0.82	0.88	0.94
EM 38 Vertical Mode vs. Lower and Upper Measurement average:								
Threshold value (dS/m):	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0
Actual clay %	0.64	0.76	0.82	0.85	0.85	0.84	0.89	0.91
Average clay%	0.65	0.76	0.83	0.88	0.87	0.87	0.88	0.93

TABLE 3: Cost comparison for Soil Sampling Method vs. EM Method (28 Hectare Survey)

	Soil Sampling Method	EM Method
Measurement Time	4 Days	4 hours
Labor/Equipment Cost	$1584.00	$600.00
Analysis of 274 soil samples/ 548 EC_a measurements	$1096.00	$160.00
Total Cost	$2680.00	$760.00

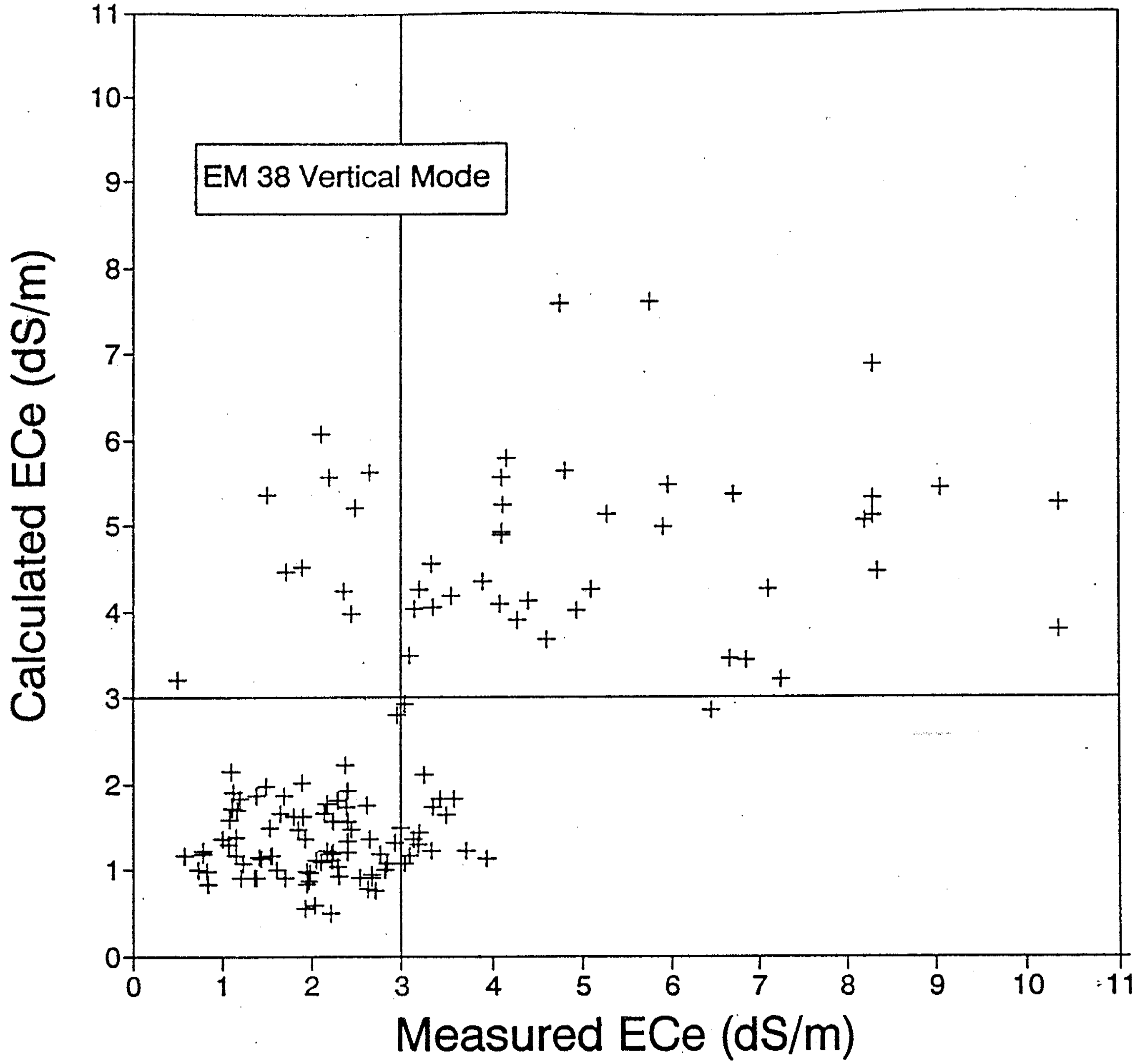


Figure 1. **EM 38 - Calculated Vertical EC_e vs. Measured EC_e (Using Sample Clay %)**

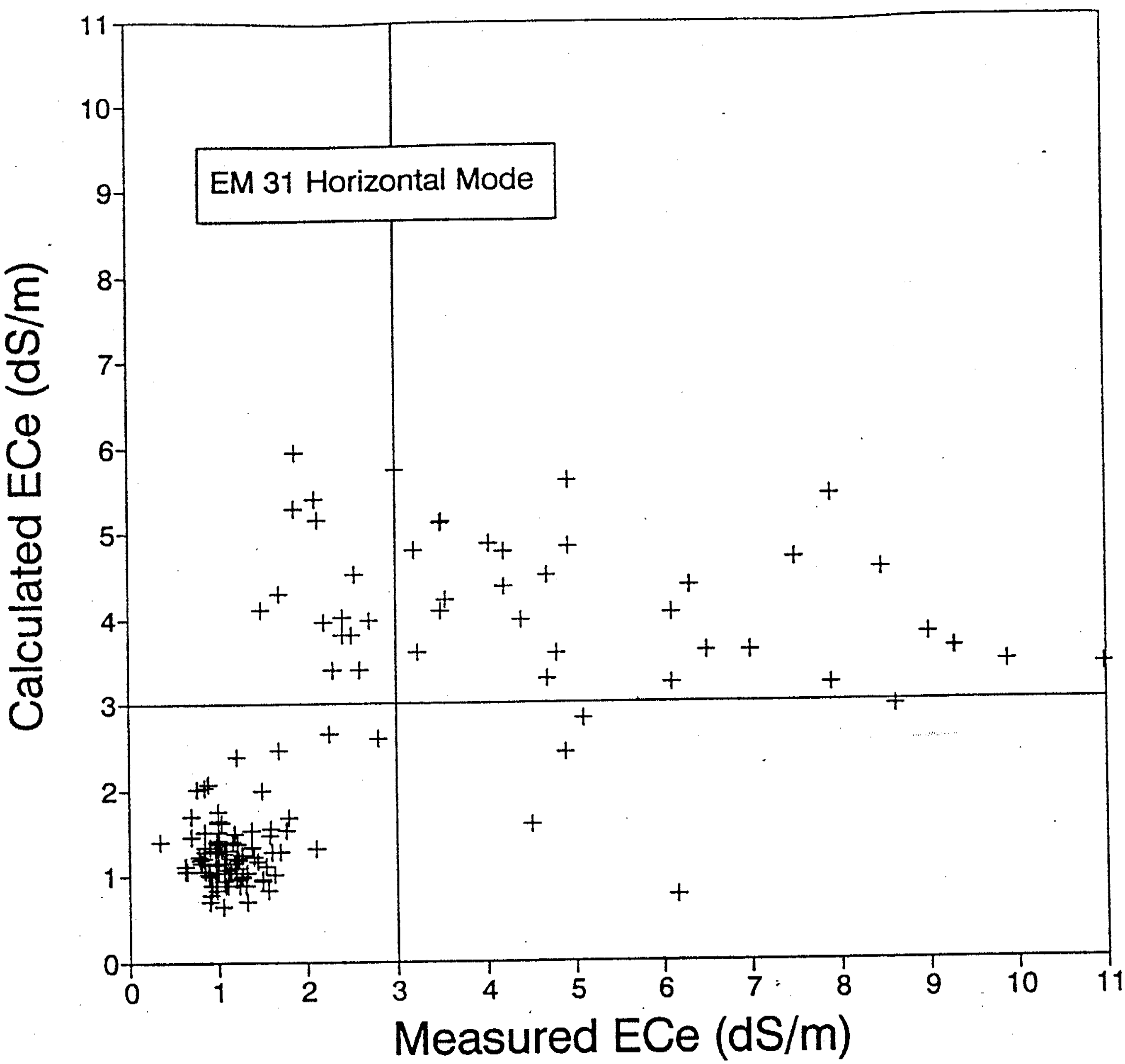


Figure 2. **EM 31 - Calculated Horizontal EC_e vs. Measured EC_e (Using Sample Clay %)**

Chapter 3

Non-Invasive Soil Water Content Measurement Using Electromagnetic Induction

Keith R. Sheets
and
Jan M. H. Hendrickx

Hydrology Program
Department of Geosciences
New Mexico Tech
Socorro, NM 87801

Submitted for publication in
Water Resources Research

ABSTRACT

The feasibility of soil water content measurement with electromagnetic induction was investigated in an arid region of southern New Mexico. Soil moisture measurements were taken monthly with a neutron probe at 65 equally spaced stations along a 1950 m transect. Non-invasive electrical conductivity measurements of the soil were taken simultaneously with a Geonics EM-31 ground conductivity Meter. Using 16 months of measurements, we found a linear relationship to exist between bulk soil electrical conductivity and total soil water content in the top 1.5 m of the soil profile. A simple linear regression model was developed to describe the relationship between soil water content and bulk soil electrical conductivity. The spatial and temporal accuracy of the regression model was addressed as well as the total number of neutron access tubes needed to accurately fit the model. We found the EM method to be the most accurate for predicting changes of water content over time. The speed and ease of use combined with the accuracy of the measurements reveals the ground conductivity meter as a valuable tool for rapid, non-invasive soil water measurements.

Introduction

Soil water content data are needed to understand the ecosystems and hydrology of arid deserts and semi-arid rangelands because many studies have shown that soil water content is an important physical parameter in determining plant growth and controlling ecosystem processes in arid and semi-arid areas. For example, Schlesinger et al. (1990) found that primary productivity and soil nutrient turnover are the greatest during periods of soil moisture availability. Noy-Meir (1973) found that soil water has both a direct effect on plant productivity and an indirect effect through its influence on decomposition and nutrient mineralization. Topp et al. (1980) demonstrated that knowledge of soil water contents over large areas is necessary for crop yield optimization and flood control. Information on areas of concentrated soil water may help in determining zones of recharge over large areas in arid regions (Gee and Hillel, 1988). Unfortunately, measurement of soil water content over large areas is a difficult procedure. Common procedures such as "*gravimetry with drying,*" "*neutron scattering,*" or "*time domain reflectometry*" require a great deal of manpower or are too destructive for repeated measurements at the same location (see Hendrickx, 1990). Further, these methods are time- consuming to perform, especially over large areas of extremely heterogeneous rangelands. For example, it took approximately one day to determine soil water content with the neutron probe in 90 access tubes 30 m apart along a 2700 m long transect in the Chihuahuan desert near Las Cruces, New Mexico (J. Anderson, personal communication, 1993). Before any of the measurements could take place, the 90 access tubes had to be installed to a depth of 1.5 m. This was a difficult operation due to the presence of caliche layers up to 1 m thick just below the surface. Therefore, there exists a definite need for quick and nondestructive measurement methods of soil water content over large areas.

The relation between soil water content and soil electrical conductivity has been confirmed by several investigators (Rhoades et al. 1976; Kachanoski et al. 1988; Hendrickx et al. 1992). Recent investigations with ground conductivity meters have shown that electrical conductivity measurements using electromagnetic induction have the potential for quick non-invasive soil water content measurements. For example, McNeill (1980a) found that the electrical conductivity of soil and rocks depends on the porosity and on the degree to which the pores are filled with moisture. Kachanoski et al. (1988) found that spatial variations of soil water were highly correlated to spatial variations of bulk soil electrical conductivity measured by electromagnetic inductive meters. However, to date, no studies have been conducted to investigate the potential of ground conductivity meters to quickly monitor soil water content over large areas during long time periods. Therefore, the objective of this study is to assess the capability of the ground conductivity meter for monitoring the spatial and temporal variability of soil water content in the Chihuahuan desert.

Materials and Methods

Study Area

The study was conducted on the New Mexico State University College Ranch, 40 km northeast of Las Cruces, NM. The area is part of the LTER (Long-Term Ecological Research Program) of the National Science Foundation which has been designed to quantify the effects of human perturbations on the stability and productivity of major ecosystems in the United States. A 2700 m transect is established here with 90 equally spaced neutron access tubes to monitor soil water content along the transect. All measurements for this study were taken along a 1950 m section of the transect, from station 11 to station 75. This segment will be called "**the transect**" in this study. To allow easy cross-reference to other publications about this LTER site, we will use the original station numbers. Stations 1-10 were omitted in this study because of their dissimilar soil conditions and stations 76-90 were omitted because of their close proximity to high voltage lines that affect the EM-31 instrument. The measurements along stations 1-10 will be analyzed in a forthcoming paper.

A thorough soil survey was performed along the transect in 1983 (Nash 1985). The mean values for sand, silt, clay, $CaCO_3$, and coarse fragments were calculated at each measurement station. The sand and clay content of the soil along the transect is fairly homogeneous. The mean sand and clay content and their standard deviations are: 72.5% $\pm$ 4.4 and 13.8% $\pm$ 3.9, respectively.

There are five soil series recognized along the transect: Bucklebar (stations 11-25), Berino (stations 26-45), Onite (stations 46-55), Dona Ana (stations 56-70), and Alladin (stations 71-89). All are Typic Haplargids, mixed, thermic (except Alladin which is a Torriorthentic Haplustoll). The Bucklebar and Berino soils are fine-loamy and the Onite, Dona Ana and Alladin soils are coarse-loamy. The Bucklebar soils are deep and well-drained, consisting of sandy loam, sandy clay loam, and silty clay loam. They lack a calcic horizon within 1 m depth. The Berino soils are similar to Bucklebar soils, except they have a calcic horizon within 1 m. The Onite soils are similar to Berino soils with a coarser texture. Onite soils are not calcareous in the first 5 cm from the soil surface. The

Dona Ana Soils are similar to Onite soils, except they are calcareous throughout the soil profile. The Alladin are similar to the Onite soils with a coarser texture.

Climate in the region is characterized by an abundance of sunshine, low relative humidity, and an average Class A pan evaporation of 239 cm per year (Malm and Houghton, 1977). Rainfall is extremely variable. Average annual precipitation is 23 cm with 52% of the rainfall occurring between 1 July and 30 September. Nash (1985) presents more details of the soils along the transect.

Data Collection

Sixty-five measurement stations were established along the transect at 30 m intervals. Soil water content and the bulk soil electrical conductivity of the soil profile (EC_a) were measured simultaneously at each station 16 times between February 1992 and June 1993 (approximately once a month).

Neutron probe measurements: Soil water content was measured at the 65 stations with a neutron probe at depths of 30, 60, 90, 110, and 130 cm below the soil surface. Neutron probe readings were converted to volumetric water contents using a single calibration curve for the entire transect (Wierenga et al. 1987). Next, the water contents at each depth were used to calculate the total amount of water in the soil profile at each station to a depth of 1.5 m using the following equation:

$$TWC = \theta_{30} * 0.45m + \theta_{60} * 0.30m + \theta_{90} * 0.25m + \theta_{110} * 0.20m + \theta_{130} * 0.30m \quad (4)$$

where: TWC = Total amount of water measured in the top 1.5 m of the soil profile, in meters;

θ_n = soil water content at a depth of n centimeters.

EM measurements: The EC_a was measured approximately 10 m south from each measurement station with a Geonics EM-31 ground conductivity Meter. Measurements had to be located 10 m away from the neutron probe measurement stations because of the presence of aluminum access tubes that would affect the readings. (Barbed wire fence, high voltage lines, or any large amounts of metal will affect the EM-31 readings.) The EM-31 measures the average EC_a from the soil surface to about 6 m depth in the vertical dipole mode coil configuration and 3 m depth in the horizontal dipole mode configuration. To obtain a better resolution with depth, the EC_a measurements were taken with the EM-31 held at three different heights (89 cm at hip height; 40 cm at knee height, and at soil surface) and two different orientations (vertical; horizontal) at each station. An additional reading from the hip height/vertical mode was taken at each station on the return trip down the transect to determine the amount of instrument measurement error. A data logger was connected to the EM-31 and automatically logged each measurement. It takes approximately two hours for the initial measurement of the transect with the instrument at the three different heights/orientations and 30 minutes for the return measurements down the transect, with the instrument at one height and orientation. In theory, the Geonics EM-38 would be the ideal instrument for this study because its penetration depth is approximately 1.5 m, thus coinciding with the neutron probe depth of measurement. However, it could not be used due to the extremely high magnetic susceptibility of the soil. High concentrations of iron and manganese in the soil generate an outside signal that alters the readings of the EM-38, whereas the EM-31 has circuitry to null this outside signal. The spatial variability of EC_a around each station was measured on 3/7/93 by taking ten additional measurements at each station, 5 m on either side of the assigned station.

Slavich and Petterson (1990) reported that EC_a measurements vary considerably during the year due to changes in soil temperature. They concluded that it is necessary to standardize field measured EC_a values by conversion to an equivalent electrical conductivity at a reference temperature of 25 degrees Celsius through the use of a conversion table given in the USDA Agricultural Handbook #60 (1954). A curve was fitted to this conversion table to give the following temperature standardization equation:

$$EC_{25} = EC_a * (0.4470 + 1.4034\ e^{-\frac{T}{26.815}}) \tag{2}$$

where: EC_{25} = standardized EC_a , and T is the soil temperature in degrees Celsius. Soil temperature is measured continuously at a weather station near the center of the transect at 1, 5, 10, 20, 50, 100, and 200 cm depths with copper-constant in thermocouples.

Data Analysis

Linear regression analysis was used to study the relationship between the TWC in the soil profile and the EC_a at each station for each measurement day. We analyzed the data set two ways: 1. We regressed the measured TWC at each station from all 16 measurement days on the EC_{25} measurements from all measurement days combined (n = 1040) to produce a "single model" for the entire data set; 2. We regressed the measured

TWC at each station on the EC_a at each station for each individual measurement day (n = 65) to obtain 16 "monthly models".

The measured TWC and the predicted TWC at each station for each month were compared for each set of models. The accuracy of each model was evaluated by examining the standard deviations of the residuals between the measured and predicted TWC at each station and the R^2 values.

Each model was cross-validated by omitting one measurement station, generating a model, and then predicting the TWC for that station. This was done for ten randomly picked measurement stations. The mean of the standard deviations of the residuals between measured and predicted TWCs for those ten stations was calculated.

To establish how many neutron probe measurements are needed to accurately calibrate a single or monthly model, models were generated based on data from 2, 3, 5, 9, 17, and 33 measurement stations and the standard deviations of their residuals were compared. For the two- model case, we used the end points of the transect: stations 11 and 75. Other stations used for this analysis were obtained by evenly dividing the transect. For example, the three-model case used stations 11, 43, 75; the five-model case used stations 11, 27, 43, 59, and 75; the nine model case used stations 11, 19, 27, 35, 43, 51, 59, 67, and 75; etc.

Results and Discussion

The transect experienced a wide range of TWC over the 16 month study (Fig 1): the mean TWC of the transect varied from 10 cm of water in September, 1992, to 25 cm of water in February, 1992. The TWCs of our study period are representative of the wide range of TWCs observed over time along the transect.

Soil temperatures at different depths in the soil profile were used to calculate the temperature standardization coefficients with eq. (2). These coefficients were evaluated on the basis of the R^2 values in the single linear regression model. The R^2 for the single linear regression model without temperature standardization was 35%. Using temperature standardization coefficients calculated with soil temperatures from 20, 50, 75, and 100 cm below ground surface, the R^2 values for the single model were, respectively, 61, 64, 62, and 59%. These values indicate that the temperature standardization coefficients are not sensitive to the exact depth of soil temperature measurements taken under the conditions of this study. We selected a 50 cm depth to determine the temperature standardization coefficients. This depth agrees well with that of Slavich and Petterson (1990), who used soil temperatures from depths of 50 cm during the winter and 70 cm in the summer for their coefficients. A standardization coefficient is not needed for each of the monthly models because they only compare EC_a and total water in the profile from one measurement day.

In a preliminary study, we tested which of the six height/mode configurations of the EM-31 yields the best correlation with TWC. It was found that, in general, the horizontal/soil surface mode performed best. However, this configuration is cumbersome to implement under many field conditions. Therefore, we will compare this configuration with the vertical/hip configuration, which is the most practical operating configuration for the EM-31.

Figure 2 shows the EC_a measurements taken on 4/1/93 in the vertical/hip configuration. At each station two measurements were taken: one going up the transect and one coming down. Therefore, the time interval between the measurements decreases from approximately 200 minutes at station 11 to approximately 10 minutes at station 75. It can be seen that the difference between upward and downward measurements is related to the time between the two measurements, for example, 0.5 mS/m difference at station 14 to 0.0 mS/m difference at station 70. The change in EC_a with time on 4/1/93 is caused by the increase in temperature of the soil surface layer. Consequently, on the return trip down the transect, an increase in EC_a is observed consistently at stations 11-40 where the time between measurements was 180 minutes or more. EC_a differences at stations 40-75 were less affected by the temperature effects due to the short interval of time between the subsequent measurements, so these differences represent the "instrument error" or "pure error." Based on the smallest differences regularly observed between upward and downward measurements, we have determined the maximum "pure error" at approximately 0.2 mS/m in the desert environment of this study.

The effect of short range spatial variability on EC_a readings is evaluated with the ten additional measurements taken at each station on 3/7/93. The measurements were taken 5 m on either side of the station, 1 m apart. The standard deviation around each station was determined. Over the transect the standard deviations ranged from 0.87 mS/m at station 74 to 0.40 mS/m at station 59. The mean standard deviation of all stations was approximately 0.5 mS/m and, as expected, is considerably larger than the "pure error" of the EM-31 instrument.

Single Models

Inspection of the data plots and evaluation of several linear regression models including quadratic and logarithmic terms, leaves no doubt that a simple linear regression model best describes the relation between TWC and EC_a along the transect. The R^2 for the single model is 0.64 for the horizontal/soil surface configuration and 0.58 for the vertical/hip configuration. The regression coefficients for the respective models are presented in Table 1. The best correlation with EC_a to TWC is found with the EM-31 at the surface in the horizontal mode. This was expected because, with the instrument in the horizontal mode the relative sensitivity is greatest to material at the soil surface. For example, the soil to a depth of 1.5 meters contributes 50% of the measured EC_a in the horizontal mode and only 25% in the vertical mode (McNeill, 1980b).

The adequacy of the two single models was checked with a residual analysis and a lack-of-fit test (e.g. Montgomery and Peck, 1982). Residual analysis revealed that the residuals are uncorrelated and normally distributed with zero mean, proving that the model satisfies the

assumptions for linear regression analysis. Figures 3a and 3b present the histograms of the residuals for the two single models.

The standard deviation of the residual water contents for the single model is 0.032 m for the horizontal/soil surface configuration and 0.035 m for the vertical/hip configuration. The horizontal/soil surface configuration was consistently more accurate than the vertical/hip configuration, as was to be expected. Although the single simple linear regression models are significant and residual analysis does not reveal violation of the regression assumptions, the relatively low R^2 is not entirely satisfactory. Therefore, we conducted a lack-of-fit analysis (e.g Draper and Smith, 1981). This analysis can only be carried out if repeat measurements are available. The data presented in Figure 2 and those obtained on other days indicate that many EC_a measurements are rather close together compared to the general spread of the EC_a values. Thus, although there are very few exact repeat measurements, we do have many *approximate repeats*. These are transformed to real repeats by rounding them to 0.2 mS/m, a value equal to the "instrument error" or "pure error." The lack-of-fit test conducted with the RSREG-procedure of SAS (1985) did not reveal any significant lack of fit, which is another confirmation that, indeed, the simple linear regression model is the best model. Because no model can explain the pure error variation, an R^2 of 100% is impossible to obtain when repeat measurements exist. (Draper and Smith, 1981). This explains the relatively low R^2 values in Table 1.

Model validation was conducted by cross-validation on ten randomly selected stations. The standard deviations of the residuals from the cross-validation are 0.021 m for the horizontal/soil surface configuration and 0.022 m for the vertical/hip configuration. This indicates the model performs well in its intended operating environment.

An important question for future applications of electromagnetic induction for non-invasive soil water content measurements is the number of neutron access tubes needed to calibrate the EM-31 readings. We found that five neutron probe measurements were adequate to calibrate the single model in the vertical/hip configuration and nine neutron probe measurements were needed for the horizontal/surface configuration. There was no improvement in the model with the addition of any more stations (Fig. 4).

Monthly Models

We analyzed the monthly models with the same methods as the single models. A residual analysis and the lack-of-fit test were conducted as described above for each of the monthly models to test their adequacy. The percent variability that can be explained by the monthly models was calculated in the same way as for the single model.

The regression equation coefficients, R^2 values, and the percentage of variability that can be explained by each of the monthly simple linear regression models are presented in Table 1. The residuals of the monthly models are also normally distributed with mean zero, proving that the monthly models satisfy the requirements of linear regression analysis (Figures 3c and 3d). The standard deviations of the residuals for the monthly models are 0.027 m for the horizontal/soil surface configuration and 0.029 m for the vertical/hip configuration. Again the horizontal/soil surface configuration was slightly more accurate than the vertical/hip configuration. The residuals of the monthly models are approximately 20% smaller than those of the single models. Thus, the monthly models are more accurate than the single model for predicting the actual value of TWC. Note that a mean residual standard deviation of 0.029 m over the 1.5 m soil profile presents a water content of 1.9 volume percent.

The standard deviations of the residuals from the cross-validation test for the monthly models are 0.019 m and 0.021 m for the horizontal/soil surface configuration and the vertical/hip configuration, respectively. These residuals are 5-10% lower than those of the single models, indicating the monthly models performed better in the cross-validation test than the single model.

To adequately calibrate the monthly models, five neutron probe measurements were needed for the vertical/hip configuration and nine neutron probe measurements were needed for the horizontal/surface configuration. These numbers are identical to those found for the single model. There was no improvement in the model with the addition of any more stations (Fig. 4). Site-specific soil water content measurements with the neutron probe will always be required for calibration of the EM method, but these results show that the number of neutron probe soil water content measurements can be greatly reduced. This is important because of the costs involved in installing neutron access tubes, especially in areas with stony soils or caliche layers. Five to nine probes along the transect means one access tube every 200-400 meters. Visualizing each calibration access tube in the center of a square with sides of 400-800 meter, we find that for our conditions, we need one access tube in every 16-64 ha for calibration.

Comparison of Single and Monthly Models for Predicting Changes in Soil Water

In many hydrological and ecological studies it is often of more interest to know the change in water content between two dates than the absolute water contents on those dates.

Comparisons of Figures 3a and 3b with 3c and 3d shows that the predictive capability for soil water contents of the monthly model exceeds that of the single model. This is also illustrated in Figures 5a and 5b where we plot for two typical stations (30 and 60) the predicted and measured water content with time for both models. Although the predictions of the single model at station 60 are a few times closer to the measured values than the predictions of the monthly models, it appears that the latter have a greater capability to predict changes in soil water over time. The same trend can be detected at station 30 (Figure 5b). To further investigate the strength of the models to predict monthly changes in TWC, a plot of the differences of the predicted TWC from subsequent months vs. differences of measured TWC from subsequent months was generated for each model (Figs. 6a & 6b). The linear trend in Figure 6b versus the curved relationship found in Figure 6a clearly demonstrates the superior capability of the monthly model to predict changes in water content over time. Another indication is the plots (histograms) of the residuals between predicted and measured differences of TWC between subsequent months (Figures 7a and 7b). The residuals for the single model have a larger distribution width (Fig.7a) than those of the monthly model (Fig 7b). The width of the monthly model based on the horizontal/surface configuration is the smallest, with most of the data within ± 0.03 m which equals a volumetric water content of $\pm$ 2% in the 1.5 m soil profile. This number compares favorably with other invasive methods when used in the field. For example, Topp and Davis (1985) concluded that the TDR method can be used for irrigation scheduling without making a calibration for each field or soil because it gives an immediate soil water content measurement in the field with an accuracy of 0.02 m^3m^{-3}.

Temporal Variability vs. Spatial Variability of Soil Moisture

In Figures 8a and 8b we compare the measured and the predicted TWC along the transect for the single and monthly models during a relatively wet (March 1992) and dry month (May 1993) see Figure 1. Although the models predict the trends quite well, there is less agreement between the measured and predicted values than found in Figures 5a and 5b where the models were used to predict changes in TWC over time for individual stations. It appears that both the single and monthly models predicted the temporal variability of TWC more accurately than the spatial variability. This observation is confirmed by comparing the pooled standard deviations of the residuals with respect to time and space for the single and monthly models. The standard deviations were consistently lower when calculated with temporal data. The contrast between the temporal and spatial standard deviations is greater with the monthly models, a fact which is yet another indication that the formulation of monthly models indeed increases the accuracy of the model prediction.

A nice example of the interplay between temporal and spatial variability is presented by the measurements at station 60. In Figure 8b, it can be seen that the monthly models overpredict the TWC at station 60 by approximately 5 cm water in March 1992 and May 1993. However, Figure 5b reveals that the changes in TWC at station 60 are predicted correctly by the monthly model. This was quite typical for most other stations.

The cause for the relatively large deviations in space is the relative heterogeneity of the soils. It is mentioned in the Methods and Materials section that five different soil series are recognized along the transect. There is little doubt that the development of a monthly model for each soil series would improve the predictions. However, there are a few drawbacks to this approach. First of all, we face the difficulty of how to determine the exact boundary between different soil series in the field. Next, it is almost certain that partitions of the transect according to soil series would increase the number of access tubes needed for calibration. Nevertheless, these questions should be addressed to obtain a better understanding of the possibilities of the EM-technique for soil water measurements in semi-arid regions and we will deal with them in a forthcoming paper.

One striking feature in Figures 8a and 8b is that the variability of the TWCs predicted on the basis of EM measurements is less than that on the basis of neutron probe measurements. This phenomenon can be explained by the fact that the volume of the EM-

31 measurement is at least four times larger than the volume of the neutron measurements; thus, much of the small scale water content variability is averaged out. An important consequence of this observation is that water content measurements with the EM instrument will be more reliable than those with the neutron probe. This means that at least part of the mismatch between predicted and measured values is caused by variability of the neutron probe measurements and not by the failure of the model or EM equipment. Another part of the mismatch can be explained by the fact that the EM measurements were taken 10 m south of the access tubes, a distance that is certainly large enough to cause discrepancies between neutron probe and EM measurements.

Conclusions

The results of our study demonstrate that electromagnetic induction is a viable method for measurement of total soil water content (TWC) in the soil profile over long periods of time if the measurements are standardized for the soil temperature.

Regression analysis of simultaneous soil water content measurements with the neutron probe and electrical conductivity measurements with the EM-31 revealed that a simple linear relationship exists between TWC and the electrical conductivity of the soil (EC_a). As is the case with other methods for soil water content measurement such as neutron scattering and Time Domain Reflectometry, it is necessary to use a calibration curve to relate TWC and EC_a because this relationship is site specific. In this study it was found that approximately one neutron access tube per 40 ha area yielded a reliable calibration curve.

For accurate results it is necessary to take calibration measurements with the neutron probe each time the EM-31 is used for water content determination. Doing so, the EM method is capable of detecting soil water content changes with an accuracy of approximately 0.02 m^3m^{-3}, a rate which is comparable to that of other field methods.

The tremendous advantage of the EM instruments are their speed and ease of use. Measurements taken with the instrument in the vertical/hip configuration are almost as accurate as those taken in the horizontal/soil surface configuration, so measurements are able to be taken as fast as one can walk. For this transect, the measurement time would be about one hour as compared to one day with the neutron probe.

The speed and ease of use combined with the accuracy of the measurements determined in this study, leaves no doubt electromagnetic induction has great potential for quick detection of soil water content changes over large areas of semi-arid rangeland and arid desert. As no other method is presently available with these characteristics, electromagnetic induction is an ideal tool for ecological and hydrological water balance studies that cover large spatially variable areas in arid or semi-arid regions.

Acknowledgements:

We thank Dr. Allan Gutjahr for the statistical advice for this paper. We are particularly indebted to Dr. John Anderson for making available the monthly water content measurements and the countless bits of information about the LTER site. Financial support was provided by a grant of the Special Grants Water Quality Research Program of the U.S. Dept. of Agriculture. Initial seed money was given by the New Mexico Tech Research Council. The study was conducted on the Hormada Experimental Range Site of the Long Term Ecological Research Network of the National Science Foundation.

Bibliography

Cable, D., Seasonal patterns of soil water recharge and extraction on semi-desert ranges, *Journal of Range Management, 33*(1), 9-15, 1980.

Draper, N.R. and H. Smith, *Applied Regression Analysis*, 2nd edition,709 pp., John Wiley and Sons, New York, 1981.

Gee, G.W. and D. Hillel, Groundwater recharge in arid areas: Review and critique of estimation methods, *Hydrological Processes, 2*, 255-266, 1988.

Hendrickx, J.M.H., Determination of hydraulic soil properties, in *Process studies in hillslope hydrology,* edited by M.G. Anderson and T.P. Burt, pp. 43-92, John Wiley and Sons Ltd., 1990.

Hendrickx, J.M.H., Soil salinity assessment by electromagnetic induction of irrigated land, *Soil Sci. Soc. Am. J., 56*, 1933-1941, 1992.

Kachanoski, R.G., E.G. Gregorich, I.J. Van Wesenbeeck., Estimating spatial variations of soil water content using non-contacting electromagnetic inductive methods, *Can. J. Soil Sci. 68*, 715-722, 1988.

Malm, N.R. and F.E. Houghton, Climatic guide, Las Cruces, 1851-1976, *New Mexico Agricultural Experiment Station Research Report*, No. 350, 20pp. 1977.

McNeill, J.D., Electrical conductivity of soils and rocks, *Tech Note TN-5*, Geonics Ltd., Ontario, Canada, pp. 8-10, 1980a.

McNeill, J.D., Electromagnetic terrain conductivity measurement at low induction numbers. *Tech Note TN-6*, Geonics Ltd., Ontario, Canada, pp. 6-8, 1980b.

Montgomery, D.C. and E.A. Peck, *Introduction to Linear Regression Analysis*, 504 pp. John Wiley and Sons, New York, 1982.

Nash, M.S., Numerical classification, spatial dependence, and vertical kriging of soil sites in southern New Mexico, M.S. Thesis, New Mexico State University, Las Cruces, 1985.

Noy-Meir, I., Desert ecosystems: Environment and producers. *Annu. Rev. Ecol. Syst. 4*, 25-51, 1973.

Rhoades, J.D., P.A.C. Raats, and R.J. Prather, Effects of liquid-phase electrical conductivity, water content, and surface conductivity on bulk soil electrical conductivity, *Soil Sci. Soc. Am. J., 40*, 651-655, 1976.

SAS Institute Inc., *SAS® User's Guide: Statistics, version 5 edition,* pp. 725-734, Cary NC:SAS Institute Inc, 1985.

Schlesinger, W.H., J.F. Reynolds, G.L. Cunningham, L.F. Huenneke, W.M. Jarrell, R.A. Virginia, and W.G. Whitford, Biologic feedbacks in global desertification, *Science, 247,* 1043-1048, 1990.

Slavich, P.G., and G.H. Petterson, Estimating average rootzone salinity from electromagnetic induction (EM-38) measurements, *Aust. J. Soil Res., 28*, 453-463, 1990.

Topp, G.G., J.L. Davis, A.P. Annan, Electromagnetic determination of soil water content: Measurements in coaxial transmission lines, *Water Resources Research, 16*, 574-582, 1980.

Topp, G.C. and J.L. Davis, Time domain reflectrometry (TDR) and its application to irrigation scheduling, *Advances in Irrigation, 3:107-127, 1985.*

Wierenga, P.J., J.M.H. Hendrickx, M.H. Nash, J. Ludwig, L.A. Daugherty, Variation of soil and vegetation with distance along a transect in the Chihuahuan desert, *J. of Arid Environments, 13*, 53-63, 1987.

U.S. Department of Agriculture, 1954, *Diagnosis and improvement of saline and alkaline soils*, U.S.D.A. Agricultural Handbook no. 60, edited by L.A. Richards, 1954, U.S. Gov. Print. Office, Washington D.C.

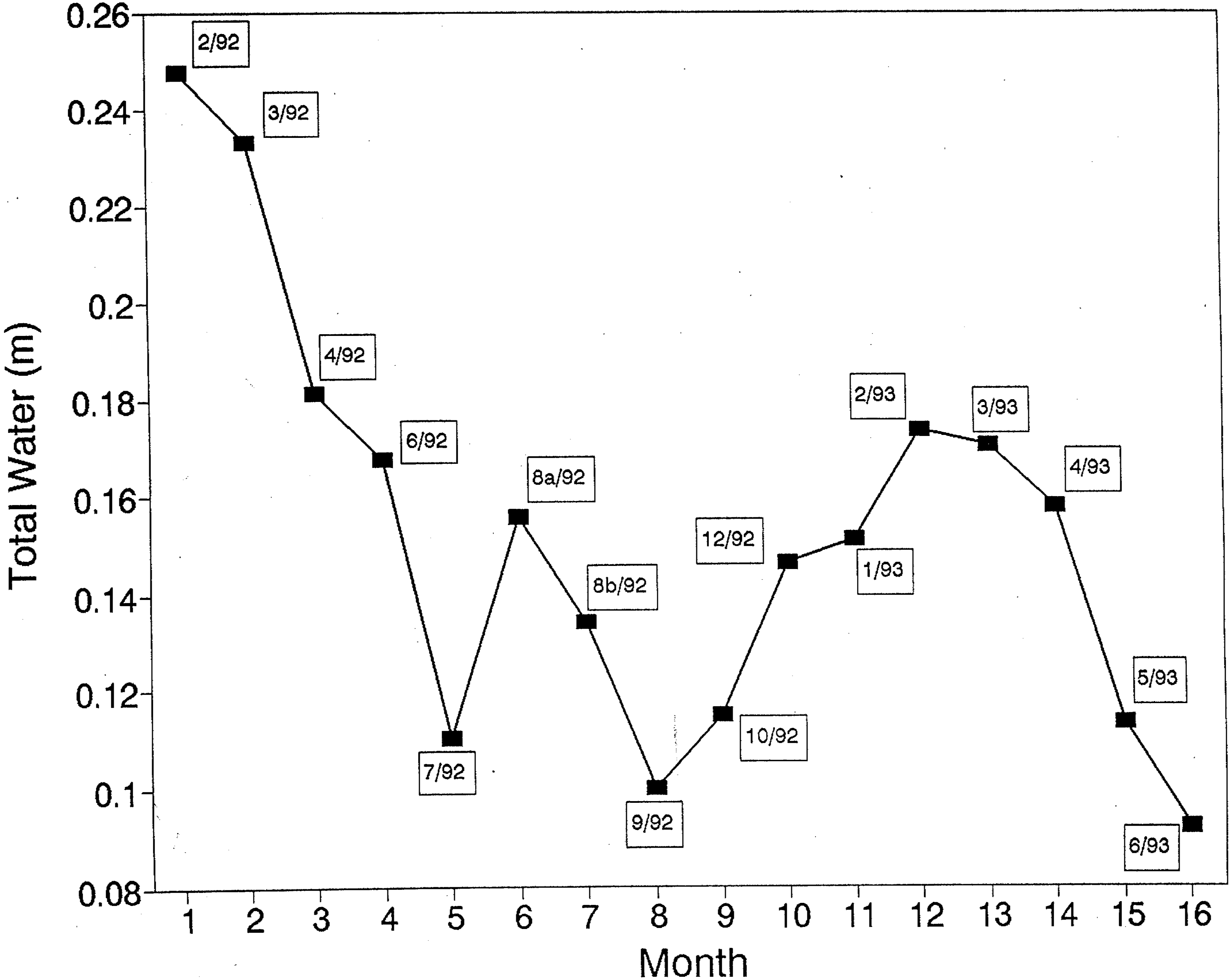
Table 1: Single and Monthly Model equation, F-values and R^2.

		EM31 Meas. Height cm	§ $a * 10^{-3}$	§ $b * 10^{-4}$	§ F	R^2 %
Single Models: $TWC = a + b * EC_{25}$ (n = 1040)						
Single		0*	-21.5	101	1786	64
Model		89**	-49.2	111	1412	58
Month	TWC (mm)	Monthly Models: $TWC = a + b * EC_a$ (n = 65)				
2/92	248	0	111	89.9	38	38
		89	125	78.7	14	19
3/92	233	0	81.3	85.6	46	43
		89	70.4	90.9	21	26
4/92	181	0	48.8	80.1	39	38
		89	16.8	98.7	25	28
6/92	168	0	51.3	65.9	23	27
		89	3.7	91.7	20	25
7/92	110	0	- 5.5	75.6	20	25
		89	-26.1	82.3	15	19
8a/92	156	0	25.7	78.4	32	34
		89	5.23	89.6	20	24
8b/92	134	0	10.1	76.2	14	18
		89	-24.0	94.2	15	19
9/92	100	0	6.1	67.3	15	19
		89	-18.7	78.4	14	18
10/92	115	0	5.61	89.8	27	30
		89	23.5	63.0	8	11
12/92	146	89	50.2	96.9	28	31
		0	59.9	77.2	13	17
1/93	151	89	28.8	96.5	39	38
		0	37.2	85.4	16	20
2/93	174	89	80.8	84.3	47	45
		0	63.9	91.7	29	32
3/93	171	89	31.12	98.9	53	46
		0	32.9	93.4	23	27
4/93	158	89	- 7.13	112	44	41
		0	- 7.78	108	24	27
5/93	113	89	-50.0	123	42	41
		0	-39.6	103	20	24
6/93	92	89	-27.2	95.6	26	30
		0	- 9.42	72.0	11	15

§ - significance probability of 0.01

* - 0 cm = Horizontal/soil surface configuration
** - 89 cm = Vertical/hip configuration
*** - Maximum R^2 attainable obtained from lack-of-fit analysis divided by R^2 (Draper and Smith, 1981).

Figure 1. Average total water in profile for 16 month study.



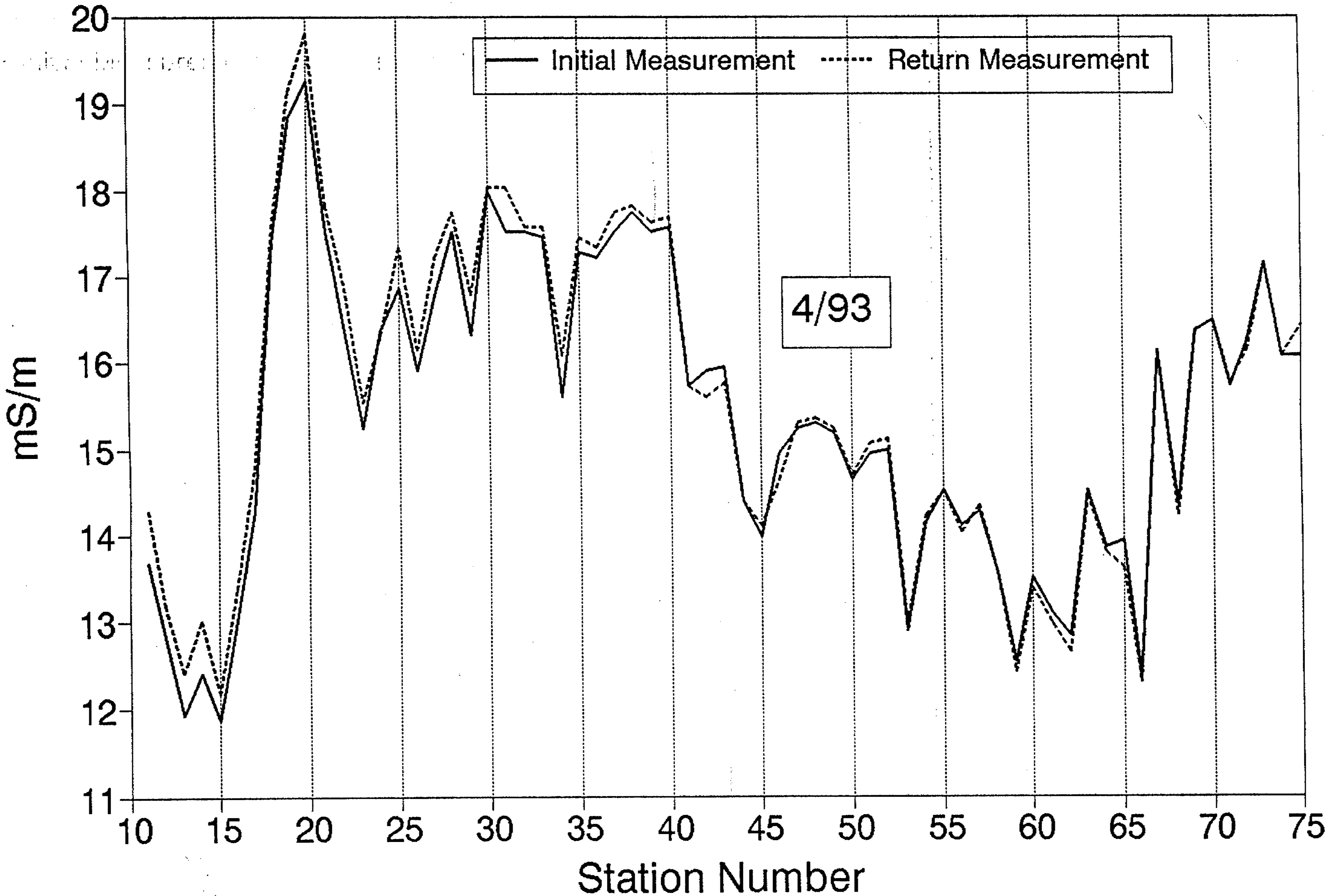


Figure 2. **A plot of EC_a measurements taken on April 1, 1994, illustrating measurement error. Measurement error increases with time between measurements due to increased temperature of surface soil.**

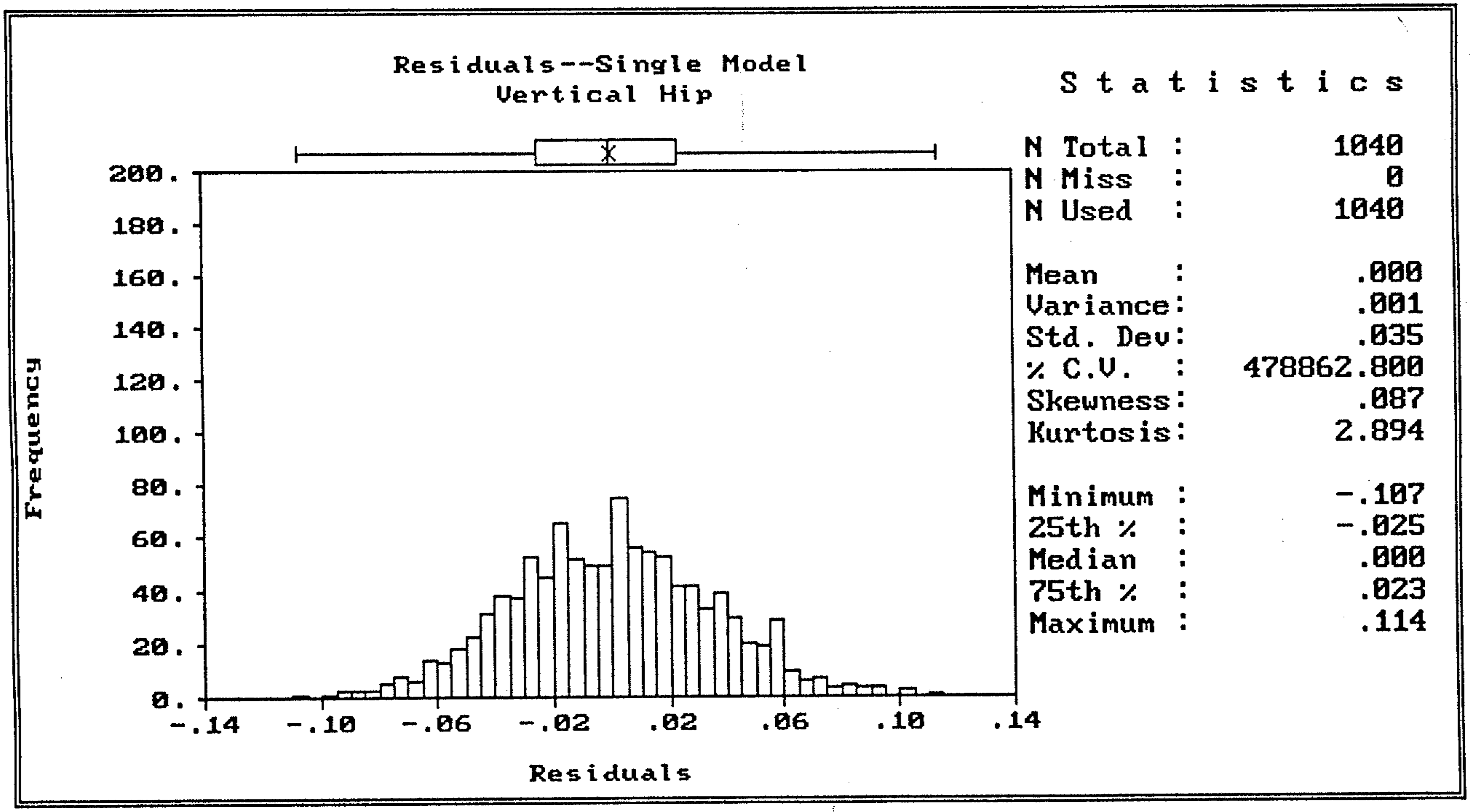
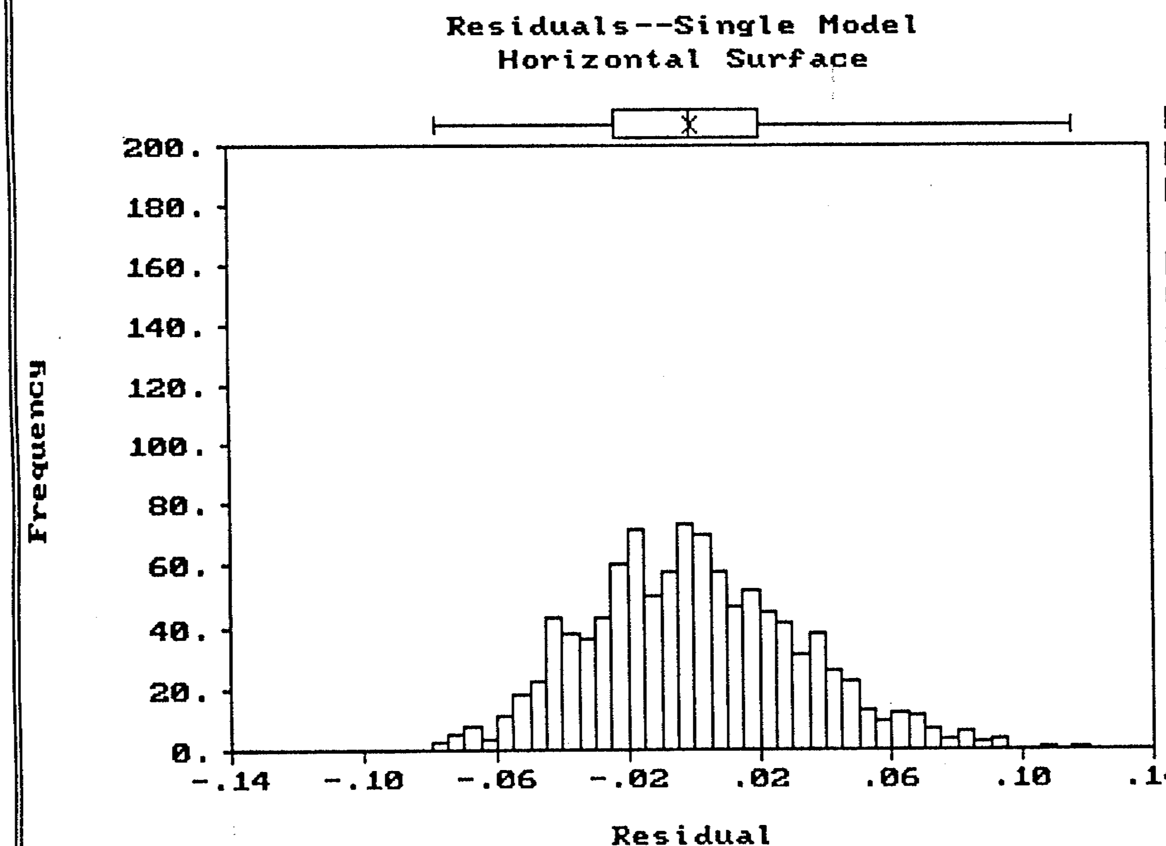


Figure 3*a*. Distribution of residuals for single model with instrument in the vertical/hip orientation.



Statistics	
N Total :	1040
N Miss :	0
N Used :	1040
Mean :	.000
Variance:	.001
Std. Dev:	.032
% C.V. :	26310.980
Skewness:	.312
Kurtosis:	2.943
Minimum :	-.077
25th % :	-.023
Median :	-.000
75th % :	.021
Maximum :	.116

Figure 3*b*. Distribution of residuals for single model with instrument in the horizontal/surface orientation.

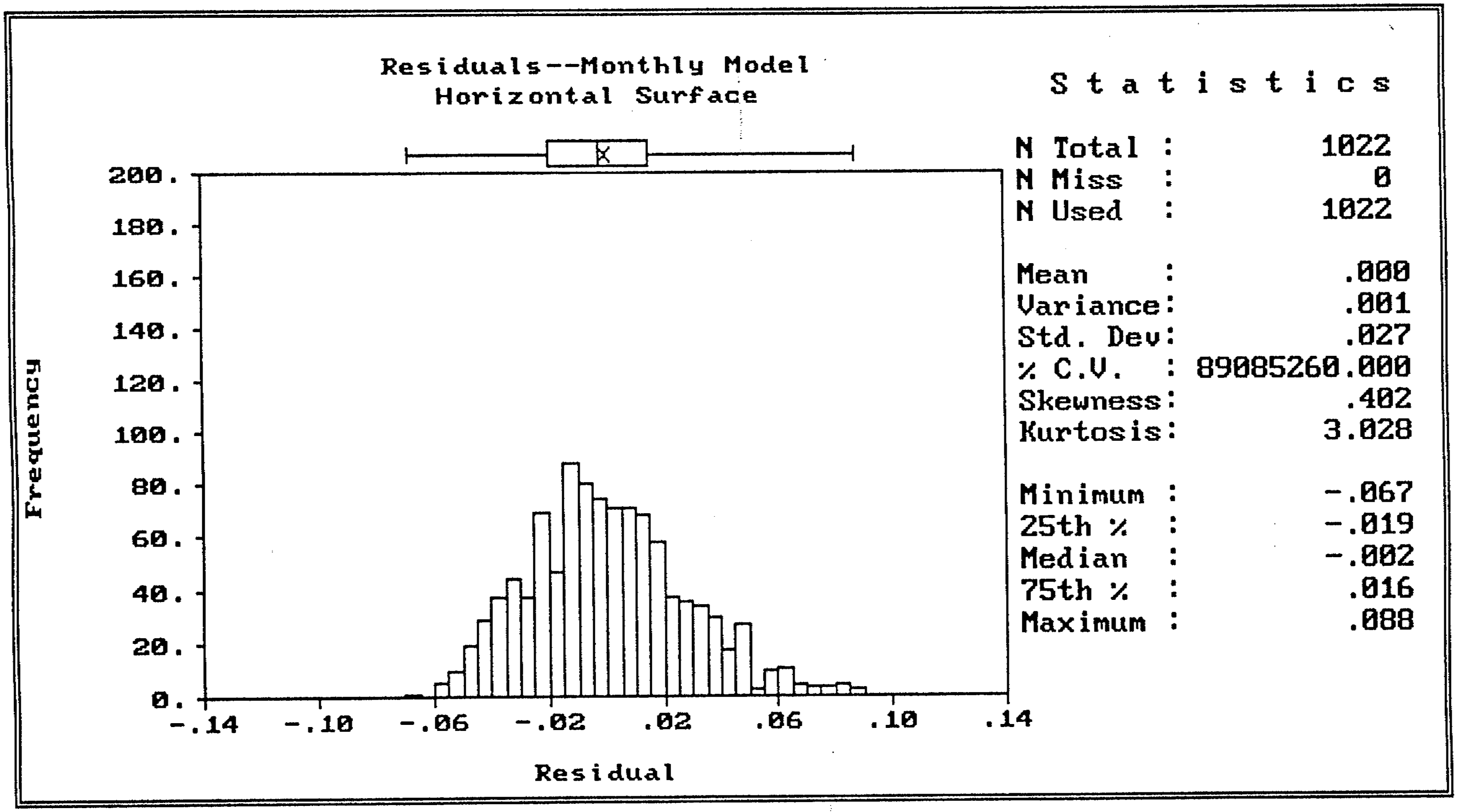


Figure 3*c*. Distribution of residuals for monthly model with instrument in the vertical/hip orientation.

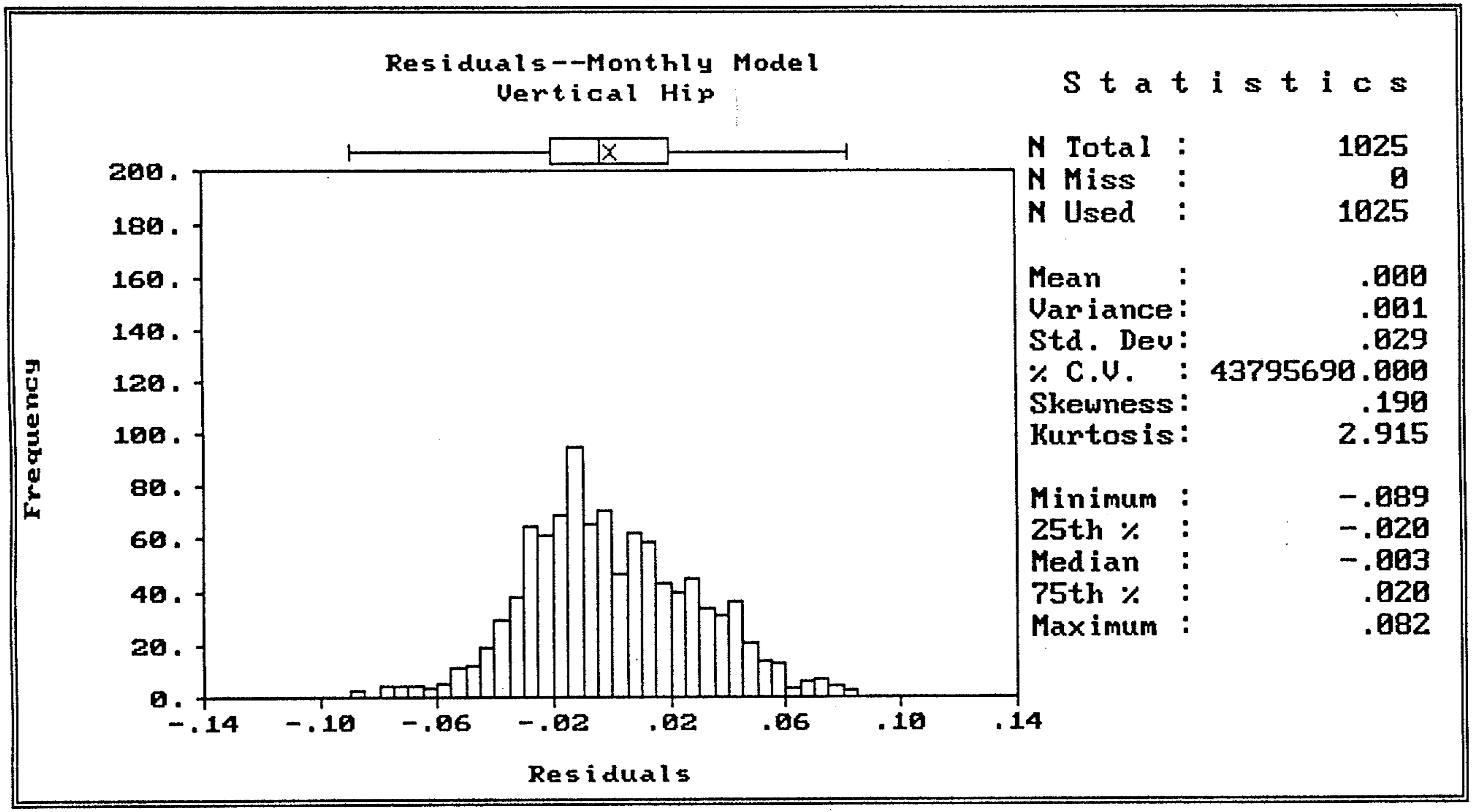


Figure 3*d*. Distribution of residuals for monthly model with instrument in the horizontal/surface orientation.

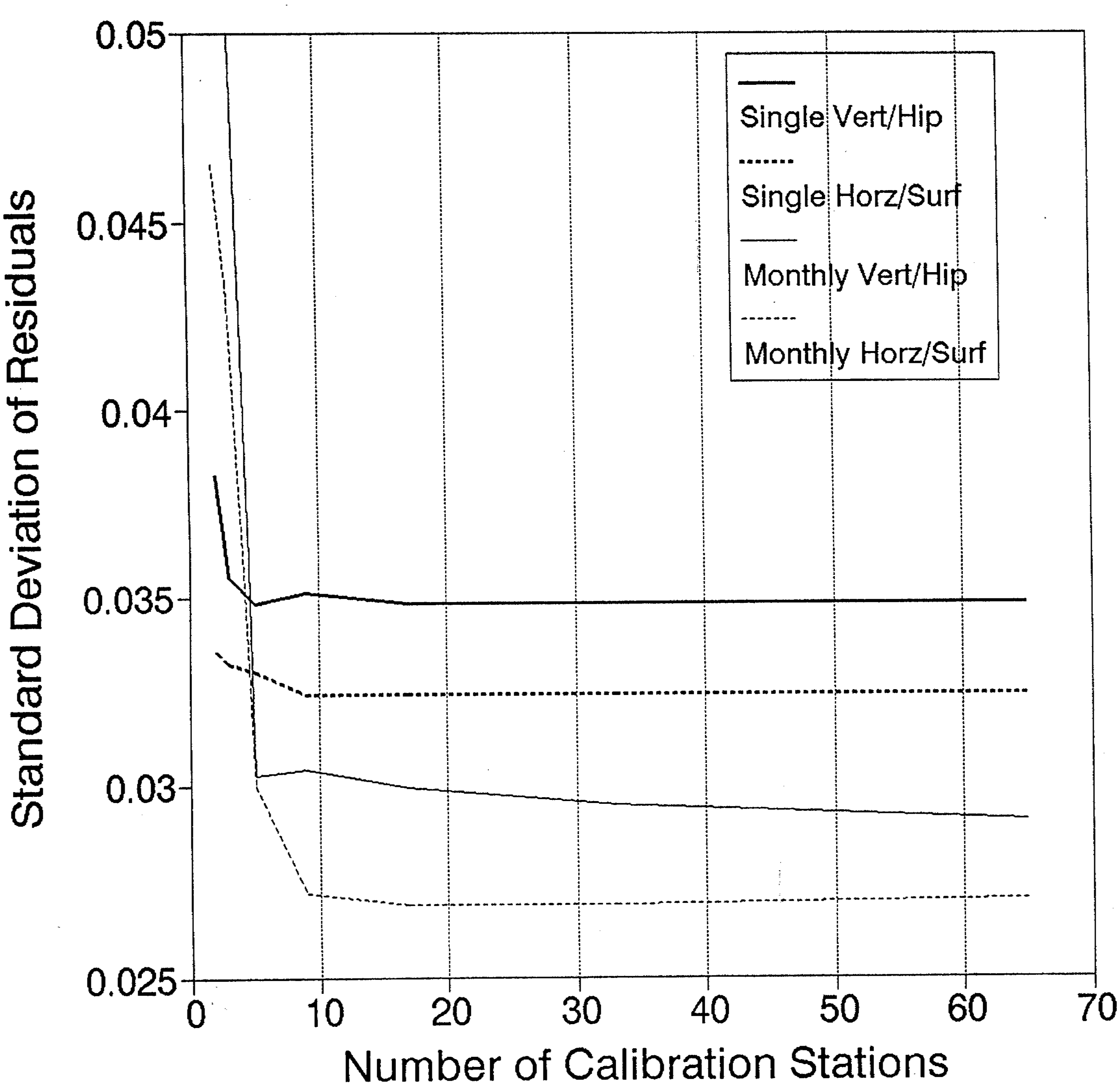
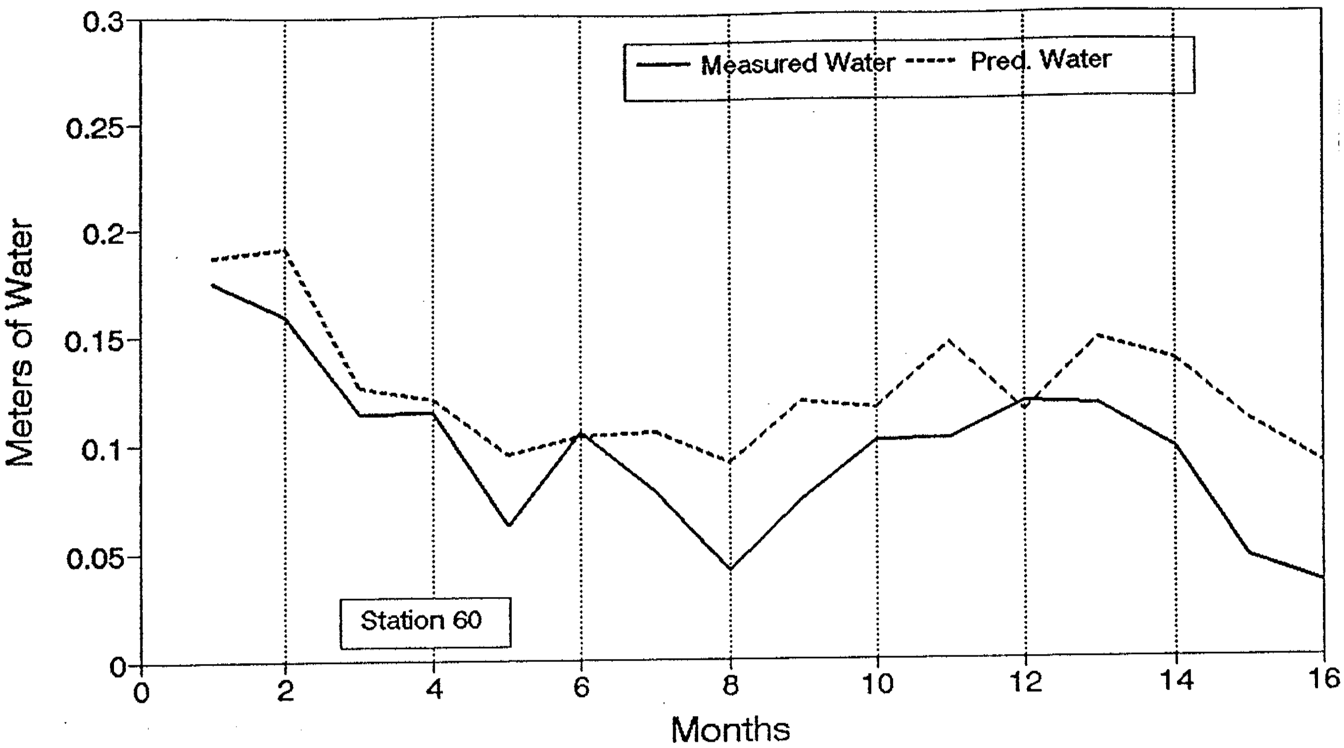


Figure 4. **Effect of the number of calibration stations in calibrating model.**



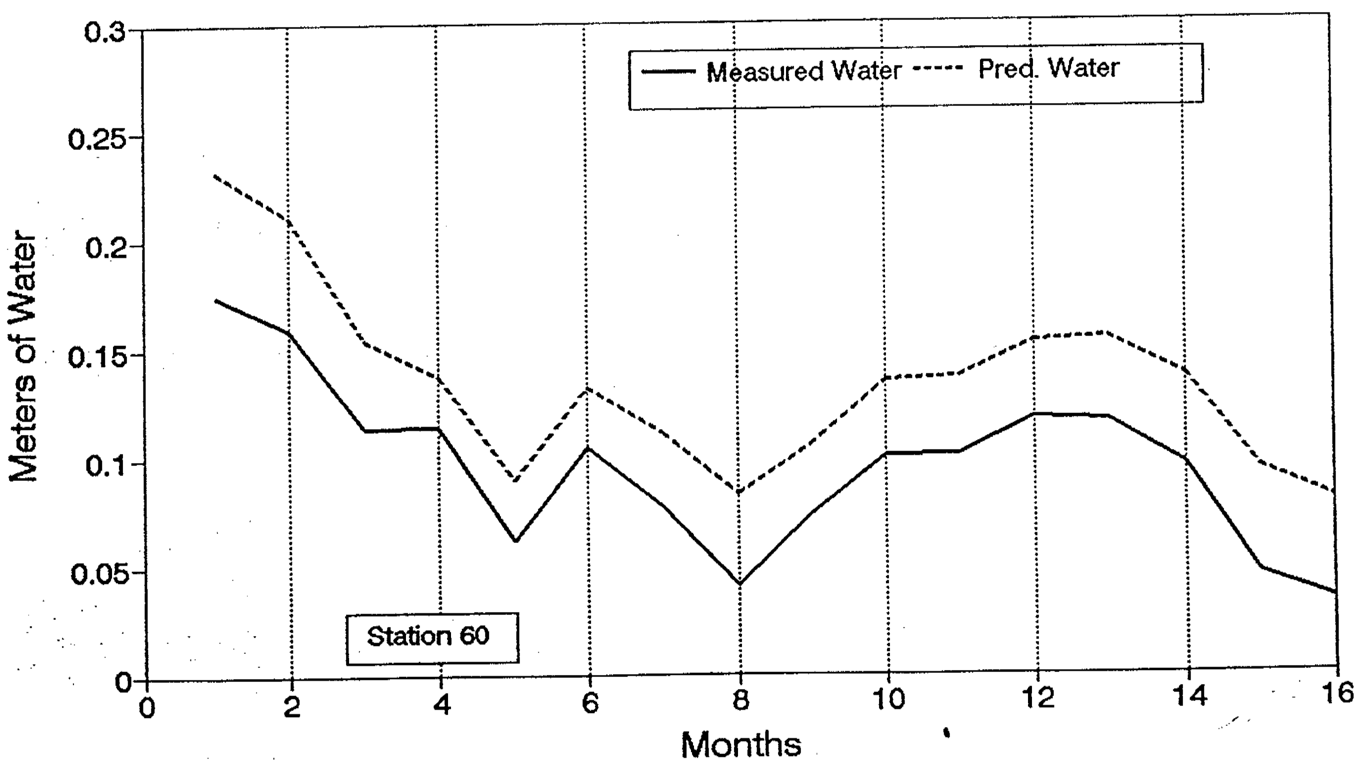
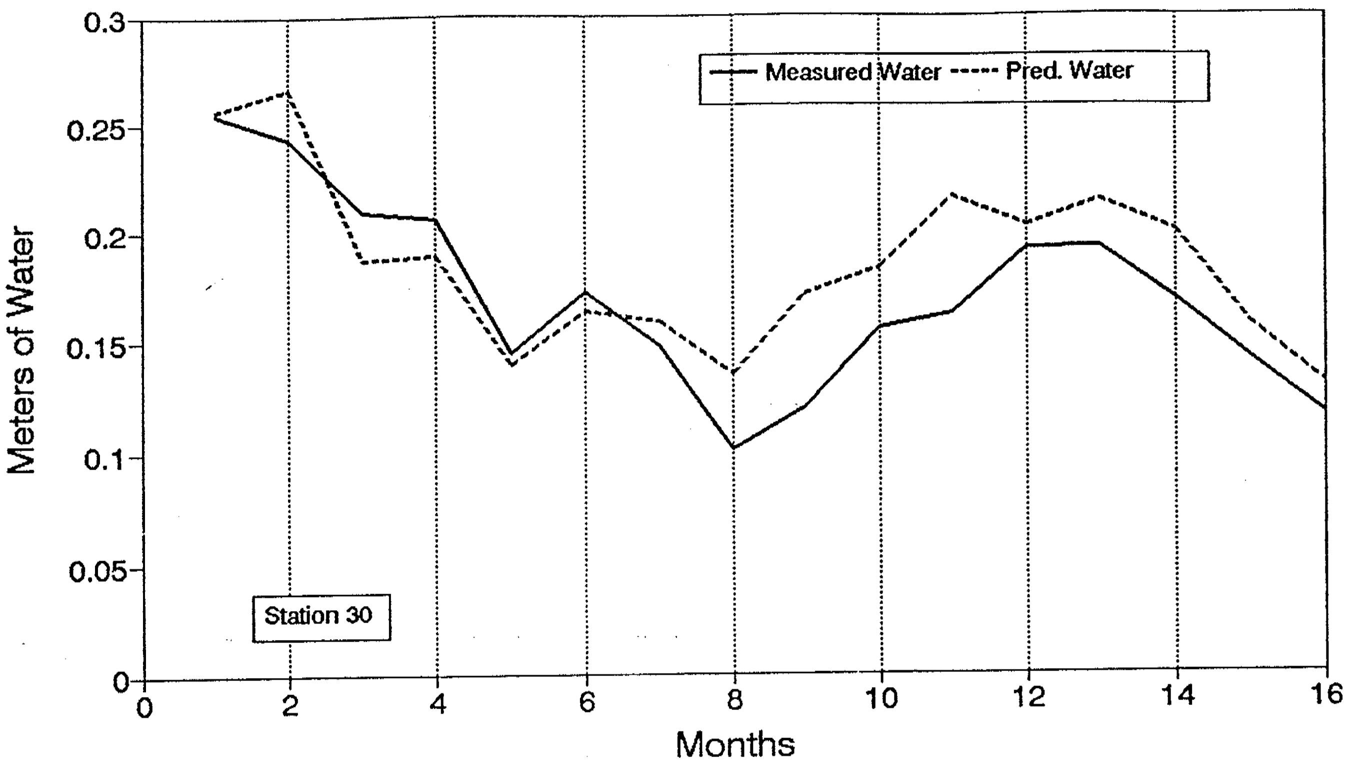


Figure 5*a*. Predicted (dashed line) and observed (solid line) total water in profile at Station 60 for single (top) and monthly (bottom) models for 16 month study period.



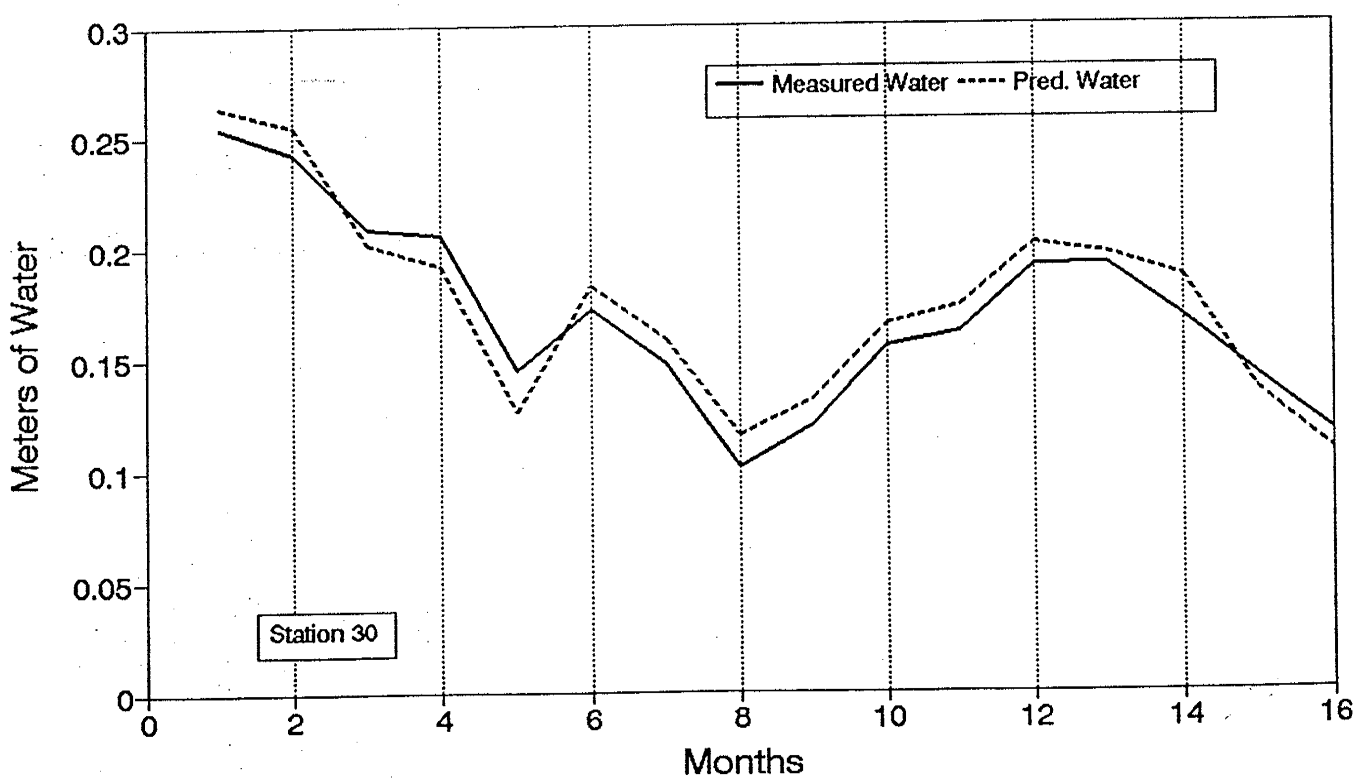


Figure 5*b*. Same as Figure 5*a*, but for Station 30.

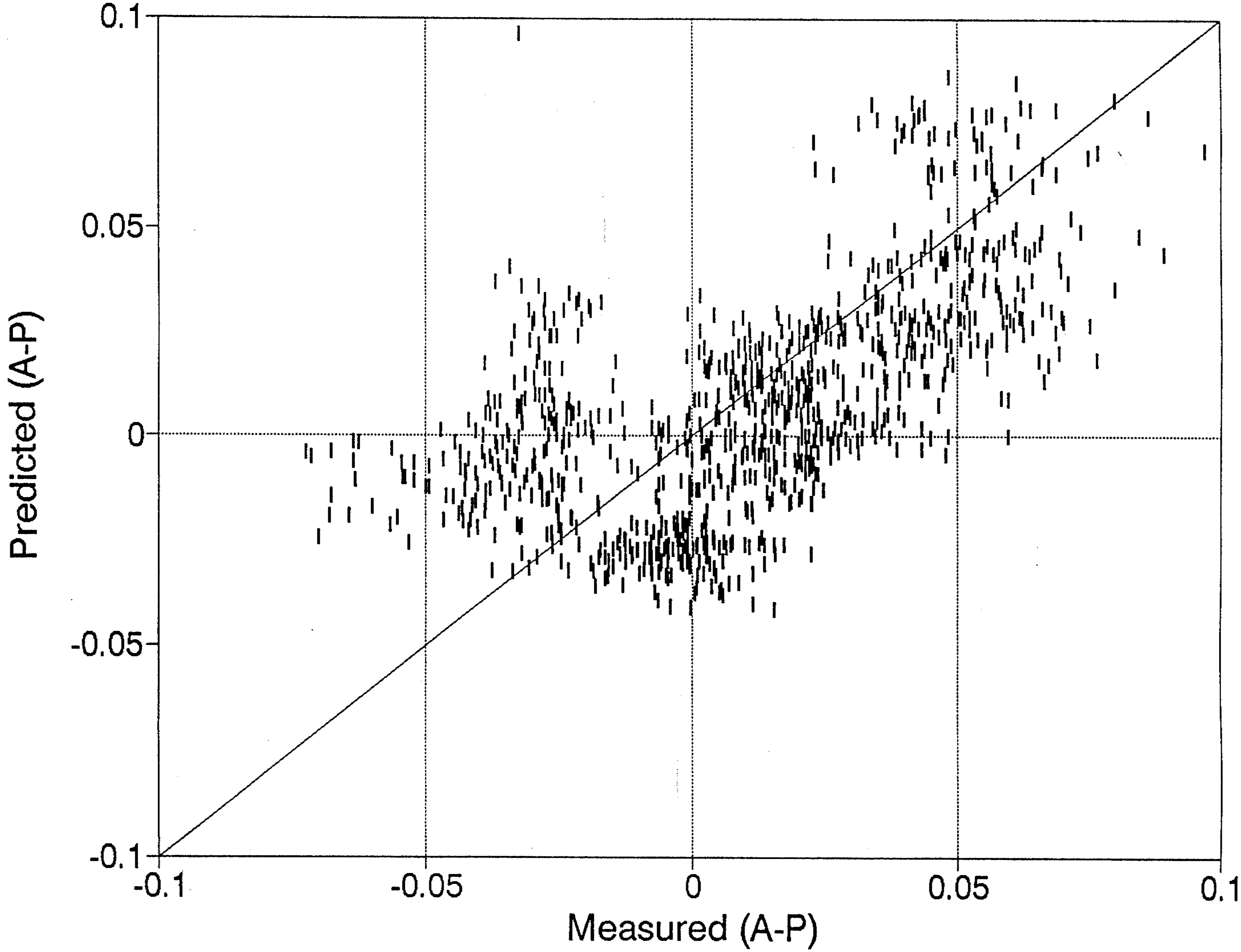


Figure 6a. Differences of residuals for subsequent months for the single model.

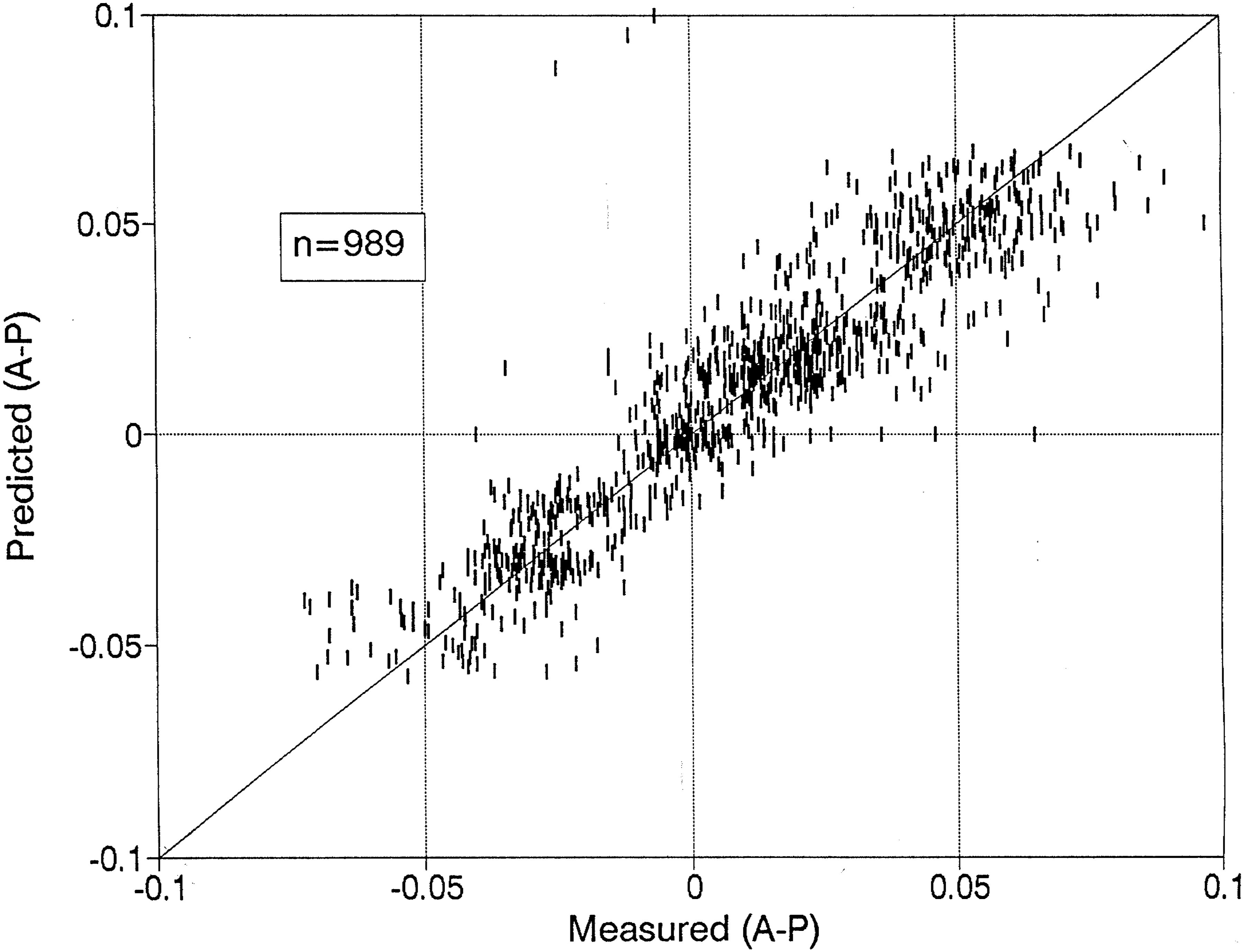


Figure 6*b*. **Differences of residuals for subsequent months for the monthly model.**

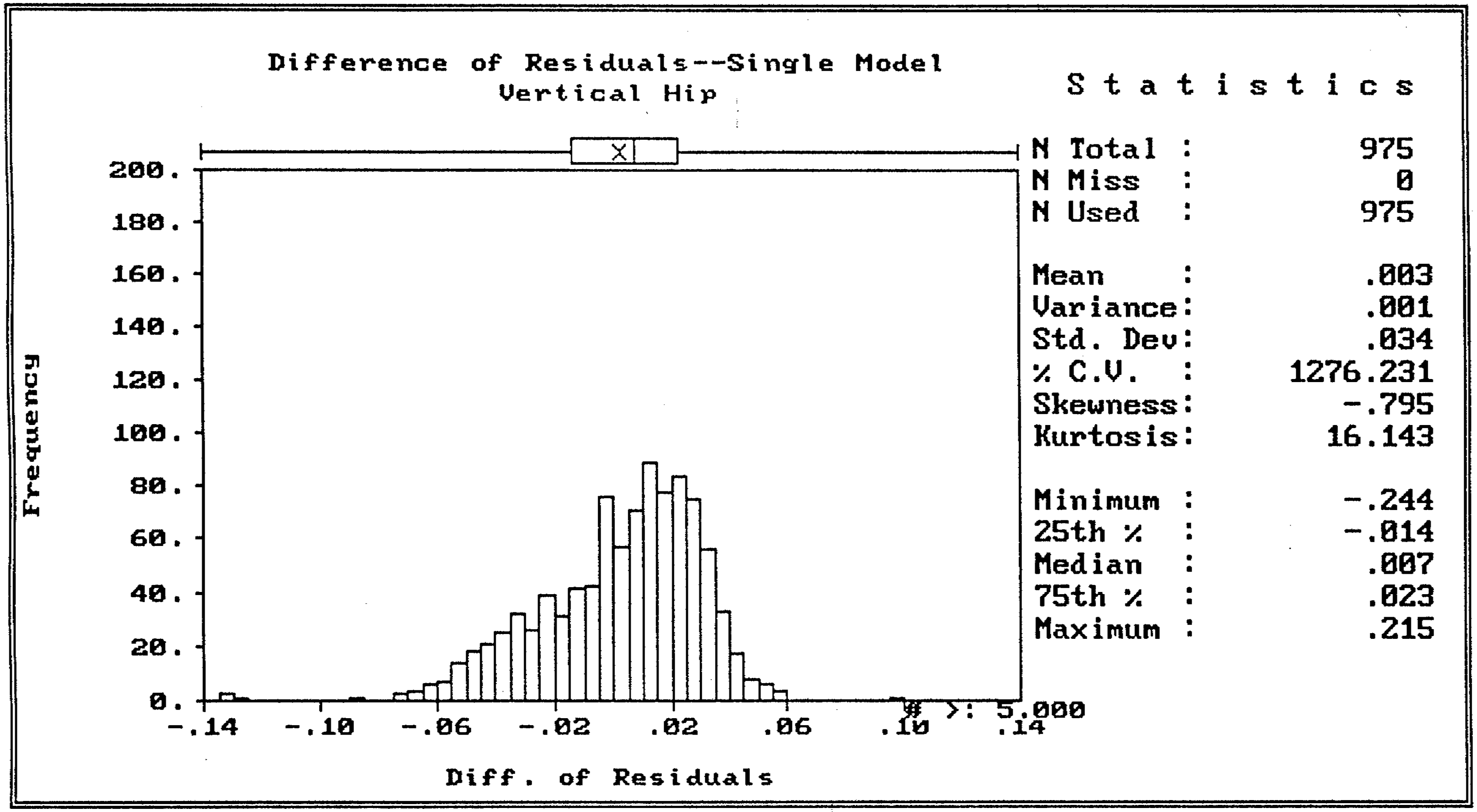


Figure 7a. Distribution of difference of residuals for subsequent months for the single model.

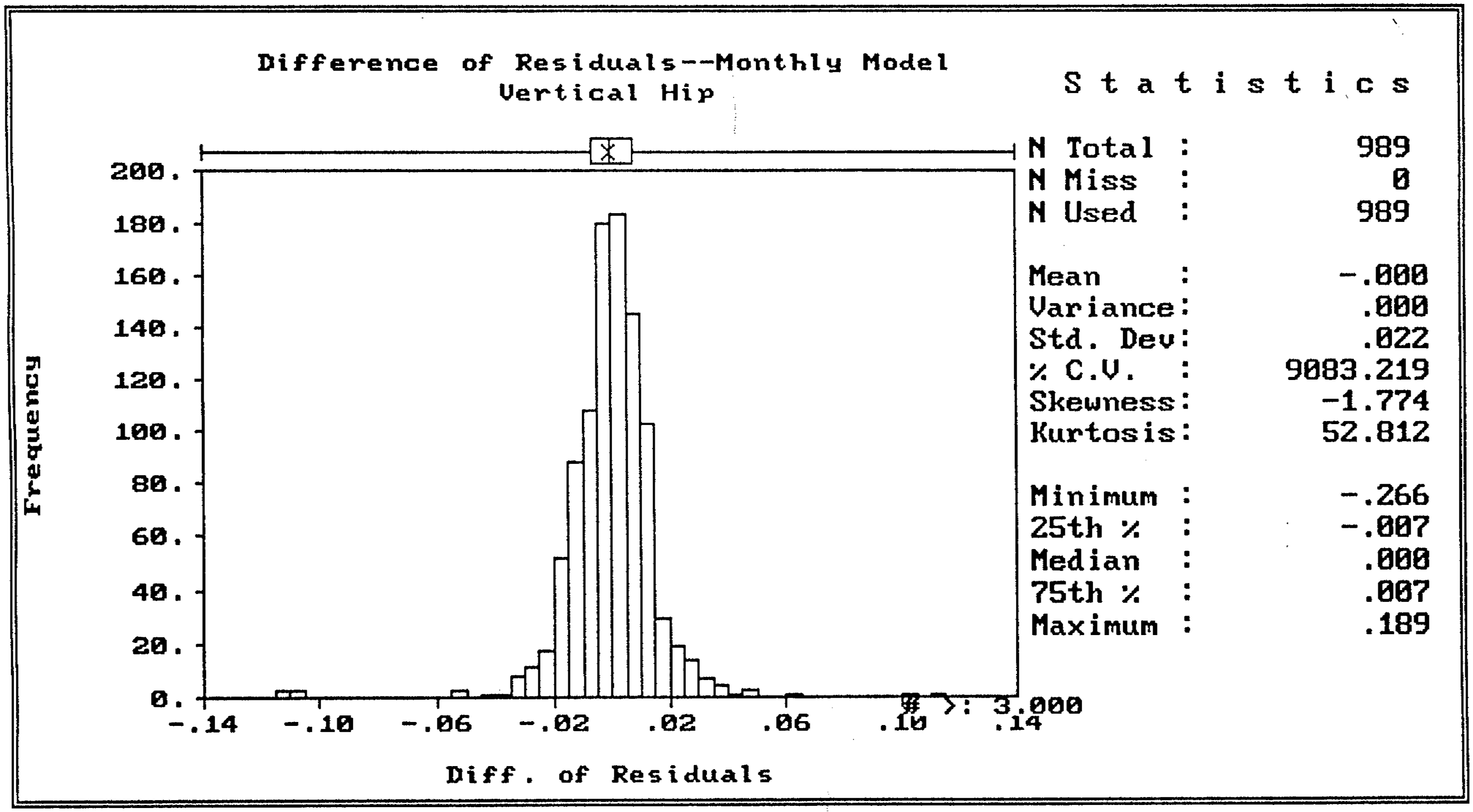
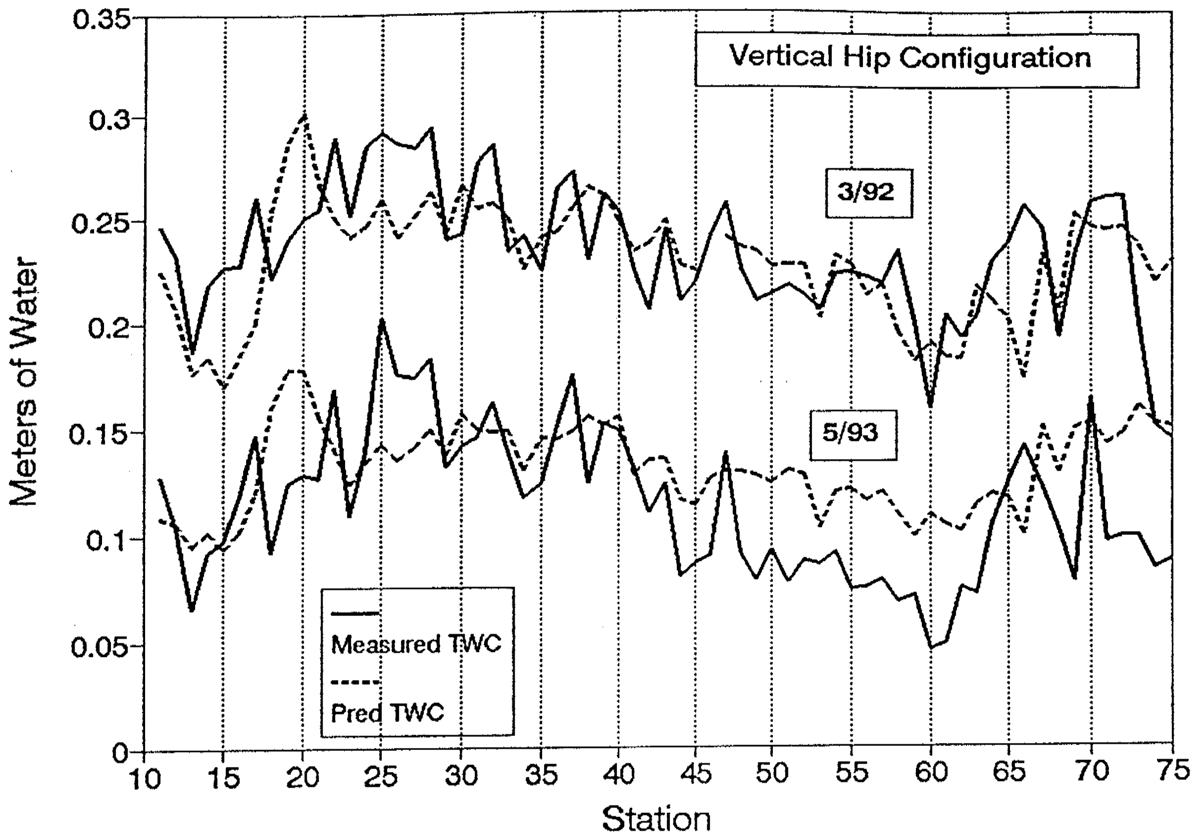


Figure 7b. Distribution of difference of residuals for subsequent months for the monthly model.



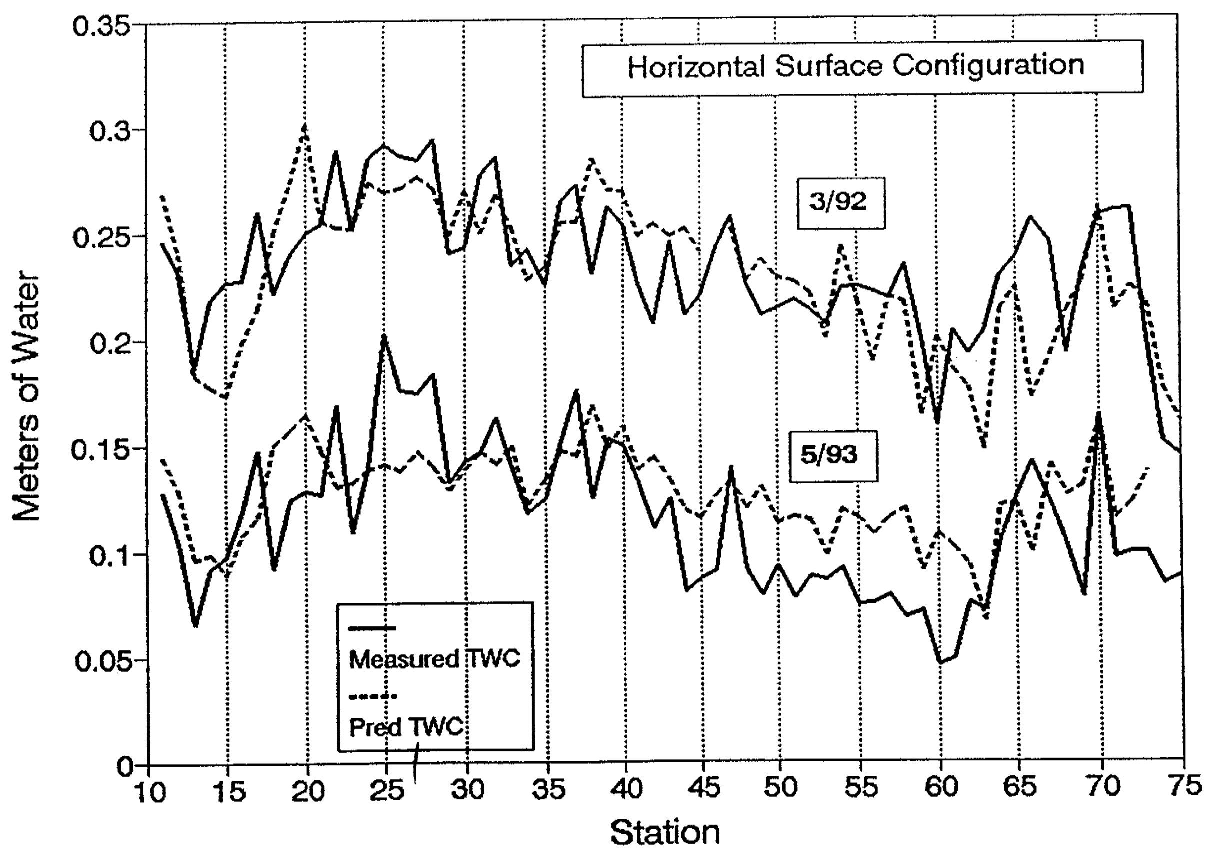


Figure 8a. Predicted (dashed line) and observed (solid line) total water in profile for a relatively wet month (top) and dry month (bottom) using the single model.

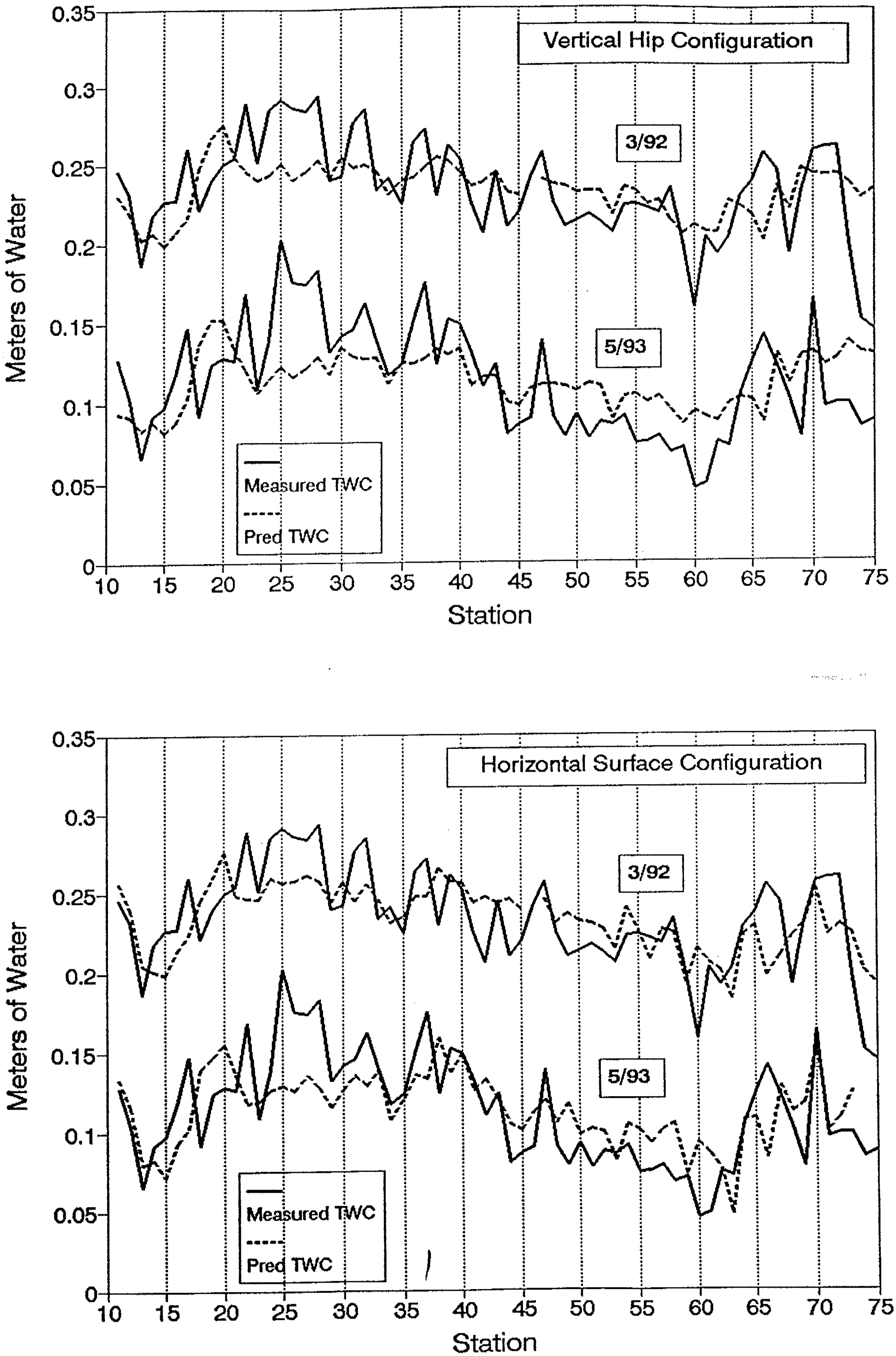


Figure 8b. Predicted (dashed line) and observed (solid line) total water in profile for a relatively wet month (top) and dry month (bottom) using the monthly model.

Appendices

Appendix A1

EC_a Measurements and Converted EC_e Measurements for the EM 38

Bosque del Apache Salinity Survey

Bosque Del Apache
EM 38 Salinity Survey

	EC_a (mS/m) Vert.	EC_a (mS/m) Horz.	EC_e (dS/m) lower	EC_e (dS/m) Ave.	EC_e (dS/m) upper	Calculated EC_e (dS/m) EM 38 Vertical Sample Clay %	Calculated EC_e (dS/m) EM 38 Vertical 38.7% Clay
Line A							
0	56.20	47.10	0.77	0.50	0.23	3.22	2.38
1	31.90	35.90	1.21	3.43	5.65	1.82	1.34
2	21.50	25.80	1.04	2.18	3.32	1.22	0.90
3	20.50	22.10	1.23	1.54	1.85	1.16	0.85
4	30.70	32.20	1.03	2.63	4.22	1.75	1.29
5	33.30	39.80	0.84	1.12	1.39	1.90	1.40
6	38.80	42.60	0.84	2.38	3.91	2.22	1.63
Line B							
0	104.70	78.00	6.16	4.10	2.03	5.56	4.45
1	32.80	38.20	0.70	1.69	2.67	1.87	1.38
2	20.90	26.90	1.09	2.24	3.38	1.19	0.87
3	24.20	31.40	1.01	1.15	1.29	1.38	1.01
4	20.80	27.00	1.12	2.78	4.43	1.18	0.87
5	27.50	29.70	1.06	2.41	3.76	1.57	1.15
6	19.10	20.10	0.63	1.23	1.82	1.08	0.79
7	32.80	36.30	0.35	1.38	2.40	1.87	1.38
Line C							
0	91.30	66.40	8.47	5.11	1.74	4.25	3.88
1	56.60	47.00	4.80	2.96	1.12	2.80	2.39
2	18.80	31.20	0.89	0.57	0.25	1.17	0.78
3	19.20	20.50	0.63	0.78	0.92	1.19	0.80
4	25.70	27.90	0.79	0.99	1.19	1.35	1.07
5	23.90	28.50	0.97	1.53	2.08	1.49	1.00
6	13.60	19.50	0.90	0.83	0.76	0.84	0.56
7	31.80	24.80	0.98	1.49	2.00	1.98	1.34
8	16.20	18.60	0.64	0.73	0.82	1.00	0.67

	EC_a (mS/m)		EC_e (dS/m)			Calculated EC_e (dS/m) EM 38 Vertical	
	Vert.	Horz.	lower	Ave.	upper	Sample Clay %	38.7% Clay
Line D							
0	92.90	73.80	4.94	4.28	3.62	3.90	3.94
1	97.10	56.20	1.89	2.20	2.51	5.57	4.12
2	101.10	62.40	2.54	2.36	2.18	4.24	4.29
3	31.70	26.90	1.59	2.29	2.99	1.81	1.33
4	23.70	23.50	1.26	1.93	2.60	1.35	0.99
5	23.40	22.40	0.78	2.41	4.03	1.33	0.98
6	21.70	23.60	0.83	0.78	0.73	1.23	0.90
7	29.80	23.20	1.20	1.16	1.12	1.70	1.25
8	37.50	33.20	1.00	1.10	1.19	2.14	1.58
9	41.60	42.60	1.21	2.18	3.15	1.78	1.75
10	37.00	33.20	1.37	3.26	5.15	2.11	1.56
Line E							
0	79.50	52.40	4.94	3.34	1.74	4.55	3.37
1	144.40	92.10		1.50	2.99	5.37	6.14
2	116.00	72.90		1.71	3.42	4.47	4.93
3	78.70	61.40	1.87	1.89	1.91	4.51	3.34
4	27.60	28.90	1.16	2.24	3.32	1.57	1.16
5	27.90	30.70	1.38	1.08	0.77	1.59	1.17
6	22.80	25.50	0.90	1.07	1.24	1.30	0.95
7	31.90	36.80	0.99	1.19	1.38	1.82	1.34
8	35.20	64.40	1.68	1.90	2.11	2.01	1.48
9	38.40	41.50	1.00	2.45	3.90	1.46	1.62
10	31.20	27.00	1.20	2.65	4.10	1.36	1.31
Line F							
0	116.70	75.00	4.20	4.10	4.00	4.90	4.96
1	114.50	86.90	3.20	3.55	3.90	4.18	4.87
2	118.30	73.90	1.50	4.40	7.30	4.12	5.03
3	112.70	94.70	1.70	3.20	4.70	4.26	4.79
4	35.80	44.20	1.50	1.10	0.70	1.71	1.51
5	22.80	23.20	1.00	2.85	4.70	1.08	0.95
6	27.20	35.10	1.80	3.00	4.20	1.49	1.14
7	30.40	34.00	1.00	1.65	2.30	1.66	1.28
8	31.50	32.50	1.50	1.55	1.60	1.17	1.32
9	31.40	35.20	1.10	1.15	1.20	1.17	1.32
10	26.90	38.20	1.40	2.10	2.80	1.09	1.13
11	32.40	29.50	0.90	2.05	3.20	1.11	1.36

	EC_a (mS/m)		EC_e (dS/m)			Calculated EC_e (dS/m) EM 38 Vertical	
	Vert.	Horz.	lower	Ave.	upper	Sample Clay %	38.7% Clay
Line G							
0	100.40	74.60	4.40	3.10	1.80	3.49	4.26
1	116.20	79.50	4.70	3.35	2.00	4.04	4.94
2	114.30	74.00	2.40	2.45	2.50	3.98	4.86
3	122.30	87.90	6.30	7.10	7.90	4.26	5.20
4	105.80	68.70	6.10	4.60	3.10	3.68	4.50
5	37.50	24.50	4.50	3.35	2.20	1.74	1.58
6	18.50	19.20	1.20	1.35	1.50	0.90	0.77
7	37.40	50.50	2.10	3.50	4.90	1.64	1.57
8	26.50	39.30	1.70	1.40	1.10	1.15	1.11
9	33.00	27.50	0.90	1.90	2.90	1.62	1.39
10	29.40	37.10	1.50	1.20	0.90	0.90	1.23
11	29.60	28.30	1.10	3.10	5.10	1.17	1.24
Line H							
0	125.00	85.00	4.04	4.08	4.12	4.08	5.32
1	153.10	114.00	7.90	5.28	2.66	5.13	6.52
2	103.30	79.00	7.00	6.67	6.33	3.45	4.39
3	133.30	104.50	3.56	3.90	4.23	4.36	5.67
4	95.10	65.90	10.98	7.25	3.52	3.21	4.04
5	78.30	53.90	8.62	6.44	4.26	2.85	3.32
6	59.10	58.80	3.24	3.04	2.83	2.92	2.50
7	32.30	31.50	1.32	3.34	5.35	1.23	1.36
8	30.00	31.80	1.19	1.85	2.50	1.47	1.26
9	25.50	32.00	1.00	1.60	2.20	1.00	1.07
10	37.70	39.20	1.00	2.40	3.80	1.92	1.59
11	44.20	43.30	0.70	1.80	2.90	1.62	1.86
Line I							
0	157.40	120.70	9.90	10.35	10.80	5.27	6.70
1	156.20	109.60	5.10	8.20	11.30	5.05	6.65
2	173.80	148.30	2.20	2.10	2.00	6.06	7.40
3	165.40	132.30	6.50	6.70	6.90	5.35	7.04
4	132.70	94.30	4.70	4.10	3.50	4.93	5.64
5	113.50	90.00	9.00	10.35	11.70	3.79	4.82
6	93.50	68.80	3.50	4.94	6.37	4.02	3.97
7	134.50	92.60	3.52	4.15	4.78	5.79	5.72
8	45.70	38.70	1.58	3.59	5.59	1.82	1.93
9	30.50	28.60	1.77	2.40	3.02	1.74	1.28
10	23.80	38.70	1.00	2.30	3.60	1.03	0.99
11	34.20	41.20	1.21	3.13	5.05	1.36	1.44
12	31.20	34.40	0.93	3.73	6.52	1.23	1.31

	EC_a (mS/m)		EC_e (dS/m)			Calculated EC_e (dS/m) EM 38 Vertical	
	Vert.	Horz.	lower	Ave.	upper	Sample Clay %	38.7% Clay
Line J							
0	153.00	103.90	9.30	8.30	7.30	5.12	6.51
1	154.10	129.50	6.10	5.90	5.70	4.99	6.56
2	163.40	144.90	2.60	5.95	9.30	5.47	6.95
3	171.10	145.10	2.30	9.05	15.80	5.43	7.28
4	153.90	122.00	2.40	2.65	2.90	5.62	6.55
5	149.70	106.20	2.11	2.49	2.86	5.22	6.37
6	133.60	86.80	2.13	4.11	6.08	5.25	5.68
7	100.60	70.10	2.25	3.15	4.05	4.03	4.27
9	24.40	30.20	0.89	1.70	2.50	0.90	1.02
10	25.60	36.10	1.26	1.37	1.48	0.91	1.07
11	31.20	34.52	1.60	2.93	4.26	1.33	1.31
12	23.30	24.00	0.91	2.54	4.17	0.92	0.97
13	33.00	28.00	1.63	3.19	4.74	1.31	1.39
Line K							
0	148.10	115.70	7.50	5.75	4.00	7.60	6.30
1	154.40	145.70	2.50	4.80	7.10	5.64	6.57
2	122.50	98.70	7.90	8.35	8.80	4.47	5.21
3	164.60	143.10	2.80	8.30	13.80	5.33	7.01
4	106.40	105.20	4.90	6.85	8.80	3.43	4.52
10	19.40	20.00	1.09	0.82	0.54	0.98	0.81
11	23.80	19.50	1.24	1.99	2.73	0.96	0.99
12	28.60	28.50	0.81	2.25	3.68	1.21	1.20
13	23.80	37.60	0.84	2.40	3.96	1.21	0.99
14	23.60	39.20	1.54	2.82	4.10	1.00	0.99
Line L							
0	167.20	154.40	4.20	8.30	12.40	6.87	7.12
1	147.80	129.40	2.70	4.75	6.80	7.58	6.29
11	12.10	20.50	0.97	2.21	3.45	0.50	0.49
12	19.60	24.50	1.31	2.64	3.97	0.78	0.81
13	23.50	24.30	0.98	2.68	4.37	0.95	0.98
14	21.70	23.70	0.85	1.98	3.10	0.87	0.90
15	27.80	32.10	1.44	3.94	6.44	1.12	1.16
Line M							
12	17.40	17.70	1.57	2.71	3.85	0.75	0.72
13	14.70	16.30	1.05	2.04	3.03	0.58	0.61
14	24.70	34.70	1.07	3.04	5.01	1.07	1.03
15	35.30	39.20	1.18	3.21	5.24	1.43	1.48

	EC_a (mS/m)		EC_e (dS/m)			Calculated EC_e (dS/m) EM 38 Vertical	
	Vert.	Horz.	lower	Ave.	upper	Sample Clay %	38.7% Clay
Line N							
13	14.00	16.30	1.32	1.93	2.54	0.55	0.58
14	19.20	24.00	1.08	1.95	2.81	0.83	0.80
15	23.20	26.50	1.26	2.31	3.36	0.93	0.97
Line O							
14	40.90	54.30	1.15	2.15	3.15	1.66	1.72
15	22.60	22.90	1.06	2.68	4.30	0.91	0.94
Line P							
14	22.70	25.20	0.97	1.95	2.93	0.98	0.95
15	19.50	21.10	0.85	2.24	3.62	1.11	0.81
Line Q							
15	27.80	25.90	1.00	1.43	1.86	1.12	1.16

Appendix A2

EC_a Measurements and Converted EC_e Measurements for the EM 31

Bosque del Apache Salinity Survey

Bosque Del Apache
EM 31 Salinity Survey

	EC_a (mS/m)		EC_e (dS/m)		Calculated EC_e (dS/m)	
	Vert.	Horz.	lower	upper	EM 31 Sample Clay %	Horizontal 38.7% Clay
Line A						
0	38.80	36.60	0.77	0.23	2.01	1.54
1	21.12	43.20	1.21	5.65	2.38	1.82
2	13.20	23.82	1.04	3.32	1.31	0.99
3	22.80	21.66	1.23	1.85	1.19	0.90
4	22.38	29.40	1.03	4.22	1.62	1.23
5	22.14	27.42	0.84	1.39	1.51	1.15
6	28.14	37.00	0.84	3.91	2.04	1.56
Line B						
0	144.00	15.20	6.16	2.03	0.76	0.63
1	27.00	30.80	0.70	2.67	1.69	1.29
2	27.48	23.88	1.09	3.38	1.31	1.00
3	21.18	24.90	1.01	1.29	1.37	1.04
4	24.06	19.56	1.12	4.43	1.07	0.81
5	20.76	22.92	1.06	3.76	1.26	0.96
6	23.04	19.26	0.63	1.82	1.05	0.80
7	23.40	25.56	0.35	2.40	1.40	1.07
Line C						
0	119.40	101.40	8.47	1.74	4.56	4.31
1	93.80	75.00	4.80	1.12	3.58	3.18
2	33.80	34.40	0.89	0.25	2.07	1.45
3	26.40	18.72	0.63	0.92	1.12	0.78
4	23.28	23.52	0.79	1.19	1.19	0.98
5	19.38	21.78	0.97	2.08	1.30	0.91
6	20.82	16.68	0.90	0.76	1.00	0.69
7	26.40	23.40	0.98	2.00	1.40	0.98
8	18.06	17.76	0.64	0.82	1.06	0.74

	EC_a (mS/m)		EC_e (dS/m)		Calculated EC_e (dS/m)	
	Vert.	Horz.	lower	upper	EM 31 Sample Clay %	Horizontal 38.7% Clay
Line D						
0	124.20	119.40	4.94	3.62	4.84	5.08
1	141.00	107.40	1.89	2.51	5.94	4.56
2	135.60	111.60	2.54	2.18	4.52	4.74
3	29.60	28.20	1.59	2.99	1.55	1.18
4	30.60	22.68	1.26	2.60	1.24	0.95
5	27.24	22.26	0.78	4.03	1.22	0.93
6	25.92	21.90	0.83	0.73	1.20	0.91
7	19.08	20.10	1.20	1.12	1.10	0.84
8	24.24	29.40	1.00	1.19	1.62	1.23
9	25.32	33.40	1.21	3.15	1.37	1.40
10	25.86	27.84	1.37	5.15	1.53	1.17
Line E						
0	138.60	101.40	4.94	1.74	5.61	4.31
1	165.60	159.60	3.00	2.99	5.73	6.79
2	159.60	137.40	3.50	3.42	5.11	5.84
3	97.80	95.40	1.87	1.91	5.28	4.05
4	22.32	25.44	1.16	3.32	1.40	1.06
5	26.16	24.42	1.38	0.77	1.34	1.02
6	28.02	24.30	0.90	1.24	1.33	1.02
7	24.12	29.80	0.99	1.38	1.64	1.25
8	20.94	44.60	1.68	2.11	2.46	1.88
9	33.00	35.20	1.00	3.90	1.29	1.48
10	29.80	28.80	1.20	4.10	1.21	1.21
Line F						
0	175.20	118.20	4.20	4.00	4.79	5.02
1	142.20	136.20	3.20	3.90	4.80	5.79
2	150.60	122.40	1.50	7.30	4.11	5.20
3	122.40	117.60	1.70	4.70	4.29	5.00
4	46.60	43.40	1.50	0.70	2.00	1.83
5	25.50	22.80	1.00	4.70	1.04	0.95
6	28.98	31.80	1.80	4.20	1.68	1.34
7	21.72	33.00	1.00	2.30	1.74	1.39
8	40.80	26.80	1.50	1.60	0.96	1.12
9	35.40	29.20	1.10	1.20	1.04	1.22
10	37.00	31.40	1.40	2.80	1.22	1.32
11	27.96	21.72	0.90	3.20	0.71	0.90

	EC_a (mS/m)		EC_e (dS/m)		Calculated EC_e (dS/m)	
	Vert.	Horz.	lower	upper	EM 31 Sample Clay %	Horizontal 38.7% Clay
Line G						
0	126.60	118.20	4.40	1.80	3.97	5.02
1	137.40	133.80	4.70	2.00	4.50	5.69
2	137.40	119.40	2.40	2.50	4.01	5.08
3	125.40	130.20	6.30	7.90	4.38	5.54
4	136.80	120.60	6.10	3.10	4.05	5.13
5	45.60	35.60	4.50	2.20	1.59	1.50
6	21.60	20.34	1.20	1.50	0.96	0.85
7	21.72	31.20	2.10	4.90	1.31	1.31
8	29.20	30.40	1.70	1.10	1.28	1.28
9	27.42	28.14	0.90	2.90	1.33	1.18
10	32.80	31.80	1.50	0.90	0.94	1.34
11	23.70	23.70	1.10	5.10	0.90	0.99
Line H						
0	180.60	154.20	4.04	4.12	4.87	6.56
1	172.20	167.40	7.90	2.66	5.41	7.13
2	111.00	111.60	7.00	6.33	3.60	4.74
3	111.00	133.80	3.56	4.23	4.22	5.69
4	97.80	104.40	10.98	3.52	3.41	4.44
5	87.80	84.00	8.62	4.26	2.95	3.56
6	49.00	75.40	3.24	2.83	3.60	3.20
7	31.40	28.60	1.32	5.35	1.04	1.20
8	23.22	24.36	1.19	2.50	1.15	1.02
9	34.60	30.00	1.00	2.20	1.14	1.26
10	23.70	30.80	1.00	3.80	1.51	1.29
11	23.22	40.80	0.70	2.90	1.44	1.72
Line I						
0	160.80	107.40	9.90	10.80	3.46	4.56
1	142.20	90.60	5.10	11.30	2.81	3.85
2	177.00	117.60	2.20	2.00	3.95	5.00
3	177.00	115.80	6.50	6.90	3.61	4.92
4	143.40	91.80	4.70	3.50	3.28	3.90
5	136.20	117.60	9.00	11.70	3.79	5.00
6	112.80	98.40	3.50	6.37	4.08	4.18
7	111.00	123.60	3.52	4.78	5.13	5.26
8	43.00	38.40	1.58	5.59	1.47	1.62
9	27.24	27.90	1.77	3.02	1.53	1.17
10	29.60	33.40	1.00	3.60	1.41	1.40
11	16.32	31.60	1.21	5.05	1.20	1.33
12	17.58	23.58	0.93	6.52	0.89	0.98

	EC_a (mS/m) Vert.	Horz.	EC_e (dS/m) lower	upper	Calculated EC_e (dS/m) EM 31 Sample Clay %	Horizontal 38.7% Clay
Line J						
0	183.60	112.20	9.30	7.30	3.62	4.77
1	156.00	103.80	6.10	5.70	3.23	4.41
2	153.00	105.60	2.60	9.30	3.40	4.49
3	152.40	111.00	2.30	15.80	3.39	4.72
4	165.00	108.00	2.40	2.90	3.80	4.59
5	167.40	160.20	2.11	2.86	5.39	6.82
6	117.60	135.60	2.13	6.08	5.15	5.77
7	110.40	68.40	2.25	4.05	2.64	2.90
9	27.96	28.74	0.89	2.50	1.03	1.20
10	26.04	28.92	1.26	1.48	1.00	1.21
11	31.80	31.40	1.60	4.26	1.29	1.32
12	17.52	20.70	0.91	4.17	0.78	0.86
13	23.94	26.64	1.63	4.74	1.01	1.11
Line K						
0	161.40	94.80	7.50	4.00	4.69	4.03
1	168.00	108.00	2.50	7.10	3.80	4.59
2	146.40	91.20	7.90	8.80	3.20	3.87
3	111.00	83.40	2.80	13.80	2.59	3.54
4	112.80	78.00	4.90	8.80	2.42	3.31
10	28.20	23.58	1.09	0.54	1.15	0.98
11	23.04	22.80	1.24	2.73	0.88	0.95
12	24.60	27.96	0.81	3.68	1.14	1.17
13	19.98	26.22	0.84	3.96	1.28	1.10
14	18.42	27.18	1.54	4.10	1.11	1.14
Line L						
0	149.40	110.40	4.20	12.40	4.37	4.69
1	115.80	80.40	2.70	6.80	3.97	3.41
11	23.28	21.78	0.97	3.45	0.88	0.91
12	22.74	23.16	1.31	3.97	0.90	0.97
13	20.10	21.48	0.98	4.37	0.83	0.89
14	29.60	27.24	0.85	3.10	1.06	1.14
15	35.40	30.20	1.44	6.44	1.18	1.27
Line M						
12	20.70	20.10	1.57	3.85	0.84	0.84
13	17.82	17.04	1.05	3.03	0.65	0.71
14	19.86	25.68	1.07	5.01	1.08	1.07
15	23.76	38.20	1.18	5.24	1.50	1.61

	EC_a (mS/m) Vert.	Horz.	EC_e (dS/m) lower	upper	Calculated EC_e (dS/m) EM 31 Sample Clay %	Horizontal 38.7% Clay
Line N						
13	20.70	18.48	1.32	2.54	0.71	0.77
14	22.56	21.24	1.08	2.81	0.89	0.88
15	25.08	25.44	1.26	3.36	0.99	1.06
Line O						
14	9.66	26.76	1.15	3.15	1.04	1.12
15	26.88	24.18	1.06	4.30	0.94	1.01
Line P						
14	26.20	26.94	0.97	2.93	1.13	1.13
15	24.50	24.54	0.85	3.62	1.35	1.03
Line Q						
15	31.00	26.70	1.00	1.86	1.04	1.12

Appendix A3

Laboratory Determined EC_e Values and Observed Clay Contents

Bosque del Apache Salinity Survey

Bosque del Apache
Salinity and Soil Survey
Lab Measured EC_e and Clay contents

-3 = 100% Sand
+3 = 100% Clay

Line A

Station	Lower		Upper (15")	
0	0.77	(-3)	0.23	(-2)
1	1.21	"	5.65	"
2	1.04	"	3.32	"
3	1.23	"	1.85	"
4	1.03	"	4.22	"
5	0.84	"	1.39	"
6	0.84	"	3.91	"

Line B

Station	Lower		Upper (15")	
0	6.16	(-2)	2.03	(-2)
1	0.70	"	2.67	"
2	1.09	"	3.38	"
3	1.01	"	1.29	"
4	1.12	"	4.43	"
5	1.06	"	3.76	"
6	0.63	"	1.82	"
7	0.35	"	2.40	"

Line C

Station	Lower		Upper (15")	
0	8.47	(0)	1.74	(-3)
1	4.80	(-1)	1.12	"
2	0.89	(-3)	0.25	"
3	0.63	"	0.92	"
4	0.79	"	1.19	(-1)
5	0.97	"	2.08	(-3)
6	0.90	"	0.76	"
7	0.98	"	2.00	"
8	0.64	"	0.82	"

Line D

Station	Lower		Upper (15")	
0	4.94	(1)	3.62	(-2)
1	1.89	(-3)	2.51	"
2	2.54	(1)	2.18	"
3	1.59	(-3)	2.99	"
4	1.26	"	2.60	"
5	0.78	"	4.03	"
6	0.83	"	0.73	"
7	1.20	"	1.12	"
8	1.00	"	1.19	"
9	1.21	"	3.15	(1)
10	1.37	"	5.15	"

Line E

Station	Lower		Upper (15")	
0	4.94	(-3)	1.74	(-2)
1	*	(3)	2.99	"
2	*	(2)	3.42	"
3	1.87	(-3)	1.91	"
4	1.16	"	3.32	"
5	1.38	"	0.77	"
6	0.90	"	1.24	"
7	0.99	"	1.38	"
8	1.68	"	2.11	"
9	1.0	"	3.9	(3)
10	1.2	"	4.1	(1)

Line F

Station	Lower		Upper (15")	
0	4.2	(-1)	4.0	(-1)
1	3.2	(2)	3.9	"
2	1.5	(3)	7.3	"
3	1.7	(-3)	4.7	(3)
4	1.5	"	0.7	(-1)
5	1.0	"	4.7	"
6	1.8	"	4.2	(-2)
7	1.0	"	2.3	"
8	1.5	"	1.6	(3)
9	1.1	"	1.2	"
10	1.4	(-2)	2.8	(1)
11	0.9	(3)	3.2	(-1)

Line G

Station	Lower	Upper (15")
0	4.4 (3)	1.8 (-1)
1	4.7 "	2.0 "
2	2.4 "	2.5 "
3	6.3 "	7.9 "
4	6.1 (1)	3.1 (1)
5	4.5 (-2)	2.2 (-1)
6	1.2 (-3)	1.5 "
7	2.1 "	4.9 (1)
8	1.7 (-3)	1.1 "
9	0.9 "	2.9 (-1)
10	1.5 (2)	0.9 (3)
11	1.1 (-3)	5.1 (2)

Line H

Station	Lower	Upper (15")
0	4.04 (3)	4.12 (1)
1	7.90 (2)	2.66 "
2	7.00 "	6.33 "
3	3.56 (3)	4.23 "
4	10.98 (2)	3.52 "
5	8.62 "	4.26 (-1)
6	3.24 (-3)	2.83 "
7	1.32 "	5.35 (3)
8	1.19 "	2.5 (-1)
9	1.0 (-3)	2.2 (2)
10	1.0 (-3)	3.8 (-1)
11	0.7 (-2)	2.9 (2)

Line I

Station	Lower	Upper (15")
0	9.90 (2)	10.80 (1)
1	5.10 (3)	11.30 (1)
2	2.20 (3)	2.00 (-1)
3	6.50 (3)	6.90 (1)
4	4.70 (3)	3.50 (-2)
5	9.0 (2)	11.7 (1)
6	3.5 (-3)	6.37 "
7	3.52 "	4.78 "
8	1.58 "	5.59 (2)
9	1.77 "	3.02 (-2)
10	1.00 "	3.60 (1)
11	1.21 "	5.05 (2)
12	(0.93 ")	6.52 "

Line J

Station	Lower		Upper (15")	
0	9.30	(2)	7.30	(1)
1	6.10	(3)	5.70	(1)
2	2.60	(2)	9.30	(1)
3	2.30	(3)	15.80	(2)
4	2.40	(2)	2.90	(-1)
5	2.11	(3)	2.86	(-1)
6	2.13	(-2)	6.08	(1)
7	2.25	"	4.05	"
8				
9	0.89	(-3)	2.50	(3)
10	1.26	(-2)	1.48	"
11	1.60	(-3)	4.26	(1)
12	0.91	"	4.17	(2)
13	1.63	"	4.74	"

Line K

Station	Lower		Upper (15")	
0	7.50	(-3)	4.00	(-1)
1	2.50	(2)	7.10	"
2	7.90	"	8.80	"
3	2.80	"	13.80	(2)
4	4.90	(3)	8.80	(1)
10	1.09	(-3)	0.54	(-1)
11	1.24	"	2.73	(2)
12	0.81	"	3.68	(1)
13	0.84	"	3.96	(-1)
14	1.54	"	4.10	(1)

Line L

Station	Lower		Upper (15")	
0	4.20	(-3)	12.40	(2)
1	2.70	"	6.80	(-1)
11	0.97	"	3.45	(1)
12	1.31	"	3.97	(2)
13	0.98	"	4.37	"
14	0.85	"	3.10	"
15	1.44	"	6.44	"

Line M

Station	Lower		Upper (15")	
12	1.57	(-3)	3.85	(1)
13	1.05	"	3.03	(2)
14	1.07	"	5.01	(1)
15	1.18	"	5.24	(2)

Line N

Station	Lower		Upper (15")	
13	1.32	(-3)	2.54	(2)
14	1.08	"	2.81	(1)
15	1.26	"	3.36	(2)

Line O

Station	Lower		Upper (15")	
14	1.15	(-3)	3.15	(2)
15	1.06	"	4.30	"

Line P

Station	Lower		Upper (15")	
14	0.97	(-3)	2.93	(1)
15	0.85	"	3.62	(-2)

Line Q

Station	Lower		Upper (15")	
15	1.0	(-3)	1.86	(2)

Appendix B1

EM 31 EC_a Measurements

Non-Invasive Soil Water Content Measurement Using Electromagnetic Induction

02/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	15.06	10.440	16.320	12.960	15.900	17.160
12	14.28	10.140	15.360	12.480	15.780	15.840
13	12.30	7.800	13.740	9.540	14.400	12.120
14	12.00	7.320	13.140	9.480	13.800	11.220
15	11.70	7.320	12.900	9.360	13.140	11.100
16	12.90	8.280	13.920	10.200	14.040	12.360
17	13.92	9.180	15.000	11.160	15.180	13.980
18	16.50	9.960	18.120	12.660	19.200	15.540
19	19.20	11.640	21.180	14.280	21.600	18.120
20	19.74	12.360	21.900	15.780	22.500	19.080
21	17.34	10.200	18.900	13.140	19.260	15.780
22	16.44	10.740	17.820	13.080	18.120	16.560
23	15.72	9.960	17.340	13.140	18.060	15.120
24	16.08	10.920	17.400	14.160	17.340	17.880
25	16.26	10.380	17.820	13.560	17.220	16.500
26	16.62	10.800	17.640	13.620	17.820	17.040
27	16.74	10.740	17.880	13.980	17.940	17.580
28	17.64	10.800	18.960	13.920	17.940	17.820
29	16.68	10.560	18.060	13.320	18.360	16.140
30	17.58	11.160	18.540	13.920	18.720	17.580
31	17.28	10.740	18.600	13.380	19.020	16.140
32	17.58	11.220	19.140	14.520	19.440	18.060
33	17.70	10.740	19.140	14.160	19.440	16.860
34	15.78	10.080	16.920	12.120	17.880	15.240
35	16.02	10.260	17.160	13.200	17.460	15.660
36	16.62	10.500	18.060	13.440	18.480	16.500
37	16.62	11.220	18.000	14.160	18.240	17.760
38	17.94	11.940	19.320	15.360	19.620	19.020
39	17.70	11.220	19.380	13.860	18.360	17.100
40	17.46	11.460	19.080	14.340	19.620	18.060
41	15.78	10.200	17.040	12.240	17.100	16.380
42	15.96	10.380	17.340	14.400	17.760	16.500
43	16.68	10.080	18.300	12.960	19.560	16.380
44	15.36	10.140	16.560	13.500	16.860	16.260
45	15.30	9.840	16.740	12.420	17.160	15.660
46	15.72	10.140	17.100	13.500	17.460	16.500
47	16.02	10.560	17.700	12.840	17.700	16.440
48	15.90	9.540	17.280	11.820	17.760	14.760
49	15.90	9.960	17.220	12.480	18.540	15.060
50	15.66	9.600	17.100	12.060	17.340	14.760
51	15.60	9.660	17.040	12.240	17.580	15.000
52	15.18	9.360	16.620	11.880	16.020	14.460
53	14.28	8.880	15.540	10.980	16.020	13.620
54	16.14	9.900	17.640	12.960	18.480	15.540
55	16.20	9.780	17.760	12.360	18.540	15.240
56	14.70	8.700	16.200	11.160	17.220	13.860
57	15.12	9.240	16.620	11.520	17.760	14.040
58	13.80	8.940	15.180	12.060	15.840	14.520
59	12.66	7.740	13.380	9.420	14.520	11.820
60	13.56	8.280	14.760	10.140	15.720	11.820

61	13.44	8.820	14.760	9.960	15.660	12.180
62	12.60	7.980	13.740	9.960	14.160	11.520
63	13.68	7.500	17.100	8.340	16.740	10.740
64	13.98	9.240	15.360	10.800	16.080	13.020
65	13.50	8.820	14.820	10.980	15.660	13.920
66	12.12	7.440	13.380	9.120	14.340	11.400
67	14.82	8.520	16.440	10.800	17.700	12.720
68	14.16	8.820	16.380	11.280	17.940	13.500
69	14.88	9.900	15.960	12.480	16.980	15.240
70	15.90	10.440	17.160	13.080	18.240	16.440
71	16.02	9.480	17.820	12.000	18.660	14.520
72	17.94	10.680	20.100	12.540	22.260	15.060
73	15.84	9.120	17.460	11.880	18.480	13.980
74	15.18	8.700	16.680	10.560	18.300	12.660
75	15.06	8.040	16.860	9.000	17.880	11.100

03/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	17.64	12.84	19.38	16.68	19.02	20.52
12	16.38	12.06	17.94	15.24	17.94	18.48
13	14.52	9.84	16.08	12.24	15.72	14.46
14						
15	14.10	9.36	13.14	11.70	15.78	13.74
16	15.06	10.32	16.50	13.44	16.62	15.54
17	16.08	10.86	18.00	13.80	18.12	16.68
18	19.50	13.26	21.84	16.32	21.72	19.20
19	21.66	13.98	24.12	17.46	25.56	20.88
20	22.56	15.24	24.72	19.14	25.20	22.80
21	20.28	13.56	22.44	16.56	23.16	19.56
22	19.26	13.02	21.24	16.68	21.36	19.38
23	18.66	13.02	20.22	16.86	20.82	19.32
24	19.02	14.34	20.04	17.64	19.98	20.88
25	19.86	13.44	21.90	16.92	22.74	20.52
26	18.66	13.50	20.34	17.22	19.92	20.64
27	19.32	14.22	20.82	17.76	20.76	21.06
28	20.10	13.80	21.84	17.64	22.56	20.64
29	18.84	12.90	20.76	16.68	21.18	19.08
30	20.28	13.80	21.90	17.28	22.68	20.58
31	19.56	13.14	21.30	16.74	21.72	19.14
32	19.74	13.62	21.30	17.28	21.36	20.46
33	19.26	13.08	20.94	16.38	21.06	19.32
34	17.70	11.88	19.32	14.94	19.50	17.58
35	18.66	12.36	20.64	15.12	21.42	18.00
36	18.84	12.66	20.52	16.62	20.52	19.50
37	19.56	12.72	21.60	16.62	22.44	19.50
38	20.22	13.98	22.14	18.00	22.62	21.60
39	19.98	13.14	22.32	17.28	22.68	20.58
40	19.14	12.90	20.70	17.04	20.76	20.52
41	18.24	12.60	19.80	15.96	20.16	19.02
42	18.48	12.72	20.22	16.50	20.52	19.44
43	19.20	12.60	20.76	16.56	22.08	19.02
44	17.82	12.78	19.38	16.32	19.44	19.26
45	17.64	11.88	19.44	15.60	20.16	18.48
46	18.84	12.84	21.12	16.38	21.36	19.32
47	18.66	12.42	20.64	16.38	21.06	19.26
48	18.36	11.28	20.40	14.94	20.82	17.52
49	18.24	12.12	20.40	15.30	20.88	18.24
50	17.76	11.52	19.80	14.88	20.28	17.64
51	17.82	11.64	19.62	14.94	20.64	17.52
52	17.82	11.34	19.50	14.52	20.40	17.10
53	16.14	10.44	17.88	13.26	18.42	15.60
54	18.06	12.30	19.80	15.60	20.94	18.66
55	17.82	11.40	19.92	15.06	20.58	16.86
56	16.86	10.20	18.84	12.96	19.80	14.82
57	17.16	11.34	18.96	13.92	19.92	16.98
58	15.72	11.04	17.40	14.04	18.12	16.80
59	14.82	8.94	16.44	11.16	17.34	13.08
60	15.42	10.56	16.98	13.26	17.52	15.66

61	14.94	9.78	16.26	12.54	17.10	14.58
62	14.88	9.60	16.62	12.18	17.46	13.98
63	17.10	9.66	22.56	9.90	23.34	11.88
64	16.68	11.22	18.54	14.40	18.36	16.56
65	16.08	11.10	17.88	14.22	18.30	17.28
66	14.28	9.48	15.42	12.00	16.14	13.62
67	18.06	11.34	20.46	13.98	20.34	15.06
68	16.38	11.04	17.88	13.98	18.24	16.50
69	19.32	12.12	22.02	14.70	22.74	17.46
70	18.90	12.96	21.06	16.68	22.80	19.98
71	18.84	11.64	21.06	14.40	22.32	16.56
72	18.90	11.94	21.00	15.24	22.20	17.34
73	18.30	11.52	20.58	14.52	21.42	16.74
74	17.22	10.50	19.32	12.24	19.56	13.92
75	17.88	10.38	20.10	11.70	21.06	12.84

04/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	16.74	11.04	18.36	15.54	18.90	19.86
12	15.24	10.08	17.46	13.92	17.58	17.70
13	13.74	7.86	15.60	11.22	15.54	13.86
14	14.34	7.86	16.62	10.32	17.64	13.32
15	13.02	6.96	14.88	10.26	15.42	12.24
16	14.04	8.22	15.72	11.16	16.44	14.04
17	15.12	8.70	16.92	12.24	17.40	15.00
18	18.36	11.16	20.94	14.58	20.94	18.42
19	20.70	12.30	23.40	15.96	24.72	19.98
20	21.66	12.96	24.36	17.88	24.90	22.02
21	19.14	10.86	21.54	14.64	22.38	19.02
22	18.30	11.46	20.82	15.12	20.58	18.60
23	17.34	11.28	18.66	14.94	19.26	18.42
24	17.28	11.22	18.84	15.12	17.82	19.20
25	18.24	10.14	20.76	15.06	21.36	17.82
26	16.98	10.56	18.78	14.52	17.94	17.70
27	18.24	11.40	20.40	15.48	20.46	19.14
28	18.72	10.98	21.42	14.76	22.08	17.64
29	17.22	10.26	19.02	14.40	19.26	17.82
30	18.78	11.40	20.46	15.54	21.06	19.20
31	18.00	10.92	19.62	14.94	19.02	18.12
32	17.70	10.50	19.98	14.22	19.98	17.22
33	17.64	10.14	19.26	13.74	19.26	16.86
34	16.32	9.42	18.30	12.66	18.36	15.96
35	16.26	9.90	17.88	12.78	18.06	16.08
36	17.46	10.38	19.80	14.52	20.16	17.82
37	18.12	10.62	20.58	14.46	21.18	18.18
38	19.02	12.36	21.54	16.74	20.46	20.40
39	18.72	11.40	21.60	15.90	21.66	19.86
40	17.58	11.04	19.98	15.12	19.14	18.48
41	16.62	10.38	19.26	14.28	18.96	18.18
42	17.34	10.92	19.26	15.54	19.08	18.90
43	18.12	10.92	20.76	15.12	21.42	18.96
44	16.44	10.92	18.42	15.60	18.84	19.08
45	16.80	10.32	19.08	14.82	20.04	18.48
46	18.12	11.46	20.34	15.48	20.64	19.50
47	17.40	10.92	20.28	15.24	19.74	18.60
48	17.28	9.90	19.74	12.78	20.22	16.74
49	17.16	10.02	19.44	14.04	20.52	17.34
50	16.86	9.42	19.26	12.78	19.68	15.78
51	16.86	9.96	19.32	13.68	20.40	16.68
52	16.74	9.60	19.08	14.28	18.90	16.62
53	15.12	8.46	17.22	11.10	18.30	13.98
54	17.28	10.98	19.38	14.70	20.16	18.78
55	17.04	9.60	18.90	13.20	20.52	16.80
56	15.24	8.40	17.40	10.50	19.38	12.78
57	16.20	9.48	18.36	12.90	18.12	15.90
58	14.34	9.06	16.44	12.84	16.62	16.50
59	13.32	7.02	14.82	9.66	16.14	11.34
60	13.92	8.52	15.54	11.76	16.68	14.46

61	13.50	7.74	14.94	10.56	16.62	13.98
62	13.68	7.62	15.66	9.72	16.26	12.60
63	15.78	7.80	21.96	9.00	22.32	10.38
64	15.84	9.24	18.18	13.26	17.28	15.36
65	15.24	9.24	17.52	12.96	18.24	15.84
66	12.72	7.44	14.28	10.02	15.06	12.36
67	17.22	9.12	19.98	12.30	19.44	14.34
68	15.30	8.76	17.16	12.42	18.36	15.90
69	18.24	9.90	21.18	13.62	21.54	16.26
70	17.64	11.16	20.58	15.30	22.44	19.32
71	16.92	8.82	19.56	11.82	20.94	14.04
72	17.34	9.72	19.80	12.90	18.90	14.52
73	16.92	9.24	19.26	12.96	19.68	15.18
74	15.36	8.28	17.34	10.50	17.22	12.66
75	16.32	7.74	18.30	10.38	19.26	11.16

06/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	17.52	11.94	19.20	17.28	18.90	21.66
12	16.86	11.34	19.14	15.78	19.68	19.02
13	15.48	9.72	17.88	13.32	17.70	16.02
14	16.38	9.90	19.20	13.38	20.22	15.48
15	14.88	9.12	17.28	11.94	17.22	13.86
16	15.18	8.82	17.58	12.66	18.48	15.18
17	16.56	10.26	19.20	14.34	19.44	15.90
18	20.52	11.94	23.58	16.80	23.52	20.16
19	22.38	12.90	25.56	17.70	27.18	21.18
20	23.04	13.74	26.10	20.34	26.10	23.34
21	20.58	11.76	22.92	17.22	23.76	20.40
22	20.34	12.00	23.04	17.16	23.82	22.50
23	18.36	11.70	19.80	16.14	20.10	19.32
24	18.96	12.66	21.30	16.92	21.72	19.98
25	19.14	11.58	21.66	15.60	22.50	18.78
26	17.82	11.10	19.74	15.54	19.26	18.18
27	19.26	12.36	21.48	17.64	21.78	21.42
28	20.22	12.06	22.86	16.50	23.52	18.84
29	17.88	11.04	19.50	15.66	19.44	19.14
30	20.52	12.30	23.64	16.74	24.06	19.14
31	19.02	10.80	21.36	16.50	21.42	19.56
32	19.38	15.06	21.90	16.44	22.56	19.02
33	18.66	11.64	20.94	15.84	21.24	19.02
34	18.00	10.86	20.16	14.40	20.28	17.28
35	18.60	10.56	21.12	14.22	22.38	17.82
36	19.08	11.52	21.00	16.38	22.80	20.22
37	19.32	11.58	22.14	15.90	21.84	18.84
38	20.22	13.08	22.92	18.66	22.80	23.64
39	20.10	11.76	23.70	16.44	23.34	19.80
40	19.20	12.72	21.48	17.76	20.10	21.54
41	18.12	11.88	20.16	14.52	20.94	17.64
42	18.78	11.70	20.94	16.56	20.88	19.74
43	19.20	11.34	21.36	16.14	22.20	18.30
44	17.82	11.64	20.22	16.74	20.64	20.04
45	18.24	12.18	20.94	16.74	21.84	19.74
46	19.38	.	22.32	16.56	22.74	20.16
47	19.08	11.52	22.20	16.20	22.02	19.38
48	18.66	10.80	21.66	14.16	22.74	16.44
49	18.42	12.12	20.88	15.36	22.02	17.94
50	18.18	11.04	21.30	13.68	21.24	16.56
51	18.60	11.22	21.60	14.94	22.80	18.12
52	18.30	12.30	21.24	15.36	21.12	19.20
53	15.72	9.36	18.12	12.42	19.08	15.30
54	18.24	11.28	20.88	16.26	21.36	19.02
55	17.28	9.54	20.16	14.40	20.70	15.60
56	15.36	8.64	17.70	12.42	19.08	13.32
57	17.28	10.56	19.86	13.86	20.46	16.74
58	15.12	10.08	17.52	14.16	18.24	17.46
59	13.98	9.00	15.90	11.28	16.80	12.36
60	14.58	8.82	16.62	12.54	16.98	15.12

61	14.16	8.82	16.26	11.70	16.92	13.56
62	14.64	8.58	17.16	11.10	17.94	13.32
63	15.48	8.04	24.06	10.68	22.62	10.92
64	16.80	10.38	19.08	15.66	19.38	16.26
65	16.38	9.30	19.62	13.68	19.80	16.92
66	13.86	8.10	15.54	10.86	15.78	13.14
67	18.42	9.78	21.84	13.44	23.16	13.98
68	16.44	10.32	19.08	12.90	19.86	17.82
69	18.90	10.62	22.44	12.60	24.12	17.88
70	18.84	11.58	21.54	16.74	23.04	20.34
71	17.40	10.80	20.04	13.02	22.08	13.32
72	18.12	10.14	20.88	14.76	21.06	16.20
73	18.30	10.44	20.88	13.50	21.90	16.86
74	16.68	9.36	19.62	12.30	20.70	14.16
75	17.28	8.88	19.86	12.24	20.64	12.5

07/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	15.12	9.96	17.10	14.40	17.16	18.00
12	15.54	11.76	17.64	12.90	18.66	15.54
13	14.88	9.24	17.16	12.66	17.52	13.86
14	15.66	11.34	18.48	11.70	19.26	14.40
15	14.16	9.36	16.32	12.30	17.70	12.96
16	14.04	9.96	15.90	11.10	16.44	12.96
17	15.24	10.80	17.52	11.94	18.06	13.74
18	18.66	12.48	21.66	13.86	22.50	17.04
19	21.06	14.22	23.82	18.06	25.56	18.96
20	21.12	15.06	24.24	16.50	25.38	19.02
21	19.14	13.14	22.20	15.00	22.80	16.44
22	18.36	12.24	21.18	15.72	21.24	17.28
23	16.50	11.40	18.42	13.38	19.38	14.82
24	16.56	11.22	18.06	.	18.84	16.14
25	17.10	12.36	19.68	.	21.42	16.68
26	16.38	12.00	18.48	.	19.26	14.70
27	17.34	12.12	20.10	14.64	20.64	17.58
28	18.54	10.74	20.82	14.58	20.82	16.68
29	16.14	9.90	18.60	12.90	19.86	15.12
30	18.48	13.08	21.06	15.54	22.38	16.56
31	17.46	12.42	19.80	13.98	19.68	15.72
32	17.40	11.70	19.98	13.74	20.64	16.20
33	17.58	11.10	20.10	14.82	20.16	16.20
34	16.32	10.62	18.90	11.58	19.08	14.70
35	17.10	11.82	19.50	.	21.36	15.00
36	16.92	12.12	19.80	.	20.76	15.42
37	17.46	13.14	19.74	.	19.74	16.02
38	18.96	13.74	21.12	.	22.14	19.92
39	18.30	11.10	21.36	15.90	22.26	18.18
40	18.06	13.02	20.28	15.66	20.76	18.06
41	16.38	10.44	19.02	14.34	19.50	16.68
42	16.92	13.20	19.02	.	20.28	17.52
43	17.28	11.04	19.92	13.98	20.76	15.24
44	15.90	11.04	18.24	13.26	19.20	15.30
45	16.26	10.62	18.18	12.84	19.44	14.70
46	17.34	12.72	20.16	.	19.74	16.92
47	17.04	11.82	20.10	.	20.28	15.78
48	16.68	12.18	19.08	12.42	20.88	13.14
49	16.68	13.38	19.26	14.88	19.26	16.50
50	16.38	12.24	19.08	.	19.44	14.34
51	17.58	12.06	20.22	.	21.78	16.26
52	16.68	12.90	18.60	.	20.58	16.50
53	13.80	10.68	15.78	11.46	16.38	13.32
54	16.50	11.64	19.26	15.60	20.70	15.72
55	15.66	10.44	18.54	13.68	19.20	14.88
56	14.94	9.66	16.56	.	18.90	14.04
57	16.20	10.92	18.42	14.04	18.90	14.40
58	14.52	10.26	16.80	.	17.28	15.90
59	13.32	9.96	15.42	10.14	16.68	11.40
60	14.10	9.12	15.66	.	16.62	13.14

61	13.68	10.26	15.30	11.22	16.44	11.82
62	13.26	9.66	15.72	9.72	16.68	11.10
63	14.82	11.46	20.10	11.94	22.38	8.88
64	15.66	12.48	18.18	.	18.90	16.74
65	15.72	12.48	19.20	14.52	19.86	15.24
66	13.68	8.70	15.54	11.16	15.96	11.70
67	19.68	13.92	22.20	.	24.06	17.70
68	16.92	13.80	18.96	15.72	19.56	15.90
69	18.60	13.86	21.12	16.20	22.80	16.50
70	18.12	13.98	21.36	.	22.74	19.80
71	16.44	10.68	19.68	.	21.60	13.20
72	17.40	13.26	19.98	15.12	20.76	14.28
73	18.24	14.76	21.30	15.90	21.84	16.32
74	17.04	12.72	19.98	12.84	20.52	12.96
75	17.34	13.50	20.04	13.38	21.06	13.00

08a/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	15.54	11.04	17.16	17.10	16.86	20.76
12	15.18	10.68	17.22	13.86	17.28	17.70
13	14.52	9.06	16.62	14.16	16.44	15.12
14	15.48	6.96	18.06	12.78	18.30	14.94
15	14.40	7.92	16.62	11.28	16.98	13.38
16	14.40	10.20	16.08	12.48	16.62	14.58
17	15.84	10.08	18.60	12.36	18.72	15.42
18	19.56	11.46	22.68	16.98	23.58	18.90
19	21.42	11.40	24.84	17.64	25.56	20.28
20	21.42	13.68	24.18	18.96	24.90	22.44
21	19.80	11.40	22.32	16.44	22.92	18.72
22	19.26	11.52	21.54	16.92	21.96	19.08
23	17.58	11.58	19.32	16.02	19.50	18.18
24	18.00	12.12	19.74	16.62	19.98	19.08
25	18.54	11.76	21.48	16.50	21.36	18.60
26	17.34	11.52	19.14	15.78	19.14	18.36
27	17.58	12.36	19.32	17.52	18.36	19.74
28	19.26	13.38	21.36	16.62	21.12	19.74
29	17.40	11.64	19.56	13.92	20.40	18.36
30	19.80	11.76	22.50	16.20	23.52	18.48
31	18.30	12.18	20.28	16.38	20.58	19.44
32	18.66	12.06	20.94	16.26	21.18	19.14
33	18.54	12.36	20.70	15.72	20.94	19.44
34	17.52	12.06	19.26	14.34	19.74	17.28
35	18.30	10.62	20.64	14.94	21.36	18.24
36	18.48	12.78	20.76	15.48	21.00	18.42
37	18.54	12.48	21.00	16.26	21.24	18.54
38	19.14	11.94	21.24	17.58	20.46	20.52
39	18.90	12.66	21.84	16.50	22.32	19.62
40	19.08	13.56	21.00	18.48	20.16	21.78
41	16.80	10.62	19.08	14.64	18.84	17.04
42	17.58	11.88	20.16	15.12	20.46	18.54
43	17.58	10.62	20.04	13.62	20.76	16.14
44	15.72	9.78	18.30	13.20	18.66	15.48
45	15.36	10.26	17.76	13.20	18.18	15.18
46	16.92	9.96	19.44	14.16	19.38	16.62
47	16.86	10.86	19.38	14.58	19.98	16.50
48	16.74	9.66	18.90	13.20	20.10	15.00
49	16.80	11.10	19.14	14.64	19.98	17.46
50	16.38	9.90	18.84	13.14	18.90	15.72
51	17.10	11.04	19.56	13.38	20.46	17.10
52	17.22	10.44	19.44	13.14	20.40	15.84
53	13.92	9.24	15.72	11.52	16.32	14.58
54	16.08	10.68	18.24	13.68	18.48	15.84
55	15.54	10.14	18.12	12.60	18.24	14.58
56	15.78	10.32	18.36	11.94	19.80	14.34
57	16.02	10.68	18.18	12.54	18.96	15.30
58	14.88	10.74	16.98	12.78	17.82	15.60
59	13.74	8.28	15.90	10.44	16.74	12.30
60	14.16	9.24	16.44	12.24	16.80	15.18

61	13.62	9.66	15.24	10.80	15.96	13.80
62	13.32	7.62	15.48	9:96	16.44	12.66
63	13.86	9.36	22.08	8.88	23.64	9.30
64	15.06	9.42	17.64	12.78	17.82	15.06
65	15.24	8.88	17.70	12.78	18.48	15.12
66	13.14	8.16	14.88	10.38	15.36	11.22
67	18.00	10.98	21.06	13.50	22.80	16.74
68	15.48	8.94	17.28	12.24	18.78	14.58
69	17.64	9.66	20.28	13.26	22.68	15.84
70	17.40	12.42	20.22	15.84	21.54	19.02
71	16.62	10.08	18.90	12.12	21.00	13.68
72	16.86	10.68	19.80	12.96	19.98	14.76
73	17.82	12.18	20.76	14.52	21.90	16.08
74	16.86	11.10	19.68	14.04	19.92	15.00
75	17.10	10.68	19.92	11.64	19.98	12.66

08b/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	15.00	9.90	16.38	17.52	16.50	20.46
12	14.76	9.18	16.62	14.10	17.70	15.18
13	14.46	9.84	15.48	14.58	16.80	14.64
14	15.30	10.62	17.88	12.42	18.00	18.06
15	14.28	6.78	16.14	9.60	16.86	13.32
16	14.52	10.02	16.50	12.66	16.98	14.52
17	16.20	9.72	18.96	13.02	19.44	14.10
18	19.50	11.28	22.74	16.14	23.94	19.26
19	21.90	12.60	25.50	17.46	27.06	21.24
20	21.30	12.96	24.24	18.84	24.72	20.28
21	20.22	11.52	22.50	16.62	24.48	19.50
22	19.08	11.82	21.72	14.76	22.50	18.12
23	16.68	9.42	18.66	14.70	19.74	17.16
24	17.40	12.78	19.56	15.36	19.68	18.54
25	17.58	13.62	19.32	13.74	20.16	16.62
26	16.20	11.16	18.30	12.00	19.08	16.26
27	16.80	12.18	18.54	16.26	18.00	19.32
28	18.96	11.94	21.24	15.90	22.02	18.96
29	17.46	9.90	19.44	13.92	20.46	16.50
30	19.38	11.28	22.02	13.86	22.86	18.30
31	18.30	10.80	20.76	15.42	21.30	18.66
32	18.66	10.50	20.94	15.60	22.14	17.64
33	18.18	12.42	19.98	16.74	20.88	16.98
34	16.80	9.12	18.66	13.80	19.38	13.02
35	18.90	10.08	22.02	15.66	22.38	17.52
36	18.12	10.44	20.70	15.18	21.66	17.64
37	18.36	11.46	20.40	15.48	22.02	18.12
38	18.84	13.20	20.82	16.92	20.58	19.56
39	19.56	12.12	22.68	15.90	23.88	18.90
40	19.56	12.96	21.72	19.08	21.54	21.48
41	16.98	11.88	19.14	13.74	19.26	16.92
42	18.18	13.20	21.30	17.04	22.20	20.34
43	17.82	10.80	20.22	14.16	21.12	16.08
44	15.36	9.96	17.70	11.58	18.30	15.18
45	15.00	10.44	16.56	11.16	17.58	14.82
46	16.38	10.08	18.96	12.78	19.32	15.66
47	16.98	12.00	19.20	15.48	19.86	17.94
48	16.80	8.64	18.72	12.78	20.46	15.12
49	16.86	10.86	18.84	15.06	20.10	18.42
50	16.38	10.38	19.14	12.54	20.04	16.20
51	17.46	10.80	20.22	14.52	21.36	17.22
52	17.64	11.58	20.10	12.90	20.76	14.76
53	13.62	8.82	15.48	10.44	16.32	13.98
54	15.54	9.66	17.46	12.90	18.18	14.28
55	15.36	9.30	17.88	12.60	19.08	13.62
56	15.78	9.72	17.82	11.04	19.62	14.28
57	15.84	12.60	18.12	12.54	18.84	17.58
58	15.00	9.90	17.40	15.36	18.84	15.42
59	13.86	7.26	15.78	9.00	16.92	12.30
60	14.34	9.12	16.44	12.00	17.28	14.46

61	13.68	8.46	15.48	10.62	16.50	14.04
62	13.50	8.88	15.78	9.84	16.68	11.64
63	14.40	11.34	22.32	8.88	23.52	13.68
64	15.18	10.80	17.34	11.16	17.88	15.06
65	15.66	11.04	18.18	13.62	19.32	13.26
66	13.56	6.48	15.42	10.20	16.08	12.66
67	18.06	10.74	21.66	12.96	22.38	15.66
68	15.54	10.86	17.88	14.76	19.26	16.14
69	18.24	11.28	21.90	.	23.04	16.98
70	17.88	13.50	20.52	15.36	21.66	18.72
71	16.92	10.38	19.38	11.52	21.24	13.98
72	17.34	10.50	19.74	13.80	20.88	14.70
73	18.18	11.94	21.00	13.32	22.56	16.74
74	17.46	11.76	20.40	12.66	21.30	15.60
75	17.28	11.58	19.50	13.80	20.52	14.46

09/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	13.62	9.00	14.88	12.84	15.30	15.90
12	13.56	9.36	15.42	10.74	16.38	13.50
13	13.14	7.44	14.82	9.96	15.72	11.94
14	13.86	8.76	16.20	10.68	17.22	12.66
15	12.72	7.50	14.76	9.60	15.54	11.04
16	13.02	7.38	14.94	10.02	15.48	12.60
17	14.46	8.76	16.62	10.98	17.64	12.60
18	17.58	10.56	20.52	13.86	22.14	16.50
19	19.92	10.62	23.22	14.04	24.78	18.24
20	19.26	10.62	22.14	14.64	23.76	16.62
21	18.24	11.40	20.82	13.26	22.44	16.92
22	16.32	9.06	18.60	12.84	19.44	15.12
23	14.58	9.90	16.68	11.58	17.70	14.10
24	15.00	9.60	16.62	12.06	17.64	13.92
25	15.60	9.18	18.12	11.34	19.02	14.22
26	14.58	8.16	16.86	11.34	17.16	13.26
27	15.54	9.06	17.52	12.84	18.54	15.12
28	16.74	12.00	19.68	12.60	20.52	14.58
29	15.24	9.60	17.76	11.88	18.12	13.50
30	17.10	11.28	19.68	12.60	20.52	14.76
31	16.26	8.82	18.78	13.20	19.98	14.82
32	16.44	9.36	19.02	12.42	20.28	13.98
33	16.50	9.12	18.84	13.02	19.80	15.12
34	15.06	9.12	17.40	10.98	18.12	12.48
35	16.50	10.86	19.62	13.26	19.74	14.88
36	15.78	8.70	18.54	12.12	19.56	14.16
37	16.14	9.90	18.60	12.66	19.14	15.00
38	16.74	11.22	19.74	14.40	19.56	17.70
39	16.98	10.14	19.56	13.20	20.76	16.14
40	17.64	12.60	20.58	14.58	20.64	18.24
41	15.24	10.20	17.58	13.08	18.06	15.18
42	15.78	9.60	18.66	12.72	19.68	16.02
43	15.84	9.90	18.30	11.82	19.14	14.34
44	13.80	9.06	16.44	11.34	16.92	13.50
45	13.50	10.08	15.30	10.08	16.50	12.12
46	14.46	10.38	17.04	11.82	17.70	13.50
47	14.76	9.48	16.98	12.06	18.06	13.86
48	14.58	9.06	16.68	11.34	18.24	13.08
49	15.06	9.42	17.64	12.06	18.78	15.36
50	14.40	8.58	16.62	10.32	17.52	13.14
51	15.60	8.34	17.76	11.16	19.50	14.46
52	15.42	9.24	17.76	10.68	18.36	13.26
53	12.30	7.50	13.98	8.58	14.94	11.46
54	14.22	8.40	16.74	11.40	17.22	13.62
55	13.98	9.60	16.62	10.62	17.64	13.56
56	13.74	9.90	15.78	12.12	17.70	12.24
57	14.28	8.64	16.74	11.52	17.16	13.62
58	13.56	9.48	15.78	11.64	17.22	14.40
59	12.36	7.14	14.16	9.42	15.66	10.50
60	12.96	8.46	14.82	10.26	16.08	11.22

61	12.48	8.04	14.40	9.96	15.36	11.16
62	12.24	7.92	14.46	8.82	15.54	10.80
63	13.50	8.88	21.84	9.42	22.98	7.32
64	13.92	8.82	16.14	11.46	17.10	13.08
65	14.04	9.54	16.68	11.88	18.06	15.36
66	12.72	7.74	14.70	9.90	15.24	10.50
67	17.28	10.38	20.88	14.46	21.12	15.06
68	14.88	9.84	17.34	11.82	18.42	13.98
69	16.74	11.94	19.98	12.30	21.66	15.30
70	16.98	10.98	19.62	15.60	21.60	19.08
71	15.90	11.22	18.12	12.12	20.16	12.60
72	16.26	9.36	18.66	11.40	20.22	15.00
73	17.52	11.82	20.64	14.58	22.14	16.26
74	16.62	12.18	19.92	13.44	20.76	14.88
75	16.38	9.96	18.96	13.08	19.74	13.32

10/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	13.02	8.94	14.58	12.36	14.58	14.76
12	12.90	8.94	14.58	10.80	15.36	13.02
13	12.24	7.44	13.92	10.02	14.70	11.52
14	12.90	8.64	14.64	10.20	15.60	12.54
15	12.06	7.14	13.80	9.48	14.46	11.10
16	12.60	7.80	14.28	10.14	15.00	12.42
17	14.16	8.70	16.26	11.58	16.92	13.32
18	17.22	11.16	20.10	13.50	20.94	16.38
19	19.02	11.64	21.96	14.28	23.52	17.04
20	18.48	12.54	20.94	14.88	22.38	17.40
21	17.28	10.56	20.04	12.48	21.00	15.72
22	15.84	10.50	18.42	12.12	18.84	14.52
23	14.52	9.54	16.56	11.94	16.92	13.86
24	15.00	10.44	16.50	12.72	17.10	14.10
25	15.42	9.54	17.22	12.90	18.36	14.52
26	14.70	9.18	16.92	11.70	17.58	14.04
27	15.12	9.96	16.98	13.50	17.10	15.48
28	16.32	10.98	18.42	13.38	19.44	15.06
29	14.94	10.50	16.50	12.78	18.00	13.86
30	17.10	10.80	19.32	13.08	19.32	15.48
31	16.20	11.04	18.24	13.44	18.84	15.42
32	16.38	11.28	18.36	14.04	19.08	15.60
33	16.44	11.94	18.48	14.22	19.26	15.48
34	14.88	9.90	16.86	11.28	17.16	13.74
35	16.44	11.28	18.84	13.74	19.80	15.78
36	15.66	10.62	18.06	12.24	18.90	14.58
37	16.02	10.74	18.60	12.78	19.62	15.12
38	16.44	10.80	18.48	13.74	19.26	16.38
39	16.80	10.68	18.96	13.92	20.16	15.36
40	17.10	11.16	19.20	15.42	20.16	18.42
41	14.64	10.14	16.56	11.94	16.92	14.34
42	15.18	10.62	17.40	13.62	18.30	14.94
43	15.18	9.90	17.04	12.90	18.18	14.46
44	13.80	9.24	15.90	10.86	16.32	12.72
45	13.26	8.34	14.94	10.92	15.72	12.12
46	14.40	9.30	16.20	12.00	16.62	13.32
47	14.28	9.72	16.02	11.82	16.74	13.92
48	14.58	8.82	16.14	10.74	17.64	12.54
49	14.88	10.80	16.74	12.36	18.00	13.98
50	14.22	10.20	16.08	10.92	17.16	12.66
51	14.58	9.66	16.44	10.92	17.64	12.84
52	14.58	10.02	16.02	12.06	18.24	12.84
53	12.78	8.46	14.46	9.84	15.18	11.40
54	14.16	10.08	15.96	12.24	16.68	13.68
55	14.22	10.08	16.02	11.46	17.04	12.54
56	14.28	9.90	16.56	11.46	17.46	13.20
57	14.28	9.06	16.20	11.58	17.28	12.42
58	13.62	9.96	15.42	11.52	16.62	13.56
59	12.30	7.92	13.92	10.02	15.06	10.38

60	13.02	9.12	15.06	10.68	15.78	11.82
61	12.42	9.12	13.98	10.50	15.00	11.46
62	12.06	6.78	13.92	8.88	14.76	10.80
63	13.44	8.10	21.12	9.84	22.74	7.50
64	13.32	8.64	15.00	11.04	16.08	12.54
65	13.50	10.20	15.42	10.98	17.04	12.84
66	12.00	7.44	13.92	9.60	14.64	10.26
67	16.50	10.32	19.02	12.36	20.52	13.32
68	14.28	8.34	16.02	10.92	17.16	12.90
69	16.14	9.84	19.08	12.90	21.06	13.38
70	16.20	11.40	18.30	13.26	20.16	15.96
71	15.42	10.44	17.70	11.04	19.26	12.18
72	15.72	10.50	18.30	12.30	19.20	13.38
73	16.68	10.86	19.02	12.24	21.00	13.86
74	15.84	10.26	17.70	12.84	19.68	12.90
75	15.90	8.88	17.46	11.58	18.36	12.30

12/92 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	9.84	6.00	11.40	8.88	11.22	10.74
12	9.78	6.42	11.16	9.18	12.00	9.78
13	9.06	4.50	10.62	6.54	10.86	7.92
14	9.72	4.56	11.64	7.02	12.18	8.58
15	9.24	4.50	10.62	6.42	11.22	7.68
16	9.84	5.52	11.10	7.50	11.40	8.94
17	10.98	5.70	12.84	8.10	13.50	9.18
18	13.92	7.56	16.20	10.50	17.58	12.18
19	15.36	8.04	17.70	11.28	19.20	13.26
20	15.30	8.58	17.10	11.52	18.48	13.80
21	13.92	8.04	16.02	10.62	17.16	11.52
22	12.60	6.54	14.22	9.54	15.00	10.92
23	11.70	6.30	13.32	9.00	13.86	11.16
24	11.94	7.20	13.38	10.26	13.98	11.34
25	12.60	6.78	14.64	9.36	15.24	11.16
26	11.94	6.78	13.32	9.24	13.86	10.74
27	12.24	6.96	13.80	9.90	14.10	12.12
28	13.26	7.32	15.42	10.98	15.72	12.12
29	12.18	6.90	13.74	8.82	14.58	10.26
30	13.68	7.02	15.54	11.70	16.62	12.42
31	13.26	8.04	15.12	11.04	15.60	12.60
32	13.14	7.38	14.94	10.14	15.78	11.70
33	13.20	8.46	14.76	11.16	15.66	12.06
34	11.94	6.54	13.50	9.00	13.80	10.38
35	13.02	7.14	14.64	9.54	15.54	11.10
36	12.60	7.86	14.16	9.72	14.82	11.76
37	12.84	8.88	15.24	10.08	15.54	11.70
38	13.14	8.34	15.24	11.22	15.60	12.24
39	13.20	7.98	15.36	10.50	15.84	11.94
40	13.38	9.18	15.24	11.82	15.42	13.20
41	11.58	7.32	12.54	9.66	13.62	11.22
42	11.70	6.84	13.50	9.60	14.22	10.86
43	11.88	6.96	13.56	10.32	14.16	10.98
44	10.80	6.60	12.36	9.42	12.54	10.44
45	10.26	5.52	11.52	7.92	12.42	9.24
46	11.10	7.38	12.66	8.10	12.54	9.78
47	10.86	6.60	12.66	9.06	13.20	10.26
48	10.86	6.36	12.72	7.56	13.56	9.06
49	11.28	6.72	13.32	9.06	13.68	10.14
50	10.74	5.28	12.06	7.80	13.02	8.82
51	11.10	5.88	12.60	8.70	13.56	8.88
52	11.10	7.26	12.36	9.06	12.96	10.14
53	9.72	6.06	10.98	7.02	11.88	8.10
54	10.74	6.60	11.94	8.58	12.36	9.72
55	10.74	7.26	12.36	8.04	13.56	9.54
56	10.32	6.12	12.42	7.32	13.68	7.38
57	10.92	6.06	12.72	8.10	13.26	10.32
58	10.02	6.24	11.94	8.34	12.84	9.60
59	9.12	5.58	9.90	7.56	11.52	7.92

60	9.72	5.46	11.16	7.56	12.18	8.64
61	9.18	5.58	10.26	7.02	11.28	7.86
62	8.70	5.52	9.96	6.78	11.28	7.32
63	9.18	5.22	15.00	4.98	16.38	5.22
64	9.66	5.52	11.34	7.44	11.94	9.00
65	9.78	6.36	11.46	8.28	12.72	8.82
66	8.70	4.44	9.72	6.84	11.16	7.26
67	12.36	6.48	14.64	9.30	15.90	10.14
68	10.56	5.58	12.24	7.98	13.56	9.00
69	12.36	6.30	14.64	10.08	16.56	10.80
70	12.42	8.04	14.46	10.32	15.96	11.94
71	11.88	7.08	14.16	8.82	15.72	8.64
72	12.24	6.42	14.82	8.58	15.54	9.96
73	13.38	7.80	15.60	10.86	16.74	10.68
74	12.48	8.10	14.64	8.52	16.56	10.08
75	12.42	6.90	13.32	8.64	5.06	8.52

01/93 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	11.34	8.58	12.42	10.74	12.48	12.78
12	11.28	7.98	12.60	9.54	13.44	11.40
13	10.50	7.26	11.82	8.94	12.36	9.54
14	11.10	8.76	12.36	10.44	13.44	10.20
15	10.62	7.86	12.12	9.06	12.60	10.08
16	11.40	8.52	12.42	10.20	13.26	11.10
17	12.48	8.52	14.64	10.98	14.88	11.70
18	15.54	10.62	17.46	13.50	19.32	14.88
19	17.04	11.22	19.68	14.40	20.94	16.14
20	17.22	11.76	19.26	14.52	20.52	16.92
21	15.54	9.00	18.00	13.20	18.78	13.92
22	14.28	9.90	16.14	12.42	17.10	14.88
23	13.68	9.36	15.24	11.58	15.66	13.26
24	14.04	10.20	15.60	12.78	15.60	14.76
25	14.52	9.84	15.96	13.56	17.34	14.22
26	13.92	10.02	15.48	12.36	15.36	14.22
27	14.28	11.16	15.30	13.68	15.90	14.94
28	15.36	10.92	16.68	14.16	17.28	15.06
29	14.04	9.84	15.84	12.00	16.98	13.50
30	15.90	11.76	17.88	14.46	18.12	15.42
31	15.30	11.52	16.68	13.14	17.76	15.42
32	15.36	11.58	16.38	13.20	17.58	14.88
33	15.12	11.70	16.08	13.14	17.34	15.24
34	13.80	9.30	15.24	11.52	15.84	13.44
35	15.18	11.64	16.92	13.50	18.12	14.70
36	14.46	10.80	15.30	11.70	16.74	14.16
37	15.06	10.98	15.78	12.48	18.18	14.70
38	15.18	10.20	16.86	13.86	17.16	15.36
39	14.82	11.64	17.58	13.86	18.42	14.58
40	15.30	11.52	17.28	14.22	17.46	16.38
41	13.26	9.90	14.82	12.18	15.36	13.80
42	13.50	10.02	15.24	12.66	15.96	13.08
43	13.68	9.78	15.48	11.88	15.84	13.86
44	12.60	9.42	14.04	10.98	14.70	12.06
45	12.00	8.94	13.26	10.62	14.04	11.88
46	12.84	8.64	14.40	9.96	24.78	12.42
47	12.72	9.30	14.64	10.44	14.94	12.72
48	12.96	9.06	14.52	10.98	15.90	11.34
49	13.08	9.30	14.28	10.92	16.02	12.66
50	12.60	7.50	14.52	10.38	15.00	11.40
51	12.78	8.76	13.98	10.68	15.42	11.82
52	12.84	8.58	14.28	10.20	15.12	12.12
53	11.46	6.60	13.02	9.42	13.98	10.74
54	12.78	7.56	14.52	10.50	15.00	12.48
55	12.60	8.70	14.52	11.04	15.42	11.46
56	12.36	6.78	14.28	8.70	15.66	9.96
57	12.78	8.28	14.76	10.14	15.24	12.12
58	11.76	8.46	13.62	11.34	14.58	12.60
59	11.10	8.46	11.64	8.16	13.08	9.18

60	11.70	7.44	13.44	9.96	13.98	10.74
61	10.98	7.68	12.54	8.58	13.08	10.08
62	10.68	7.56	12.48	8.64	13.20	9.72
63	11.52	8.28	18.36	7.74	19.68	7.92
64	11.58	7.98	12.96	9.24	13.74	11.52
65	11.58	8.34	13.44	10.38	14.28	10.98
66	10.44	5.88	11.34	8.40	12.42	8.88
67	14.04	8.82	16.14	11.94	17.22	12.12
68	12.24	8.52	13.44	10.56	14.94	11.40
69	14.16	8.82	16.20	11.94	18.12	12.66
70	13.92	9.90	15.78	12.00	17.52	13.62
71	13.44	8.22	15.48	9.96	16.74	11.40
72	13.92	9.90	15.36	11.40	17.28	11.94
73	14.88	9.60	17.10	12.42	18.42	12.66
74	14.04	9.72	15.96	11.70	17.58	12.06
75	14.34	9.36	15.96	10.56	16.50	10.80

2/93 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	12.20	8.60	13.20	11.20	13.20	14.20
12	11.80	8.00	13.20	10.40	12.60	11.80
13	10.32	5.70	11.34	7.92	11.52	9.12
14	10.80	6.06	12.12	8.28	12.96	9.54
15	10.26	5.88	11.34	8.04	11.76	9.30
16	11.10	6.84	12.18	8.94	12.72	10.68
17	12.18	7.08	13.86	9.54	14.22	10.74
18	15.00	8.76	16.80	12.00	17.34	13.56
19	16.56	9.84	18.72	12.96	19.92	15.00
20	16.80	10.14	18.72	13.62	19.14	15.72
21	15.06	8.70	16.62	11.34	17.28	13.02
22	13.80	7.98	15.30	11.34	16.02	12.60
23	13.02	7.86	14.16	10.86	14.88	12.60
24	13.62	9.18	14.64	12.42	15.12	14.82
25	14.16	8.70	15.30	11.52	16.14	13.68
26	13.32	8.22	14.64	11.64	14.58	13.86
27	13.98	9.12	15.12	12.48	14.94	14.64
28	14.94	9.18	16.20	12.12	.	.
29	13.62	8.46	14.76	11.10	15.42	12.96
30	15.00	9.24	16.62	12.66	16.80	14.88
31	14.64	9.06	15.84	11.88	16.50	14.16
32	14.76	9.24	15.96	12.30	16.50	14.64
33	14.46	9.18	15.96	11.94	16.17	14.19
34	13.02	7.74	.	.	.	.
35	.	.	.	.	.	.
36	.	.	.	.	.	.
37	.	.	.	.	.	13.50
38	14.34	9.12	15.90	12.18	15.90	14.46
39	14.16	8.52	15.78	11.34	16.38	13.80
40	14.16	9.42	15.60	12.30	15.36	14.64
41	12.48	7.86	13.50	10.44	13.74	12.48
42	12.54	7.98	13.50	10.14	14.46	12.66
43	12.54	7.38	13.86	10.32	14.64	12.06
44	11.58	6.90	12.78	9.30	13.02	10.98
45	10.98	6.60	12.12	9.00	12.66	10.80
46	11.58	7.02	12.90	9.30	12.54	10.86
47	11.70	7.08	12.96	9.48	13.38	11.28
48	11.64	6.48	13.14	8.70	13.98	10.14
49	11.70	6.60	13.08	9.24	13.56	10.92
50	11.16	6.12	12.60	8.64	13.44	10.26
51	11.28	6.42	12.66	8.34	13.08	10.14
52	11.34	6.42	12.84	8.64	12.54	9.90
53	9.96	5.64	10.98	7.38	11.46	8.82
54	11.04	6.60	12.24	8.76	12.72	10.92
55	11.10	5.94	12.48	7.98	13.02	9.72
56	10.68	5.22	12.18	6.90	13.26	8.10
57	11.04	6.06	12.36	8.40	13.14	9.90
58	10.20	6.00	11.58	7.98	12.12	10.02
59	9.18	4.68	10.26	6.18	10.86	7.74
60	9.72	5.40	10.86	7.50	11.46	9.06

61	9.12	4.98	10.26	6.72	10.92	8.34
62	8.82	4.80	10.26	6.24	10.92	7.44
63	9.78	4.98	16.14	4.02	18.72	5.34
64	9.48	5.40	10.80	7.50	11.40	9.12
65	9.90	5.46	11.28	7.92	11.70	9.18
66	8.58	4.38	9.36	6.12	9.90	7.44
67	11.82	6.30	13.56	8.76	13.92	9.54
68	10.38	5.70	11.22	7.50	11.82	9.06
69	11.88	5.88	13.98	8.46	14.82	9.66
70	11.88	6.78	13.26	9.66	14.22	11.64
71	11.40	5.88	12.90	7.62	14.04	8.76
72	11.82	6.06	13.32	8.58	13.86	9.60
73	12.66	6.30	14.28	8.82	15.36	9.96
74	12.06	5.76	13.38	7.92	13.62	8.70
75	11.82	5.04	13.08	7.26	13.92	8.10

03/93 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	13.26	9.60	14.22	12.72	14.16	15.36
12	12.60	8.16	13.74	10.98	14.64	12.84
13	11.58	7.56	12.84	9.48	13.50	11.10
14	12.36	6.96	13.80	9.42	14.82	11.16
15	11.70	7.26	12.90	9.54	13.62	10.68
16	12.78	8.16	13.80	10.62	14.46	12.36
17	14.10	8.64	15.36	11.28	16.38	12.96
18	17.16	10.86	18.90	13.74	19.98	16.26
19	18.72	11.10	20.76	14.76	21.96	17.58
20	19.08	11.64	20.88	15.60	21.84	18.30
21	17.22	10.50	18.72	13.56	19.62	15.90
22	16.20	10.02	17.58	12.96	18.42	15.18
23	15.42	10.08	16.44	13.08	16.92	15.48
24	16.14	10.92	17.22	14.70	17.46	17.70
25	16.56	10.38	18.00	13.62	18.78	16.50
26	15.78	10.08	16.80	13.80	17.40	16.62
27	16.62	10.74	17.58	14.64	17.94	17.70
28	17.34	10.74	18.60	14.40	19.32	17.10
29	15.96	9.90	17.22	13.14	17.82	15.12
30	17.52	11.04	19.02	14.52	19.50	17.40
31	17.22	11.10	18.66	14.58	19.38	17.16
32	17.22	11.04	18.66	14.70	18.78	17.40
33	17.04	10.86	18.60	14.34	19.14	17.10
34	15.54	9.60	16.74	12.54	17.28	14.88
35	16.68	10.32	18.18	13.44	19.02	15.66
36	16.80	10.86	18.18	14.22	18.36	17.04
37	16.98	10.38	18.72	14.22	19.74	16.74
38	17.34	11.22	18.84	15.06	19.56	18.00
39	17.16	10.32	18.84	13.68	19.38	16.50
40	17.04	11.22	18.36	14.76	18.90	18.12
41	15.36	9.84	16.56	13.08	17.10	15.60
42	15.24	10.08	16.74	13.38	17.28	16.14
43	15.48	9.78	16.92	12.72	17.40	15.06
44	14.10	8.82	15.36	11.70	16.02	13.92
45	13.56	8.34	14.70	11.34	15.54	13.74
46	14.46	9.30	15.90	11.76	16.32	14.34
47	14.58	9.60	15.90	12.30	16.50	15.06
48	14.76	8.94	16.32	11.52	17.28	13.02
49	14.76	9.12	16.20	11.94	17.16	14.52
50	14.22	8.40	15.66	11.10	16.50	13.08
51	14.40	8.40	15.84	11.22	16.50	13.26
52	14.46	8.70	15.90	11.22	15.96	13.08
53	12.84	7.56	13.98	9.90	14.52	11.88
54	14.10	9.06	15.24	11.88	15.54	13.86
55	14.28	8.46	15.72	10.92	16.74	13.14
56	13.98	7.62	15.54	9.66	16.86	11.40
57	14.04	8.64	15.42	10.98	16.38	13.08
58	13.14	8.40	14.46	10.92	15.54	13.38
59	12.18	7.32	13.32	9.24	14.16	10.80
60	13.08	8.46	14.34	10.68	14.94	12.60

61	12.42	7.74	13.56	9.96	14.34	11.76
62	12.30	7.56	13.56	9.60	14.40	10.98
63	13.44	7.62	20.94	7.32	23.64	9.12
64	13.32	8.28	14.52	10.68	15.06	12.72
65	13.26	8.46	14.58	10.86	15.48	13.08
66	11.94	7.08	12.90	9.60	13.50	11.04
67	15.54	9.00	17.46	11.64	18.06	13.38
68	13.80	9.24	15.06	10.68	15.90	13.02
69	15.78	8.82	17.64	11.52	19.14	13.38
70	15.78	10.08	17.70	13.08	18.84	16.62
71	15.42	8.76	17.22	11.10	18.66	12.90
72	15.84	9.66	17.52	11.70	18.12	13.44
73	16.68	9.48	18.66	12.30	19.92	14.28
74	15.90	9.06	17.58	10.92	17.52	13.08
75	15.96	8.40	17.40	10.56	17.88	12.24

04/93 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	13.68	9.18	14.76	13.08	14.46	16.02
12	12.84	8.52	14.52	10.74	15.18	12.96
13	11.94	7.62	13.26	9.96	13.86	10.98
14	12.42	7.92	14.46	10.26	15.30	11.40
15	11.88	7.56	13.44	9.06	14.10	10.44
16	13.02	8.46	14.46	10.92	15.12	12.60
17	14.28	9.24	16.20	12.00	16.86	13.32
18	17.40	11.28	19.62	13.98	20.16	16.44
19	18.84	12.30	21.54	14.34	22.80	17.88
20	19.26	12.36	21.24	15.42	22.50	18.00
21	17.52	10.32	19.50	13.80	20.22	16.08
22	16.38	10.56	18.48	13.08	19.20	15.30
23	15.24	10.32	16.62	12.96	16.62	15.12
24	16.38	10.98	17.88	14.52	18.00	16.74
25	16.86	12.12	18.12	14.28	19.50	16.86
26	15.90	10.92	17.04	13.86	17.16	16.80
27	16.80	11.82	18.30	15.54	18.36	17.88
28	17.52	11.94	19.20	14.94	19.50	17.22
29	16.32	10.08	17.16	13.38	18.78	15.48
30	18.00	11.64	19.56	14.52	20.16	17.46
31	17.52	11.82	19.14	16.08	19.92	17.82
32	17.52	12.18	19.44	14.94	19.80	17.16
33	17.46	12.42	19.26	14.58	19.86	17.34
34	15.60	10.20	16.98	13.02	17.94	15.12
35	17.28	10.80	19.38	13.68	19.92	16.68
36	17.22	12.36	18.54	14.88	19.32	17.58
37	17.52	11.46	19.08	14.52	19.92	17.16
38	17.76	13.32	19.32	16.20	20.22	18.36
39	17.52	11.46	19.14	15.54	20.94	17.04
40	17.58	12.72	19.68	15.96	19.86	18.24
41	15.72	11.22	17.52	14.16	17.64	16.14
42	15.90	10.20	17.88	14.22	18.12	16.50
43	15.96	10.08	17.58	13.56	18.90	14.82
44	14.40	9.30	15.78	11.82	16.62	13.92
45	13.98	9.72	15.42	12.18	16.26	13.98
46	14.94	10.32	16.08	12.90	17.16	14.34
47	15.24	10.44	16.86	13.44	17.52	15.30
48	15.30	10.56	17.04	12.12	17.94	13.92
49	15.18	10.38	16.80	13.14	17.58	14.76
50	14.64	10.14	16.44	11.94	17.34	14.04
51	14.94	10.68	17.22	12.78	18.00	13.92
52	15.00	9.12	16.56	11.40	17.40	13.08
53	12.90	8.04	14.16	10.08	14.88	12.24
54	14.16	10.14	15.72	12.78	16.50	14.10
55	14.52	9.72	15.18	11.82	17.22	13.56
56	14.10	9.72	14.94	10.80	17.76	12.54
57	14.28	9.72	16.08	12.12	17.04	13.92
58	13.56	9.66	15.24	12.06	16.08	13.98
59	12.54	8.34	14.22	9.84	14.70	11.16
60	13.50	8.70	14.70	11.04	15.84	12.48

61	13.08	7.86	14.34	10.44	15.24	12.36
62	12.84	9.00	14.46	10.20	15.30	11.22
63	14.52	8.22	21.66	11.82	23.28	10.56
64	13.86	9.18	15.48	11.82	16.26	13.50
65	13.92	9.18	15.48	11.64	16.68	13.68
66	12.36	8.28	13.62	10.32	14.16	11.40
67	16.14	10.38	17.70	14.10	20.46	14.10
68	14.34	9.78	15.72	12.00	16.74	13.92
69	16.38	10.98	17.82	14.10	20.76	14.64
70	16.50	11.28	18.06	14.76	20.10	16.86
71	15.72	10.14	17.76	12.12	19.62	12.90
72	16.26	10.32	18.18	12.24	19.44	14.16
73	17.16	10.74	18.90	13.56	21.30	15.60
74	16.08	11.16	18.42	12.84	18.84	14.28
75	16.08	10.74	17.64	12.24	19.08	13.08

05/93 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	12.90	8.70	14.16	11.88	14.46	14.94
12	12.72	7.80	13.92	10.44	13.38	13.50
13	11.82	6.84	13.14	8.64	14.34	10.56
14	12.36	7.02	14.28	8.82	15.12	10.80
15	11.70	6.54	12.96	8.40	13.98	9.90
16	12.36	7.38	13.86	9.72	14.58	11.64
17	13.86	7.98	15.54	10.38	16.68	12.42
18	17.10	9.78	19.02	13.02	19.56	15.42
19	18.60	10.68	20.94	13.50	22.56	16.08
20	18.60	10.44	20.70	13.44	22.14	16.74
21	16.80	9.36	18.78	12.12	19.92	15.18
22	15.54	9.00	17.28	11.46	18.24	13.68
23	14.16	8.52	15.48	11.40	16.02	13.80
24	15.00	9.36	16.56	11.94	17.22	14.40
25	15.72	9.42	17.52	11.40	18.36	14.58
26	15.12	9.12	16.62	11.70	17.52	14.34
27	15.60	9.54	17.10	12.66	17.70	15.12
28	16.32	9.96	18.36	12.18	18.96	14.46
29	15.30	8.94	16.68	11.16	17.94	13.50
30	16.92	9.36	18.60	12.18	19.92	14.40
31	16.32	10.14	18.00	12.36	19.02	15.12
32	16.20	9.30	18.00	11.94	19.08	14.58
33	16.26	9.72	18.18	12.42	18.84	15.36
34	14.70	8.34	16.08	10.62	16.80	12.84
35	15.96	8.88	17.70	11.70	19.02	13.92
36	15.90	9.90	17.52	12.54	18.78	15.12
37	16.20	9.54	18.12	12.12	18.54	14.94
38	16.80	10.50	18.78	13.92	19.20	17.04
39	16.44	9.84	18.60	12.54	19.32	15.24
40	16.80	10.38	18.72	13.86	19.26	16.20
41	14.58	9.18	16.08	11.94	16.68	14.34
42	15.12	9.78	16.62	12.18	17.88	14.88
43	15.18	8.82	16.86	11.04	17.40	13.86
44	13.56	7.86	15.24	10.38	16.32	12.60
45	13.38	8.04	14.94	10.14	15.96	12.30
46	14.40	8.64	16.26	10.86	16.68	13.20
47	14.64	8.88	16.32	11.52	17.10	13.86
48	14.64	8.22	16.44	10.50	17.46	12.66
49	14.52	8.70	16.26	11.16	16.92	13.62
50	14.22	7.92	15.60	10.08	16.86	12.06
51	14.70	9.18	16.20	10.56	17.40	12.36
52	14.52	8.10	16.26	10.14	16.86	12.18
53	12.48	7.32	13.74	8.94	14.58	10.68
54	13.86	8.10	15.30	10.38	16.56	12.60
55	13.98	8.28	15.72	10.02	17.04	12.30
56	13.50	7.44	15.12	9.42	16.44	11.58
57	13.86	8.04	15.30	10.20	16.20	12.30
58	13.02	8.16	14.58	10.92	15.42	12.66
59	12.12	6.90	13.26	8.22	14.28	10.02
60	12.96	7.86	14.46	9.60	15.18	11.64

61	12.54	7.38	13.62	9.30	15.12	11.04
62	12.30	7.02	13.74	8.70	14.88	10.26
63	13.38	7.20	19.98	6.48	24.30	7.92
64	13.74	8.28	15.06	10.86	16.02	12.78
65	13.62	8.40	15.12	10.80	16.26	12.90
66	12.18	7.20	13.26	8.88	14.10	10.80
67	16.38	9.66	18.36	11.94	19.86	14.52
68	14.58	8.76	15.84	10.74	16.92	13.20
69	16.26	9.12	18.36	11.46	19.92	13.62
70	16.50	12.00	18.42	13.44	19.68	16.56
71	15.66	8.94	17.40	.	19.20	12.24
72	16.08	9.24	17.94	.	19.02	12.90
73	17.10	10.80	19.38	.	20.64	14.22
74	16.44	11.28	18.30	11.46	19.26	.
75	16.32	9.18	17.82	10.56	18.42	12.66

06/93 EM 31 Conductivity Readings mS/m

Station	VHIP	HHIP	VKNEE	HKNEE	VSURF.	HSURF.
11	12.48	8.34	13.56	10.26	14.40	13.08
12	12.60	6.72	13.68	10.74	15.06	11.34
13	11.70	6.96	12.96	8.34	13.92	10.56
14	12.30	6.54	13.62	8.58	14.94	10.02
15	11.46	6.96	12.66	7.68	13.62	10.56
16	12.18	7.98	13.32	7.20	14.40	11.16
17	13.44	7.62	14.94	9.78	15.96	12.12
18	16.56	9.84	18.54	11.94	20.16	14.46
19	18.00	10.56	20.28	12.42	21.84	16.14
20	17.94	10.62	19.68	13.08	21.60	16.02
21	16.32	9.18	17.94	11.34	19.20	13.20
22	14.88	8.76	16.56	11.28	17.64	13.56
23	13.86	7.92	15.24	10.50	16.08	12.84
24	14.34	8.64	15.72	11.22	16.62	13.08
25	14.88	8.64	16.44	11.46	17.64	13.86
26	14.52	8.58	15.84	10.86	17.22	12.78
27	14.76	9.24	16.14	11.58	17.04	15.36
28	15.72	8.22	17.46	12.84	18.54	14.34
29	14.58	8.64	15.84	10.32	17.16	12.24
30	16.26	9.60	17.88	11.34	19.44	13.98
31	15.66	8.94	17.22	11.88	18.42	14.16
32	15.72	9.24	17.04	11.40	18.48	12.66
33	15.84	9.96	17.28	11.40	18.72	14.40
34	14.04	8.16	15.54	10.56	16.32	12.12
35	15.06	7.68	16.68	10.86	18.12	13.26
36	14.82	8.16	16.44	11.52	17.88	13.80
37	15.30	9.00	16.68	11.10	18.00	13.86
38	15.90	9.84	17.52	12.30	19.08	15.96
39	15.36	9.78	16.62	10.14	17.88	13.56
40	15.78	.	17.28	.	18.60	14.40
41	13.68	8.52	15.54	.	16.44	12.84
42	14.16	.	15.60	11.64	16.86	13.62
43	14.52	8.82	16.14	10.98	16.92	13.08
44	13.32	.	15.00	10.98	16.08	12.72
45	12.90	7.62	14.34	.	15.78	12.36
46	13.98	7.98	15.06	9.54	16.68	12.54
47	13.86	.	15.12	.	16.80	12.84
48	13.92	8.10	15.36	9.60	16.92	11.94
49	13.98	8.64	15.42	.	16.56	13.68
50	13.56	6.96	14.88	.	16.08	11.76
51	13.62	.	15.06	.	16.38	12.24
52	13.44	.	14.70	9.48	15.96	12.18
53	12.12	.	13.44	7.92	14.40	10.56
54	13.86	7.62	15.06	10.56	16.32	12.72
55	13.74	7.74	15.30	9.60	16.92	11.88
56	12.60	7.32	13.80	7.98	15.54	9.66
57	13.50	8.10	14.76	9.60	16.20	12.18
58	12.36	7.32	13.68	.	15.06	11.22
59	11.34	5.34	12.66	7.44	13.62	9.30
60	12.48	.	13.38	9.24	15.00	11.28

61	11.94	7.02	13.14	8.52	14.28	9.84
62	11.58	.	12.60	8.28	14.10	9.66
63	13.02	6.42	19.20	4.92	24.18	7.38
64	12.78	6.66	14.16	.	15.54	12.06
65	12.96	7.62	14.28	9.24	15.96	11.52
66	11.58	.	12.66	8.52	13.80	9.54
67	16.08	8.64	17.82	10.32	19.56	13.26
68	14.16	7.98	15.66	10.26	16.86	12.54
69	15.42	8.46	17.52	10.02	19.44	13.20
70	15.66	.	17.34	11.88	19.02	15.54
71	15.30	8.16	16.50	10.44	18.48	10.80
72	15.48	8.64	17.04	10.44	18.42	.
73	16.32	8.52	18.12	.	19.62	13.56
74	15.90	8.76	17.34	.	18.30	12.06
75	15.48	7.62	17.10	.	17.58	12.30

Appendix B2

Soil Water Content Data

Non-Invasive Soil Water Content Measurement Using Electromagnetic Induction

Soil Water Content

02/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.179036	0.211956	0.122636	0.166706	0.204563	0.269522
12	0.165911	0.182239	0.158446	0.174485	0.164996	0.253339
13	0.107753	0.153967	0.143274	0.148139	0.152955	0.206012
14	0.156303	0.187248	0.163961	0.166947	0.103563	0.231959
15	0.144310	0.168633	0.184045	0.182070	0.159024	0.245662
16	0.125454	0.190403	0.183901	0.162371	0.158542	0.239587
17	0.143322	0.212727	0.216435	0.204322	0.199650	0.283181
18	0.150354	0.192040	0.172895	0.148982	0.126778	0.236325
19	0.162733	0.199361	0.165502	0.147368	0.159867	0.251847
20	0.163310	0.236327	0.165887	0.119794	0.096868	0.238879
21	0.185153	0.208512	0.175038	0.136941	0.147320	0.261216
22	0.181107	0.249717	0.187200	0.163190	0.225562	0.30352
23	0.163840	0.238615	0.154424	0.134436	0.115315	0.2454
24	0.183371	0.261132	0.190692	0.184479	0.207140	0.307567
25	0.187248	0.233413	0.185635	0.194737	0.218482	0.305186
26	0.183684	0.241336	0.182094	0.242757	0.163551	0.298199
27	0.181685	0.247092	0.205093	0.214557	0.163792	0.299208
28	0.196712	0.252968	0.207814	0.224238	0.178699	0.314822
29	0.178578	0.222817	0.165309	0.128705	0.077603	0.237554
30	0.191559	0.252293	0.166947	0.137061	0.076688	0.254045
31	0.200469	0.211282	0.188332	0.203648	0.126995	0.279507
32	0.184045	0.245912	0.210632	0.193389	0.185008	0.303432
33	0.195026	0.206176	0.125550	0.155291	0.136652	0.253056
34	0.182215	0.148259	0.152064	0.203552	0.132823	0.245048
35	0.146260	0.156688	0.164852	0.170535	0.179758	0.242071
37	0.159433	0.233510	0.211619	0.169138	0.212582	0.292305
38	0.156062	0.230885	0.187513	0.125791	0.072136	0.233171
39	0.155339	0.199650	0.187007	0.202901	0.188115	0.273564
40	0.186309	0.179349	0.142600	0.193967	0.203335	0.273088
41	0.145731	0.198229	0.158133	0.170294	0.168079	0.249063
42	0.142552	0.201095	0.160421	0.122853	0.084394	0.214471
43	0.128271	0.175785	0.179831	0.228958	0.173256	0.253184
44	0.124201	0.152161	0.181131	0.157483	0.140240	0.22039
45	0.121480	0.177712	0.161890	0.178049	0.165213	0.233626
46	0.128199	0.150764	0.162757	0.163142	0.160300	0.224326
47	0.133979	0.160758	0.207164	0.280397	0.193293	0.274376
48	0.110932	0.152281	0.182359	0.211547	0.211932	0.247082
49	0.112473	0.147103	0.174894	0.194954	0.176267	0.230338
50	0.124009	0.140601	0.164900	0.202998	0.187296	0.235998
51	0.118470	0.141540	0.159337	0.184238	0.216484	0.237401
52	0.118494	0.143178	0.180096	0.184671	0.199337	0.238035
53	0.123334	0.134966	0.160734	0.197098	0.175135	0.228134
54	0.113027	0.133906	0.174485	0.232907	0.193774	0.239369
55	0.117121	0.147224	0.181902	0.238398	0.186237	0.245898
56	0.109776	0.142528	0.175063	0.232450	0.207477	0.244656
57	0.110932	0.151390	0.202709	0.195364	0.156375	0.231999
58	0.111534	0.143467	0.218073	0.212293	0.190210	0.24727

59	0.126176	0.163624	0.198326	0.137808	0.104767	0.21444
60	0.090872	0.094075	0.125767	0.143611	0.150499	0.174429
61	0.116038	0.198181	0.171065	0.162034	0.099397	0.216664
62	0.130535	0.139493	0.160035	0.157579	0.125983	0.209908
63	0.125911	0.164852	0.179349	0.142600	0.130631	0.218662
64	0.141589	0.163864	0.169235	0.200156	0.174412	0.247538
65	0.151005	0.204370	0.170391	0.159554	0.162877	0.252635
66	0.185514	0.158615	0.149728	0.182793	0.149584	0.249932
67	0.148524	0.194593	0.167067	0.159939	0.126032	0.236778
68	0.163046	0.169644	0.140529	0.093545	0.064454	0.197441
69	0.156519	0.157940	0.167404	0.205984	0.154256	0.24714
70	0.201962	0.211450	0.202155	0.147055	0.110739	0.267489
71	0.146742	0.167910	0.213184	0.240060	0.207573	0.279987
72	0.148018	0.220216	0.211330	0.187922	0.144358	0.266397
73	0.116856	0.163503	0.150403	0.161312	0.166947	0.221583
74	0.104334	0.099951	0.114930	0.121649	0.148091	0.174425
75	0.095351	0.097350	0.115074	0.126802	0.134340	0.166544

Soil Water Content

03/92

Stat.	Depth 30 cm	60 cm	90 cm	110cm	130 cm	TWC (m)
11	0.164635	0.186983	0.105393	0.147007	0.201745	0.246454
12	0.149969	0.161480	0.142142	0.159289	0.158639	0.230915
13	0.102552	0.134894	0.127862	0.129548	0.139855	0.186448
14	0.144767	0.174316	0.149825	0.153678	0.109584	0.218507
15	0.133714	0.153822	0.168295	0.167886	0.149439	0.226801
16	0.127814	0.169379	0.169572	0.154352	0.152233	0.227263
17	0.128006	0.197122	0.203552	0.189704	0.184141	0.26081
18	0.140818	0.177928	0.164828	0.134701	0.121480	
19	0.156447	0.191294	0.154400	0.137759	0.153846	0.240095
20	0.186140	0.230668	0.146911	0.115074	0.125743	0.250429
21	0.174509	0.193798	0.159144	0.125020	0.175616	
22	0.169572	0.236640	0.173136	0.159337	0.222046	
23	0.167982	0.226140	0.141107	0.133039	0.154280	0.251602
24	0.169861	0.247862	0.172173	0.172125	0.188958	0.284952
25	0.165791	0.225538	0.166248	0.190547	0.231487	0.291385
26	0.177278	0.227152	0.157916	0.234352	0.172871	0.286131
27	0.162684	0.233558	0.196279	0.202347	0.171836	0.284365
28	0.170367	0.237676	0.202299	0.210439	0.177254	0.293807
29	0.153919	0.208368	0.169066	0.138289	0.128729	0.240317
30	0.166778	0.239048	0.148500	0.151558	0.095231	0.24277
31	0.182022	0.200614	0.185177	0.198904	0.162564	0.276938
32	0.153485	0.246490	0.220674	0.168657	0.178892	0.285583
33	0.175954	0.194737	0.110282	0.159867	0.123840	0.234296
34	0.171908	0.132630	0.161264	0.199602	0.146309	0.241277
35	0.129548	0.150041	0.154785	0.158759	0.170776	0.22499
36	0.165646	0.196712	0.130511	0.169283	0.214605	0.26442
37	0.142552	0.219012	0.196809	0.155074	0.206104	0.2719
38	0.136290	0.221637	0.178434	0.124611	0.108211	0.229816
39	0.146838	0.185394	0.171787	0.201432	0.188861	0.261587
40	0.173979	0.162179	0.128030	0.180047	0.194424	0.253288
41	0.128536	0.180457	0.135809	0.155099	0.161167	0.2253
42	0.128295	0.183491	0.148500	0.117001	0.109150	0.20605
43	0.125357	0.162179	0.151414	0.225948	0.189945	0.245091
44	0.117242	0.144912	0.162323	0.147513	0.146212	0.210179
45	0.115219	0.158903	0.148091	0.169475	0.164009	0.21964
	0.119240	0.142769	0.186815	0.269753	0.201047	0.257457
48	0.095905	0.129379	0.161312	0.190836	0.217013	0.22557
49	0.099734	0.130342	0.157820	0.177567	0.171595	0.21043
50	0.109078	0.124177	0.141781	0.189753	0.178988	0.21343
51	0.104550	0.127573	0.142311	0.168392	0.210824	0.217823
52	0.107031	0.121552	0.159626	0.167260	0.183684	0.213093
53	0.098843	0.114376	0.135881	0.183130	0.189656	0.206285
54	0.100047	0.119144	0.160517	0.225587	0.190355	0.223118
55	0.107633	0.124876	0.153461	0.227465	0.180505	0.223907
56	0.096194	0.119867	0.150041	0.219831	0.202492	0.221471

57	0.105008	0.129596	0.182046	0.193750	0.160902	0.218665
58	0.099806	0.124803	0.217736	0.207381	0.187537	0.234525
59	0.110739	0.151414	0.185851	0.128440	0.104888	0.198874
60	0.092341	0.076423	0.107994	0.126971	0.139734	0.158793
61	0.100023	0.179542	0.159337	0.157290	0.108933	0.202845
62	0.122178	0.121504	0.145056	0.137398	0.123479	0.192219
63	0.126032	0.143635	0.153292	0.131041	0.127741	0.202658
64	0.129066	0.161264	0.159939	0.181492	0.153894	0.22891
65	0.140433	0.188115	0.156495	0.157386	0.156254	0.237107
66	0.196592	0.135472	0.147416	0.176243	0.180842	0.255463
67	0.137904	0.178506	0.203889	0.149776	0.158350	0.244041
68	0.147561	0.154785	0.132871	0.104719	0.084225	0.192267
69	0.140890	0.135713	0.154641	0.196857	0.164033	0.231356
70	0.186790	0.198109	0.182600	0.147176	0.128199	0.257033
71	0.137904	0.155484	0.197507	0.214966	0.193100	0.259002
72	0.137470	0.197001	0.201312	0.182961	0.173184	0.259837
73	0.101492	0.142335	0.134532	0.150354	0.153798	0.198215
74	0.089692	0.082588	0.096001	0.107922	0.132461	0.150461
75	0.077964	0.086802	0.095279	0.107537	0.124587	0.143828

Soil Water Content

04/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.099493	0.103683	0.083117	0.169716	0.197290	0.189786
12	0.089788	0.115411	0.115941	0.141637	0.150692	0.177548
13	0.047693	0.096387	0.105827	0.115965	0.126369	0.137938
14	0.083142	0.131474	0.124322	0.133979	0.101733	0.165252
15	0.076182	0.101998	0.140095	0.151101	0.135183	0.17068
16	0.072473	0.110378	0.146694	0.130439	0.137230	0.169657
17	0.075219	0.141661	0.165189	0.160035	0.155893	0.196419
18	0.080709	0.141396	0.137230	0.113702	0.108307	0.168278
19	0.105417	0.164779	0.129572	0.123599	0.144527	0.197342
20	0.146598	0.179614	0.109584	0.100625	0.130414	0.206499
21	0.099590	0.147585	0.132510	0.113148	0.166658	0.194846
22	0.117988	0.176050	0.133039	0.150836	0.220361	0.235445
23	0.089836	0.207019	0.123985	0.123286	0.159072	0.205907
24	0.108981	0.187922	0.132726	0.150667	0.180096	0.222762
25	0.109150	0.191053	0.151462	0.191101	0.224455	0.249856
26	0.122275	0.166080	0.144695	0.219012	0.160999	0.233124
27	0.111077	0.193268	0.168416	0.178265	0.167573	0.235994
28	0.118927	0.202636	0.180192	0.196375	0.171233	0.250001
29	0.094918	0.179012	0.147368	0.131281	0.127501	0.197765
30	0.107729	0.213160	0.139927	0.144213	0.108428	0.208779
31	0.109246	0.165020	0.146549	0.173618	0.143274	0.21301
32	0.094099	0.198976	0.169644	0.161962	0.157916	0.224216
33	0.097735	0.126296	0.090053	0.143082	0.108909	0.165672
34	0.096266	0.096290	0.130077	0.178506	0.153316	0.186422
35	0.080324	0.112666	0.126826	0.144719	0.153389	0.176613
36	0.104719	0.156592	0.107994	0.163479	0.203118	0.214731
37	0.085020	0.165044	0.173425	0.138771	0.191294	0.216271
38	0.084442	0.186477	0.160613	0.111077	0.105586	0.187986
39	0.104021	0.156857	0.157218	0.188789	0.185827	0.226677
40	0.103322	0.111366	0.106477	0.168922	0.188139	0.19675
41	0.081359	0.153316	0.124129	0.145971	0.146260	0.186711
42	0.075387	0.151390	0.132702	0.110186	0.110450	0.167689
43	0.062937	0.107368	0.134870	0.205550	0.182961	0.190248
44	0.096700	0.126007	0.143828	0.139228	0.139662	0.187018
45	0.067970	0.113051	0.124322	0.159650	0.155171	0.174064
47	0.061973	0.104478	0.153027	0.254654	0.202323	0.209116
48	0.032714	0.059710	0.086706	0.111655	0.173184	0.128597
49	0.036567	0.070571	0.106597	0.135399	0.141035	0.133666
50	0.065971	0.088897	0.104719	0.160975	0.164202	0.163991
51	0.053713	0.073701	0.094942	0.126778	0.186983	0.151467
52	0.044947	0.065417	0.101829	0.122371	0.162082	0.138407
53	0.047572	0.065778	0.089788	0.152305	0.185538	0.14971
54	0.077964	0.099951	0.143876	0.219084	0.182769	0.199686
55	0.050534	0.086971	0.137302	0.206369	0.174533	0.176791
56	0.027006	0.065224	0.111558	0.207838	0.195364	0.159786
57	0.060504	0.091715	0.157049	0.176146	0.149487	0.174079
58	0.043334	0.070089	0.176026	0.187417	0.154593	0.168395

59	0.042491	0.110402	0.155243	0.106043	0.087886	0.138627
60	0.035218	0.054026	0.089138	0.107994	0.125189	0.113496
61	0.031630	0.124972	0.114737	0.123310	0.097013	0.134175
62	0.058289	0.086441	0.114424	0.112305	0.106164	0.135079
63	0.059951	0.095881	0.135110	0.110426	0.116086	0.146431
64	0.072136	0.106862	0.131715	0.152714	0.147344	0.172195
65	0.069872	0.174894	0.141492	0.144286	0.146911	0.192214
66	0.140722	0.096049	0.137350	0.169235	0.169066	0.211044
67	0.063563	0.135086	0.185249	0.134123	0.153702	0.188377
68	0.097856	0.131643	0.119867	0.100456	0.106357	0.165493
69	0.069126	0.114015	0.146646	0.185538	0.158374	0.186593
70	0.139662	0.164202	0.165863	0.131859	0.125502	0.217597
71	0.055712	0.092317	0.158566	0.189825	0.162371	0.179083
72	0.065562	0.099397	0.141805	0.156977	0.158518	0.173724
73	0.061155	0.110739	0.111366	0.130222	0.140384	0.156743
74	0.039505	0.062407	0.085357	0.097470	0.139084	0.119058
75	0.036158	0.056459	0.081697	0.094942	0.104165	0.103871

Soil Water Content

06/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.092269	0.090751	0.062600	0.106862	0.188452	0.162304
12	0.102889	0.092220	0.096098	0.128777	0.132461	0.163484
13	0.057109	0.078566	0.077241	0.082804	0.099830	0.115089
14	0.109945	0.126513	0.106477	0.109824	0.089138	0.162755
15	0.110523	0.119433	0.121938	0.131402	0.128175	0.180783
16	0.094340	0.109728	0.121143	0.108741	0.115965	0.162195
17	0.115074	0.136772	0.136917	0.135255	0.131065	0.193415
18	0.113702	0.109680	0.095086	0.084731	0.090511	0.151941
19	0.135809	0.142022	0.099108	0.094316	0.116254	0.182237
20	0.156568	0.143419	0.091233	0.083984	0.117820	0.188432
21	0.141805	0.135737	0.108524	0.101661	0.156929	0.199075
22	0.143997	0.141926	0.113774	0.113798	0.203455	0.219616
23	0.124972	0.178097	0.105152	0.103563	0.146549	0.200632
24	0.111245	0.124418	0.102335	0.123696	0.154737	0.18413
25	0.154737	0.187031	0.133690	0.164876	0.217712	0.257452
26	0.151294	0.124683	0.126923	0.194906	0.148572	0.220771
27	0.115965	0.167501	0.141661	0.159650	0.144117	0.213015
28	0.153630	0.184864	0.172173	0.196495	0.162395	0.255653
29	0.112160	0.160782	0.140120	0.126104	0.126826	0.197005
30	0.140625	0.187441	0.117073	0.117699	0.112016	0.205926
31	0.122154	0.119891	0.103419	0.128079	0.112088	0.176034
32	0.129740	0.190812	0.150956	0.142528	0.143009	0.224774
33	0.144358	0.127308	0.081408	0.131643	0.104093	0.181062
34	0.133617	0.086946	0.099036	0.143828	0.119746	0.17566
35	0.109343	0.108018	0.117916	0.139012	0.146477	0.182834
36	0.126778	0.148331	0.093111	0.151149	0.188356	0.211564
37	0.115580	0.153846	0.159650	0.133762	0.186405	0.220751
38	0.069439	0.151438	0.119096	0.095544	0.100577	0.155735
39	0.091040	0.122034	0.140842	0.168368	0.172919	0.198338
40	0.122540	0.100938	0.090511	0.153798	0.171378	0.190225
41	0.099903	0.165719	0.116447	0.127597	0.147127	0.193441
42	0.070980	0.122756	0.110450	0.090462	0.107103	0.146604
43	0.076471	0.095857	0.107922	0.184479	0.165815	0.17679
44	0.071365	0.101034	0.102263	0.102552	0.112112	0.142134
45	0.073701	0.091426	0.080661	0.116086	0.136074	0.144798
47	0.052557	0.070306	0.109415	0.206827	0.174075	0.165684
48	0.040155	0.059011	0.083238	0.094990	0.149271	0.120362
49	0.076230	0.097807	0.083671	0.095423	0.120709	0.139861
50	0.068427	0.073003	0.078927	0.131787	0.135713	0.139496
51	0.065947	0.062118	0.070643	0.088488	0.153581	0.129744
52	0.055206	0.060336	0.081961	0.101612	0.137278	0.12494
53	0.053183	0.055808	0.069607	0.122949	0.150330	0.127765
54	0.075941	0.091474	0.115026	0.192594	0.167212	0.179055
55	0.048704	0.055447	0.077651	0.154376	0.146694	0.132847
56	0.041793	0.049764	0.090607	0.182697	0.177134	0.146067
57	0.068379	0.078494	0.129403	0.149054	0.122058	0.153098

58	0.054556	0.064863	0.129764	0.138651	0.114255	0.138457
59	0.056579	0.096266	0.108404	0.085550	0.071558	0.120019
60	0.064213	0.054701	0.069752	0.092678	0.108957	0.113967
61	0.059975	0.100071	0.076206	0.085381	0.077241	0.11631
62	0.079048	0.075556	0.093497	0.089403	0.091040	0.126805
63	0.079240	0.080107	0.111414	0.096892	0.096820	0.135968
64	0.103876	0.114280	0.115965	0.128970	0.124466	0.173153
65	0.110836	0.165068	0.122130	0.122973	0.143443	0.197557
66	0.097928	0.091715	0.156519	0.152811	0.154376	0.187587
67	0.062455	0.104839	0.149921	0.124659	0.139228	0.163737
68	0.100890	0.110330	0.104743	0.089595	0.102287	0.15329
69	0.083936	0.080468	0.115195	0.168777	0.153509	0.170518
70	0.148596	0.168512	0.154858	0.133497	0.110258	0.215913
71	0.055953	0.066934	0.108717	0.132702	0.136050	0.139794
72	0.050799	0.068740	0.093425	0.110595	0.126995	0.127055
73	0.089499	0.111053	0.100119	0.120011	0.128030	0.161031
74	0.061877	0.056049	0.073918	0.092582	0.128970	0.120346
75	0.040372	0.036952	0.058722	0.077795	0.096122	0.088329

Soil Water Content

07/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.054219	0.066043	0.040974	0.110691	0.158590	0.12417
12	0.042491	0.053352	0.060336	0.085863	0.106549	0.099348
13	0.000372	0.042852	0.044972	0.048752	0.062575	0.052789
14	0.052991	0.068548	0.069920	0.068476	0.069174	0.096338
15	0.048512	0.062142	0.086296	0.096989	0.097832	0.110794
16	0.049643	0.075676	0.076134	0.078518	0.080565	0.103949
17	0.046826	0.097422	0.092991	0.094677	0.099132	0.122221
18	0.043767	0.041191	0.042539	0.041745	0.054604	0.067417
19	0.069752	0.083840	0.071630	0.081624	0.111775	0.124305
20	0.085694	0.082467	0.060167	0.057085	0.090487	0.116907
21	0.069969	0.078735	0.084899	0.081070	0.145249	0.13612
22	0.074039	0.097928	0.070282	0.078686	0.167525	0.146261
23	0.084370	0.100192	0.064791	0.080733	0.130776	0.139601
24	0.079312	0.083238	0.066308	0.092076	0.117193	0.130812
25	0.076832	0.105177	0.090487	0.121528	0.199867	0.173015
26	0.087789	0.092533	0.084924	0.145996	0.111173	0.151047
27	0.075748	0.128030	0.111486	0.135592	0.119698	0.163395
28	0.085694	0.144213	0.139951	0.186092	0.152377	0.199745
29	0.067849	0.129933	0.120998	0.115628	0.118542	0.15845
30	0.084538	0.133762	0.084442	0.095183	0.087356	0.144525
31	0.081889	0.087091	0.078421	0.100360	0.088584	0.12923
32	0.070161	0.151679	0.102913	0.115291	0.127476	0.164105
33	0.082973	0.105056	0.057591	0.098169	0.086176	0.128739
34	0.075122	0.058241	0.073099	0.074520	0.072088	0.106082
35	0.054315	0.072088	0.085791	0.099541	0.125646	0.125118
36	0.071654	0.101757	0.063780	0.107007	0.150932	0.145397
37	0.053737	0.106308	0.109776	0.112160	0.163286	0.154936
38	0.040998	0.122949	0.081865	0.061323	0.067849	0.108419
39	0.062118	0.087187	0.100240	0.135038	0.138795	0.147815
40	0.079915	0.079048	0.061251	0.109198	0.135351	0.137434
41	0.039144	0.097157	0.082901	0.109776	0.134219	0.129708
42	0.034761	0.094051	0.083479	0.067801	0.081576	0.102761
43	0.029728	0.055471	0.078759	0.141757	0.132413	0.117784
44	0.029535	0.050414	0.066043	0.057687	0.069848	0.077418
45	0.027849	0.055808	0.049186	0.082250	0.112714	0.091835
47	0.026284	0.047693	0.084562	0.169403	0.131715	0.120671
48	0.022551	0.045814	0.068861	0.080468	0.123840	0.094353
49	0.026043	0.051474	0.060312	0.076350	0.091137	0.084851
50	0.026380	0.044514	0.055303	0.100336	0.101588	0.089595
51	0.032112	0.037434	0.049282	0.066188	0.129548	0.090103
52	0.029583	0.043165	0.066573	0.084779	0.116688	0.094867
53	0.023683	0.038758	0.054050	0.105032	0.099180	0.086558
54	0.020312	0.037313	0.069680	0.125550	0.089692	0.089772
55	0.026477	0.036591	0.058385	0.134701	0.102600	0.095208
56	0.006513	0.033484	0.062431	0.126489	0.092052	0.081497
57	0.024213	0.054508	0.103202	0.092004	0.089018	0.098155

58	0.015591	0.040276	0.059348	0.063780	0.071317	0.068087
59	0.023250	0.059132	0.063852	0.055784	0.057229	0.072491
60	0.011907	0.020673	0.040613	0.061468	0.091811	0.06155
61	0.007331	0.038807	0.033412	0.043864	0.052028	0.047675
62	0.025056	0.041456	0.053858	0.054436	0.069029	0.068772
63	0.033942	0.050534	0.057037	0.054267	0.061829	0.074095
64	0.033749	0.062214	0.066164	0.081456	0.088223	0.09315
65	0.040733	0.100962	0.085213	0.104213	0.129090	0.129491
66	0.046392	0.047548	0.100408	0.140794	0.144502	0.131752
67	0.026597	0.076591	0.106597	0.100047	0.125743	0.119328
68	0.044996	0.075556	0.076688	0.074930	0.093352	0.105079
69	0.021829	0.045164	0.092798	0.137759	0.123118	0.111059
70	0.067031	0.105273	0.133617	0.119048	0.113991	0.153157
71	0.015808	0.049571	0.083238	0.093015	0.090896	0.088666
72	0.031173	0.053930	0.083671	0.091450	0.099734	0.099335
73	0.026934	0.044610	0.057205	0.081335	0.098530	0.085631
74	0.019276	0.030835	0.046730	0.070041	0.117699	0.078925
75	0.017036	0.018843	0.031052	0.046730	0.063683	0.049533

Soil Water Content

08a/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.162010	0.068163	0.042949	0.120758	0.15336	0.174252
12	0.150619	0.157459	0.063804	0.071654	0.087886	0.171664
13	0.113798	0.107705	0.043045	0.043912	0.057807	0.120406
14	0.151390	0.154737	0.060095	0.063828	0.058337	0.159837
15	0.142311	0.135616	0.069511	0.079650	0.090318	0.165128
16	0.140553	0.140986	0.062479	0.068403	0.070932	0.156125
17	0.143467	0.196905	0.087091	0.087862	0.089379	0.189791
18	0.143611	0.115821	0.042178	0.039192	0.046465	0.131694
19	0.166537	0.116712	0.059662	0.064839	0.103997	0.169038
20	0.205839	0.074544	0.046657	0.052003	0.086200	0.162916
21	0.187417	0.131402	0.067657	0.070185	0.137735	0.19603
22	0.189584	0.168536	0.062792	0.068163	0.163431	0.214234
23	0.174677	0.105586	0.055279	0.074303	0.140625	0.181148
24	0.163359	0.081432	0.064237	0.090366	0.119240	0.167846
25	0.177037	0.210632	0.083238	0.115508	0.187248	0.242942
26	0.200325	0.089475	0.092485	0.142480	0.087091	0.194733
27	0.124081	0.146453	0.105971	0.131089	0.117892	0.187851
28	0.192353	0.145971	0.132365	0.180144	0.144502	0.242821
29	0.148596	0.127163	0.109343	0.096916	0.094556	0.180103
30	0.167091	0.133690	0.065947	0.081986	0.079216	0.171947
31	0.179734	0.084177	0.075796	0.094243	0.080541	0.168093
32	0.175954	0.168970	0.091715	0.097229	0.111919	0.205821
33	0.191679	0.155291	0.048752	0.085333	0.073147	0.184042
34	0.192980	0.079457	0.065851	0.073942	0.068933	0.162609
35	0.143491	0.117507	0.071173	0.085333	0.101901	0.165253
36	0.180505	0.160517	0.054195	0.089114	0.126104	0.198585
37	0.153919	0.114352	0.100481	0.104286	0.160975	0.197839
38	0.134051	0.126610	0.077795	0.058217	0.064237	0.148669
39	0.129644	0.092533	0.091618	0.116736	0.110980	0.165645
40	0.179662	0.111751	0.060408	0.104406	0.112281	0.184041
41	0.141637	0.136387	0.061973	0.081480	0.119818	0.172387
42	0.124442	0.102239	0.082202	0.067560	0.075194	0.143291
43	0.128825	0.086368	0.083214	0.138988	0.114737	0.166904
44	0.116182	0.057157	0.062527	0.056290	0.066958	0.116406
45	0.112618	0.100986	0.046633	0.080637	0.100938	0.139041
47	0.104237	0.053954	0.089379	0.173353	0.125983	0.157903
48	0.099541	0.058746	0.073966	0.097807	0.120782	0.136705
49	0.116543	0.082250	0.065851	0.078831	0.097229	0.138517
50	0.099541	0.046489	0.057085	0.101781	0.098072	0.122789
51	0.111847	0.052220	0.050631	0.066814	0.125165	0.129567
52	0.136001	0.150667	0.152088	0.095038	0.111606	0.196912
53	0.111028	0.044707	0.053906	0.105779	0.103828	0.129155
54	0.116929	0.043430	0.070523	0.127163	0.081648	0.133205
55	0.100794	0.036182	0.059613	0.129427	0.091980	0.124595
56	0.100095	0.045188	0.065730	0.122178	0.078108	0.1229
57	0.122130	0.087982	0.105923	0.086296	0.083479	0.150137
58	0.090029	0.037867	0.063563	0.062648	0.064430	0.099623

59	0.116664	0.063515	0.047837	0.043599	0.052967	0.108122
60	0.112401	0.042949	0.033460	0.053111	0.074833	0.104902
61	0.113340	0.070956	0.032160	0.041552	0.045068	0.102161
62	0.129885	0.057061	0.052389	0.052437	0.062383	0.117866
63	0.102046	0.049740	0.055303	0.044947	0.054653	0.100054
64	0.147055	0.123623	0.054123	0.065610	0.085285	0.1555
65	0.157410	0.145755	0.077940	0.091956	0.111125	0.185775
66	0.188813	0.074930	0.089114	0.127091	0.133473	0.195183
67	0.117771	0.074448	0.099686	0.088801	0.111534	0.151473
68	0.099541	0.065104	0.061034	0.067849	0.082949	0.118038
69	0.095833	0.043189	0.062046	0.110137	0.100384	0.123736
70	0.185514	0.099590	0.113966	0.105441	0.115797	0.197677
71	0.141757	0.074448	0.083479	0.097181	0.084996	0.15193
72	0.103250	0.048199	0.076832	0.087476	0.096483	0.12657
73	0.125213	0.150306	0.066718	0.067151	0.084490	0.156894
74	0.083888	0.026862	0.042491	0.061564	0.106092	0.100571
75	0.095279	0.019661	0.023659	0.036856	0.055977	0.078853

Soil Water Content

08b/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.093617	0.068042	0.045285	0.119505	0.156519	0.142671
12	0.102190	0.112184	0.072256	0.078084	0.097832	0.094564
13	0.064117	0.088704	0.045670	0.047693	0.060480	0.132719
14	0.111631	0.118398	0.062142	0.062238	0.063274	0.144136
15	0.109078	0.110282	0.079433	0.080878	0.086441	0.124983
16	0.088271	0.111631	0.072834	0.066766	0.067368	0.205129
17	0.117723	0.173690	0.178988	0.134051	0.094966	0.107288
18	0.097518	0.088199	0.047982	0.043888	0.053906	0.159298
19	0.131089	0.139228	0.060071	0.061612	0.103997	0.127163
20	0.118157	0.088945	0.048969	0.049788	0.083695	0.181392
21	0.143539	0.152450	0.081648	0.067103	0.124105	0.190551
22	0.148645	0.157603	0.066693	0.068813	0.153148	0.146251
23	0.106838	0.100456	0.052991	0.077025	0.131281	0.143884
24	0.104189	0.088391	0.067488	0.087958	0.120059	0.223892
25	0.152257	0.174653	0.097013	0.120348	0.182191	0.173275
26	0.136604	0.127934	0.071173	0.139927	0.092148	0.185215
27	0.125983	0.129548	0.113196	0.125839	0.120637	0.225087
28	0.144310	0.160782	0.132967	0.174436	0.145947	0.148166
29	0.078831	0.133160	0.106862	0.092100	0.092028	0.147877
30	0.111799	0.140264	0.067585	0.077747	0.076808	0.145705
31	0.123262	0.089933	0.078566	0.095712	0.081576	0.193587
32	0.139999	0.183636	0.090438	0.100023	0.109608	0.176672
33	0.162179	0.168271	0.053858	0.088175	0.073701	0.144257
34	0.137133	0.105851	0.061757	0.073147	0.069078	0.156874
35	0.120854	0.121215	0.074616	0.081287	0.104045	0.194099
36	0.150981	0.170872	0.069848	0.097326	0.126561	0.205402
37	0.127236	0.176074	0.105658	0.102431	0.161408	0.113776
38	0.059686	0.126754	0.077868	0.056579	0.060360	0.144763
39	0.088777	0.092702	0.090222	0.118518	0.102479	0.218813
40	0.154135	0.147416	0.125189	0.162251	0.138265	0.164939
41	0.132413	0.134388	0.064502	0.089933	0.103081	0.121717
42	0.072329	0.104213	0.083358	0.067007	0.078879	0.136864
43	0.066549	0.074448	0.088271	0.142311	0.113509	0.080258
44	0.041022	0.052485	0.061853	0.053954	0.065995	0.099158
45	0.048295	0.058530	0.052509	0.083406	0.100192	0.095045
47	0.046152	0.057783	0.096122	0.175954	0.125141	0.134867
48	0.044947	0.053906	0.074352	0.091113	0.129331	0.112008
49	0.066356	0.080926	0.067801	0.078735	0.094532	0.115195
50	0.049065	0.046489	0.056218	0.099132	0.106284	0.101792
51	0.040059	0.045477	0.053111	0.079722	0.123840	0.098044
52	0.066597	0.085526	0.118879	0.125911	0.128536	0.149089
53	0.040179	0.039216	0.057735	0.108717	0.107729	0.098341
54	0.029752	0.040035	0.069656	0.129885	0.084562	0.094159
55	0.025754	0.036591	0.053304	0.130174	0.095255	0.090504
56	0.025417	0.037458	0.061058	0.121625	0.086248	0.088139
57	0.049812	0.063057	0.099012	0.082780	0.080709	0.106854
58	0.046754	0.045983	0.069343	0.070161	0.066838	0.086254

59	0.053641	0.065176	0.051739	0.044875	0.048849	0.080256
60	0.058506	0.034713	0.035266	0.046730	0.074424	0.077231
61	0.040516	0.051907	0.035315	0.042226	0.045935	0.064859
62	0.087452	0.050992	0.055279	0.054243	0.061492	0.097767
63	0.050655	0.057976	0.052606	0.048078	0.064213	0.082219
64	0.118590	0.127982	0.051642	0.064960	0.092389	0.145379
65	0.120589	0.168031	0.074207	0.088175	0.109873	0.173823
66	0.158446	0.092196	0.090920	0.129620	0.125670	0.185315
67	0.050848	0.081528	0.101540	0.091931	0.111751	0.124637
68	0.061371	0.071799	0.064285	0.062118	0.079120	0.101388
69	0.045718	0.044369	0.070498	0.108331	0.093256	0.101151
70	0.164972	0.128343	0.111245	0.103708	0.109391	0.19411
71	0.094773	0.066790	0.086248	0.100167	0.091739	0.131802
72	0.041191	0.050029	0.076832	0.088199	0.099710	0.100305
73	0.072353	0.126730	0.092124	0.066019	0.074207	0.129075
74	0.043117	0.029968	0.040468	0.054099	0.102383	0.080045
75	0.037795	0.018241	0.027319	0.035844	0.053424	0.052506

Soil Water Content

09/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.060143	0.060842	0.040492	0.108428	0.146068	0.120946
12	0.048921	0.054604	0.060191	0.076543	0.088247	0.095226
13	0.010486	0.045333	0.042347	0.045838	0.058024	0.05548
14	0.052943	0.061468	0.056218	0.059445	0.056459	0.085146
15	0.037699	0.060408	0.066958	0.072377	0.073725	0.088419
16	0.049017	0.069029	0.064358	0.066284	0.062985	0.091008
17	0.048680	0.106068	0.108355	0.099325	0.092389	0.128397
18	0.044634	0.044442	0.042467	0.035002	0.047404	0.065256
19	0.069752	0.082491	0.054990	0.054291	0.086682	0.106746
20	0.103732	0.070330	0.047259	0.048295	0.084008	0.114455
21	0.079144	0.081624	0.065104	0.066236	0.120445	0.125759
22	0.102624	0.088319	0.061588	0.078421	0.164418	0.153083
23	0.056699	0.083888	0.047452	0.059951	0.124755	0.111961
24	0.078662	0.079674	0.061540	0.084081	0.117892	0.126869
25	0.098795	0.119722	0.083671	0.120613	0.177591	0.178692
26	0.076471	0.096724	0.070547	0.128440	0.088247	0.133228
27	0.058746	0.147440	0.103948	0.128970	0.113581	0.156523
28	0.086633	0.127139	0.125381	0.168199	0.140890	0.184379
29	0.049234	0.122973	0.090246	0.077530	0.073581	0.119189
30	0.037891	0.122973	0.059854	0.070089	0.061299	0.101314
31	0.089066	0.082395	0.073677	0.088151	0.072040	0.12246
32	0.074159	0.143684	0.087187	0.087163	0.100167	0.145756
33	0.094629	0.112594	0.053424	0.083310	0.070643	0.127572
34	0.084731	0.060432	0.060553	0.062889	0.056314	0.100869
35	0.059541	0.073725	0.071125	0.078494	0.096218	0.111256
36	0.078903	0.104334	0.059060	0.089090	0.106766	0.131419
37	0.063876	0.109535	0.105779	0.097494	0.145971	0.15134
38	0.047717	0.115917	0.076158	0.053930	0.058939	0.103755
39	0.061636	0.084273	0.085237	0.107970	0.083045	0.120835
40	0.086754	0.091281	0.083286	0.129114	0.120493	0.149216
41	0.044081	0.086802	0.054966	0.073172	0.083575	0.099325
42	0.041335	0.091498	0.075459	0.065249	0.072256	0.099642
43	0.037362	0.056025	0.080179	0.136050	0.111631	0.114364
44	0.029800	0.047813	0.060745	0.058168	0.067464	0.074813
45	0.022912	0.047910	0.046754	0.080204	0.099012	0.082116
						0.072603
47	0.029222	0.048343	0.084851	0.168271	0.110691	0.115727
48	0.014604	0.038590	0.060890	0.082732	0.119313	0.085712
49	0.022286	0.043045	0.058867	0.070330	0.089860	0.078683
50	0.033123	0.037819	0.053834	0.094580	0.089716	0.08554
51	0.023972	0.033629	0.046778	0.062431	0.115941	0.079839
52	0.027825	0.044177	0.067247	0.084803	0.109584	0.092422
53	0.023274	0.031726	0.051112	0.096098	0.094773	0.080421
54	0.015254	0.028909	0.069174	0.127356	0.086152	0.084147
55	0.006753	0.032906	0.055303	0.124948	0.084586	0.077102
56	0.006922	0.027970	0.060384	0.110715	0.068957	0.069432
57	0.022912	0.042828	0.097085	0.075796	0.073870	0.08475
58	0.017446	0.038638	0.057542	0.049764	0.058578	0.061354

59	0.029174	0.060769	0.042828	0.039529	0.044081	0.063196
60	0.004128	0.015664	0.028788	0.043069	0.061684	0.040873
61	0.014532	0.033629	0.030787	0.038518	0.043117	0.044964
62	0.027175	0.037699	0.048078	0.047452	0.052774	0.060881
63	0.028788	0.052413	0.044634	0.039481	0.051450	0.063168
64	0.034978	0.059782	0.047982	0.053641	0.074905	Q.07887
65	0.025610	0.098482	0.070330	0.082467	0.104623	0.106532
66	0.061444	0.051835	0.089114	0.122973	0.118036	0.125484
67	0.029174	0.078975	0.097735	0.084803	0.103443	0.109248
68	0.041961	0.063226	0.050510	0.058771	0.076423	0.085159
69	0.009113	0.040757	0.058048	0.094484	0.079601	0.073617
70	0.064261	0.098482	0.115195	0.097205	0.096579	0.135676
71	0.032714	0.050703	0.080806	0.093906	0.087621	0.095201
72	0.022455	0.045333	0.077819	0.083117	0.096627	0.088771
73	0.060745	0.054195	0.061709	0.065971	0.072834	0.094065
74	0.020769	0.025297	0.033316	0.045044	0.081359	0.058681
75	0.019252	0.014436	0.021130	0.030209	0.042347	0.037023

Soil Water Content

10/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.085164	0.058457	0.038349	0.114087	0.147224	0.132433
12	0.116375	0.049740	0.052943	0.067970	0.078831	0.11777
13	0.087549	0.047307	0.040131	0.046344	0.058265	0.09037
14	0.122949	0.056338	0.047572	0.052196	0.053882	0.110725
15	0.114809	0.051714	0.056025	0.062527	0.066164	0.113539
16	0.122829	0.075893	0.057446	0.058000	0.064069	0.123223
17	0.134292	0.109535	0.085357	0.078373	0.081552	0.154771
18	0.137711	0.041287	0.040492	0.034616	0.038542	0.102965
19	0.115965	0.070330	0.049451	0.052461	0.077290	0.119325
20	0.124996	0.065489	0.039746	0.038710	0.075243	.
21	0.129114	0.076712	0.055062	0.055808	0.107127	0.13818
22	0.129475	0.099084	0.060191	0.062696	0.147031	0.159685
23	0.103635	0.088825	0.039144	0.051666	0.103659	0.1245
24	0.103274	0.077145	0.061949	0.083984	0.109295	0.134689
25	0.167718	0.100240	0.073581	0.117097	0.156784	0.194395
26	0.118133	0.086152	0.076567	0.130198	0.092124	0.151824
27	0.101420	0.122419	0.104141	0.123045	0.104382	0.164324
28	0.112618	0.119578	0.108861	0.140697	0.122130	0.178545
29	0.088440	0.120396	0.085405	0.073364	0.069174	0.132693
30	0.109608	0.095399	0.047813	0.057518	0.060721	0.119616
31	0.099445	0.076736	0.074135	0.084899	0.076326	0.126182
32	0.140722	0.134557	0.072329	0.075748	0.082636	0.161715
33	0.155893	0.097157	0.046657	0.073485	0.061347	0.144064
34	0.130150	0.050438	0.056386	0.062455	0.056579	0.11726
35	0.091474	0.067825	0.063804	0.068283	0.082949	0.116003
36	0.171065	0.103804	0.050703	0.074231	0.088006	0.162044
37	0.135448	0.107464	0.102046	0.089186	0.126923	0.174616
38	0.093593	0.106284	0.070932	0.052581	0.054460	0.118589
39	0.080781	0.087452	0.079746	0.102744	0.075532	0.125732
40	0.177952	0.093882	0.063731	0.105466	0.095471	0.17391
41	0.116062	0.074014	0.051883	0.074111	0.072497	0.123974
42	0.064887	0.088729	0.073485	0.060793	0.069945	0.107331
43	0.080228	0.055712	0.083238	0.127597	0.105803	0.130886
44	0.057879	0.047813	0.059035	0.055953	0.066116	0.086174
46	0.094316	0.040348	0.048632	0.052919	0.070474	0.098431
47	0.055929	0.049162	0.083262	0.171282	0.112112	0.128622
48	0.049258	0.039433	0.065538	0.090511	0.121095	0.104811
49	0.070017	0.045116	0.057735	0.068981	0.076904	0.096344
50	0.041696	0.037193	0.056338	0.094725	0.090631	0.09014
51	0.076639	0.034351	0.045742	0.064020	0.112160	0.10268
52	0.081528	0.051931	0.067368	0.079866	0.108066	0.117502
53	0.051450	0.035604	0.053665	0.102359	0.094797	0.096161
54	0.080541	0.031245	0.068187	0.122780	0.087187	0.113376
55	0.089114	0.029294	0.051618	0.118927	0.083864	0.110739
56	0.045333	0.022214	0.046633	0.114617	0.069559	0.082513
57	0.083406	0.039505	0.071534	0.069029	0.064960	0.100562
58	0.035820	0.039071	0.055664	0.054123	0.058313	0.070075

59	0.072425	0.049547	0.037651	0.036302	0.038518	0.075684
60	0.081263	0.015278	0.024719	0.040372	0.058000	0.072806
61	0.075122	0.035242	0.027705	0.036760	0.042034	0.071266
62	0.088126	0.034905	0.048632	0.046176	0.052654	0.087318
63	0.049764	0.050727	0.046922	0.038349	0.055495	0.073661
64	0.103250	0.063876	0.045020	0.052630	0.078181	0.110861
65	0.091835	0.106212	0.067392	0.070691	0.089933	0.131155
66	0.131787	0.036133	0.081721	0.111510	0.100649	0.143071
67	0.069824	0.076350	0.091811	0.078710	0.093063	0.120939
68	0.056314	0.061444	0.048199	0.049932	0.069222	0.086577
69	0.050438	0.039047	0.069656	0.088680	0.071534	0.091021
70	0.122299	0.082660	0.094821	0.087958	0.095255	0.149706
71	0.079818	0.046802	0.069632	0.085526	0.085333	0.110072
72	0.037241	0.042804	0.074472	0.083479	0.091426	0.092341
73	0.104550	0.087524	0.043045	0.059324	0.064165	0.11518
74	0.037458	0.018144	0.030113	0.042973	0.076712	0.061436
75	0.044707	0.014917	0.023466	0.026958	0.040902	0.048122

Soil Water Content

12/92

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.158695	0.073674	0.039838	0.097926	0.146461	0.166998
12	0.157802	0.065323	0.056602	0.070561	0.081378	0.143284
13	0.123257	0.063350	0.042889	0.049422	0.060546	0.113241
14	0.152963	0.083134	0.048466	0.054506	0.051548	0.132256
15	0.139065	0.090992	0.062580	0.062364	0.065785	0.13773
16	0.144674	0.144058	0.065785	0.062149	0.063012	0.1561
17	0.138788	0.177770	0.090962	0.086925	0.089236	0.182682
18	0.156908	0.079621	0.043844	0.040238	0.046617	0.127489
19	0.159897	0.092780	0.047788	0.053335	0.083381	0.147416
20	0.179743	0.085661	0.045847	0.043690	0.074506	.
21	0.195798	0.090315	0.056941	0.057773	0.119374	0.176806
22	0.183132	0.104243	0.061594	0.073766	0.156076	0.190657
23	0.163903	0.094629	0.041194	0.056324	0.097772	0.15304
24	0.176445	0.084829	0.068127	0.092163	0.116107	0.175145
25	0.175736	0.172994	0.074537	0.106709	0.168556	0.221522
26	0.175490	0.101932	0.078235	0.138726	0.097063	0.185973
27	0.171761	0.135891	0.103350	0.127633	0.108897	0.202093
28	0.179773	0.122517	0.112779	0.144643	0.113581	0.208851
29	0.146954	0.122055	0.099159	0.073797	0.075954	0.165081
30	0.172501	0.113950	0.050285	0.063874	0.060639	0.155348
31	0.180143	0.082241	0.078389	0.089113	0.071948	0.164741
32	0.184118	0.150375	0.067819	0.075400	0.085785	0.185736
33	0.193548	0.126061	0.049114	0.077957	0.064306	0.172077
34	0.176353	0.071486	0.055585	0.066155	0.059930	0.145911
35	0.147355	0.102610	0.064367	0.072534	0.081439	0.152123
36	0.197338	0.142270	0.054784	0.079190	0.091270	0.188398
37	0.159527	0.156939	0.101778	0.093273	0.133118	0.202903
38	0.137124	0.124644	0.070654	0.052164	0.055647	0.143889
39	0.151022	0.085384	0.082611	0.110191	0.076694	0.159274
40	0.198633	0.135522	0.068897	0.109451	0.094721	0.197572
41	0.142270	0.120052	0.057033	0.070746	0.084552	0.15381
42	0.127016	0.100237	0.079282	0.064522	0.068836	0.140604
43	0.129112	0.070962	0.142548	0.137740	0.116416	0.177499
44	0.132594	0.059745	0.061347	0.054753	0.067048	0.123993
45	0.134936	0.082888	0.047573	0.081933	0.095368	0.142478
46	0.131793	0.063813	0.046987	0.055739	0.071363	0.122754
47	0.119713	0.060331	0.097649	0.181160	0.116878	0.167678
48	0.107941	0.057187	0.070099	0.094567	0.130745	0.141391
49	0.106555	0.071486	0.057711	0.070900	0.084891	0.123471
50	0.112995	0.047850	0.061008	0.110160	0.094228	0.130755
51	0.120483	0.059868	0.051209	0.072010	0.119898	0.135351
52	0.116354	0.047573	0.074937	0.084675	0.112749	0.136125
53	0.114998	0.042457	0.055924	0.110684	0.100299	0.130694
54	0.123873	0.047449	0.069298	0.124798	0.084521	0.137618
55	0.110068	0.052133	0.064676	0.122702	0.078759	0.129508
56	0.107787	0.033551	0.059036	0.117217	0.079560	0.12064
57	0.112132	0.055770	0.086031	0.066370	0.072071	0.123593
58	0.109759	0.051548	0.060639	0.056140	0.058297	0.108733

59	0.131207	0.098173	0.041440	0.036972	0.037681	0.117554
60	0.110776	0.056263	0.027296	0.039129	0.063628	0.100466
61	0.118141	0.071948	0.030162	0.039499	0.043906	0.10336
62	0.127571	0.048744	0.046587	0.046494	0.058081	0.1104
63	0.126154	0.058235	0.053859	0.038020	0.058019	0.112714
64	0.141685	0.127818	0.048805	0.054907	0.075523	0.147943
65	0.150282	0.128095	0.068374	0.073859	0.097834	0.167271
66	0.178078	0.066956	0.085291	0.115121	0.104428	0.175897
67	0.129543	0.077341	0.098203	0.084583	0.099066	0.152684
68	0.133087	0.068158	0.050038	0.052781	0.069883	0.124367
69	0.131115	0.043536	0.062488	0.091270	0.072534	0.127699
70	0.178880	0.102610	0.100977	0.084737	0.105353	0.185077
71	0.138018	0.063443	0.086401	0.091301	0.085754	0.146728
72	0.095522	0.044830	0.077957	0.087048	0.095461	0.121971
73	0.121439	0.121161	0.055308	0.058512	0.065631	0.136215
74	0.106431	0.033182	0.029761	0.045785	0.077803	0.097787
75	0.107263	0.053582	0.021965	0.029761	0.046987	0.089883

Soil Water Content

01/93

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.166461	0.068928	0.044953	0.119682	0.149604	0.175642
12	0.145752	0.095368	0.054537	0.073551	0.085076	0.148066
13	0.109913	0.087356	0.044337	0.046001	0.068219	0.116418
14	0.140822	0.106339	0.049114	0.053304	0.052257	0.133888
15	0.135583	0.106216	0.057989	0.066031	0.066093	0.140409
16	0.150621	0.143410	0.060546	0.059807	0.065446	0.157534
17	0.142178	0.168895	0.094629	0.086894	0.091886	0.18325
18	0.153765	0.098758	0.046463	0.041779	0.047943	0.133176
19	0.163841	0.084182	0.048590	0.053890	0.087017	0.148014
20	0.198571	0.074506	0.046309	0.045015	0.085754	0.158015
21	0.178263	0.122918	0.057495	0.060762	0.116508	0.178572
22	0.205104	0.101562	0.065384	0.084521	0.160760	0.204244
23	0.181098	0.063844	0.044275	0.059468	0.125075	0.161132
24	0.172316	0.089359	0.067203	0.094968	0.118080	0.175568
25	0.193825	0.153703	0.078851	0.117124	0.170590	0.227647
26	0.201992	0.083504	0.100114	0.136354	0.084490	0.193594
27	0.179342	0.122147	0.108897	0.128311	0.109420	0.20306
28	0.181098	0.124613	0.116169	0.140052	0.109883	0.208896
29	0.156785	0.120391	0.088250	0.076571	0.072133	0.165687
30	0.180359	0.111762	0.055123	0.068219	0.065076	0.161638
31	0.184180	0.087479	0.077926	0.094043	0.076509	0.170368
32	0.179003	0.176230	0.072410	0.072102	0.091270	0.193324
33	0.193825	0.152686	0.048559	0.077649	0.064183	0.179952
34	0.188556	0.062549	0.069976	0.074229	0.059683	0.15386
35	0.150930	0.117463	0.070253	0.076016	0.084367	0.161234
36	0.192069	0.159127	0.053428	0.082087	0.098912	0.193617
37	0.166584	0.181530	0.103843	0.096447	0.126677	0.212675
38	0.140421	0.139651	0.068836	0.048528	0.054599	0.148379
39	0.151546	0.094413	0.085846	0.105260	0.077433	0.162263
40	0.198109	0.145167	0.069021	0.107818	0.101377	0.201931
41	0.140822	0.109297	0.059807	0.077711	0.076540	0.149615
42	0.117124	0.117402	0.077526	0.064460	0.071887	0.141766
43	0.117494	0.077495	0.087387	0.141531	0.112317	0.159969
44	0.118665	0.077125	0.055647	0.056602	0.070685	0.122974
45	0.126801	0.092995	0.054753	0.082456	0.099837	0.14509
46	0.109513	0.104551	0.047542	0.050346	0.057187	0.119757
47	0.124058	0.078851	0.100699	0.181776	0.122702	0.177822
48	0.094413	0.058636	0.079159	0.107171	0.119436	0.137131
49	0.107787	0.073366	0.063042	0.074352	0.090808	0.128387
50	0.110838	0.053150	0.060515	0.107602	0.099806	0.132413
51	0.121562	0.069082	0.051671	0.078820	0.125106	0.141641
52	0.086031	0.061964	0.076478	0.086308	0.115861	0.128443
53	0.103658	0.048713	0.058975	0.107849	0.102887	0.12844
54	0.099683	0.070623	0.069914	0.123473	0.086524	0.134175
55	0.100022	0.069051	0.080577	0.116693	0.082456	0.133945
56	0.095399	0.064522	0.064491	0.122271	0.078635	0.126454
57	0.102086	0.070346	0.088127	0.070839	0.066802	0.123283

58	0.095153	0.054506	0.064059	0.062765	0.060608	0.105921
59	0.119836	0.119436	0.041471	0.034846	0.041071	0.119415
60	0.110345	0.056016	0.031456	0.044152	0.059344	0.100958
61	0.110807	0.077002	0.036387	0.041502	0.042026	0.102969
62	0.116755	0.057958	0.050254	0.050007	0.054414	0.108816
63	0.114289	0.068682	0.043135	0.041533	0.059283	0.10891
64	0.130006	0.117587	0.043228	0.059683	0.094844	0.144976
65	0.149481	0.097772	0.073890	0.081162	0.102148	0.161947
66	0.174904	0.086863	0.086863	0.113858	0.103627	0.180341
67	0.128958	0.092102	0.093581	0.085846	0.097125	0.155364
68	0.140236	0.070839	0.047080	0.049791	0.068004	0.126487
69	0.125537	0.041718	0.074105	0.091177	0.068836	0.12642
70	0.179280	0.121100	0.097125	0.090808	0.104767	0.190879
71	0.136970	0.073859	0.083936	0.093643	0.086678	0.14951
72	0.089390	0.050346	0.086432	0.093766	0.090160	0.122739
73	0.103812	0.117186	0.070592	0.059314	0.074259	0.13366
74	0.116724	0.055462	0.031518	0.042611	0.075862	0.108325
75	0.102579	0.073890	0.023105	0.029268	0.041841	0.09251

Soil Water Content

02/93

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.176907	0.142856	0.047080	0.119405	0.149604	0.202997
12	0.165167	0.151084	0.059653	0.073242	0.084614	0.174596
13	0.125260	0.124890	0.045138	0.049545	0.071548	0.136492
14	0.158973	0.162886	0.054137	0.051918	0.053520	0.160378
15	0.149728	0.161808	0.072996	0.060762	0.070531	0.167481
16	0.150621	0.178202	0.099867	0.060146	0.061625	0.176724
17	0.161623	0.197369	0.124397	0.085815	0.088774	0.206836
18	0.167940	0.152008	0.061625	0.040331	0.048220	0.159114
19	0.165074	0.166769	0.051301	0.050962	0.080669	0.171532
20	0.213240	0.130067	0.042242	0.048281	0.084120	.
21	0.187755	0.178541	0.068712	0.056972	0.110191	0.199682
22	0.208617	0.195983	0.068189	0.086339	0.165167	0.236538
23	0.198232	0.148341	0.042457	0.057002	0.115953	0.190507
24	0.194319	0.150282	0.070038	0.095461	0.114936	0.203611
25	0.190312	0.210867	0.090530	0.118450	0.166553	0.245189
26	0.212685	0.160976	0.101593	0.147940	0.085908	0.22476
27	0.179311	0.212038	0.105014	0.128557	0.107109	0.228399
28	0.198756	0.207939	0.112194	0.141469	0.112009	0.241767
29	0.182485	0.160606	0.086247	0.075307	0.071825	0.188471
30	0.182917	0.205905	0.053520	0.066216	0.068743	0.19133
31	0.203255	0.151977	0.075584	0.090438	0.074999	0.196541
32	0.191114	0.235365	0.076232	0.073828	0.086986	0.21653
33	0.198294	0.200389	0.099867	0.080238	0.060824	0.208611
34	0.179065	0.129235	0.065816	0.067788	0.065045	0.168875
35	0.158017	0.164828	0.096015	0.074013	0.083905	0.184534
36	0.191360	0.195520	0.096509	0.086740	0.096940	0.215325
37	0.171145	0.208617	0.097433	0.094721	0.132563	0.222672
38	0.153580	0.219680	0.072564	0.049052	0.062827	0.181815
39	0.160575	0.170929	0.082672	0.107171	0.080515	0.189794
40	0.193579	0.170220	0.107171	0.109698	0.098111	0.216342
41	0.159157	0.172963	0.058297	0.081501	0.073119	0.17632
42	0.141839	0.183132	0.079498	0.064337	0.072071	0.17313
43	0.139343	0.143780	0.094999	0.139497	0.105692	0.189195
44	0.135183	0.138572	0.060762	0.055831	0.070038	0.149772
45	0.130006	0.160359	0.066001	0.078358	0.102795	0.169621
46	0.131022	0.140914	0.066155	0.055153	0.065138	0.148345
47	0.130221	0.145845	0.115121	0.185628	0.123503	0.20531
48	0.115491	0.129328	0.078820	0.093550	0.139281	0.170969
49	0.111917	0.139281	0.087017	0.083165	0.089482	0.157379
50	0.133025	0.121500	0.063135	0.110098	0.095800	0.162855
51	0.124305	0.132471	0.067480	0.084213	0.125383	0.167006
52	0.115892	0.110961	0.068897	0.083782	0.102117	0.150055
53	0.123257	0.111454	0.056972	0.106832	0.102302	0.155202
54	0.117402	0.116169	0.072164	0.122671	0.082087	0.154883
55	0.112225	0.125352	0.082025	0.121223	0.091732	0.160377
56	0.116878	0.123781	0.078050	0.124181	0.074722	0.156495
57	0.115337	0.129482	0.096293	0.070284	0.067942	0.149259

58	0.120052	0.120453	0.068651	0.065754	0.062611	0.139256
59	0.128033	0.161499	0.056047	0.034753	0.039314	0.138821
60	0.110961	0.092841	0.051178	0.043443	0.062303	0.117959
61	0.105661	0.149851	0.038051	0.036202	0.042488	0.122002
62	0.134196	0.132255	0.054907	0.047573	0.053767	0.139436
63	0.139343	0.135676	0.046741	0.036910	0.053982	0.138669
64	0.142301	0.163133	0.066925	0.059868	0.087942	0.168063
65	0.154011	0.186245	0.076601	0.079683	0.097402	0.189486
66	0.202824	0.130129	0.090438	0.120946	0.103874	0.20827
67	0.170991	0.139990	0.093057	0.080638	0.096971	0.187426
68	0.155059	0.116693	0.053397	0.049976	0.074660	0.150527
69	0.149820	0.127109	0.064306	0.091670	0.077865	0.163322
70	0.183903	0.185382	0.115923	0.087479	0.091208	0.21221
71	0.147632	0.144982	0.088897	0.096478	0.085630	0.177138
72	0.069206	0.077064	0.082857	0.087664	0.094752	0.120935
73	0.139497	0.145999	0.091948	0.065847	0.065908	0.162502
74	0.108742	0.098080	0.074629	0.048004	0.077896	0.129985
75	0.102918	0.098573	0.104983	0.053212	0.046371	0.126684

Soil Water Content

03/93

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.165598	0.145660	0.049576	0.119959	0.144643	0.197996
12	0.149789	0.148310	0.089113	0.075893	0.079159	0.173103
13	0.120853	0.090838	0.047449	0.064028	0.066925	0.126381
14	0.139959	0.152131	0.091763	0.052966	0.054445	0.158488
15	0.131423	0.140606	0.126308	0.072564	0.069329	0.168211
16	0.141038	0.165690	0.139189	0.079529	0.063166	0.182827
17	0.142301	0.187385	0.178356	0.141469	0.092841	0.220986
18	0.152131	0.150560	0.081439	0.048097	0.050839	0.158858
19	0.151453	0.171299	0.080114	0.053674	0.073581	0.172381
20	0.199680	0.171484	0.056355	0.046587	0.072133	.
21	0.171576	0.168248	0.100114	0.063813	0.113889	0.199641
22	0.178726	0.204056	0.095615	0.075923	0.160390	0.228849
23	0.168125	0.185937	0.057773	0.059314	0.104182	0.188998
24	0.167848	0.161592	0.076386	0.098573	0.122147	0.199464
25	0.166184	0.216753	0.118943	0.110314	0.170159	0.242655
26	0.180205	0.204919	0.092194	0.143904	0.102672	0.225199
27	0.185105	0.195212	0.111115	0.129790	0.110283	0.228683
28	0.174442	0.218047	0.125476	0.141192	0.115399	0.23814
29	0.138449	0.196907	0.092657	0.077341	0.076139	0.182848
30	0.168371	0.219649	0.073612	0.062765	0.063628	0.191706
31	0.189296	0.162270	0.087818	0.093612	0.072503	0.196292
32	0.178294	0.227631	0.120237	0.076478	0.082333	0.218576
33	0.186522	0.183348	0.104521	0.113457	0.066494	0.207709
34	0.182485	0.135706	0.076694	0.073612	0.063350	0.175731
35	0.136384	0.149173	0.137032	0.095861	0.086986	0.185651
36	0.175767	0.194072	0.111886	0.105199	0.097803	0.215669
37	0.141223	0.205536	0.171545	0.113488	0.126400	0.228715
38	0.137956	0.213394	0.084737	0.053767	0.055308	0.174628
39	0.148772	0.166245	0.102117	0.114567	0.082641	0.190056
40	0.155151	0.193363	0.097556	0.137062	0.112040	0.21324
41	0.140267	0.179804	0.088835	0.072534	0.079344	0.17758
42	0.118912	0.174689	0.089606	0.064676	0.070993	0.162552
43	0.118634	0.145845	0.104182	0.144397	0.114505	0.186415
44	0.101347	0.122856	0.102456	0.053921	0.065045	0.138375
45	0.107880	0.129882	0.100484	0.088096	0.092410	0.157974
46	0.112071	0.125167	0.108866	0.063751	0.061686	0.146455
47	0.117402	0.129851	0.149759	0.195921	0.131454	0.207846
48	0.087140	0.110900	0.085908	0.112009	0.129451	0.155197
49	0.101408	0.121192	0.106955	0.076663	0.090376	0.151175
50	0.109328	0.115121	0.083288	0.107880	0.096878	0.155195
51	0.102733	0.112749	0.101162	0.095122	0.119713	0.160283
52	0.094505	0.096724	0.086000	0.088897	0.122702	0.147634
53	0.098265	0.101655	0.064059	0.107602	0.100176	0.142304
54	0.092348	0.097032	0.089452	0.130006	0.082672	0.143832
55	0.077495	0.089729	0.113519	0.122302	0.076848	0.137686
56	0.080823	0.107510	0.101408	0.126831	0.077310	0.142535
57	0.108003	0.116385	0.106863	0.068959	0.069329	0.144823
58	0.099713	0.111516	0.075831	0.064429	0.062734	0.128989

59	0.106185	0.149266	0.095676	0.043906	0.036017	0.136068
60	0.100638	0.073828	0.080145	0.048220	0.065323	0.116713
61	0.091023	0.132841	0.059961	0.042642	0.043782	0.117466
62	0.121624	0.117679	0.072195	0.046371	0.054630	0.133746
63	0.131022	0.138542	0.055153	0.037619	0.054229	0.138103
64	0.130930	0.149882	0.100638	0.069206	0.097371	0.172095
65	0.136939	0.171114	0.078574	0.078943	0.098111	0.177822
66	0.194996	0.123134	0.092718	0.114690	0.100977	0.201099
67	0.130098	0.156137	0.107787	0.080792	0.099713	0.178404
68	0.143503	0.126677	0.055246	0.054137	0.069914	0.148193
69	0.134535	0.125506	0.074629	0.090253	0.076632	0.15789
70	0.182362	0.186399	0.128095	0.091763	0.102548	0.219123
71	0.121192	0.120175	0.113581	0.096324	0.090530	0.165408
72	0.083751	0.081994	0.076201	0.090469	0.093180	0.127384
73	0.107818	0.130160	0.117895	0.092995	0.069883	0.156604
74	0.092348	0.085507	0.085415	0.077187	0.083412	0.129023
75	0.089729	0.081624	0.091147	0.089667	0.070500	0.126735

Soil Water Content

04/93

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.138757	0.137987	0.052380	0.123781	0.148310	0.186
12	0.129112	0.134751	0.096293	0.081162	0.083874	0.164
13	0.064429	0.092595	0.081039	0.053705	0.061502	0.106
14	0.113088	0.133149	0.079930	0.051795	0.050069	0.136
15	0.101285	0.126092	0.125537	0.080700	0.063381	0.15
16	0.112471	0.144705	0.143749	0.090376	0.064090	0.167
17	0.114505	0.179619	0.168526	0.148095	0.102548	0.208
18	0.098265	0.139035	0.092903	0.054938	0.052565	0.136
19	0.125229	0.163102	0.090037	0.058944	0.079252	0.163
20	0.160144	0.172655	0.074537	0.045816	0.077834	0.175
21	0.146492	0.160174	0.103750	0.064860	0.117741	0.188
22	0.168433	0.195181	0.115491	0.072903	0.161869	0.226
23	0.098111	0.162301	0.071856	0.057218	0.093735	0.15
24	0.140760	0.161808	0.078142	0.097371	0.119898	0.187
25	0.180143	0.192161	0.106123	0.126030	0.164458	0.24
26	0.161345	0.167817	0.101069	0.148279	0.102333	0.209
27	0.148433	0.220820	0.123318	0.129913	0.107787	0.222
28	0.162301	0.215427	0.134874	0.140175	0.106555	0.231
29	0.115984	0.189357	0.096601	0.081008	0.073304	0.171
30	0.123195	0.196013	0.082456	0.064522	0.066956	0.168
31	0.170652	0.156507	0.092687	0.098604	0.076755	0.19
32	0.151423	0.221437	0.129851	0.083073	0.090006	0.211
33	0.159219	0.171052	0.101408	0.112810	0.069113	0.192
34	0.171299	0.121038	0.082734	0.075646	0.066463	0.169
35	0.122517	0.143441	0.121963	0.100823	0.088989	0.176
36	0.163009	0.181222	0.105445	0.111947	0.105938	0.208
37	0.126492	0.197431	0.169974	0.119836	0.125876	0.22
38	0.104397	0.202423	0.094783	0.055400	0.056386	0.159
39	0.135583	0.165321	0.108465	0.112964	0.088127	0.187
40	0.160267	0.149296	0.114906	0.140483	0.102795	0.205
41	0.118419	0.161160	0.095707	0.075369	0.080176	0.165
42	0.091917	0.153980	0.093951	0.065908	0.069729	0.145
43	0.083473	0.126801	0.108465	0.147663	0.136477	0.173
44	0.062334	0.101069	0.105568	0.054753	0.065785	0.115
45	0.067911	0.094475	0.095307	0.084398	0.090376	0.127
46	0.102425	0.119805	0.102364	0.067634	0.059468	0.139
47	0.099066	0.129420	0.148618	0.195490	0.134104	0.2
48	0.051178	0.077742	0.078789	0.097525	0.136754	0.127
49	0.068867	0.099929	0.111393	0.087048	0.081378	0.131
50	0.074691	0.101716	0.085507	0.113488	0.095214	0.137
51	0.071301	0.087572	0.091393	0.094475	0.125969	0.138
52	0.062796	0.076848	0.088743	0.086801	0.113981	0.125
53	0.062765	0.084768	0.064183	0.107602	0.099683	0.121
54	0.050254	0.058821	0.083443	0.131454	0.080484	0.112
55	0.028775	0.043567	0.075831	0.127448	0.088466	0.097
56	0.045847	0.086401	0.101316	0.127941	0.079960	0.121
57	0.062395	0.092472	0.116169	0.070716	0.069051	0.12
58	0.056787	0.087603	0.093766	0.067387	0.062395	0.107

59	0.078173	0.136323	0.113981	0.074013	0.038266	0.131
60	0.060978	0.060916	0.083473	0.057896	0.061163	0.097
61	0.056417	0.119682	0.064552	0.043998	0.044399	0.1
62	0.090130	0.099867	0.086678	0.052966	0.056571	0.12
63	0.102394	0.123473	0.062857	0.043875	0.054568	0.124
64	0.100145	0.134628	0.119004	0.082487	0.079529	0.156
65	0.099683	0.171022	0.098789	0.081563	0.098696	0.167
66	0.170713	0.113827	0.095492	0.119651	0.105599	0.19
67	0.095923	0.146122	0.120514	0.086463	0.095399	0.163
68	0.120637	0.121654	0.057588	0.055739	0.071979	0.138
69	0.098419	0.109883	0.070623	0.091147	0.075739	0.136
70	0.148372	0.168279	0.148279	0.102579	0.098881	0.205
71	0.077125	0.101193	0.110838	0.100268	0.091609	0.14
72	0.057958	0.072657	0.084644	0.086617	0.095153	0.115
73	0.093704	0.125784	0.109544	0.097834	0.073766	0.149
74	0.073027	0.077341	0.087849	0.078235	0.083134	0.119
75	0.072626	0.074845	0.092009	0.095738	0.086247	0.123

Soil Water Content

05/93

Stat.	30 cm	60 cm	Depth 90 cm	110cm	130 cm	TWC (m)
11	0.066216	0.076355	0.045539	0.093026	0.150282	0.128
12	0.055369	0.070222	0.070038	0.079313	0.083597	0.104
13	0.028189	0.046525	0.042488	0.050100	0.061286	0.066
14	0.055184	0.076478	0.067295	0.061039	0.051178	0.092
15	0.045631	0.071424	0.078019	0.071270	0.071578	0.097
16	0.064552	0.097402	0.097186	0.079621	0.068096	0.119
17	0.063628	0.116539	0.122548	0.115522	0.101501	0.148
18	0.068682	0.069051	0.062025	0.047727	0.051856	0.092
19	0.072780	0.120021	0.088157	0.058882	0.072441	0.124
20	0.109944	0.106000	0.061008	0.049329	0.074876	0.129
21	0.075276	0.093982	0.085661	0.063844	0.101285	0.127
22	0.100854	0.126924	0.087479	0.074629	0.162208	0.169
23	0.066463	0.096478	0.047388	0.058543	0.088373	0.109
24	0.081902	0.111793	0.070007	0.091763	0.110160	0.139
25	0.115121	0.160421	0.103442	0.118604	0.177524	0.203
26	0.112410	0.131762	0.096909	0.150005	0.105229	0.176
27	0.093828	0.155429	0.112872	0.129975	0.104028	0.174
28	0.091917	0.166800	0.123935	0.143873	0.106986	0.183
29	0.070746	0.129667	0.094321	0.075954	0.075461	0.132
30	0.083504	0.164057	0.081963	0.067295	0.071178	0.142
31	0.092533	0.122302	0.090438	0.101131	0.084675	0.147
32	0.077433	0.178695	0.125969	0.077926	0.090777	0.163
33	0.091640	0.127663	0.071671	0.099621	0.073242	0.139
34	0.088774	0.093643	0.060485	0.076324	0.064676	0.118
35	0.061286	0.083350	0.100699	0.091886	0.092903	0.124
36	0.081686	0.129975	0.089883	0.097834	0.111639	0.151
37	0.078420	0.139651	0.147940	0.110222	0.130930	0.175
38	0.055400	0.145814	0.109174	0.061409	0.052750	0.124
39	0.075492	0.130314	0.104675	0.117587	0.099837	0.153
40	0.086771	0.111824	0.074937	0.122548	0.111732	0.149
41	0.066771	0.122610	0.092040	0.078204	0.086185	0.131
42	0.047018	0.097803	0.097341	0.066987	0.074044	0.11
43	0.045446	0.065600	0.080607	0.142609	0.118511	0.124
44	0.030254	0.053613	0.076509	0.059930	0.064768	0.08
45	0.033305	0.056941	0.052811	0.072380	0.088774	0.086
46	0.042396	0.062642	0.078481	0.071055	0.061193	0.09
47	0.036387	0.065908	0.093119	0.186183	0.140606	0.139
48	0.022550	0.041933	0.058420	0.074136	0.128187	0.091
49	0.026248	0.049853	0.063350	0.071732	0.072410	0.079
50	0.032997	0.047203	0.059529	0.096909	0.097125	0.092
51	0.000609	0.044429	0.059961	0.061656	0.120422	0.077
52	0.029268	0.043474	0.061779	0.076694	0.101408	0.087
53	0.023783	0.038944	0.048436	0.092318	0.110222	0.086
54	0.023629	0.034753	0.062426	0.125599	0.098080	0.091
55	0.002735	0.027450	0.045323	0.121747	0.096909	0.074
56	0.009299	0.034075	0.051425	0.117802	0.080515	0.075
57	0.014107	0.047018	0.082919	0.081008	0.071147	0.079
58	0.020116	0.042180	0.065723	0.057002	0.062210	0.068

59	0.026371	0.062857	0.068867	0.057280	0.039776	0.071
60	0.008128	0.024522	0.030870	0.046433	0.059067	0.046
61	0.006064	0.049884	0.038944	0.040115	0.042889	0.048
62	0.037588	0.046833	0.065538	0.052195	0.056633	0.075
63	0.028436	0.055985	0.069760	0.044306	0.052103	0.072
64	0.045107	0.078235	0.096293	0.072657	0.074290	0.105
65	0.046556	0.121932	0.090407	0.071486	0.098943	0.124
66	0.095646	0.074444	0.087726	0.116693	0.102795	0.141
67	0.036941	0.091208	0.120822	0.089914	0.097341	0.121
68	0.061471	0.093150	0.062518	0.052133	0.067634	0.102
69	0.025108	0.045323	0.046648	0.086647	0.077156	0.077
70	0.087017	0.132039	0.135676	0.111947	0.094783	0.164
71	0.028159	0.051795	0.084275	0.098419	0.090931	0.096
72	0.035616	0.054013	0.076940	0.086894	0.098512	0.098
73	0.040300	0.073273	0.079097	0.084244	0.073643	0.099
74	0.031055	0.047234	0.058235	0.073766	0.086124	0.083
75	0.038913	0.059560	0.061101	0.072380	0.074198	0.087

Soil Water Content

06/93

			Depth			
Stat.	30 cm	60 cm	90 cm	110cm	130 cm	TWC (m)
11	0.055862	0.067295	0.036017	0.095060	0.140606	0.116
13	0.012442	0.041964	0.042488	0.044861	0.059683	0.085
14	0.044522	0.055893	0.048251	0.049915	0.047419	0.056
15	0.043074	0.055308	0.060392	0.063258	0.0675	0.073
16	0.047819	0.070561	0.069575	0.066155	0.063073	0.084
17	0.046648	0.091208	0.085107	0.082333	0.087418	0.092
18	0.052688	0.041872	0.043813	0.036756	0.043443	0.112
19	0.064367	0.074352	0.057311	0.054814	0.078851	0.068
20	0.091085	0.075523	0.044553	0.042426	0.070469	0.1
21	0.062210	0.074413	0.057002	0.056663	0.091516	0.104
22	0.083011	0.093735	0.063689	0.069452	0.149204	0.103
23	0.070192	0.074999	0.040084	0.054938	0.107726	0.14
24	0.067018	0.093334	0.057002	0.082580	0.096416	0.107
25	0.097895	0.110129	0.083504	0.116570	0.161160	0.118
26	0.092718	0.088589	0.079498	0.138079	0.093365	0.17
27	0.076170	0.128804	0.108773	0.127725	0.099929	0.144
28	0.086709	0.118080	0.102641	0.099436	0.082549	0.156
29	0.059776	0.121716	0.089575	0.079652	0.074907	0.145
30	0.082087	0.108897	0.059160	0.062087	0.065384	0.124
31	0.077372	0.092965	0.079159	0.090191	0.076108	0.116
32	0.059067	0.145752	0.084151	0.072164	0.083319	0.123
33	0.077187	0.113488	0.044368	0.080176	0.059992	0.131
34	0.068990	0.068035	0.051918	0.063412	0.056201	0.114
35	0.055770	0.063104	0.068343	0.065045	0.074568	0.094
36	0.065045	0.104274	0.055677	0.072903	0.091824	0.096
37	0.059190	0.103380	0.102487	0.087572	0.108835	0.117
38	0.039591	0.124459	0.091393	0.061163	0.058913	0.133
39	0.054784	0.090438	0.077680	0.101439	0.084829	0.108
40	0.064953	0.091609	0.043382	0.097217	0.090499	0.117
						0.114
42	0.030470	0.030347	0.082949	0.083227	0.062919	0.103
43	0.028035	0.054198	0.070839	0.136200	0.110591	0.079
44	0.026433	0.052935	0.067048	0.058482	0.067141	0.107
45	0.027111	0.051425	0.052411	0.074044	0.094475	0.076
46	0.032534	0.043074	0.049052	0.060824	0.058697	0.084
47	0.021780	0.046771	0.071732	0.161777	0.121161	0.07
48	0.020054	0.040423	0.065230	0.085322	0.114752	0.11
49	0.008251	0.040547	0.053952	0.067048	0.074074	0.089
50	0.024307	0.039006	0.049483	0.088527	0.094505	0.065
51	0.020116	0.037896	0.045508	0.060022	0.112872	0.081
52	0.024029	0.039406	0.059653	0.076755	0.100484	0.078
53	0.018698	0.036048	0.043875	0.084644	0.103904	0.083
54	0.018760	0.037188	0.060577	0.126523	0.092965	0.078
55	0.002242	0.026186	0.049853	0.116077	0.102179	0.088
56	.	0.029576	0.046556	0.112132	0.087695	0.075
57	.	0.041471	0.079991	0.078173	0.065754	0.073
58	.	0.025847	0.053243	0.049514	0.054722	0.075
59	0.011210	0.040516	0.034568	0.033983	0.036171	0.051

60	0.003198	0.014877	0.023228	0.033767	0.049946	0.043
61	0.005016	0.034168	0.028436	0.035924	0.041656	0.033
62	0.020208	0.034137	0.044183	0.043074	0.050716	0.039
63	0.019746	0.047295	0.055862	0.039468	0.043967	0.054
64	0.011888	0.057064	0.048035	0.046278	0.064213	0.058
65	0.016387	0.102857	0.064059	0.067819	0.091917	0.063
66	0.042365	0.041317	0.067079	0.110622	0.096971	0.095
67	0.022150	0.071856	0.097248	0.087295	0.089205	0.099
68	0.039314	0.065662	0.057095	0.051024	0.065292	0.1
69	0.011919	0.036818	0.048466	0.076108	0.077557	0.081
70	0.029360	0.083381	0.104028	0.097803	0.087418	0.067
71	0.011580	0.047912	0.073982	0.088188	0.085754	0.11
72	0.021749	0.045693	0.066031	0.087849	0.099960	0.081
73	0.017404	0.032596	0.043597	0.056972	0.064522	0.088
74	0.016294	0.025046	0.032504	0.045539	0.064737	0.059
75	0.011333	0.013675	0.026525	0.032041	0.042919	0.052