UNSATURATED SOIL HYDRAULIC PROPERTIES AND PARAMETERS FOR THE OAKES AREA, DICKEY COUNTY, NORTH DAKOTA

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Water Resources Investigation No.18
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Acknowledgement

The data presented in this report are the product of thousands of hours of field, laboratory, and data processing work by many people. The authors wish to express their thanks to North Dakota Water Commission technicians Mike Hove, Jim MacArthur, and Kelvin Kunz for their many difficult and long hours of field work. Thanks to Chris Koppang for his field work, for his careful work in the SWC soil hydraulics laboratory, and for his assistance in processing the field data. Thanks to Jim Arndt, director of the NDSU soil characterization laboratory, who supervised the laboratory determinations of soil physical and chemical properties published in this report. Finally, thanks to Milton Lindvig, director of the Water Appropriations Division of the North Dakota State Water Commission for his support in the conception, financial support, and logistics of this project.

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INTRODUCTION

In recent years there has been an increasing awareness of the importance of the unsaturated soil zone in controlling and mediating physical and chemical processes affecting groundwater. Unsaturated soil hydraulic property data, including hydraulic conductivity $K(\theta,\psi)$ and soil water-retention in relation to soil pore-water pressure state [$\theta(\psi)$ for volumetric water content θ and negative pore-water pressure head (suction) ψ] are needed for modeling recharge processes and contaminant transport. The unsaturated hydraulic conductivity function is commonly presented in the literature as a function of water content $K(\theta)$ and as a function of negative soil pore-water pressure head $K(\psi)$. Because this report presents data as a function of both θ and ψ, we will use the symbol $K(\theta,\psi)$ representing both, unless a specific limiting application more appropriately represented by a single water or pressure assignment is discussed.

Good field $K(\theta,\psi)$ data are difficult and expensive to obtain. For this reason, there have been many attempts to develop models based on soil properties such as soil particle-size distribution, or the soil water-retention relationship. Because of the need for specialized laboratory facilities in measuring soil-water retention, many attempts have also been made to estimate $\theta(\psi)$ using soil-texture properties. However, these attempts have been limited by the lack of data sufficiently comprehensive to allow for the comparison of hydraulic properties with physical, morphologic, and chemical properties.

The data presented in this report were measured by the North Dakota State Water Commission during the field seasons of 1984 and 1985, and in the laboratory during 1985 and 1986. The data acquisition plan was based on two objectives. The first objective was that of evaluating the variation of soil hydraulic properties and the potential effect of that variation on ground-water recharge in an unconfined shallow aquifer in southeastern North Dakota. Parts of the investigation pertaining to the variation of soil-hydraulic parameters have already been reported, while others are still in progress. Schuh et al. (1988) evaluated the precision of a particle-size based model for predicting $\theta(\psi)$ in relation to in-situ and laboratory methods. The distributions of the pore-interaction factors for predicting $K(\theta)$ using the models of Mualem (1976b, 1978) were evaluated by Schuh and

Cline (1990). An examination of the accuracy of parameterized water-retention functions for describing $\theta(\psi)$ on sandy soils and of the sensitivity of infiltration and drainage simulations to various parameterized formats for field-measured hydraulic data on sandy soils was reported by Alessi et al. (in review a, in review b, SSSAJ). An evaluation of the sensitivity of simulated infiltration rate and drainage response to the variability of the $K(\theta,\psi)$ pore-interaction factor is currently in progress. A final summary and interpretative report is planned .

The second objective was to generate a data set with the greatest possible comparative value. In adopting this objective it was recognized that completeness in itself is a valuable asset in extending the usefulness of any data set. In examining a compendium of published hydraulic data compiled by Mualem (1976a) it became apparent to us that much data had been published, but that few data sets were sufficiently complete to allow for their versatile application in model confirmation. For example, many data sets containing $K(\theta,\psi)$ and $\theta(\psi)$ data did not have complementary soil particle-size data, and even fewer reported the detailed fractionation (5 sand classes and 2 silt classes) needed for proper application of many published particle-size indices (Arya and Paris 1981, Bloemen 1980, Shirazi and Boersma 1984). In many other cases, vital soil water-chemical data, such as SAR, are not available. Such limitations result naturally from time and budget constraints which frequently limit data acquisition to immediate project needs. However, a reasonably limited additional expenditure and effort can often result in a data set with extensive value beyond the limitations of immediate project goals.

The objective of completeness was based on three considerations. First, the authors were influenced by recognition of the value of previous data acquisition work published by Cassel (1975). Second, it was based on the ongoing character of the North Dakota Water Commission recharge investigative work which is expected to lead to eventual needs for comparative data continuity between project areas in North Dakota. Finally, it was considered desirable to provide a data set that would have extensive value for scientific applications beyond our immediate project needs and requirements.

Every data set has its blemishes and limitations, and despite all efforts to the contrary these data are no exception. In presenting these data, the authors are aware that completeness is a relative quality. As research progresses, new properties and parameters will likely be required to properly define soil hydraulic phenomena, and any current data acquisitions will eventually appear limited. Moreover, all project planning is subject to oversight and uniformity of results is hampered by problems encountered in the field and laboratory. Already we regret the omission of "coarse fragment" determinations which could have been obtained with little additional effort. Fortunately the soils measured did not contain large quantities of gravel and stones, and our omission may not prove to be a major liability. We regret also not having put greater efforts into the completeness of soil-water profiles during field sorption. Our primary data acquisition work has been concerned with drainage, and this report will concern itself entirely with desorption data. Infiltration data and more limited sorption data were obtained for the field sites studied and will be evaluated and presented in a later report.

The purpose of this report is to describe and present the desaturation hydraulic data and accompanying physical, chemical and morphologic data measured on eleven sites in southeastern North Dakota. It is the intention of the authors to explain as fully as possible the methods, limitations, and problems encountered in implementing field and laboratory procedures so that other users can decide for themselves the appropriateness of their application in modeling applications. It is hoped that these data will prove useful.

METHODS AND MATERIALS

Site Locations

Soil hydraulic properties were measured on 11 sites near Oakes in Dickey County North Dakota (Fig. 1). Two groups of three sites (sites A, B, and C; and sites D, E, and F) were measured as toposequential sets. All others (Sites G, H, I, J, and K) were measured at separate locations. No site desorption data were measured for site K because of slow water movement (virtually no infiltration after a few hours) within the solonized Exline soil. Specific locations and site descriptions are summarized on Table 1 and illustrated on Fig. 2.

Most of the sites measured overlie the Oakes aquifer, which consists of surficial or near surficial sand and gravel varying in depth

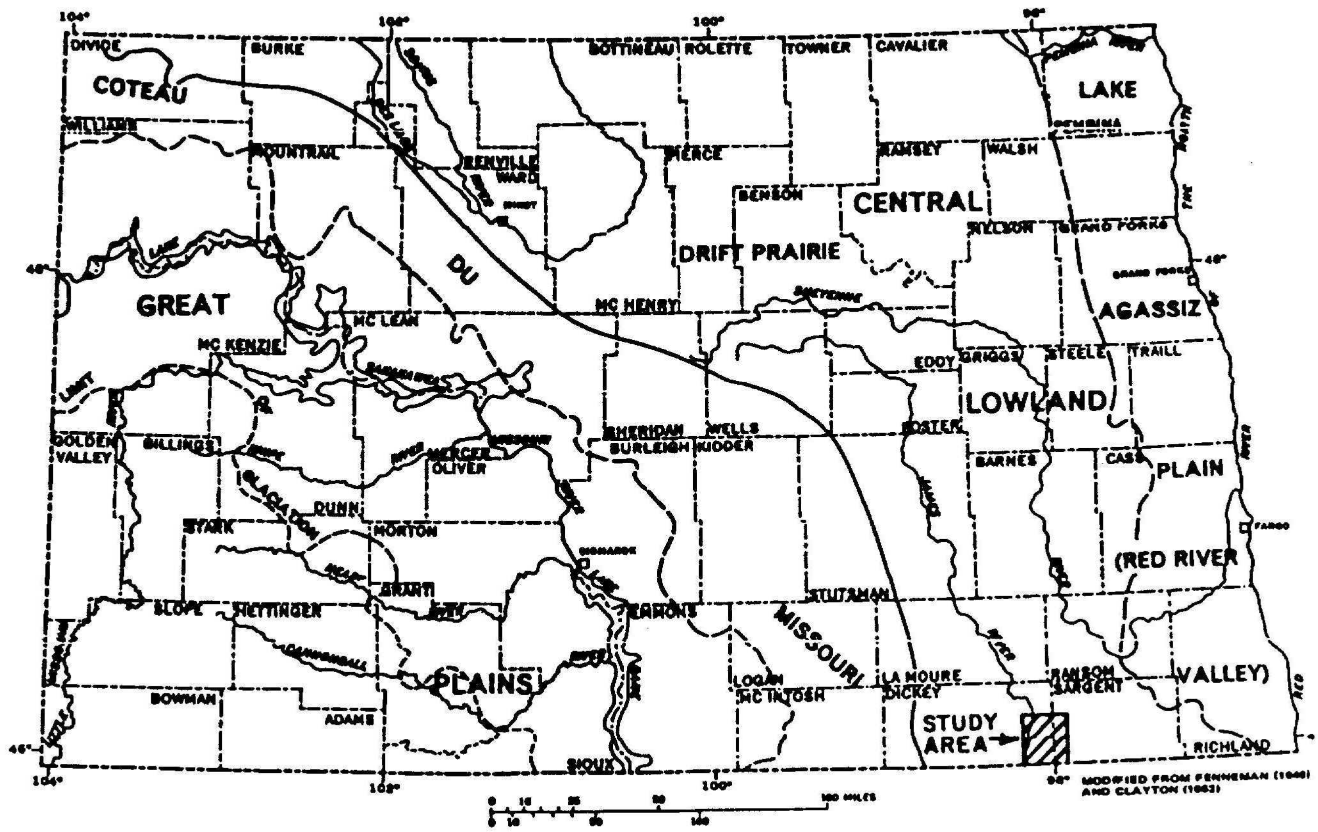

Figure 1. Physiographic divisions in North Dakota and location of study area.

Table 1. List of measured soil series, classifications, and locations.

Site	Date *	Series	Classification	Location
A	9/28/84 to 10/23/84	Hamar sand	sandy,mixed, frigid Typic Haplaquoll	Dickey County ND, T 130 N, Range 59 W, Sec. 26, AD [280 feet (85.3 m) south and 100 feet (30.5 m) west of east quarter corner.
B	9/28/84 to 10/23/84	Hecla loamy sand	sandy, mixed Aquic Haploboroll	Dickey County ND, T 130 N, Range 59 W, Sec. 26, AD [280 feet (85.3 m) south and 170 feet (51.1 m) west of east quarter corner.
C	9/28/84 to 10/23/84	Hecla loamy sand	same as above	Dickey County ND, T 130 N, Range 59 W, Sec. 26, AD [285 feet (86.9 m) south and 360 feet (109.7 m) west of east quarter corner.
D	6/19/85 to 7/31/85	Hecla loamy-fine sand	same as above	Dickey County ND, T 130 N, Range 59 W, Sec. 9, DAA [66 feet (20.1 m) south and 445 feet (135.6 m) west of east quarter corner.
E	6/19/85 to 8/02/85	Ulen loamy-fine sand	sandy, frigid Aeric Calciaquoll	Dickey County ND, T 130 N, Range 59 W, Sec. 9, DAA [355 feet (108.2m) south and 465 feet (141.7 m) west of east quarter corner.
F	6/19/85 to 8/02/85	Arveson fine-sandy loam	coarse-loamy frigid Typic Calciaquoll	Dickey County ND, T 130 N, Range 59 W, Sec. 9, DAA [525 feet (159.9 m) south and 470 feet (143.3 m) west of east quarter corner.
G	6/24/85 to 8/01/85	Heimdal loam	coarse-loamy mixed Udic Haploboroll	Dickey County ND, T 131 N, Range 59 W, Sec. 25, CBB [300 feet (90.5 m) south and 100 feet (30.5 m) east of west quarter corner.
H	8/21/85 to 10/23/85	Stirum fine sandy loam	coarse-loamy, mixed, frigid, Typic Natraquoll	Dickey County ND, T 130 N, Range 59 W, Sec. 29 CBB [950 feet (289.8 m) south and 650 feet (198.3 m) west of east quarter corner.
I	8/21/85 to 10/23/85	Eckman loam	coarse-silty mixed Udic Haploboroll	Dickey County ND, T 129 N, Range 60 W, Sec. 25, BBB [125 feet (38.1 m) south and 75 feet (22.8 m) east of northwest corner.
J	8/19/85 to 10/21/85	Gardena loam	coarse-silty, mixed, Pachic Udic Haploboroll	Dickey County ND, T 130 N, Range 59 W, Sec. 18, CC [185 feet (56.5 m) north and 90 feet (27.5 m) east of southwest corner.
K	9/28/84 to 10/21/85	Exline loam	fine, montmorillonitic Leptic Natriboroll	Dickey County ND, T 130 N, Range 59 W, Sec. 20, BBB [45 feet (13.7 m) south and 90 feet (17.4 m) east of NW corner

* Date from initiation of in-situ hydraulic tests to sampling of soil profile

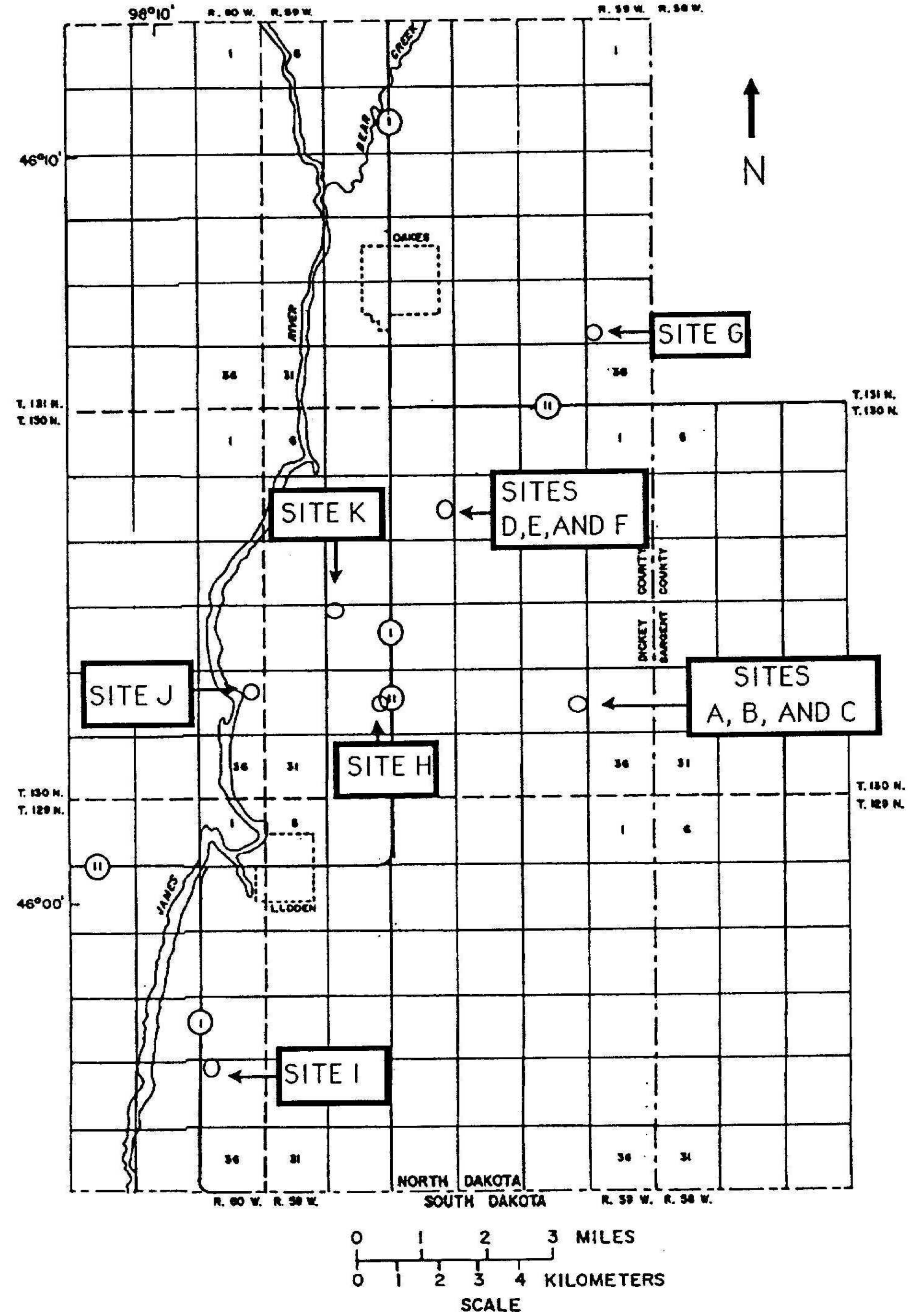

Figure 2. Map of Oakes area and measurement site locations.

from 2 to 99 feet (0.6 to 30 m) (Armstrong 1980). The Oakes aquifer occupies an area of approximately 93 mi^2 (240 km^2) on the east side of the James River Valley, with a maximum width of approximately 8 miles (13 km) and a maximum length of about 16 miles (26 km). The Oakes aquifer sediments were formed in coarse pleistocene valley fill. Later, the James River Valley was blocked and glacial Lake Dakota formed causing the deposit of finer lake sediments, and deltaic deposits of finer silts and sands on the surface. In general, the fineness of the surface layer increases in a southerly direction.

Although the landscape slopes gradually (about two feet per mile) toward the James River, the overall topography and drainage of the area is one of enclosed depressions with little external drainage. Sites A,B,C,D,E,F,H were formed in sandy parent material reworked by wind. Soil development is strongly related to landscape position and proximity to the water table, as well as to the local water quality of the Oakes Aquifer. The Oakes Aquifer water is primarily a calcium bicarbonate type, but in localized areas it may be high in gypsum or in sodium sulfate. The importance of local water quality in soil formation is illustrated by the solonized Stirum (site H) and Exline (site K) series soils, which formed in close proximity to the water table in areas where the aquifer is high in sodium. The finer soils were formed in glacial till ground moraine (Site G, Heimdal series); in silty lacustrine surface deposits (Site I, Eckman Series), in silt and clay lacustrine deposits overlying sands (site K, Exline Series); and in deep silty river-valley deposits (Site J, Gardena Series).

Field $K(\theta,\psi)$ and $\theta(\psi)$

Field $K(\theta,\psi)$ and $\theta(\psi)$ were measured at each site using the instantaneous profile method (Watson 1966, Hillel et al., 1972) and a field apparatus similar to that used by Cassel (1975). On each site a 10-ft. (3-m) by 10-ft. (3-m) square area was enclosed by a wooden dike placed 6 inches (15.2 cm) into the soil. Within the diked area two replicate pairs of neutron-probe access tubes were installed and tensiometers were placed at 6 inch (15.2 cm) [and sometimes 1 ft. (30.4 cm)] increments to maximum depths varying from 4.6 ft. (1.4 m) to 7.5 ft. (2.5 m). A gypsum crust was placed around the top of the neutron-probe access tube to prevent piping during flooding. A slurry of silt-sized silica-flour was poured into each insert hole to insure hydraulic contact between tensiometer cups and soil, and to prevent piping tensiometer stems were sealed to the surrounding soil by packing the stem with sufficient moist bentonite to force extrusion of the bentonite above the soil surface during insertion (Fig. 3A). The field apparatus is illustrated on Fig. 3B.

During field installation all sites were scaffolded to avoid disturbance of the soil surface. Tensiometers were placed in an approximate circular pattern set at a radius of about 18 inches (46 cm) from the corresponding neutron probe access tube. A silt-loam slurry was used to insure a snug fit between the tensiometer ceramic cups and the soil. A float controlled infiltrometer was placed within the plot area. Infiltration data will be examined and discussed at a later time.

After installation and before flooding preliminary $\theta(\psi)$ readings were made on most sites. The plot areas were flooded with water pumped from a shallow well [approximately 25 feet (7.6 m) deep] on the location for measurement sites A, B, and C, and from a tile drain located near sites D, E, and F. Sites G, H, I, J, and K were also flooded using water from the tile drain located on the location for sites D, E, and F. To avoid erosion and scouring water was applied on sites A, B, and C through slotted 2 inch (5.08 cm) pvc well screen, and on sites D through K through a perforated wooden box fitted with a float valve (Fig. 4). Water was applied until tensiometers indicated that no further response to infiltration was occurring. Application times for sites A through F were approximately 12 to 20 h. Application times for Sites G, I, and J were from approximately 20 h to 40 h. Water was applied for 39 h on site H, and for 1151 h on the solonized Exline soil (site G). During flooding, tensiometer readings, and in some cases periodic neutron readings, were made for each site.

Following flooding, initial time (t=0) readings were read when half of the soil surface was still ponded. Immediately after initiation of drainage the soil was covered with a polyethylene vapor barrier. The vapor barrier was covered with 3.5 inch (8.9 cm) of spun fiberglass insulation , and two additional weather and vapor barriers were placed over the insulation. A tent of 6 mil polyethylene was placed over the measurment area. Polyethylene sheeting was set from the dike to a distance of 10 feet (3.04 m) and covered with soil, to avoid lateral influx of rainwater.

A

B

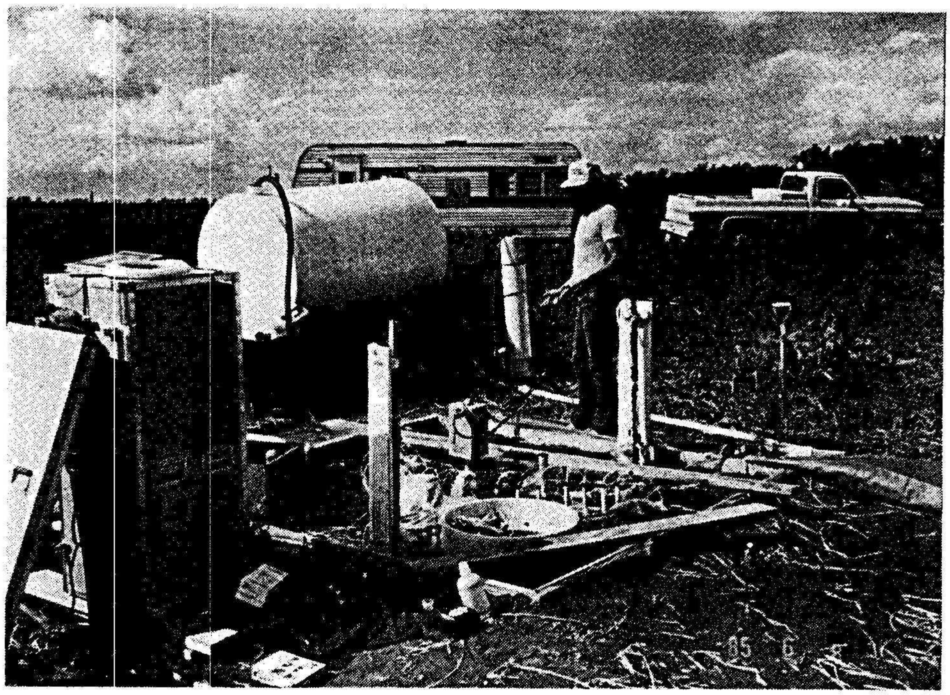

Figure 3. Photo illustration of tensiometer insertion and sealing with bentonite (3A) and field apparatus during flooding (3B).

Soil-water content was measured using a 10-mc Americium-Beryllium source Troxler neutron probe. The neutron probe was calibrated using 92 data points, including the original Troxler calibration block readings, and samples taken from the neutron probe access tube holes during construction of in-situ measurement sites at Oakes. For sandy soils neutron readings were made at approximate 10-minute intervals using 30-second counts, and tensiometer readings were made at intervals varying from one to 5 minutes for the first hour. Readings were then made at approximate 15-minute intervals for up to 3 hours of drainage, and at hourly intervals for up to 12 hours of drainage. After the first few hours, neutron readings were increased to 2-minute counts. Neutron and tensiometer readings were made 3 or 4 times on the second day following application, 2 times the third day of operation, and daily for at at least one week following the initiation of drainage. For loamy soils initial readings at 0.5- to 1-h intervals were sufficient for measurements at early times. Late time readings were similar to sands, but were continued for approximately one month. No field drainage measurements were made on the Exline soil (Site K).

Field Sampling

Following completion of the instantaneous-profile method experiment, each of the sites was excavated to a depth of 5.5 feet (approximately 1.7 m). Soil profile faces were prepared between each of the neutron probes and corresponding tensiometer sets. A detailed soil morphologic description was made for each replication. Bulk soil samples were taken from sampling areas corresponding to tensiometer depths intervals for determination of particle-size distribution and soil chemical parameters. A 3-inch (7.6-cm) diameter by 3-inch (7.6 cm) length (345 cm^3) cylindrical core was taken from each replicate depth interval for measurement of bulk density.

In addition, two 1.2 inch (3-cm) length by 2.1 inch (5.3-cm) diameter (66 cm^3) cylindrical undisturbed core samples were taken from each replicate depth interval for laboratory measurement of $\theta(\psi)$, and one 2.4-inch (6-cm) length by 2.1-inch (5.3-cm) diameter (132 cm^3) cylindrical undisturbed core sample was taken from each replicate depth interval for measurement of laboratory $K(\theta)$. Each of the undisturbed samples was carefully wrapped in several layers of aluminum foil to hold the ends of the samples firmly in place during transportation and handling, and samples were placed on a plastic foam cushion.

Laboratory Physical and Chemical Properties

Bulk density was measured using the 345 cm^3 sample according to the core method described by Blake and Hartge (1986). Particle size was determined for each layer using the pipette method (Gee and Bauder, 1986). The USDA particle-size fractions for very-coarse (1.0 to 2.0-mm), coarse (0.5 to 1.0-mm), medium (0.25 to 0.5-mm), fine (0.1 to 0.25-mm), very-fine sand (0.05 to 0.1-mm), as well as coarse (0.02 to 0.05-mm) and fine (0.002 to 0.02)-mm silt, and clay (<0.002-mm) fractions were measured. Coarse fragments (>2mm) were removed by seiving prior to determination of particle-size distribution.

Calcium, magnesium, sodium, and potassium were measured using atomic absorption spectroscopy, as described by Rhoades (1986), on soil-saturation extracts from bulk soil samples. Chloride was measured by titration with silver nitrate (Adriano and Doner 1986), carbonate and bicarbonate according to the method of Nelson (1986), and sulfate by difference, as described by Skarie et al. (1987). pH was measured (without CaCl2)using the method described by McClean (1986), and ECE by the method described by Rhoades (1986). Organic carbon was measured using the wet combustion method (Nelson and Sommers 1986).

Laboratory Measurement of Soil Hydraulic Properties

The laboratory $\theta(\psi)$ measured was the "main drying curve" described by Klute (1986). For measurement of moisture retention each 66-cm^3 core was carefully trimmed and placed on a 2.4-inch (6-cm) diameter sample plate (1-bar bubbling pressure) and and fastened in place with a rubber band. The sample plate assembly was placed in a pan, and distilled water was slowly added over a period of 3 days for sandy soils, or for as long as 8 days for the finer soils. Sample-plate assemblies were then set on 1-ft. (30-cm) diameter ceramic plates (1-bar bubbling pressure) within pressure pot extractors. Plate to plate boundaries were hydraulically connected using two moist Watman no. 2 paper filters.

Changes in soil moisture with each pressure step were measured gravimetrically. Sandy soils were measured in 10-cm pressure-head increments to 80 cm, and thereafter at 100, 120, 180, 330, 500, and 800 cm. Finer soils were measured at 20-cm pressure-head increments to 100 cm, and thereafter at 120, 150, 250, 330, 500, and 800 cm. Pressure steps were measured using a water manometer to 200-cm pressure head. Higher pressures were controlled using a Bourdon gauge. Each pressure step was allowed to equilibrate until outflow ceased, and after the final pressure step samples were dried at 105^{o} C and weighed. The sample drainage time for 1.2 inch (3-cm) thick samples was less than 1 day for low pressure heads (10 to 30 cm) for most samples, but increased to 2 and 3 days for intermediate pressure head ranges (approximately 40 to 300 cm). Final pressure-head steps (500 and 800 cm) required as least 1 week of drainage, and sometimes more. In general the full moisture-release curve required about 1 month of measurement time. In addition, 15,300-cm (15-bar) moisture was measured for disturbed samples as described by Klute (1986).

Laboratory $K(\theta)$ and diffusivity $[D(\theta)]$ were measured for the drier soil-water content range (between 'field capacity' and 500-cm suction) using the one-step method (Doering, 1965). 132 cm^3 cylindrical core samples were used in tempe cells with 0.4 inch (1-cm) thick 1-bar porous ceramic plates. Plate impedance effect was negligible for the range of $K(\theta)$ measured. Sample preparation and wetting procedures were similar to those used for the $\theta(\psi)$ samples.

DATA HANDLING AND INTERPRETATION

IN SITU $K(\theta,\psi)$ AND $\theta(\Psi)$

In-situ $K(\theta,\psi)$ were determined from field data by solving the Richards Equation

$$K(\theta) = \frac{\int_0^z \frac{\partial \theta}{\partial t} dz}{\left(\frac{d\psi}{dz} + 1 \right)} \qquad (1)$$

for each soil depth. The integrated change in soil water content to each depth was calculated using a finite-difference algorithm employing a mid-point numerical approximation, similar to that discussed by Hanks and Bouwers (1962) and Cassel (1975). In addition to the integrated sum of all water content changes in overlying layers, the bottom or designated layer was allocated half of the water content change for the full layer, and K* values (where K* indicates an average hydraulic conductivity for a composite layer) were assigned to midpoints. Water content values assigned to each midpoint were the arithmetic mean of four values, including the top and bottom boundaries of the designated layer measured at the beginning and end of the time interval. Soil water-pressure head values were the geometric mean of the corresponding four time and depth nodes. The geometric mean weighting was preferred because water content is usually better fitted to soil-water pressure head as a semi-log function than as a linear function. The FORTRAN computer program used to process these data is in Appendix 4.

Data Interpretation

Field hydraulic data seldom follow idealized soil water behavior patterns with great exactness over extended periods of time. For this reason, data processing and presentation always involve interpretation. The criteria of interpretation must first include the integrity of the data. To meet this criterion, data must first be carefully examined by the interpreter and anomalous phenomena noted. Such data may represent physically impossible conditions, indicating recording or instrument errors. They may, however, represent legitimate departures from idealized behavior. The interpreter must therefore exercise care in not overinterpreting.

Second, the intent of the application of the data must be considered. For use of $K(\theta,\psi)$ in certain model applications, for example, presentation of the data in functional form using smoothing procedures might be appropriate, even though doing so might tend to mask certain physical phenomena of minor importance indicated by the data. In doing so, however, the modeler must be aware of the limitations imposed by functional form, and of the potential for error in some applications and ranges of data representation. Alessi et al. (in review (a), in review (b)) have demonstrated significant differences in infiltration and drainage results for models using different data functional forms, including those of van Genuchten (1980) , Brooks and Corey (1964) , and Hutson and Cass (1987) using sandy soil data presented in this report. For a study of the precision of field measurement methods, then, preliminary smoothing of raw data using simplified functional assumptions would not be appropriate. It is far more appropriate to apply functional relationships to finished data products, where variability can be assessed as a part of the product variability. In most cases, where observed data were not certainly erroneous, it was considered desirable to attempt to leave as much of the field variability as possible within the data set.

Data Interpolation

Field ψ and θ measurements were not always concurrent. Tensiometer readings could be made more quickly than neutron probe readings, and during early times when drainage was occurring quickly, it was considered desirable to take as many readings as possible. To synchronize values, θ and ψ were plotted as functions of time during drainage, and $\theta(\psi)$ pairs were interpolated for each soil depth at selected times. Although random scatter was not great, it was sufficient to cause large oscillations using a cubic spline interpolation procedure (Rogers and Adams 1976). Other interpolation procedures, including a quadratic spline, a b-spline, and a polynomial least-squares procedure were also attempted. Each was found to exhibit undesirable fitting traits on some data sets.

For preliminary processing of field hydraulic properties a nonlinear least squares fitting procedure was considered undesirable because of the necessity for assuming a fitting equation form which introduces a bias into the interpretation of the data. Functional formats, such those of Brooks and Corey (1964), or van Genuchten (1980) frequently provide excellent fits for $K(\theta)$ and $\theta(\psi)$ data. However, there are some cases in which field data do not properly follow designated functional form, and it was considered important that anomalous data should not be masked by data smoothing procedures. Because of the limitatations inherent to numerical methods, interpolation curves were hand drawn using a french curve or a flexible curve. Although slight smoothing of data was unavoidable where scatter of data appeared to be random, curves were drawn to conform as exactly as possible to the actual measurements.

Generally, tensiometer readings tended to follow the idealized semi-log profile over time with very little deviation. However, neutron readings frequently decreased in a stepwise pattern, characterized by plateaus and jumps, similar to those described by Haines (1930). In interpolating these data the varying drainage rates were followed as closely as possible. An example of the stepped pattern is given on Fig. (4A) for the data of Site I, Replication 1.

K(θ,ψ) Values Near Saturation

Idealized K(θ,ψ) data are frequently characterized as nearly constant between saturation and the soil air-entry pressure on coarse soils, or as gradually declining on finer soils. Using the instantaneous profile method, field data frequently appear to be of a more complex nature. On several data sets it was observed that K(θ,ψ) values corresponding to the earliest times of measurement, increased rather than decreased with increasingly negative soil pore-water pressure heads (Fig. 4B). On others, substantial variability was observed in nearly saturated K(θ,ψ) values. These observations are believed to be caused by both method and soil factors.

The occasional increasing K(θ,ψ) during drainage from saturation to near air-entry pressure is likely caused or enhanced by the assumption of time=0 at half ponding on the soil surface. As ponded pressure at the soil surface decreases after cessation of drainage, the subsoil frequently begins to desaturate immediately, before the surface pond has reached the soil surface. This condition is most clearly observed where the surface soil layer has a substantial hydraulic impedance. However, despite desaturation, water is still entering the soil from the partially ponded surface. Infiltration water at this stage is not accounted for in the integrated soil-water content change at any given depth, but is nonetheless supplying underlying soil layers with water. The additional influent surface water results in underestimation of drainage through each soil layer.

Larger scatter of K(θ,ψ) values between air-entry pressure and saturation is influenced by the dynamic interaction of soil, air, and water, and by chemical, physical, and microbiological factors altering the distribution of water-filled porosity. Soil macroporosity is not static, but frequently changes between measurement times and conditions, and even changes progressively during a given field measurement period. For example, Kohl et al. (1989) have

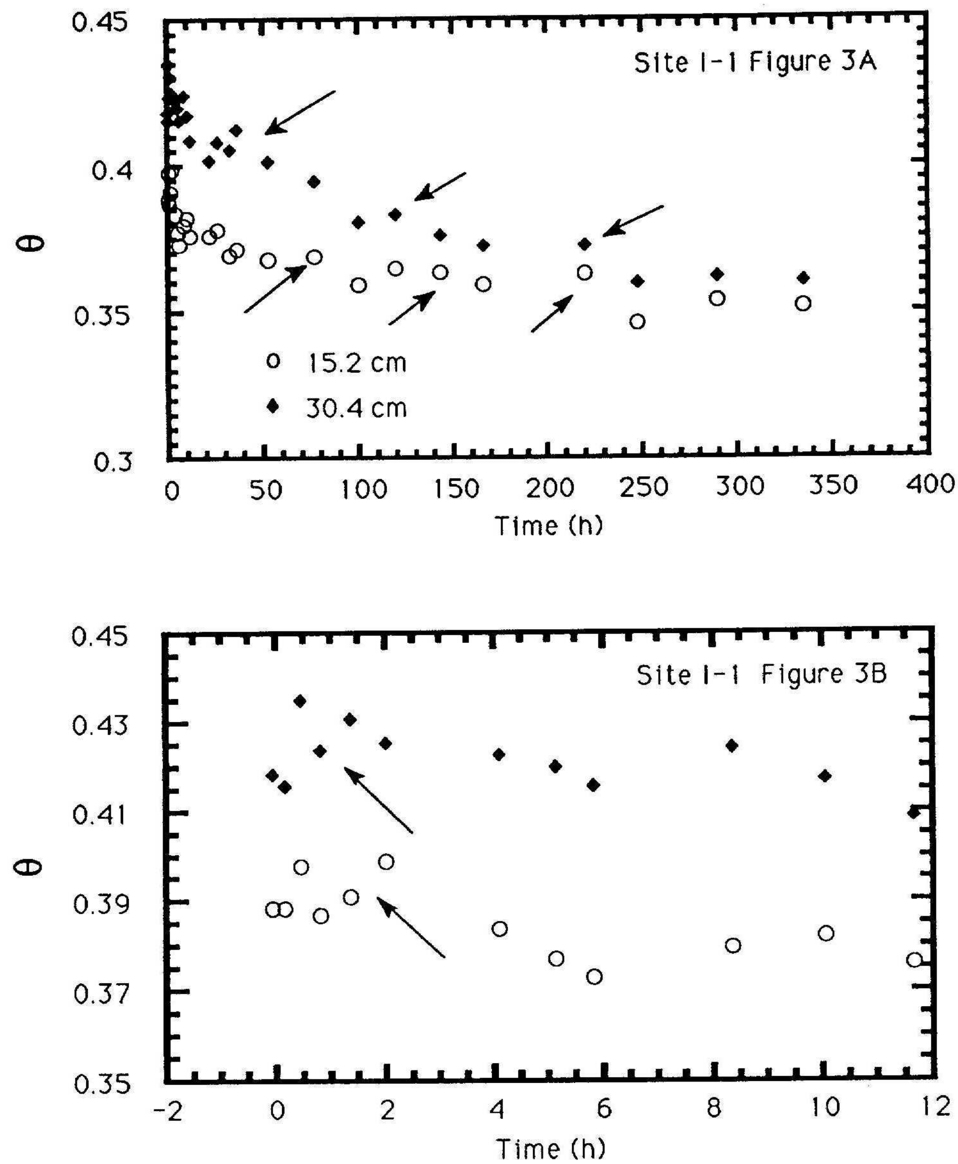

Figure 4. Water-content profiles for site I, replication 1 at 15.2 cm and 30.4 cm depths illustrating (4A) stepped drainage and (4B) the slight increase in water content during the first 2 hours of drainage that may have contributed to variability of K(θ,ψ) measurement near saturation.

demonstrated that repeated measurements of steady state infiltration rate give varying results, depending upon the initial soil saturation state prior initiation of infiltration.

Air entrapment during infiltration is an important factor influencing $K(\theta,\psi)$ near saturation. Initial entrapment of air causes loss of large water-filled porosity and decreases drainage rate. Gradually, air is purged from the soil, either through solution or through direct venting of bubbles. The solubility of nitrogen and oxygen in water is extremely small. However, in the presence of adequate carbon substrate oxygen can be transformed to highly soluble CO_2 which can then be dissolved and replaced by water. Schuh (1991) demonstrated that in-situ sandy subsoils eluted for more than 3.75 days with water containing soluble organic carbon added by passage through a composted organic-mat filter (sunflower-seed hulls) exhibited large (up to one order of magnitude) increases in $K(\psi)$ compared with the same soil positions measured using clean water but without an organic mat filter. Water chemistry data indicated that production of CO_2 in the presence of carbon substrate and the consequent removal of oxygen was the cause of the increased $K(\psi)$. The same phenomenon was observed in data from a laboratory study by Okubo and Matsumoto (1979) and in a soil column study by Worcester (1967). In each case an initial incubation period was needed before the increase in $K(\psi)$ occurred. On the other hand, under anaerobic conditions highly soluble nitrates can be denitrified to low solubility gases, clogging pores. Microbial formation of polysacharrides during extended periods of infiltration has also been shown (Allison, 1947) to clog pores.

Youngs and Peck (1964) found that entraped air near the soil surface could achieve sufficient force from the surface tension at the soil-air-water interface to displace soil grains and create large porous vents to the surface. Worcester (1967) observed the formation of such bubbles and noted their persistence following the cessation of irrigation in soil column experiments. The venting of air bubbles to the soil surface was also observed during the infiltration phase on many of the measurement sites in this experiment.

Additional factors such as increased soil swelling during prolonged periods of infiltration and slaking and increased swelling caused by adding waters with sodium adsorption ratios (SAR) and total salinities different from soil solution waters can affect $K(\theta,\psi)$ values near saturation over extended periods of flooding. Their effect on near saturation $K(\theta,\psi)$ measurements during the irrigation phase will be discussed in a later report. However, it is certain that proportions of air and water-filled pores near saturation are far from constant, even over relatively short time periods, and that considerable temporal variability in large porosity must be expected.

Hydraulic Gradient Measurement Sensitivity

During steady-state infiltration through a surface crust the hydraulic gradient of an homogeneous soil profile maintains a constant value of 1.0. Conditions of transient flow may, in some cases, continue the unit gradient for part of the soil property measurement range during drainage. However, a soil profile in perfect static equilibrium must have a zero hydraulic gradient, and there is therefore a tendency for gradients to decline over extended periods of drainage and measurement. The case of static equilibrium is most frequently observed for deep soils within the range of water table influence, which are only slowly and indirectly influenced by evapotranspiration. In this case the equilibrium field soil-water profile can be viewed as an inverted soil-water retention curve with negative pore-water pressure head corresponding to height above the water surface. At the groundwater surface the pore-water pressure head is 0. For draining soils beyond the influence of the water table, $K(\psi)$ may become negligibly small so that an apparent static condition is reached, while a measurable hydraulic gradient, and actual flow of extremely small magnitude still remain.

The second factor influencing soil hydraulic gradient is the layering of the measured soil. When fine soil layers overlie coarse soil layers perching and ponded conditions can occur during unsaturated drainage in a soil profile. Large hydraulic gradients can form across materials of extremely low hydraulic conductivity (hydraulic barriers). Such large gradients are hydraulically induced by the desorption of the soil underlying the barrier, which results in a decreased water content (and greater negative soil-water pressure head). They are also enhanced by the increased water (and lower negative pore-water pressure) held above the layer, which causes a net increase in matric potential head difference across the barrier. In this manner the hydraulic gradient increases to enhance flow through a limiting layer.

For a soil layer underlying a hydraulic barrier, the hydraulic gradient tends to approach a quasi-steady-state flow condition with a hydraulic gradient of approximately 1. Lower flows induced by the hydraulic barrier will be accommodated by lower $K(\theta,\psi)$ values in the underlying layer caused by the decrease in θ resulting from the overlying impedance. The gradient transitions tend to be abrupt at the boundaries, and unit hydraulic-gradient conditions can be approximated in underlying layers within a relatively small depth (a few centimeters) beneath the limiting layer. The effect of the barrier on gradient adjustment in an underlying layer is thus highly dampened by the change in $K(\theta,\psi)$ in that layer.

For unsaturated soil layers overlying a hydraulic barrier the effect of the barrier on hydraulic gradient is enhanced rather than dampened by changes in $K(\theta,\psi)$. This occurs because the accumulation of water above the barrier increases, rather than decreases $K(\theta,\psi)$, while the effect of the barrier is to decrease flow. Soil overlying an hydraulic barrier thus tends to proceed rather quickly to full saturation, at which state all further reductions in flow are adjusted in the hydraulic gradient. Once the overlying soil is saturated, the hydraulic gradient in the overlying soil reduces quickly, and can become almost negligible in some cases. Within a heterogeneous soil profile several barriers may exist. The influence of material discontinuities at any given depth is related to the specific $K(\theta,\psi)$ functions of the soil layers above and below it.

The sensitivity of measurement of $K(\theta,\psi)$ in a soil layer overlying a hydraulic barrier can be adversely effected by the low gradients resulting from ponding above the barrier. As gradients become fractionally small, slight errors in tensiometer placement caused by surface irregularities, or even errors caused by slowed tensiometer response times due to air bubble formation can become large in relation to the size of the gradient itself. In some such cases, inverse gradients can sometimes be measured in implausible circumstances, resulting in negative $K(\theta,\psi)$ values. A similar circumstance can result from malfunctioning tensiometers. When inverse gradients were measured, the cause was investigated. In some cases data were simply discarded for the problem layers over the problematic data ranges. In others, layers were combined for an average measurement transversing a larger soil unit.

Surface Boundary-Layer Assumptions

One common problem using the instantaneous profile method is the characterization of the surface soil layer. Neutron measurements at the soil surface are invalid because of the inclusion of nonsoil air volume within the neutron-attenuation radius. In calibrating the neutron probe it was found that the readings taken 6 inches (15.2 cm) beneath the surface did not differ from the main calibration curve. In all plots the 6 inch (15.2 cm) layer was the closest layer to the surface, and the water content from that layer was used as an estimate of the average water content to the soil surface. In previous work, Cassel (1975) assumed that water content was constant to the surface (from which follows a gravitational hydraulic gradient (gradient=1). **Because many of the soils measured exhibited a decreasing gradient, we preferred to assume that the hydraulic gradients were the same for the 0 to 6-inch (15.2-cm) layer and the 6-inch (15.2-cm) to 12 inch (30.4-cm) layer. The gradient measured for the 15.2 to 30.4 cm layer was thus extrapolated to the soil surface. Hydraulic gradient values are included with the data, and K can be easily adjusted for a unit gradient in the surface layer if preferred.**

One-Dimensional Vertical Flow Assumptions

Solution of the Richards equation for $K(\theta,\psi)$ assumes one-dimensional vertical flow, and requires horizontal hydraulic uniformity. In order to avoid effects of large horizontal hydraulic gradients and subsequent horizontal flow a flooded buffer area surrounding the specific measurement area is needed. In measuring infiltration, this is commonly accomplished using a double-ring infiltrometer, with an outer buffer ring.

A square 3.05 meter (10 foot) wide buffer dike was used in our measurements. The width selection is somewhat arbitrary, but it is based on the precedence of previous measurements made by Cassel (1975), and on the conclusions of research conducted by Swartzendruber and Olson (1961a, 1961b) concerning the relationship between vertical flow assumptions and the diameter of the outer ring in measurement of infiltration using double ring infiltrometers.

Swartzendruber and Olson (1961a, 1961b) determined that in using a double-ring infiltrometer the assumption of one-dimensional vertical flow in the inner ring was never perfectly met, but was closely approximated under conditions where total diameter (r_n) of the outer ring, and a ring-diameter buffer index are sufficiently large. The proposed ring-diameter buffer index, B, is defined as

$$B = (r_n - r_i)/r_n \qquad (2)$$

where r_i is the diameter of the inner ring. They found that practical validity of the one-dimensional vertical flow assumption for non-layered soils was dependent upon time, depth of the wetting front, B, and r_n. They also found that sensitivity to these parameters varied with soil texture.

Swartzendruber and Olson (1961a) found that on sandy soils one-dimensional vertical flow for the inner ring could be assumed for very small B values (there had to be some buffer, although small) provided r_n was at least 24 inches (61 cm). For r_n of 12 inches (30 cm) the same assumptions could be made if B was sufficiently large (about 0.5). For r_n of 8 inches (20 cm) no buffer radius would be sufficient to assure one-dimensional vertical flow assumption validity. Data from finer soils (Swartzendruber and Olson 1961b) indicated that departure from vertical-flow assumptions was texturally dependent, and was more marked over time and wetting depth for finer soils.

It was also demonstrated (Schwarzendruber and Olson 1961b) that wetting depth was an important consideration. Based on data from experiments considering a maximum wetting depth of 24 inches (61 cm) they concluded that a good rule of thumb would be to allow for an outer buffer ring radius at least equal to the depth of infiltration to insure the validity of the one-dimensional vertical flow assumption.

Our square outer area had an equivalent circular r_n greater than 10 ft. (3.1 m) and a B value of about 0.5, allowing for an approximate 5 ft. (1.5 m) (r_i) instrumented area in the center of the basin. **Applying the rule of Swartzendruber and Olson, one-dimensional vertical flow assumptions should be valid to about 10 ft. (3.1 m).** The maximum depth of measurement on all sites was about 6.6 ft (2 m), and on most sites measurement depths did not exceed 5 ft. (1.5 m).

It is cautioned that we have extrapolated the Swartzendruber rule application beyond its experimental basis. It is also observed that the field soils measured were not uniformly packed soil columns, and that soil layering would be expected to enhance horizontal flow. However, **there are other considerations which would support the**

likelihood of validity for the vertical one-dimensional flow assumption for our desorption data. They are (1) the likelihood that distances of horizontal flow effects would be greatest at or near saturation because of the larger flow velocities, and (2) the larger established buffer zone within the soil that exists for in-situ desorption measurements, compared with infiltration measurements.

(1) During infiltration the near fully saturated condition of the soil behind the wetting front insures both a large hydraulic conductivity and the largest possible hydraulic gradient for a given set of initial soil boundary conditions. The large flow velocities resulting from saturated conditions insure a maximum hydraulic interaction between the measured soil unit and surrounding soil materials. **During drainage, the decreasing $K(\theta,\psi)$ should minimize the effective distance of hydraulic interaction with surrounding soil materials during a given time span**

(2) **During the field measurement drainage phase the large horizontal boundary differences in gradient and hydraulic properties characteristic of the infiltration case no longer exist in the close proximity of the measured soil unit.** During infiltration horizontal water movement wets the soil to a considerable distance from the initial outer ring, partially homogenizing the soil water-pressure state of the surrounding soils with that of the measured pedon and decreasing the initial abrupt hydraulic gradients that drive horizontal flow. The result is that by the time drainage is initiated a soil buffer area extends beyond the initial outer ring buffer area. This would be expected to further minimize horizontal boundary influence during desorption phase measurements.

Based on these conditions, we believe that adequate horizontal protection has been given to assure practical validity of the vertical-flow assumption for most of the measured sites and horizons. **We believe that the risk of inaccuracy is most marked in cases of measurements near saturation for highly layered conditions.** Such conditions were noted for a plow pan on the Arveson soil (site F), and $K(\theta,\psi)$ results for the A_p horizon on that site were discarded. This is discussed further with the explanation of the field data presentation for Site F (page 162).

Large storms can cause lateral influx of water into the measurement area during the drainage period. When this occurs, data must be discarded unless some means of discerning the evenness of water distribution within the measurement area can be devised. In previous measurements in Minnesota the senior author was forced to discard substantial quantities of data because of the lateral influx of water during the soil drainage phase. Plastic aprons and shallow drainage ditches surrounding the measurement area are not always sufficient to insure plot protection in humid environments, and Cassel (personal communication) has stated that some lateral protection (horizontal plastic-lined ditches surrounding the plot) might be needed. In semi-arid areas, and during the dry seasons such additional protection is often unnecessary. During the measurement of these data, there was no evidence of lateral influx of water into the draining pedons.

LABORATORY K(θ)

Laboratory K(θ) was calculated from

$$K(\theta) = D(\theta)\frac{d\theta}{d\psi} \qquad (3)$$

where $d\theta/d\Psi$ is the soil specific-moisture capacity, calculated from the slope of the laboratory soil-water retention curve and D(θ) is the soil-water diffusivity measured using the one-step outflow method of Doering (1965). Using the one-step method a single pressure step is applied to a soil sample and volume outflow of water is measured as a function of time using a graduated cylinder until outflow ceases. D(θ) is then calculated from

$$D(\theta) = \frac{4L^2}{\pi^2}\frac{d\theta}{dt}\frac{1}{(\theta - \theta_f)} \qquad (4)$$

where L is the length of the sample, θ is the time-dependent water content of the sample, and θ_f is the final water content of the sample at the cessation of outflow.

One-step outflow data were measured using 6-cm (length) by 5.3-cm (diameter) undisturbed core samples in Tempe cells, fitted with 1-bar ceramic porous plates having a thickness of about 1 cm. Samples were placed in the Tempe cells and wetted slowly from the bottom (through the ceramic plate) until fully saturated. 500 cm of pressure head was then applied to the sample and outflow was measured until drainage ceased.

The one-step method does not account for the hydraulic conductivity of the pressure plate. However, on highly conductive soils pressure-plate impedance can be a significant factor and may distort the wet-range estimation of $D(\theta)$ (Gupta et al. 1974). Considering the combined porous plate and sample as two elements of resistance, or impedance $(L/K(\theta))$ in series, the effect of the porous plate on hydraulic conductivity can be approximated by

$$K_a = \frac{L_a}{\left(\frac{L_m}{K_m} - \frac{L_p}{K_p}\right)} \qquad (5)$$

where K is the hydraulic conductivity corresponding to a resistance element, and L is its length. The subscripts m, p, and a correspond to the combined soil sample and plate assembly, the plate alone, and the soil sample alone, respectively.

One way of solving the problem of plate resistance is to use an extremely thin porous membrane rather than a porous ceramic plate. Another approach is that of mathematically compensating for the effect of the plate Gupta et al. (1974) . For these data, we were only concerned with supplementing the in-situ data in the range between approximate field capacity and 500-cm negative soil pore-water pressure head. The effect of plate impedance on soil sample $K(\theta)$ is illustrated (Fig. 5) using Eq. (5) for a (2.4-inch) (6.0-cm) length soil sample on a sandy subsoil, and the hypothetical case of a 0.4 inch (1-cm) thick 1-bar ceramic plate having an hydraulic conductivity of 0.02 cm/h.

It can be seen (Fig. 5) that the plate-impedance effect gradually decreases from one of almost total control to negligible effect as the applied pressure-head increases. In the drier soil-water content range the measured (K_m) and soil (K_s) converge. For the purpose of this experiment, then, it was sufficient to plot field $K(\theta)$ and laboratory $K(\theta)$ on the same graph and determine the range of convergence

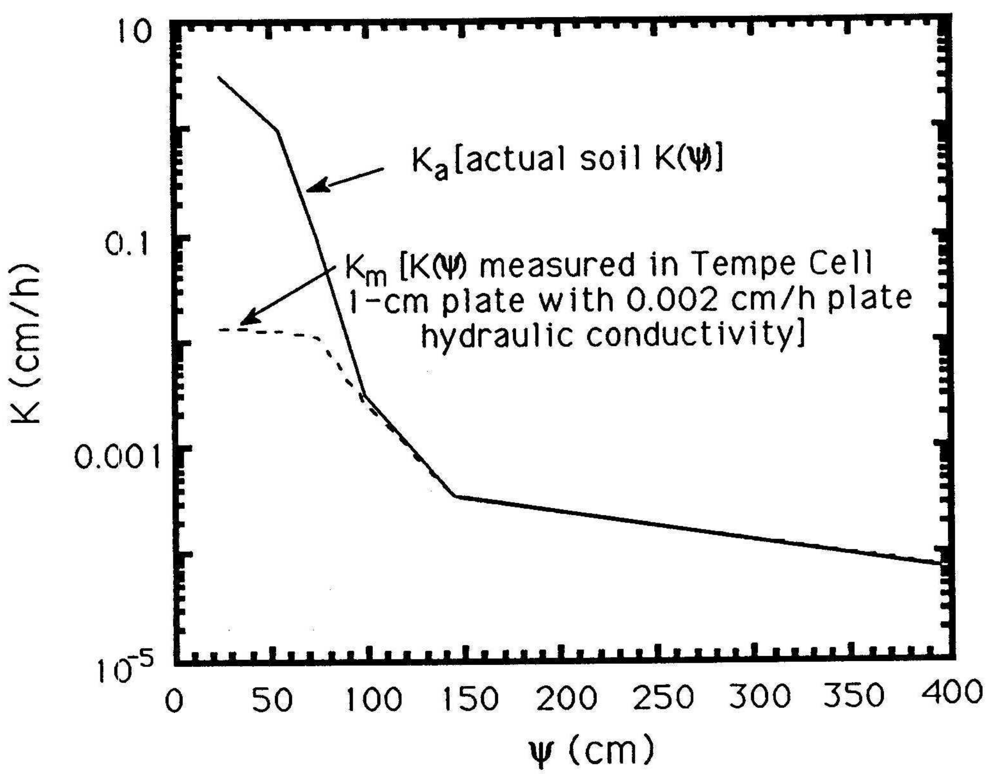

Figure 5. **Illustration of the effect of plate impedance on measurement of K(θ) using the laboratory one-step outflow method.**

between lab and field measurements. All lab data wetter than the convergence range were discarded. In most cases the lab and field data exhibited a smooth range of convergence and overlap. In some cases, because of limited field measurement ranges it was necessary to extrapolate the field curve, but good overlaps were achieved. In a few other cases, a wide divergence of the data was found, and the **laboratory data were discarded. In many instances laboratory and field $K(\theta)$ exhibited better continuity than laboratory and field $K(\psi)$. Laboratory $K(\theta,\psi)$ data are presented together for each data set.**

Use of Distilled Water

Distilled water was used in all laboratory measurements. In most of the sandy soils this caused no problem, but on fine soils with very large SAR the use of distilled water resulted predictably in expansion of the samples during wetting. The single site where this was a major problem was that of the Exline soil (site K) which had SAR values exceeding 85 in some horizons.

In future work we would consider bringing local water supplies to the laboratory to attempt to match local soil ionic strength, but even this is problematic. Soil-water ionic strength and SAR are not necessarily the same or even similar to those of underlying waters, because they have been formed in the process of repeated cycles of imbibation of underlying water and evaporation and deposition of salts, combined with periodic surface flushings from rain waters. The resulting process is one of considerable concentration and selection, and is extremely complex. Saturation of samples with waters extracted from underlying ground water might still considerably alter the soil solution chemistry. Moreover, it could be suggested that saturation with distilled water might be the best way to simulate the environmental condition of wetting from rainfall.

The question of what laboratory data means on highly expansive soils with large exchangeable sodium is further complicated by the nature of physical constraints imposed on an expansive medium. In-situ expanding soils are physically constrained by the surrounding soil and by overburden pressure of the overlying soils. Ring samples are constrained only horizontally during wetting and by a solid, nonexpansive border material which should exert no expansive counter-pressure of its own. One must question what relationship such conditions would bear to field conditions. Also, what relationship would such laboratory conditions bear to other laboratory methods in which samples are wetted without constraint, and where rings are only applied just prior to desorption measurements? These are discussed further in the section presenting site K data.

SOIL PHYSICAL DATA AND INDICES

Physical data, including soil particle-size distribution, bulk density, and organic carbon are on presented for each data set in Table χ-1.2 and χ-2.2, where χ designates the letter (A,B,C...K) describing the measured site. Several indices of particle-size distribution are provided, including the sand to silt ratio (SA/SI), the geometric mean particle diameter (GMEAN), the standard deviation of the geometric mean particle diameter (GDEV), the normalized deviate of the geometric mean particle diameter (Z), and a particle-size distribution index (F-INDEX) presented by Bloemen (1980). Soil horizons are listed with the particle-size data.

Bloemen Index (F)

Bloemen (1980) presented an index (here labeled F) for prediction of the Brooks and Corey (1964) and Campbell (1974) K(ψ) function parameters. The index, F, was calculated as :

$$F = \frac{\sum_{i=1}^{n} F_i}{\sum_{i=1}^{n} (P_{i+1} - P_i)} \tag{6}$$

where

$$F_i = (P_{i+1} - P_i)\,\tau_i \tag{7}$$

and where

$$\tau_i = \frac{\ln (P_{i+1} - P_i)}{\ln (D_{i+1} - D_i)} \tag{8}$$

P_i is the cumulative percentage by weight, from 0 to a given particle diameter D_i. Bloemen reported that the coefficient of the ln K(ψ) vs. ln ψ relationship could be calculated from

$$n = 1.4 + 4.536 \exp(0.3 F - 1) \qquad (9)$$

Although the specific relationship in Eq. (9) has not always been upheld, the Campbell and Brooks and Corey curve exponents were found to correlate significantly with F on North Dakota K(ψ) and $\psi(\theta)$ data measured by Cassel, in previous analysis by Schuh and Cline (1986a).

Geometric Mean Particle Statistics (GMEAN, GDEV, Z)

Shirazi and Boersma (1984) published a revised textural triangle in which a weighted Geometric Mean particle diameter (GMEAN) and standard deviation (GDEV) were presented. They suggested that many soil mechanical properties were highly correlated with GMEAN. Other workers have found them to be strongly correlated with soil hydraulic properties (Schuh and Bauder 1985). GMEAN for a particle-size fractionation of n classes is calculated as

$$\mathrm{GMEAN} = \exp\left[0.01 \sum_{i=1}^{n} (f_i \ln \bar{d}_i)\right] \qquad (10)$$

where f_i is the gravimetric percentage corresponding to each particle-size class with mean diameter $\bar{d}_i$. GDEV is calculated as

$$\mathrm{GDEV} = \exp\left[0.01 \sum_{i=1}^{n} (f_i \ln^2 \bar{d}_i) - \left(0.01 \sum_{i=1}^{n} f_i \ln \bar{d}_i\right)^2\right]^{0.5} \qquad (11)$$

and the index for the normalized normal deviate (Z) is

$$Z = \mathrm{GMEAN} / \mathrm{GDEV} \qquad (12)$$

analogous to the statistic for evaluation of the distribution of normally distributed data . In previous comparison of soil properties Schuh and Bauder (1985) used Z multiplied by 100 as an independent variable.

Ghosh Index (GHOSH)

Ghosh (1980) predicted the slope of the ln θ vs. ln ψ curve as

$$\mathrm{GHOSH} = 2.619\left(\frac{Si}{Sa}\right)^{0.2822}(X + 0.7)^{0.625}\, X^{0.125}\left[5.91\,\frac{C}{(Sa + C)} + 1.1\right]^{0.0625} \tag{13}$$

where

$$X = 6.2\left(\frac{Si}{Sa}\right)^{0.5} - 5.91\,\frac{C}{(Sa + C)} \tag{14}$$

and where C, Sa and Si are clay, sand, and silt respectively. As with the Bloemen index, the Ghosh Index has not always accurately predicted the ln θ vs. ln ψ curve slope accurately. However, it does correlate highly with Campbell (1974) and Brooks and Corey (1964) K(ψ) curve slope parameters.

Sand to Silt Ratio (SASI)

The ratio of sand to silt percentages has strongly correlated in some instances with the slope of the ln K(ψ) vs. ln ψ curve (Schuh and Bauder, 1986). It is presented with the data.

DATA PRESENTATION IN FUNCTIONAL FORM

For many modeling applications it is advantageous to use K(θ,ψ) and ψ(θ) data in functional form. Various relationships between hydraulic conductivity and water-retention data have been established based on pore-size distribution as characterized by the soil water-retention curve (Burdine 1953, Marshall 1958, Millington and Quirk 1961, Brooks and Corey 1964, Mualem 1976b, Mualem 1978, and others). Of these, the models of Burdine (1953) and Mualem (1976b) are in most common use. Both of these models have been adapted into common functional formats for the water-retention curve. Two water-retention model formats in common use are those of van Genuchten (1980) and Brooks and Corey (1964).

Brooks and Corey Function Parameters

The Brooks and Corey (1964) function assumes that most $\theta(\psi)$ data can be fitted well as a power function of the form

$$\frac{(\theta-\theta_r)}{(\theta_e-\theta_r)} = \left(\frac{\psi}{\psi_e}\right)^{-b} \tag{15}$$

where b is the slope of the log/log relationship between mobile water $(\theta-\theta_r)$ and ψ, θ_r is residual water content, ψ_e is the "air entry" suction, and θ_e is the "air entry" water content (corresponding to ψ_e).

The residual water-content value is theoretically described as a threshold value below which water is considered to be "immobile". In actual application of the Brooks and Corey (1964) model θ_r is empirically determined and its practical function is to improve fits of water-retention data to Eq. (15) where the log/log assumption is imperfectly held because of a continued upward concave curvature of the log θ vs. lot ψ curves. θ_r serves to empirically "pull down" the curvature and linearize the dry-range data in log/log form.

Most sandy and coarse-loamy soils cannot be adequately fitted without the θ_r parameter. On some loamy soils, θ_r tend to be near 0. On other soils, particularly finer soils, the log/log transformation results in a curve with retained downward concave curvature in the dry range. Presumably, Eq. 15 parameters for such $\theta(\psi)$ data could be best fitted using a negative θ_r, although this is not done in practice. Because of common practice, all applications in this report use only positive or 0 θ_r. The purpose of this discussion is to point out that the validity of the definition of θ_r is strongly affected by the nature of the functional form constraining the data, and that while the theoretical definition of the boundary of mobile and immobile water is useful, its quantitative interpretation in individual functional formats is of questionable theoretical meaning. Rather, such quantitative values must be viewed as primarily empirical.

The "air entry" pressure is the necessary pressure (or suction expressed as negative pressure head) to cause air to enter and displace water held in the largest pores within the predominant grain matrix. In application of Eq. 15, however, the curve is actually fitted through an inflection value for the log θ vs log ψ curve, and air entry suction is determined by extrapolation of ψ to saturation water content

(Brooks and Corey 1964). In the original application (Brooks and Corey 1964) the difference between θ_s and θ_e was considered to be negligible. This assumption holds approximately for coarse soils, but not for finer, more structured soils.

In the case of fine soils a definable inflection in the data plotted for Eq. 15 still occurs, but a gradual water loss between saturation and "air entry" suction is observed, and a discrete "air entry" value is difficult to select. For wet range representation where $\theta(\psi)$ is gradually curved, various functional substitutes for the Brooks and Corey assumption of constant θ from saturation to "air entry" have been developed. One such wet range function is that of Clapp and Hornberger (1978) who propose the quadratic function

$$\psi = -A\left(\frac{\theta}{\theta_s} - B\right)\left(\frac{\theta}{\theta_s} - 1\right) \tag{16}$$

for describing $\theta(\psi)$ between inflection and saturation water content. While Clapp and Hornberger proposed their function for complementary application with the water-retention model of Campbell (1974) it can be applied as well with the Brooks and Corey model.

In using the Clapp and Hornberger (1978) function, the concept of "air entry" is ignored, and empirically determined "inflection" values are substituted for θ_e and ψ_e in application as well as in parameter estimation. Other wet range functions have been proposed by Hutson and Cass (1987) and Alessi et al. (1989). The fit for wet range models on the Hecla soils of this data set has been examined by Alessi et al. (in review b) and the influence of wet range estimation methods on modeling field infiltration has been examined by Alessi et al. (in review a).

The Brooks and Corey $K(\psi)$ function is

$$\frac{K(\Psi)}{K_e} = \left(\frac{\Psi}{\Psi_e}\right)^{-N} \tag{17}$$

where K_e is hydraulic conductivity corresponding to ψ_e. For the Mualem model N is

$$N = 2 + (2+\rho)b \qquad (18)$$

where b is the $\theta(\psi)$ function exponent and ρ is an empirical factor accounting for the effects of pore discontinuity, and also assimilating the effects of departures from Mualem theory in defining the relationship between $K(\psi)$ and $\theta(\psi)$.

There are various methods for calculating the Brooks and Corey parameters. In the original presentation by Brooks and Corey all parameters were determined by graphic analysis. One method is to optimize all water-retention parameters (including ψ_e, θ_e, and wet-range functions) using a nonlinear curve-optimization procedure, such as a Marquardt least-squares (Alessi 1989). Another method, proposed by Mualem (1976b) optimizes fits for only θ_r and b parameters. The Mualem procedure involves successive fitting of b using linear least-squares for gradually increasing values of θ_r (beginning at 0 and increased incrementally) until the sum of the squares of the deviation from the predicted curve begins to increase. The parameter set, prior to increasing error is then selected.

Brooks and Corey and Clapp and Hornberger wet-range parameters are presented for each field data set (with dry-range lab data) in Appendix 1, and for laboratory wet and dry range data in Appendix 2. All parameters were determined using the iterative two-parameter optimization method of Mualem (1976b) for b and θ_r. ψ_e and θ_e were selected as the inflection values of a log/log graph, and θ_s was the wettest measured θ value. ρ values are presented only for the field measured water retention values (Appendix 1), and were determined by calculating N for each field measured $K(\theta,\psi)$. **The mean of calculated N values for the full $K(\theta,\psi)$ range is presented. ρ calculated in this way is systematically larger than that determined using the van Genuchten method.**

$\theta(\psi)$ functions do not always fit well for the full range of data. For parameters presented in this report, a mean square deviation (MSD) of the data from the predictive curve of 0.05 was arbitrarily set as a desirable maximum. If a final calculated MSD exceeded this value, the 15,300 cm data point was deleted from the set and a second estimation was made with data from saturation to 835 cm suction. Because of this all parameters presented have a wet range bias. In some cases large remaining MSD values indicate that data was only approximately fitted by the Brooks and Corey function form. **Because of the many choices in methods and inherent biases in the manner of calculation, it is stressed that these parameters are presented only for those who wish to use these data in functional form quickly, and without doing their own calculations. All data used in parameter calculations are presented, and users are invited to perform their own calculations using whatever methods and biases are preferred.**

Van Genuchten Function Parameters

To avert segmentation of the $\theta(\psi)$ relationship van Genuchten (1978) presented a closed-form equation of the form

$$\Theta = \frac{(\theta-\theta_r)}{(\theta_s-\theta_r)} = [1 + (a\psi)^n]^{-m} \qquad (19)$$

where n and m are empirical exponents, and where for Mualem theory

$$m = 1-1/n \qquad (20).$$

The associated $K(\Theta)$ function is

$$K_r = \Theta^p [1 - (1 - \Theta^{1/m})^m]^2 \qquad (21)$$

for $K_r = K(\Theta)/K_S$. For calculating K_r from ψ, the equation

$$K_r = \frac{[1 - (a\Psi)^{n-1}[1 + (a\Psi)^n]^{-m}]^2}{[1 + (a\Psi)^n]^{pm}} \qquad (22)$$

is used. Of the empirical parameters listed, m and n are most closely related to the curve slope parameter of the Brooks and Corey function. The coefficient a is approximately $1/\psi_i$ (where ψ_i is the $\theta(\psi)$ curve inflection value) for large m/n, and for small m/n it is approxmately $1/\psi_e$ (van Genuchten and Nielsen 1984). Schuh and Cline (1986) found that a was best approximated by $1/\psi_i$ on a wide range of coarse and loamy soils measured by Cassel (1974).

Van Genuchten (1978) has described a method for determining m, n, and a parameters graphically. Van Genuchten function parameters can also be determined using non-linear fitting methods, such as the Marquardt least-squares procedure. A FORTRAN computer program (RETC) using a Marquardt least-squares procedure was written by van Genuchten (written communication, 1986) enabling the optimization of all function parameters to both $\theta(\psi)$ and $K(\psi)$ data either separately or simultaneously. The RETC program also provided for weighting of data to enable flexibility in preference of wet or dry range bias.

Van Genuchten parameters for these data are presented in Appendix 3. For all data sets, a,m,n,ρ, θ_r, θ_s, and K_s are treated as empirical parameters. θ_s treated as an empirical parameter because despite measurements made to near saturation, some subsoils were never wetted to full saturation. In addition, θ_s and K_s are not temporally constant during measurement (as discussed previously in the discussion on DATA HANDLING AND INTERPRETATION) and are highly dependent upon methods and conditions of wetting. Two sets of parameters are presented for each data set. In the first set, a,m,n,θ_r,and θ_s are first optimized for $\theta(\psi)$. These parameters are then held constant and the $K(\theta)$ function is optimized for K_s and ρ. In the second data set all parameters are optimized simultaneously for $K(\theta)$ and $\theta(\psi)$ data. The first data set is more strongly weighted to greater precision in the $\theta(\psi)$ function.

In almost all cases optimized K_s values are realistic and plausible for the data they represent. In a few cases [Appendix 3-G (23 cm), Appendix 3-F (27 cm), Appendix 3-E (137 cm)] Ks data are unrealistically high. This usually occurred where wet range θ or $K(\theta)$ data were limited. Data fits were nonetheless good, and the reader should check the data to ascertain the range of valid application. The relatively large Ks values for deep soils on sites D and C are plausible for local sandy materials.

As in the Brooks and Corey measurements, we have used a wet range bias, and have weighted wet range data more highly in cases where curvatures near saturation were most severely cut. Again, these parameters are presented for those who wish to use the data in parameterized form without a great deal of interpretive effort. However, for those wishing to use their own methods and bias the data are all presented.

FINAL NOTES FOR DATA USERS

The basic hydraulic data are neither unedited, nor are they highly edited. Data known to be erroneous or unreliable because of faulty data input or known calculation errors have been removed or trimmed. **However, we have tried not to overinterpret and to leave application discretion to the user.** It is likely that many users will have applications or user requirements that differ from our own, and that much data editing would be most appropriately performed considering local requirements. **For this reason, many apparent outliers have been left within the data. Likely causes for some of these have already been described in previous sections and should be considered. Because of this editorial decision, it is advised that users transcribe and view the data before using it.**

One other suggestion is made for those intending to present $K(\theta)$ data in parametric form, such as that of the van Genuchten function. **The continuity of field and laboratory $K(\theta)$ data is more precise than that between field and laboratory $K(\psi)$ data for some data sets.** This likely occurs because the laboratory diffusivity method ties measured $D(\theta)$ directly to θ, and does not require exact correspondence between the $K(\theta)$ sample and the separate $\theta(\psi)$ sample. Calculation of $K(\theta)$ requires only the use of specific-water capacity (s_{pm}) from the $\theta(\psi)$ samples, rather than ψ itself. s_{pm} changes much less abruptly than ψ, minimizing the effects of any missed correspondence for $\theta(\psi)$ ranges between samples. **Because of this, $K(\theta)$ parameterization is preferred.**

SITE DESCRIPTIONS AND DATA

SITE A (HAMAR SERIES)

Site A was located in the nonirrigated corner of a center-pivot irrigated potato field, and was covered with a young cover-crop of winter barley. The location and description are summarized on Table 1. According to the La Moure County (ND) Soil Survey Report (USDA 1971) the Hamar soil series consists of "deep, somewhat poorly drained soils on sandy uplands in La Moure and Dickey Counties and on sandy terraces in the James River Valley." They "occur as nearly level areas or as slight depressions", and were "formed in coarse-textured deposits left by glacial melt water". Hamar soils are associated with Hecla, Maddock, and Ulen soils. The specific site measured (location Fig. 2) consisted of a slight depressional location associated at close distances with Hecla soils located on hummocks. The overall landscape was fairly level, and land surface variations were not large. In some years the surface of the Site A has been seen to be briefly ponded (for no more than a few days) during spring snowmelt events. During measurement the water table was approximately 9 feet (2.7 m) below land surface.

In-situ measurements and site descriptions were made during late September and October, 1984. Temperatures were frequently below freezing at night, and to sustain measurements, 6 mil polyethylene tents were constructed over the site and were heated at night with portable propane heaters. The measurement period was concurrent with sites B and C which were located nearby. Soil samples and soil profile descriptions were taken approximately two weeks after the completion of soil hydraulic measurements. Although measurements were made for more than two weeks, drainage was approximately complete at 7 days.

SITE A, REPLICATION 1

Table A-1.1. Soil morphologic data for Site A, replication 1.

Site and location: A-l Heimbuch site, Oakes Aquifer 280 feet south and 100 feet west of the east quarter corner of Section 26, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/84 by M. D. Sweeney (NDAES, Fargo, ND) and W. M. Schuh andR. Cline (NDSWC, Bismarck, ND).

Soil type and classification: Hamar loamy sand; sandy, mixed, frigid typic Haplaquoll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Somewhat poor to poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: A-l north side of pit.

Alp 0-4 inches (0-10 cm), black (lOYR 2/1) loamy sand (sand); weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; abrupt smooth boundary.

A12 4-11.5 inches (10-29 cm), black (lOYR 2/1) loamy sand; moderate coarse and medium prismatic parting to moderate coarse and medium subangular block structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; clear smooth boundary.

Bg 11.5-23.5 inches (29-60 cm), very dark grayish brown (lOYR 3/2) sand with few medium faint very dark brown (lOYR 2/2) mottles which increase to common with depth; very weak coarse prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; clear wavy boundary.

Cgl 3.5-40 inches (60-102 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand (fine sand) with common medium distinct dark yellowish brown (lOYR 3/4 and 4/4) mottles; very weak coarse prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; clear wavy boundary.

Cg2 40-63 inches (102-160 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with many medium distinct strong brown (7.5YR 4/6) mottles; very weak coarse prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; abrupt smooth boundary.

Cg3 63-72 inches (160-183 cm), dark gray (5Y 4/1) sand (loamy sand); soft, very friable to loose, nonsticky and nonplastic.

Table A-1.2 HAMAR SERIES SITE A-1 NDSWC:1984
particle-size, bulk density, and organic carbon data and indices

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT) 2.	20.	50.	100.	250.	500.	1000.	2000.
8.	3.0	3.7	6.2	9.4	41.8	33.0	2.9	0.1
23.	5.5	4.8	4.5	10.9	44.5	27.8	2.0	0.0
38.	4.0	3.6	4.0	9.3	45.6	30.9	2.4	0.1
53.	4.7	1.1	2.3	8.9	52.4	28.8	1.8	0.0
69.	2.5	3.6	1.4	9.1	53.5	27.9	1.9	0.1
84.	3.2	3.3	0.6	9.9	56.2	24.9	1.8	0.0
99.	2.9	2.5	0.5	6.1	51.6	33.6	2.7	0.1
114.	2.9	2.5	0.0	2.6	47.0	43.8	1.5	0.0
130.	2.9	1.1	0.1	1.6	39.3	52.5	2.5	0.0
160.	5.1	4.4	3.1	12.0	40.0	33.9	1.6	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	87.1	9.9	3.0	A 1 6	6=p
23.	85.2	9.3	5.5	A 1 2	8=g
38.	88.4	7.6	4.0	B 8	
53.	91.9	3.4	4.7	B 8	
69.	92.5	5.0	2.5	C 1 8	
84.	92.9	3.9	3.2	C 1 8	
99.	94.1	3.0	2.9	C 1 8	
114.	94.9	2.2	2.9	C 2 8	
130.	95.9	1.2	2.9	C 2 8	
160.	87.5	7.4	5.1	C 3 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	8.808	0.1517	3.5	0.0438	0.836	1.50	1.20
23.	8.353	0.1208	4.2	0.0284	0.767	1.58	1.00
38.	11.618	0.1469	3.7	0.0396	0.891	1.55	0.31
53.	27.029	0.1522	3.6	0.0422	1.106	1.46	0.27
69.	18.500	0.1606	3.1	0.0527	1.126	1.59	0.12
84.	23.795	0.1533	3.2	0.0477	1.175	1.65	0.20
99.	31.367	0.1783	3.1	0.0576	1.252	1.61	0.06
114.	37.960	0.1952	3.1	0.0639	1.418	1.59	0.08
130.	79.917	0.2227	3.0	0.0755	1.526	1.62	0.04
160.	11.667	0.1354	4.2	0.0326	0.806	1.68	0.12

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.656	2.591	-1.1584	2.5288	-11.58	1.15
23.	1.677	2.573	-1.1285	2.4708	-11.29	1.09
38.	1.487	3.520	-1.1883	2.5607	-11.88	1.18
53.	1.072	4.337	-1.2652	2.6651	-12.65	1.28
69.	1.256	5.146	-1.2635	2.6825	-12.64	1.30
84.	1.138	4.881	-1.2746	2.6912	-12.75	1.31
99.	1.028	2.420	-1.2985	2.7289	-12.99	1.35
114.	0.956	2.527	-1.3129	2.7521	-13.13	1.37
130.	0.721	8.782	-1.3350	2.7811	-13.35	1.40
160.	1.478	3.766	-1.1778	2.5375	-11.78	1.16

Table A-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site A, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	0.9	0.9	0.18	1.6	-	1.8	0.8	1.0
15 - 30	0.5	1.7	0.44	0.3	-	1.0	0.08	1.9
30 - 46	1.2	1.8	0.54	0.2	-	0.8	0.07	3.0
46 - 61	1.4	0.4	0.60	0.2	-	0.6	0.18	1.8
61 - 76	0.7	0.8	0.48	0.1	-	0.4	0.07	1.7
76 - 91	0.8	0.6	0.56	0.1	-	0.7	0.18	1.3
91 - 106	0.8	0.7	0.56	0.06	-	0.6	0.17	1.4
106 - 122	0.4	0.5	0.52	0.08	-	0.3	0.15	1.1
122 - 137	0.7	0.7	0.66	0.06	-	0.5	0.15	1.5
152 - 168	0.9	1.1	0.56	0.04	-	0.8	0.25	1.6

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.32	0.1	38	7.1	-	s	4.9
15 - 30	0.20	0.4	27	6.8	-	ls	5.0
30 - 46	0.29	0.3	25	6.7	-	s	4.1
46 - 61	0.26	0.6	23	7.1	-	fs	3.1
61 - 76	0.20	0.5	22	7.0	-	fs	2.8
76 - 91	0.20	0.6	19	7.1	-	fs	3.3
91 - 106	0.20	0.6	22	7.1	-	fs	3.0
106 - 122	0.14	0.7	20	7.0	-	s	2.1
122 - 137	0.19	0.8	20	7.1	-	s	2.2
152 - 168	0.25	0.6	22	6.8	-	ls	4.0

Table A-1.4 HAMAR SERIES SITE A-1 NDSWC:84
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

8.			23.			38.			53.		
CM	CC/CC	SE									
10.	0.4811	0.0363	24.	0.3743	0.0080	10.	0.4797	0.0084	10.	0.2975	0.0017
20.	0.4691	0.0216	40.	0.3436	0.0106	20.	0.4829	0.0084	20.	0.2861	0.0003
40.	0.3591	0.0044	50.	0.2828	0.0111	40.	0.2703	0.0123	40.	0.1934	0.0001
60.	0.2689	0.0022	62.	0.2431	0.0074	60.	0.2094	0.0073	60.	0.1411	0.0008
80.	0.2248	0.0055	70.	0.2205	0.0042	80.	0.1818	0.0056	80.	0.1128	0.0006
100.	0.1967	0.0034	82.	0.2025	0.0021	100.	0.1668	0.0039	100.	0.0967	0.0004
120.	0.1797	0.0038	98.	0.1883	0.0005	120.	0.1589	0.0028	120.	0.0887	0.0005
280.	0.1565	0.0052	150.	0.1650	0.0000	280.	0.1431	0.0028	180.	0.0766	0.0005
340.	0.1330	0.0032	340.	0.1373	0.0005	340.	0.1280	0.0011	340.	0.0665	0.0001
534.	0.1213	0.0023	503.	0.1245	0.0011	534.	0.1193	0.0006	534.	0.0625	0.0001
834.	0.1120	0.0019	834.	0.1170	0.0000	834.	0.1122	0.0000	834.	0.0618	0.0006
BD =	1.47			1.58			1.55			1.46	
N =	2			2			2			2	

DEPTH (CM)

69.			99.			114.			130.		
24.	0.3280	0.0102	10.	0.3338	0.0039	10.	0.4200	0.0314	24.	0.3766	0.0263
40.	0.2272	0.0015	20.	0.3248	0.0028	20.	0.3846	0.0355	40.	0.1912	0.0244
50.	0.1673	0.0016	40.	0.2102	0.0077	40.	0.1655	0.0317	50.	0.1398	0.0228
62.	0.1351	0.0011	60.	0.1416	0.0038	60.	0.1207	0.0292	62.	0.1211	0.0216
70.	0.1197	0.0009	80.	0.1103	0.0013	80.	0.1068	0.0280	70.	0.1141	0.0220
82.	0.1051	0.0001	100.	0.0946	0.0006	100.	0.1030	0.0286	82.	0.1063	0.0220
98.	0.0959	0.0010	120.	0.0864	0.0000	120.	0.0976	0.0280	98.	0.1032	0.0208
150.	0.0806	0.0008	180.	0.0752	0.0017	280.	0.0922	0.0274	150.	0.0946	0.0202
340.	0.0676	0.0011	340.	0.0670	0.0024	340.	0.0845	0.0273	340.	0.0876	0.0196
503.	0.0660	0.0011	534.	0.0625	0.0024	534.	0.0860	0.0273	503.	0.0852	0.0190
834.	0.0629	0.0010	834.	0.0610	0.0024	834.	0.0806	0.0268	834.	0.0821	0.0190
BD =	1.59			1.61			1.59			1.62	
N =	2			2			2			2	

Table A-1.5 HAMAR SERIES SITE A -1 (NDSWC 1984)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.4173	21.	2.02	1.00	0.65E+00	0.95E-03	0.68E+03
0.3	.3964	33.	3.19	1.01	0.92E+00	0.45E-02	0.21E+03
0.5	.3762	37.	3.64	1.03	0.59E+00	0.46E-02	0.13E+03
0.7	.3626	40.	3.97	1.04	0.41E+00	0.37E-02	0.11E+03
0.9	.3517	43.	4.22	1.05	0.38E+00	0.53E-02	0.72E+02
1.2	.3350	47.	4.57	1.04	0.34E+00	0.46E-02	0.73E+02
1.7	.3179	51.	4.97	0.97	0.18E+00	0.38E-02	0.47E+02
2.2	.3078	53.	5.17	0.94	0.14E+00	0.88E-02	0.16E+02
2.7	.2997	54.	5.27	0.94	0.12E+00	0.73E-02	0.16E+02
3.2	.2932	55.	5.34	0.93	0.95E-01	0.12E-01	0.82E+01
3.7	.2878	55.	5.42	0.92	0.80E-01	0.48E-02	0.17E+02
4.2	.2818	57.	5.54	0.89	0.12E+00	0.48E-02	0.26E+02
4.7	.2746	58.	5.69	0.86	0.13E+00	0.48E-02	0.27E+02
8.7	.2566	62.	6.07	0.76	0.38E-01	0.48E-02	0.80E+01
15.0	.2407	66.	6.49	0.73	0.23E-01	0.34E-02	0.68E+01
25.0	.2245	73.	7.12	0.72	0.11E-01	0.17E-02	0.63E+01
35.0	.2179	77.	7.57	0.69	0.37E-02	0.11E-02	0.33E+01
50.0	.2134	81.	7.93	0.66	0.33E-02	0.14E-02	0.24E+01
70.0	.2082	85.	8.38	0.62	0.29E-02	0.98E-03	0.30E+01
90.0	.2047	90.	8.79	0.57	0.16E-02	0.67E-03	0.23E+01
110.0	.2021	94.	9.17	0.52	0.21E-02	0.71E-03	0.29E+01
130.0	.1997	97.	9.52	0.47	0.15E-02	0.63E-03	0.24E+01
150.0	.1978	100.	9.79	0.43	0.17E-02	0.76E-03	0.22E+01

DOERING 1-STEP DATA

0.1	.3294	43.	4.22	83.33	0.24E+00	0.47E-02	0.52E+02
0.2	.3028	50.	4.85	83.33	0.13E+00	0.36E-02	0.35E+02
0.2	.2861	55.	5.35	83.33	0.79E-01	0.30E-02	0.26E+02
0.2	.2741	59.	5.77	83.33	0.55E-01	0.26E-02	0.21E+02
0.3	.2651	62.	6.12	83.33	0.42E-01	0.23E-02	0.18E+02
0.4	.2578	66.	6.44	83.33	0.33E-01	0.21E-02	0.15E+02
0.4	.2518	69.	6.73	83.33	0.26E-01	0.20E-02	0.13E+02
0.5	.2467	71.	6.99	83.33	0.22E-01	0.18E-02	0.12E+02
0.5	.2424	74.	7.23	83.33	0.19E-01	0.17E-02	0.11E+02
0.6	.2385	76.	7.45	83.33	0.16E-01	0.16E-02	0.98E+01
0.6	.2352	78.	7.66	83.33	0.14E-01	0.16E-02	0.90E+01
0.7	.2321	80.	7.86	83.33	0.12E-01	0.15E-02	0.83E+01
0.7	.2294	82.	8.04	83.33	0.11E-01	0.14E-02	0.78E+01
0.8	.2269	84.	8.22	83.33	0.99E-02	0.14E-02	0.73E+01
0.8	.2247	85.	8.38	83.33	0.90E-02	0.13E-02	0.68E+01
0.9	.2226	87.	8.54	83.33	0.82E-02	0.13E-02	0.64E+01
0.9	.2207	89.	8.69	83.33	0.75E-02	0.12E-02	0.61E+01
1.0	.2189	90.	8.84	83.33	0.69E-02	0.12E-02	0.58E+01
1.0	.2172	92.	8.98	83.33	0.64E-02	0.12E-02	0.55E+01

DEPTH 8. CM (DOERING 1-STEP CONTINUED) SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.1	.2157	93.	9.11	83.33	0.59E-02	0.11E-02	0.53E+01
1.1	.2142	94.	9.24	83.33	0.55E-02	0.11E-02	0.50E+01
1.1	.2128	96.	9.36	83.33	0.51E-02	0.11E-02	0.48E+01
1.2	.2115	97.	9.49	83.33	0.48E-02	0.10E-02	0.46E+01
1.2	.2103	98.	9.60	83.33	0.45E-02	0.10E-02	0.44E+01
1.3	.2091	99.	9.71	83.33	0.43E-02	0.10E-02	0.43E+01
1.3	.2080	100.	9.82	83.33	0.40E-02	0.98E-03	0.41E+01
1.4	.2070	101.	9.93	83.33	0.38E-02	0.96E-03	0.40E+01
1.4	.2060	102.	10.03	83.33	0.36E-02	0.94E-03	0.39E+01
1.5	.2050	103.	10.14	83.33	0.34E-02	0.92E-03	0.37E+01
1.5	.2041	104.	10.23	83.33	0.33E-02	0.91E-03	0.36E+01
1.6	.2032	105.	10.33	83.33	0.31E-02	0.89E-03	0.35E+01
1.6	.2024	106.	10.42	83.33	0.30E-02	0.87E-03	0.34E+01
1.7	.2016	107.	10.51	83.33	0.29E-02	0.86E-03	0.33E+01
1.7	.2008	108.	10.60	83.33	0.27E-02	0.85E-03	0.32E+01
1.8	.2000	109.	10.69	83.33	0.26E-02	0.83E-03	0.31E+01
1.8	.1993	110.	10.78	83.33	0.25E-02	0.82E-03	0.31E+01
1.9	.1986	111.	10.86	83.33	0.24E-02	0.81E-03	0.30E+01
1.9	.1980	112.	10.94	83.33	0.23E-02	0.80E-03	0.29E+01
2.0	.1973	112.	11.02	83.33	0.22E-02	0.79E-03	0.28E+01
4.1	.1813	137.	13.41	83.33	0.80E-03	0.55E-03	0.15E+01
8.1	.1690	163.	16.00	83.33	0.31E-03	0.39E-03	0.78E+00
12.1	.1630	180.	17.63	83.33	0.18E-03	0.33E-03	0.54E+00
16.0	.1592	192.	18.83	83.33	0.12E-03	0.29E-03	0.42E+00
20.0	.1565	202.	19.78	83.33	0.92E-04	0.27E-03	0.34E+00
24.0	.1545	210.	20.57	83.33	0.73E-04	0.25E-03	0.29E+00
28.0	.1528	217.	21.24	83.33	0.60E-04	0.23E-03	0.26E+00
32.0	.1515	223.	21.83	83.33	0.51E-04	0.22E-03	0.23E+00
36.0	.1503	228.	22.35	83.33	0.45E-04	0.21E-03	0.21E+00
40.0	.1493	233.	22.81	83.33	0.39E-04	0.20E-03	0.19E+00
44.0	.1485	237.	23.24	83.33	0.35E-04	0.20E-03	0.18E+00
48.0	.1477	241.	23.62	83.33	0.32E-04	0.19E-03	0.17E+00
122.0	.1408	283.	27.76	83.33	0.12E-04	0.14E-03	0.85E-01
194.0	.1380	304.	29.77	83.33	0.82E-05	0.12E-03	0.66E-01
266.0	.1364	317.	31.10	83.33	0.68E-05	0.11E-03	0.59E-01
338.0	.1353	327.	32.09	83.33	0.62E-05	0.11E-03	0.57E-01

DEPTH 30. CM SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3943	19.	1.81	1.00	0.25E+01	0.90E-03	0.28E+04
0.3	.3743	33.	3.20	1.01	0.36E+01	0.41E-02	0.88E+03
0.5	.3539	38.	3.68	1.03	0.25E+01	0.46E-02	0.54E+03
0.7	.3388	41.	4.02	1.04	0.18E+01	0.44E-02	0.41E+03
0.9	.3271	44.	4.30	1.05	0.15E+01	0.41E-02	0.37E+03
1.2	.3125	47.	4.62	1.04	0.12E+01	0.47E-02	0.26E+03
1.7	.2984	50.	4.93	0.97	0.64E+00	0.44E-02	0.15E+03
2.2	.2901	52.	5.08	0.94	0.52E+00	0.81E-02	0.64E+02
2.7	.2836	53.	5.17	0.94	0.43E+00	0.58E-02	0.73E+02
3.2	.2782	53.	5.24	0.93	0.35E+00	0.14E-01	0.25E+02
3.7	.2735	54.	5.30	0.92	0.31E+00	0.57E-02	0.55E+02
4.2	.2685	55.	5.38	0.89	0.44E+00	0.65E-02	0.67E+02
4.7	.2625	56.	5.48	0.86	0.48E+00	0.54E-02	0.90E+02

8.7	.2428	58.	5.69	0.76	0.16E+00	0.95E-02	0.17E+02
15.0	.2274	62.	6.07	0.73	0.89E-01	0.31E-02	0.29E+02
25.0	.2115	68.	6.68	0.72	0.45E-01	0.21E-02	0.22E+02
35.0	.2035	72.	7.08	0.69	0.18E-01	0.19E-02	0.94E+01
50.0	.1972	75.	7.39	0.66	0.16E-01	0.20E-02	0.77E+01
70.0	.1908	79.	7.78	0.62	0.12E-01	0.13E-02	0.92E+01
90.0	.1867	83.	8.12	0.57	0.70E-02	0.95E-03	0.74E+01
110.0	.1840	86.	8.42	0.52	0.80E-02	0.87E-03	0.92E+01
130.0	.1819	89.	8.68	0.47	0.58E-02	0.66E-03	0.87E+01
150.0	.1800	91.	8.89	0.43	0.72E-02	0.12E-02	0.59E+01

DOERING 1-STEP DATA

0.0	.2412	48.	4.66	83.33	0.32E+00	0.25E-02	0.13E+03
0.1	.2035	69.	6.76	83.33	0.56E-01	0.13E-02	0.45E+02
0.1	.1885	83.	8.16	83.33	0.24E-01	0.89E-03	0.27E+02
0.2	.1793	95.	9.29	83.33	0.14E-01	0.70E-03	0.20E+02
0.2	.1729	105.	10.28	83.33	0.91E-02	0.58E-03	0.16E+02
0.3	.1680	114.	11.18	83.33	0.65E-02	0.50E-03	0.13E+02
0.3	.1640	122.	12.01	83.33	0.48E-02	0.44E-03	0.11E+02
0.4	.1608	130.	12.79	83.33	0.38E-02	0.39E-03	0.97E+01
0.4	.1580	138.	13.53	83.33	0.30E-02	0.35E-03	0.86E+01
0.5	.1555	145.	14.25	83.33	0.25E-02	0.32E-03	0.77E+01
0.5	.1534	152.	14.93	83.33	0.21E-02	0.29E-03	0.71E+01
0.6	.1515	159.	15.60	83.33	0.17E-02	0.27E-03	0.65E+01
0.6	.1497	166.	16.25	83.33	0.15E-02	0.25E-03	0.60E+01

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DEPTH 30. CM SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.7	.1482	172.	16.88	83.33	0.13E-02	0.23E-03	0.56E+01
0.7	.1467	179.	17.51	83.33	0.11E-02	0.22E-03	0.52E+01
0.8	.1454	185.	18.12	83.33	0.10E-02	0.21E-03	0.49E+01
0.8	.1442	191.	18.72	83.33	0.89E-03	0.19E-03	0.46E+01
0.9	.1431	197.	19.31	83.33	0.80E-03	0.18E-03	0.44E+01
0.9	.1420	203.	19.90	83.33	0.72E-03	0.17E-03	0.42E+01
1.0	.1410	209.	20.48	83.33	0.65E-03	0.16E-03	0.40E+01
1.0	.1401	215.	21.06	83.33	0.59E-03	0.16E-03	0.38E+01
1.1	.1392	221.	21.63	83.33	0.54E-03	0.15E-03	0.36E+01
1.1	.1383	226.	22.19	83.33	0.49E-03	0.14E-03	0.35E+01
1.2	.1375	232.	22.76	83.33	0.45E-03	0.14E-03	0.33E+01
1.2	.1368	238.	23.31	83.33	0.41E-03	0.13E-03	0.32E+01
1.3	.1361	243.	23.87	83.33	0.38E-03	0.12E-03	0.31E+01
1.3	.1354	249.	24.43	83.33	0.35E-03	0.12E-03	0.30E+01
1.4	.1347	255.	24.98	83.33	0.33E-03	0.11E-03	0.29E+01
1.4	.1341	260.	25.53	83.33	0.30E-03	0.11E-03	0.28E+01
1.5	.1335	266.	26.08	83.33	0.28E-03	0.11E-03	0.27E+01
1.5	.1329	272.	26.63	83.33	0.27E-03	0.10E-03	0.26E+01
1.6	.1324	277.	27.18	83.33	0.25E-03	0.98E-04	0.25E+01
1.6	.1318	283.	27.73	83.33	0.23E-03	0.94E-04	0.25E+01
1.7	.1313	288.	28.27	83.33	0.22E-03	0.91E-04	0.24E+01
1.7	.1308	294.	28.82	83.33	0.20E-03	0.88E-04	0.23E+01
1.8	.1303	300.	29.37	83.33	0.19E-03	0.85E-04	0.23E+01
1.8	.1299	305.	29.92	83.33	0.18E-03	0.82E-04	0.22E+01
1.9	.1294	311.	30.47	83.33	0.17E-03	0.79E-04	0.22E+01
1.9	.1290	316.	31.02	83.33	0.16E-03	0.77E-04	0.21E+01
2.0	.1286	322.	31.57	83.33	0.15E-03	0.74E-04	0.21E+01

DEPTH 61. CM SITE A-1 (WET RANGE 53 AND 69 CM COMBINED)

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3612	17.	1.67	0.85	0.54E+01	0.85E-03	0.64E+04
0.3	.3476	28.	2.73	0.70	0.95E+01	0.26E-02	0.36E+04
0.5	.3320	33.	3.26	0.71	0.70E+01	0.36E-02	0.19E+04
0.7	.3233	37.	3.64	0.73	0.41E+01	0.59E-03	0.71E+04
0.9	.3101	40.	3.96	0.74	0.57E+01	0.82E-02	0.70E+03
1.2	.2882	44.	4.31	0.77	0.32E+01	0.48E-02	0.66E+03
1.7	.2731	47.	4.58	0.80	0.16E+01	0.10E-01	0.16E+03
2.2	.2637	48.	4.68	0.80	0.12E+01	0.88E-02	0.14E+03
2.7	.2568	49.	4.77	0.80	0.94E+00	0.60E-02	0.16E+03
3.2	.2509	49.	4.85	0.81	0.79E+00	0.11E-01	0.70E+02
3.7	.2453	50.	4.91	0.82	0.72E+00	0.84E-02	0.85E+02
4.2	.2403	51.	4.96	0.83	0.84E+00	0.13E-01	0.65E+02
4.7	.2348	51.	5.02	0.84	0.97E+00	0.70E-02	0.14E+03
8.7	.2146	53.	5.18	0.79	0.28E+00	0.99E-02	0.28E+02

DEPTH 53. CM

15.0	.1998	56.	5.52	0.79	0.14E+00	0.32E-02	0.44E+02
25.0	.1844	62.	6.04	0.70	0.84E-01	0.27E-02	0.31E+02
35.0	.1754	65.	6.36	0.66	0.36E-01	0.31E-02	0.12E+02
50.0	.1687	68.	6.63	0.64	0.30E-01	0.23E-02	0.13E+02
70.0	.1620	70.	6.89	0.56	0.24E-01	0.28E-02	0.86E+01
90.0	.1578	72.	7.10	0.48	0.15E-01	0.13E-02	0.11E+02
110.0	.1552	75.	7.35	0.52	0.13E-01	0.78E-03	0.17E+02
130.0	.1537	77.	7.58	0.54	0.79E-02	0.50E-03	0.16E+02
150.0	.1526	79.	7.70	0.51	0.10E-01	0.15E-02	0.66E+01

DEPTH 69. CM

8.7	.2011	51.	5.03	1.01	0.28E+00	0.50E-02	0.57E+02
15.0	.1882	55.	5.35	0.97	0.14E+00	0.36E-02	0.39E+02
25.0	.1741	59.	5.75	0.91	0.86E-01	0.34E-02	0.25E+02
35.0	.1656	61.	6.01	0.87	0.37E-01	0.31E-02	0.12E+02
50.0	.1597	64.	6.23	0.83	0.30E-01	0.24E-02	0.13E+02
70.0	.1538	66.	6.47	0.86	0.20E-01	0.29E-02	0.70E+01
90.0	.1497	68.	6.67	0.93	0.10E-01	0.13E-02	0.78E+01
110.0	.1476	71.	6.92	0.89	0.92E-02	0.42E-03	0.22E+02
130.0	.1468	73.	7.14	0.87	0.55E-02	0.22E-03	0.25E+02
150.0	.1465	74.	7.29	0.93	0.63E-02	0.26E-03	0.24E+02

DEPTH 84. CM SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3493	16.	1.56	1.04	0.56E+01	0.80E-03	0.69E+04
0.3	.3424	23.	2.29	0.96	0.85E+01	0.13E-02	0.64E+04
0.5	.3347	28.	2.76	0.87	0.74E+01	0.21E-02	0.35E+04
0.9	.3243	35.	3.42	0.79	0.87E+01	0.75E-02	0.12E+04
1.2	.3057	39.	3.78	0.74	0.44E+01	0.37E-02	0.12E+04
1.7	.2896	42.	4.08	0.72	0.25E+01	0.13E-01	0.20E+03
2.2	.2759	43.	4.21	0.76	0.18E+01	0.83E-02	0.22E+03
2.7	.2658	44.	4.34	0.80	0.13E+01	0.79E-02	0.17E+03
3.2	.2574	45.	4.44	0.81	0.12E+01	0.90E-02	0.13E+03
3.7	.2500	46.	4.52	0.83	0.10E+01	0.79E-02	0.13E+03
4.2	.2439	47.	4.59	0.84	0.11E+01	0.11E-01	0.10E+03
4.7	.2374	48.	4.67	0.84	0.14E+01	0.76E-02	0.18E+03

15.0	.2120	52.	5.11	0.70	0.25E+00	0.10E-01	0.25E+02
25.0	.1859	56.	5.46	0.70	0.14E+00	0.40E-02	0.34E+02
35.0	.1775	58.	5.69	0.70	0.56E-01	0.31E-02	0.18E+02
50.0	.1716	60.	5.87	0.69	0.44E-01	0.32E-02	0.14E+02
70.0	.1651	62.	6.11	0.67	0.32E-01	0.24E-02	0.14E+02
90.0	.1593	65.	6.34	0.64	0.20E-01	0.28E-02	0.72E+01
110.0	.1530	67.	6.52	0.58	0.19E-01	0.38E-02	0.51E+01
130.0	.1477	68.	6.69	0.53	0.12E-01	0.26E-02	0.45E+01
150.0	.1450	70.	6.82	0.45	0.15E-01	0.13E-02	0.11E+02

DOERING 1 - STEP

0.0	.0771	188.	18.43	83.33	0.13E-03	0.13E-03	0.10E+01
0.6	.0741	216.	21.14	83.33	0.10E-03	0.92E-04	0.11E+01
1.2	.0711	256.	25.11	83.33	0.70E-04	0.60E-04	0.12E+01
1.7	.0681	323.	31.71	83.33	0.42E-04	0.33E-04	0.13E+01
2.3	.0651	465.	45.55	83.33	0.18E-04	0.13E-04	0.14E+01

DEPTH 99. CM SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3577	10.	0.96	0.33	0.19E+02	0.54E-03	0.34E+05
0.3	.3412	17.	1.66	0.32	0.30E+02	0.56E-02	0.54E+04
0.5	.3246	22.	2.11	0.33	0.21E+02	0.13E-02	0.16E+05
0.7	.3205	25.	2.48	0.38	0.78E+01	0.98E-03	0.79E+04
0.9	.3170	29.	2.86	0.48	0.16E+02	0.98E-03	0.16E+05
1.7	.3157	36.	3.49	0.52	0.46E+01	0.12E-01	0.39E+03
2.2	.2950	38.	3.68	0.54	0.34E+01	0.11E-01	0.32E+03
2.7	.2778	39.	3.83	0.54	0.26E+01	0.12E-01	0.21E+03
3.2	.2655	40.	3.93	0.53	0.23E+01	0.11E-01	0.21E+03
3.7	.2557	41.	4.02	0.52	0.21E+01	0.11E-01	0.18E+03
4.2	.2484	42.	4.07	0.49	0.22E+01	0.17E-01	0.13E+03
4.7	.2415	42.	4.12	0.45	0.30E+01	0.14E-01	0.21E+03
15.0	.2126	45.	4.43	0.42	0.58E+00	0.99E-02	0.59E+02
25.0	.1852	49.	4.80	0.43	0.26E+00	0.42E-02	0.63E+02
35.0	.1763	51.	5.02	0.42	0.11E+00	0.42E-02	0.27E+02
50.0	.1706	53.	5.19	0.42	0.85E-01	0.28E-02	0.30E+02
70.0	.1644	55.	5.42	0.42	0.63E-01	0.26E-02	0.24E+02
90.0	.1578	57.	5.60	0.40	0.45E-01	0.49E-02	0.92E+01
110.0	.1470	59.	5.75	0.40	0.48E-01	0.95E-02	0.51E+01
130.0	.1376	60.	5.88	0.40	0.24E-01	0.45E-02	0.52E+01
150.0	.1339	61.	5.96	0.40	0.21E-01	0.57E-02	0.36E+01

DOERING 1 - STEP

0.1	.1913	37.	3.64	83.33	0.30E+00	0.45E-02	0.67E+02
0.2	.1623	45.	4.44	83.33	0.13E+00	0.29E-02	0.46E+02
0.2	.1444	53.	5.16	83.33	0.71E-01	0.20E-02	0.35E+02
0.3	.1320	60.	5.84	83.33	0.44E-01	0.15E-02	0.28E+02
0.3	.1227	66.	6.51	83.33	0.29E-01	0.12E-02	0.24E+02
0.4	.1155	73.	7.16	83.33	0.20E-01	0.98E-03	0.20E+02
0.4	.1096	80.	7.81	83.33	0.14E-01	0.80E-03	0.18E+02
0.5	.1046	86.	8.47	83.33	0.11E-01	0.67E-03	0.16E+02
0.5	.1005	93.	9.13	83.33	0.82E-02	0.57E-03	0.14E+02
0.6	.0969	100.	9.81	83.33	0.64E-02	0.48E-03	0.13E+02
0.6	.0937	107.	10.50	83.33	0.50E-02	0.41E-03	0.12E+02
0.7	.0909	114.	11.21	83.33	0.40E-02	0.36E-03	0.11E+02
0.7	.0884	122.	11.95	83.33	0.33E-02	0.31E-03	0.10E+02

0.8	.0862	130.	12.71	83.33	0.26E-02	0.27E-03	0.98E+01
0.8	.0841	138.	13.50	83.33	0.22E-02	0.24E-03	0.92E+01

DEPTH 99. CM (DOERING 1-STEP CONTINUED) SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.9	.0823	146.	14.32	83.33	0.18E-02	0.21E-03	0.87E+01
0.9	.0806	155.	15.19	83.33	0.15E-02	0.18E-03	0.82E+01
1.0	.0790	164.	16.09	83.33	0.12E-02	0.16E-03	0.78E+01
1.0	.0775	174.	17.05	83.33	0.10E-02	0.14E-03	0.74E+01
1.1	.0762	184.	18.06	83.33	0.87E-03	0.12E-03	0.71E+01
1.1	.0749	195.	19.13	83.33	0.73E-03	0.11E-03	0.68E+01
1.2	.0738	207.	20.27	83.33	0.62E-03	0.95E-04	0.65E+01
1.2	.0726	219.	21.49	83.33	0.52E-03	0.83E-04	0.62E+01
1.3	.0716	233.	22.80	83.33	0.44E-03	0.73E-04	0.60E+01
1.3	.0706	247.	24.21	83.33	0.37E-03	0.64E-04	0.58E+01
1.4	.0697	263.	25.74	83.33	0.31E-03	0.55E-04	0.56E+01
1.4	.0688	280.	27.40	83.33	0.26E-03	0.48E-04	0.54E+01
1.5	.0680	298.	29.22	83.33	0.22E-03	0.42E-04	0.52E+01
1.5	.0672	318.	31.22	83.33	0.18E-03	0.36E-04	0.50E+01
1.6	.0665	341.	33.43	83.33	0.15E-03	0.31E-04	0.49E+01
1.6	.0657	366.	35.90	83.33	0.12E-03	0.26E-04	0.47E+01
1.7	.0651	394.	38.67	83.33	0.10E-03	0.22E-04	0.46E+01
1.7	.0644	427.	41.82	83.33	0.83E-04	0.19E-04	0.45E+01
1.8	.0638	463.	45.44	83.33	0.67E-04	0.15E-04	0.43E+01

DEPTH 114. CM SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3687	3.	0.30	0.54	0.12E+02	0.26E-03	0.47E+05
0.3	.3545	7.	0.71	0.47	0.25E+02	0.54E-02	0.46E+04
0.5	.3401	11.	1.12	0.39	0.19E+02	0.82E-03	0.23E+05
0.7	.3377	15.	1.46	0.32	0.10E+02	0.62E-03	0.17E+05
0.9	.3352	19.	1.85	0.25	0.32E+02	0.81E-03	0.39E+05
1.7	.3377	27.	2.69	0.44	0.68E+01	0.53E-02	0.13E+04
2.2	.3065	31.	3.03	0.60	0.47E+01	0.15E-01	0.32E+03
2.7	.2719	34.	3.28	0.72	0.28E+01	0.15E-01	0.19E+03
3.2	.2516	35.	3.45	0.81	0.20E+01	0.99E-02	0.21E+03
4.7	.2470	38.	3.73	1.01	0.16E+01	0.23E-01	0.69E+02
8.7	.2007	39.	3.80	1.04	0.23E+00	0.26E-01	0.92E+01
15.0	.1853	41.	4.04	1.02	0.28E+00	0.42E-02	0.67E+02
25.0	.1698	45.	4.39	0.99	0.14E+00	0.47E-02	0.29E+02
35.0	.1607	47.	4.59	0.99	0.55E-01	0.42E-02	0.13E+02
50.0	.1549	49.	4.78	1.01	0.40E-01	0.26E-02	0.16E+02
70.0	.1500	51.	5.00	1.01	0.30E-01	0.18E-02	0.17E+02
110.0	.1451	54.	5.33	1.01	0.34E-01	0.17E-01	0.20E+01
130.0	.1313	56.	5.45	1.01	0.12E-01	0.24E-02	0.50E+01
150.0	.1293	56.	5.53	1.01	0.10E-01	0.33E-02	0.30E+01

DOERING 1-STEP

4.5	.1178	88.	8.58	83.33	0.12E-02	0.62E-03	0.19E+01
8.5	.1018	129.	12.60	83.33	0.27E-03	0.25E-03	0.11E+01
12.5	.0944	170.	16.71	83.33	0.96E-04	0.13E-03	0.77E+00
16.5	.0899	218.	21.37	83.33	0.42E-04	0.70E-04	0.60E+00
20.5	.0869	276.	27.05	83.33	0.20E-04	0.40E-04	0.50E+00

24.5	.0846	352.	34.47	83.33	0.97E-05	0.22E-04	0.43E+00
28.5	.0829	460.	45.09	83.33	0.45E-05	0.12E-04	0.39E+00

DEPTH 130. CM SITE A-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3691	1.	0.11	0.13	0.54E+02	********	********
0.7	.3700	4.	0.41	0.13	0.25E+02	0.13E-03	0.20E+06
0.9	.3696	8.	0.77	0.18	0.44E+02	0.78E-04	0.56E+06
1.2	.3679	11.	1.03	0.27	0.11E+02	0.51E-03	0.21E+05
1.7	.3622	17.	1.70	0.32	0.11E+02	0.16E-02	0.67E+04
2.2	.3396	23.	2.21	0.35	0.12E+02	0.87E-02	0.13E+04
2.7	.3096	26.	2.59	0.40	0.69E+01	0.77E-02	0.90E+03
3.2	.2896	30.	2.90	0.50	0.42E+01	0.56E-02	0.75E+03
3.7	.2804	32.	3.18	0.62	0.20E+01	0.75E-03	0.26E+04
4.2	.2785	35.	3.39	0.68	0.16E+01	0.12E-02	0.13E+04
4.7	.2694	36.	3.54	0.75	0.26E+01	0.13E-01	0.20E+03
8.7	.2032	39.	3.79	0.95	0.34E+00	0.10E-01	0.33E+02
15.0	.1876	41.	4.02	0.95	0.33E+00	0.56E-02	0.59E+02
25.0	.1724	44.	4.31	0.90	0.17E+00	0.48E-02	0.35E+02
35.0	.1640	46.	4.49	0.88	0.71E-01	0.38E-02	0.19E+02
50.0	.1587	48.	4.67	0.85	0.53E-01	0.26E-02	0.20E+02
70.0	.1549	50.	4.88	0.83	0.38E-01	0.83E-03	0.46E+02
90.0	.1599	51.	5.04	0.82	0.11E-01	********	********
110.0	.1558	53.	5.18	0.80	0.64E-01	0.13E-01	0.48E+01
130.0	.1442	54.	5.31	0.80	0.18E-01	0.31E-02	0.57E+01
150.0	.1420	55.	5.38	0.80	0.14E-01	0.28E-02	0.49E+01

1

SITE A, REPLICATION 2

Table A-2.1 Soil morphologic data for Site A, replication 2.

Site and location: A-2 Heimbuch site, Oakes aquifer 280 feet south and 100 feet west of the east quarter corner of Section 26, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/84 by M. D. Sweeney (NDAES, Fargo, ND) and W. M. Schuh and R. Cline (NDSWC, Bismarck, ND).

Soil type and classification: Hamar loamy sand ; sandy, mixed, frigid typic Haplaquoll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Somewhat poor to poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: A-2 south side of pit.

Alp 0-3 inches (0-9 cm), black (10YR 2/1) loamy sand (sand); weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; abrupt smooth boundary.

A12 3-10 inches (9-26 cm), black (10YR 2/1) loamy sand; moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; clear smooth boundary.

Bg 10-22 inches (26-56 cm), very dark grayish brown (10YR 3/2) sand with few medium faint very dark brown (10YR 2/2) mottles which increase to common with depth; very weak coarse prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; clear wavy boundary.

Clg 22-43 inches (56-110 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with common medium prominent dark brown (7.5YR 3/4) and strong brown (7.5YR 5/6) mottles; very weak coarse prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; clear gradual boundary.

C2g 43-51 inches (110-131 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with many medium prominent strong brown (7.5YR 4/6) and common medium prominent black (N2/) mottles; very weak coarse prismatic structure; soft, very friable to loose, nonsticky and nonplastic, few very fine roots; clear wavy boundary.

C3g 51-62 inches (131-158 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with common medium prominent strong brown (7.5YR 4/6) mottles; very weak coarse prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; abrupt smooth boundary.

C4g 62-72 inches (158-183 cm), dark gray (5Y 4/1) sand (loamy sand); soft, very friable to loose, nonsticky and nonplastic.

Table A-2.2 HAMAR SERIES SITE A-2 NDSWC:1984
Soil partile-size, bulk density, and organic carbon data and indices.

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	4.1	3.7	4.0	8.2	41.5	35.0	3.3	0.1
23.	4.8	6.3	3.8	9.6	41.3	31.4	2.8	0.1
38.	4.4	2.9	3.5	7.0	42.6	36.1	3.4	0.1
52.	5.4	0.4	2.1	7.9	49.6	32.2	2.4	0.1
69.	3.3	1.1	2.2	6.8	49.8	34.1	2.8	0.0
84.	3.3	1.8	1.4	6.1	47.4	36.6	3.3	0.1
99.	2.2	2.2	1.5	4.4	45.1	41.8	2.8	0.1
114.	1.5	2.9	0.5	2.2	36.3	53.0	3.7	0.0
130.	2.2	2.5	0.0	2.6	39.5	50.4	2.6	0.1
160.	5.8	4.0	4.6	17.6	40.2	26.9	0.9	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	88.2	7.7	4.1	A 1 6	6=p
23.	85.1	10.1	4.8	A 1 2	8=g
38.	89.2	6.4	4.4	B 8	
52.	92.1	2.5	5.4	B 8	
69.	93.4	3.3	3.3	C 1 8	
84.	93.5	3.2	3.3	C 1 8	
99.	94.1	3.7	2.2	C 1 8	
114.	95.1	3.4	1.5	C 2 8	
130.	95.3	2.5	2.2	C 2 8	
160.	85.6	8.6	5.8	C 4 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	11.442	0.1538	3.8	0.0401	0.865	1.50	1.30
23.	8.436	0.1317	4.2	0.0310	0.763	1.44	1.30
38.	13.937	0.1589	3.8	0.0413	0.926	1.65	0.47
52.	36.880	0.1568	3.8	0.0408	1.100	1.61	0.23
69.	28.333	0.1759	3.2	0.0556	1.175	1.63	0.12
84.	29.219	0.1812	3.2	0.0559	1.164	1.60	0.12
99.	25.459	0.1981	2.9	0.0689	1.241	1.62	0.16
114.	28.000	0.2296	2.7	0.0862	1.375	1.58	0.02
130.	38.078	0.2183	2.9	0.0763	1.390	1.59	0.04
160.	9.953	0.1155	4.3	0.0271	0.755	1.57	0.04

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.495	2.588	-1.1849	2.5549	-11.85	1.17
23.	1.674	2.439	-1.1292	2.4708	-11.29	1.09
38.	1.385	3.354	-1.2085	2.5868	-12.08	1.21
52.	0.944	2.322	-1.2751	2.6738	-12.75	1.29
69.	1.065	2.371	-1.2882	2.7115	-12.88	1.33
84.	1.052	2.364	-1.2888	2.7115	-12.89	1.33
99.	1.117	5.388	-1.2955	2.7318	-12.95	1.35
114.	1.082	8.596	-1.3114	2.7608	-13.11	1.38
130.	0.961	7.836	-1.3170	2.7608	-13.17	1.38
160.	1.566	4.093	-1.1442	2.4824	-11.44	1.10

Table A-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site A, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
			Saturation Extract Soluble Ions meq/l					
0 - 15	0.9	0.6	0.1	0.8	-	1.0	.10	1.5
15 - 30	1.2	1.3	0.4	0.2	-	1.1	.10	2.0
30 - 46	1.6	1.0	0.6	0.2	-	0.9	.20	2.5
46 - 61	1.2	0.9	0.6	0.1	-	0.9	.15	1.9
61 - 76	0.9	1.0	0.4	0.2	-	0.9	.10	1.7
76 - 91	0.9	0.8	0.5	0.2	-	1.0	.18	1.3
91 - 106	0.7	0.6	0.5	0.06	-	0.5	.12	1.3
106 - 122	0.7	0.6	0.5	0.06	-	0.6	.15	1.1
122 - 137	0.7	0.6	0.5	0.06	-	0.5	.13	1.2
152 - 168	1.3	1.4	0.6	0.02	-	1.0	.22	2.1

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.22	0.2	27	6.8	-	s	4.2
15 - 30	0.21	0.4	28	6.9	-	ls	5.7
30 - 46	0.35	0.6	39	7.1	2.5	s	3.7
46 - 61	0.24	0.6	22	7.1	-	s	3.0
61 - 76	0.22	0.5	20	7.2	3.0	s	2.7
76 - 91	0.23	0.6	20	7.6	2.4	s	2.7
91 - 106	0.17	0.6	19	7.0	1.9	s	2.8
106 - 122	0.15	0.7	21	7.2	-	s	2.4
122 - 137	0.16	0.6	21	6.8	-	s	2.6
152 - 168	0.31	0.5	25	6.9	2.9	ls	4.9

Table A-2.4 HAMAR SERIES SITE A-2 NDSWC:84

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	23.			38.			53.			69.	
CM	CC/CC	SE									
10.	0.3856	0.0035	10.	0.4054	0.0154	10.	0.3356	0.0008	10.	0.3496	0.0044
20.	0.3573	0.0078	20.	0.3748	0.0055	20.	0.3243	0.0002	20.	0.3397	0.0092
40.	0.2872	0.0126	40.	0.2610	0.0054	40.	0.2184	0.0018	40.	0.2239	0.0004
60.	0.2280	0.0020	60.	0.2011	0.0013	60.	0.1591	0.0026	60.	0.1500	0.0003
80.	0.1959	0.0006	80.	0.1695	0.0004	80.	0.1284	0.0022	80.	0.1180	0.0003
100.	0.1799	0.0028	100.	0.1542	0.0014	100.	0.1126	0.0006	100.	0.1013	0.0014
120.	0.1666	0.0041	120.	0.1418	0.0000	120.	0.1036	0.0007	120.	0.0921	0.0014
180.	0.1463	0.0044	180.	0.1234	0.0007	180.	0.0901	0.0018	180.	0.0792	0.0001
340.	0.1033	0.0167	340.	0.1025	0.0008	340.	0.0758	0.0013	340.	0.0701	0.0001
534.	0.1141	0.0010	534.	0.0933	0.0005	534.	0.0713	0.0013	534.	0.0663	0.0007
834.	0.1064	0.0014	834.	0.0864	0.0009	834.	0.0683	0.0013	834.	0.0647	0.0004
BD =	1.44			1.65			1.61			1.63	
N =	2			2			2			2	

DEPTH (CM)

	84.			99.			114.			130.	
10.	0.3597	0.0064	10.	0.3538	0.0081	10.	0.3640	0.0026	10.	0.3590	0.0057
20.	0.3618	0.0049	20.	0.3471	0.0086	20.	0.3481	0.0086	20.	0.3612	0.0031
40.	0.2110	0.0036	40.	0.2113	0.0026	40.	0.1455	0.0037	40.	0.1534	0.0040
60.	0.1397	0.0038	60.	0.1399	0.0014	60.	0.1014	0.0018	60.	0.1055	0.0042
80.	0.1078	0.0029	80.	0.1072	0.0018	80.	0.0850	0.0006	80.	0.0892	0.0031
100.	0.0944	0.0027	100.	0.0945	0.0014	100.	0.0791	0.0006	100.	0.0826	0.0026
120.	0.0847	0.0021	120.	0.0871	0.0015	120.	0.0746	0.0005	120.	0.0767	0.0025
180.	0.0736	0.0014	180.	0.0774	0.0011	180.	0.0671	0.0006	180.	0.0686	0.0020
340.	0.0661	0.0003	340.	0.0692	0.0007	340.	0.0657	0.0026	340.	0.0612	0.0019
534.	0.0654	0.0008	534.	0.0647	0.0008	534.	0.0604	0.0001	534.	0.0597	0.0009
834.	0.0624	0.0018	834.	0.0655	0.0002	834.	0.0567	0.0007	834.	0.0560	0.0014
BD =	1.60			1.62			1.58			1.59	
N =	2			2			2			2	

DEPTH (CM)

	165.	
10.	0.3862	0.0023
20.	0.3561	0.0001
40.	0.2630	0.0125
60.	0.2210	0.0135
80.	0.1954	0.0134
100.	0.1819	0.0155
120.	0.1684	0.0133
180.	0.1511	0.0116
340.	0.1278	0.0089
534.	0.1188	0.0089
834.	0.1105	0.0073
BD =	1.57	
N =	2	

Table A-2.5 HAMAR SERIES SITE A-2 (NDSWC 1984)
In-situ K(θ,ψ) and θ(ψ), and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.4146	21.	2.07	0.73	0.36E+01	0.36E-02	0.98E+03
0.3	.3710	35.	3.47	0.73	0.93E+00	0.20E-02	0.47E+03
0.5	.3563	42.	4.12	0.77	0.58E+00	0.29E-02	0.20E+03
0.7	.3467	46.	4.47	0.83	0.34E+00	0.25E-02	0.14E+03
0.9	.3389	48.	4.72	0.87	0.35E+00	0.40E-02	0.88E+02
1.1	.3314	50.	4.94	0.82	0.32E+00	0.28E-02	0.12E+03
1.4	.3238	53.	5.18	0.76	0.28E+00	0.37E-02	0.77E+02
1.7	.3110	54.	5.32	0.80	0.33E+00	0.43E-01	0.76E+01
2.2	.2971	55.	5.40	0.83	0.20E+00	0.82E-02	0.24E+02
2.7	.2874	56.	5.52	0.78	0.17E+00	0.87E-02	0.19E+02
3.2	.2799	57.	5.59	0.77	0.12E+00	0.13E-01	0.99E+01
3.7	.2743	58.	5.67	0.77	0.95E-01	0.48E-02	0.20E+02
4.2	.2705	59.	5.74	0.76	0.57E-01	0.58E-02	0.10E+02
4.7	.2681	59.	5.79	0.75	0.39E-01	0.38E-02	0.10E+02
6.2	.2626	60.	5.84	0.73	0.38E-01	0.18E-01	0.21E+01
8.7	.2502	60.	5.90	0.70	0.68E-01	0.22E-01	0.30E+01
15.0	.2335	63.	6.18	0.74	0.18E-01	0.37E-02	0.49E+01

DOERING 1-STEP DATA

0.0	.1589	142.	13.91	83.33	0.97E-02	0.41E-03	0.24E+02
0.0	.1559	149.	14.66	83.33	0.95E-02	0.38E-03	0.25E+02
0.0	.1529	158.	15.47	83.33	0.93E-02	0.34E-03	0.27E+02
0.0	.1499	167.	16.37	83.33	0.91E-02	0.31E-03	0.29E+02
0.0	.1469	177.	17.35	83.33	0.89E-02	0.28E-03	0.31E+02
0.1	.1439	188.	18.44	83.33	0.87E-02	0.26E-03	0.34E+02
0.1	.1409	200.	19.64	83.33	0.85E-02	0.23E-03	0.37E+02
0.1	.1379	214.	20.98	83.33	0.83E-02	0.21E-03	0.40E+02
0.1	.1349	229.	22.48	83.33	0.81E-02	0.18E-03	0.44E+02
0.1	.1319	247.	24.17	83.33	0.79E-02	0.16E-03	0.48E+02
0.1	.1289	266.	26.08	83.33	0.77E-02	0.14E-03	0.54E+02
0.1	.1266	282.	27.69	83.33	0.76E-02	0.13E-03	0.58E+02
0.2	.1088	506.	49.56	83.33	0.19E-02	0.50E-04	0.39E+02

DEPTH 23. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3910	16.	1.59	0.73	0.10E+02	0.29E-02	0.35E+04
0.3	.3552	33.	3.23	0.73	0.27E+01	0.18E-02	0.15E+04
0.5	.3416	40.	3.93	0.77	0.17E+01	0.24E-02	0.71E+03
0.7	.3319	44.	4.34	0.83	0.11E+01	0.25E-02	0.44E+03
0.9	.3235	47.	4.62	0.87	0.11E+01	0.41E-02	0.26E+03
1.1	.3191	49.	4.80	0.82	0.67E+00	0.31E-03	0.22E+04
1.4	.3119	51.	5.00	0.76	0.10E+01	0.65E-02	0.16E+03
1.7	.2980	53.	5.17	0.80	0.92E+00	0.12E-01	0.79E+02
2.2	.2873	54.	5.27	0.83	0.53E+00	0.83E-02	0.64E+02
2.7	.2806	55.	5.35	0.78	0.45E+00	0.77E-02	0.58E+02
3.2	.2752	55.	5.42	0.77	0.35E+00	0.10E-01	0.35E+02
3.7	.2703	56.	5.49	0.77	0.29E+00	0.48E-02	0.60E+02

4.2	.2661	57.	5.56	0.76	0.19E+00	0.80E-02	0.23E+02
4.7	.2621	57.	5.60	0.75	0.17E+00	0.14E-01	0.12E+02
6.2	.2553	57.	5.63	0.73	0.12E+00	0.23E-01	0.50E+01
8.7	.2406	58.	5.68	0.70	0.22E+00	0.45E-01	0.50E+01
15.0	.2230	61.	5.98	0.74	0.51E-01	0.26E-02	0.19E+02
25.0	.2118	66.	6.51	0.80	0.21E-01	0.15E-02	0.14E+02

DOERING 1-STEP DATA

0.0	.1589	142.	13.91	83.33	0.97E-02	0.41E-03	0.24E+02
0.0	.1559	149.	14.66	83.33	0.95E-02	0.38E-03	0.25E+02
0.0	.1529	158.	15.47	83.33	0.93E-02	0.34E-03	0.27E+02
0.0	.1499	167.	16.37	83.33	0.91E-02	0.31E-03	0.29E+02
0.0	.1469	177.	17.35	83.33	0.89E-02	0.28E-03	0.31E+02
0.1	.1439	188.	18.44	83.33	0.87E-02	0.26E-03	0.34E+02
0.1	.1409	200.	19.64	83.33	0.85E-02	0.23E-03	0.37E+02
0.1	.1379	214.	20.98	83.33	0.83E-02	0.21E-03	0.40E+02
0.1	.1349	229.	22.48	83.33	0.81E-02	0.18E-03	0.44E+02
0.1	.1319	247.	24.17	83.33	0.79E-02	0.16E-03	0.48E+02
0.1	.1289	266.	26.08	83.33	0.77E-02	0.14E-03	0.54E+02
0.1	.1266	282.	27.69	83.33	0.76E-02	0.13E-03	0.58E+02
0.2	.1088	506.	49.56	83.33	0.19E-02	0.50E-04	0.39E+02

DEPTH 38. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3635	18.	1.79	1.53	0.72E+01	0.23E-02	0.31E+04
0.3	.3363	33.	3.25	1.29	0.25E+01	0.21E-02	0.12E+04
0.5	.3221	40.	3.89	1.17	0.19E+01	0.27E-02	0.68E+03
0.7	.3107	44.	4.29	1.11	0.15E+01	0.29E-02	0.50E+03
0.9	.3010	46.	4.55	1.04	0.15E+01	0.62E-02	0.25E+03
1.4	.2897	49.	4.76	0.92	0.16E+01	0.12E-01	0.14E+03
1.7	.2789	50.	4.87	0.80	0.13E+01	0.75E-02	0.18E+03
2.2	.2662	51.	4.95	0.74	0.11E+01	0.29E-01	0.38E+02
3.2	.2618	52.	5.06	0.76	0.56E+00	0.85E-02	0.67E+02
3.7	.2557	52.	5.12	0.74	0.53E+00	0.11E-01	0.48E+02
4.2	.2490	53.	5.17	0.71	0.42E+00	0.19E-01	0.22E+02
4.7	.2419	53.	5.20	0.72	0.42E+00	0.30E-01	0.14E+02
6.2	.2278	53.	5.22	0.72	0.24E+00	0.10E+00	0.23E+01
8.7	.2158	54.	5.29	0.78	0.29E+00	0.30E-02	0.97E+02
15.0	.2062	58.	5.65	0.82	0.75E-01	0.25E-02	0.30E+02
25.0	.1928	64.	6.24	0.84	0.37E-01	0.20E-02	0.18E+02
35.0	.1790	68.	6.69	0.77	0.27E-01	0.47E-02	0.57E+01
50.0	.1673	72.	7.03	0.65	0.19E-01	0.22E-02	0.87E+01
70.0	.1607	75.	7.38	0.59	0.29E-01	0.16E-02	0.18E+02
90.0	.1568	79.	7.70	0.52	0.12E-01	0.60E-03	0.19E+02

DEPTH 53. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3582	25.	2.43	1.08	0.12E+02	0.19E-02	0.65E+04
0.3	.3382	35.	3.43	0.92	0.49E+01	0.28E-02	0.18E+04
0.5	.3230	40.	3.92	0.87	0.37E+01	0.36E-02	0.10E+04
0.7	.3095	43.	4.25	0.83	0.30E+01	0.51E-02	0.59E+03
0.9	.2960	45.	4.45	0.83	0.30E+01	0.96E-02	0.31E+03
1.1	.2839	47.	4.58	0.90	0.11E+01	0.99E-02	0.11E+03
1.4	.2743	47.	4.65	0.94	0.22E+01	0.23E-01	0.95E+02
1.7	.2654	48.	4.70	0.97	0.14E+01	0.15E-01	0.93E+02

2.2	.2512	49.	4.76	1.00	0.14E+01	0.30E-01	0.46E+02
2.7	.2442	49.	4.82	0.99	0.15E+00	-.13E-01	-.12E+02
3.2	.2441	50.	4.87	0.98	0.62E+00	0.92E-02	0.67E+02
3.7	.2381	50.	4.92	0.98	0.60E+00	0.18E-01	0.34E+02
4.2	.2314	51.	4.96	0.99	0.51E+00	0.18E-01	0.29E+02
4.7	.2241	51.	4.99	0.99	0.54E+00	0.25E-01	0.21E+02
6.2	.2104	51.	5.01	0.99	0.30E+00	0.20E+00	0.15E+01
8.7	.2026	52.	5.10	0.96	0.24E+00	-.27E-02	-.89E+02
15.0	.2072	55.	5.41	0.85	0.82E-01	-.10E-02	-.78E+02
25.0	.1911	61.	5.96	0.78	0.86E-01	0.59E-02	0.15E+02
35.0	.1642	65.	6.36	0.78	0.59E-01	0.96E-02	0.61E+01
50.0	.1518	67.	6.59	0.75	0.24E-01	0.28E-02	0.85E+01
70.0	.1444	70.	6.87	0.73	0.30E-01	0.24E-02	0.13E+02
90.0	.1395	73.	7.14	0.72	0.11E-01	0.12E-02	0.92E+01

DEPTH 69. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3544	22.	2.11	0.50	0.29E+02	0.11E-02	0.27E+05
0.3	.3425	31.	3.00	0.54	0.10E+02	0.20E-02	0.50E+04
0.5	.3305	36.	3.52	0.60	0.69E+01	0.30E-02	0.23E+04
0.7	.3181	39.	3.85	0.64	0.55E+01	0.51E-02	0.11E+04
0.9	.3034	42.	4.09	0.69	0.53E+01	0.74E-02	0.72E+03
1.1	.2886	43.	4.25	0.67	0.27E+01	0.13E-01	0.21E+03
1.4	.2765	45.	4.36	0.69	0.37E+01	0.89E-02	0.42E+03
1.7	.2644	46.	4.50	0.77	0.22E+01	0.88E-02	0.25E+03
2.2	.2534	47.	4.62	0.82	0.22E+01	0.11E-01	0.20E+03
2.7	.2457	48.	4.70	0.85	0.19E+00	0.95E-02	0.20E+02
3.2	.2398	49.	4.77	0.89	0.87E+00	0.67E-02	0.13E+03
3.7	.2351	49.	4.83	0.91	0.83E+00	0.90E-02	0.92E+02
4.2	.2301	50.	4.88	0.91	0.77E+00	0.11E-01	0.71E+02
4.7	.2234	50.	4.93	0.92	0.85E+00	0.23E-01	0.37E+02
6.2	.2131	51.	4.95	0.93	0.43E+00	0.63E-01	0.68E+01
8.7	.2009	51.	5.00	0.90	0.28E+00	0.18E-01	0.15E+02
25.0	.1884	58.	5.69	0.86	0.14E+00	0.55E-02	0.25E+02
35.0	.1708	62.	6.07	0.82	0.75E-01	0.20E-02	0.37E+02
50.0	.1649	64.	6.29	0.86	0.28E-01	0.30E-02	0.94E+01
70.0	.1575	67.	6.56	0.84	0.33E-01	0.26E-02	0.13E+02
90.0	.1526	69.	6.79	0.82	0.12E-01	0.16E-02	0.77E+01

DOERING 1-STEP DATA

0.2	.1762	60.	5.84	83.33	0.77E-01	0.19E-02	0.40E+02
0.2	.1610	69.	6.73	83.33	0.47E-01	0.15E-02	0.32E+02
0.3	.1500	77.	7.54	83.33	0.32E-01	0.12E-02	0.27E+02
0.3	.1415	85.	8.31	83.33	0.23E-01	0.10E-02	0.23E+02
0.4	.1347	92.	9.03	83.33	0.17E-01	0.85E-03	0.20E+02
0.4	.1291	99.	9.72	83.33	0.13E-01	0.74E-03	0.18E+02
0.5	.1244	106.	10.38	83.33	0.11E-01	0.66E-03	0.16E+02
0.5	.1203	112.	11.01	83.33	0.86E-02	0.59E-03	0.15E+02
0.6	.1168	119.	11.62	83.33	0.71E-02	0.53E-03	0.13E+02
0.6	.1138	125.	12.21	83.33	0.60E-02	0.49E-03	0.12E+02
0.7	.1110	130.	12.79	83.33	0.51E-02	0.45E-03	0.11E+02
0.7	.1086	136.	13.35	83.33	0.44E-02	0.41E-03	0.11E+02
0.8	.1064	142.	13.89	83.33	0.38E-02	0.38E-03	0.10E+02
0.8	.1044	147.	14.42	83.33	0.34E-02	0.36E-03	0.94E+01
0.9	.1025	152.	14.94	83.33	0.30E-02	0.33E-03	0.89E+01
0.9	.1008	158.	15.45	83.33	0.27E-02	0.31E-03	0.84E+01
1.0	.0993	163.	15.95	83.33	0.24E-02	0.30E-03	0.80E+01

1.0	.0979	168.	16.44	83.33	0.21E-02	0.28E-03	0.76E+01
1.1	.0965	173.	16.92	83.33	0.19E-02	0.27E-03	0.73E+01
1.1	.0953	177.	17.39	83.33	0.18E-02	0.25E-03	0.70E+01
1.2	.0941	182.	17.85	83.33	0.16E-02	0.24E-03	0.67E+01

DEPTH 69. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.0930	187.	18.31	83.33	0.15E-02	0.23E-03	0.64E+01
1.3	.0920	191.	18.76	83.33	0.14E-02	0.22E-03	0.62E+01
1.3	.0910	196.	19.20	83.33	0.13E-02	0.21E-03	0.60E+01
1.4	.0901	200.	19.63	83.33	0.12E-02	0.20E-03	0.58E+01
1.4	.0892	205.	20.06	83.33	0.11E-02	0.19E-03	0.56E+01
1.5	.0884	209.	20.49	83.33	0.10E-02	0.19E-03	0.54E+01
1.5	.0876	213.	20.91	83.33	0.93E-03	0.18E-03	0.52E+01
1.6	.0869	217.	21.32	83.33	0.87E-03	0.17E-03	0.51E+01
1.6	.0862	222.	21.73	83.33	0.82E-03	0.17E-03	0.49E+01
1.7	.0855	226.	22.13	83.33	0.77E-03	0.16E-03	0.48E+01
1.7	.0849	230.	22.53	83.33	0.72E-03	0.16E-03	0.46E+01
1.8	.0842	234.	22.93	83.33	0.68E-03	0.15E-03	0.45E+01
1.8	.0836	238.	23.32	83.33	0.64E-03	0.15E-03	0.44E+01
1.9	.0831	242.	23.70	83.33	0.61E-03	0.14E-03	0.43E+01
1.9	.0825	246.	24.09	83.33	0.57E-03	0.14E-03	0.42E+01
2.0	.0820	250.	24.46	83.33	0.54E-03	0.13E-03	0.41E+01
2.0	.0815	253.	24.84	83.33	0.52E-03	0.13E-03	0.40E+01
2.1	.0810	257.	25.21	83.33	0.49E-03	0.13E-03	0.39E+01
4.1	.0695	391.	38.35	83.33	0.12E-03	0.58E-04	0.20E+01

DEPTH 84. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3526	19.	1.84	1.07	0.14E+02	0.98E-03	0.15E+05
0.3	.3438	27.	2.63	0.94	0.67E+01	0.15E-02	0.46E+04
0.5	.3346	32.	3.11	0.84	0.60E+01	0.28E-02	0.22E+04
0.7	.3250	35.	3.42	0.79	0.55E+01	0.34E-02	0.16E+04
0.9	.3143	37.	3.67	0.75	0.63E+01	0.53E-02	0.12E+04
1.1	.3021	39.	3.85	0.79	0.35E+01	0.99E-02	0.36E+03
1.4	.2876	41.	4.03	0.86	0.38E+01	0.73E-02	0.52E+03
1.7	.2716	43.	4.22	0.84	0.25E+01	0.10E-01	0.24E+03
2.2	.2586	44.	4.34	0.81	0.26E+01	0.10E-01	0.25E+03
2.7	.2496	45.	4.44	0.81	0.47E+00	0.79E-02	0.60E+02
3.2	.2428	46.	4.53	0.79	0.12E+01	0.76E-02	0.16E+03
3.7	.2375	47.	4.59	0.77	0.12E+01	0.10E-01	0.12E+03
4.7	.2361	48.	4.67	0.75	0.19E+01	0.94E-01	0.20E+02
6.2	.2120	48.	4.71	0.74	0.65E+00	0.38E-01	0.17E+02
8.7	.1982	48.	4.74	0.76	0.42E+00	0.42E-01	0.10E+02
15.0	.1860	51.	4.97	0.79	0.77E-01	0.27E-02	0.28E+02
25.0	.1769	55.	5.41	0.77	0.19E+00	0.14E-02	0.14E+03
35.0	.1708	58.	5.71	0.70	0.98E-01	0.39E-02	0.25E+02
50.0	.1633	61.	5.94	0.67	0.46E-01	0.30E-02	0.15E+02
70.0	.1570	63.	6.19	0.67	0.46E-01	0.19E-02	0.25E+02
90.0	.1547	65.	6.40	0.65	0.18E-01	0.32E-03	0.55E+02

DOERING 1-STEP DATA

0.2	.1762	53.	5.19	83.33	0.92E-01	0.23E-02	0.40E+02
0.2	.1610	61.	5.93	83.33	0.56E-01	0.17E-02	0.32E+02
0.3	.1500	68.	6.62	83.33	0.37E-01	0.14E-02	0.27E+02

0.3	.1415	74.	7.27	83.33	0.27E-01	0.12E-02	0.23E+02
0.4	.1347	81.	7.89	83.33	0.20E-01	0.99E-03	0.20E+02
0.4	.1291	87.	8.49	83.33	0.15E-01	0.86E-03	0.18E+02
0.5	.1244	92.	9.06	83.33	0.12E-01	0.76E-03	0.16E+02
0.5	.1203	98.	9.61	83.33	0.97E-02	0.67E-03	0.15E+02
0.6	.1168	104.	10.15	83.33	0.80E-02	0.60E-03	0.13E+02
0.6	.1138	109.	10.68	83.33	0.67E-02	0.55E-03	0.12E+02
0.7	.1110	114.	11.19	83.33	0.57E-02	0.50E-03	0.11E+02
0.7	.1086	119.	11.70	83.33	0.49E-02	0.46E-03	0.11E+02

DEPTH 84. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.1064	124.	12.19	83.33	0.42E-02	0.42E-03	0.10E+02
0.8	.1044	129.	12.68	83.33	0.37E-02	0.39E-03	0.94E+01
0.9	.1025	134.	13.16	83.33	0.32E-02	0.36E-03	0.89E+01
0.9	.1008	139.	13.63	83.33	0.28E-02	0.34E-03	0.84E+01
1.0	.0993	144.	14.10	83.33	0.25E-02	0.31E-03	0.80E+01
1.0	.0979	149.	14.56	83.33	0.23E-02	0.30E-03	0.76E+01
1.1	.0965	153.	15.02	83.33	0.20E-02	0.28E-03	0.73E+01
1.1	.0953	158.	15.47	83.33	0.18E-02	0.26E-03	0.70E+01
1.2	.0941	162.	15.92	83.33	0.17E-02	0.25E-03	0.67E+01
1.2	.0930	167.	16.36	83.33	0.15E-02	0.23E-03	0.64E+01
1.3	.0920	171.	16.81	83.33	0.14E-02	0.22E-03	0.62E+01
1.3	.0910	176.	17.24	83.33	0.13E-02	0.21E-03	0.60E+01
1.4	.0901	180.	17.68	83.33	0.12E-02	0.20E-03	0.58E+01
1.4	.0892	185.	18.11	83.33	0.11E-02	0.19E-03	0.56E+01
1.5	.0884	189.	18.54	83.33	0.99E-03	0.18E-03	0.54E+01
1.5	.0876	193.	18.97	83.33	0.91E-03	0.18E-03	0.52E+01
1.6	.0869	198.	19.39	83.33	0.85E-03	0.17E-03	0.51E+01
1.6	.0862	202.	19.82	83.33	0.79E-03	0.16E-03	0.49E+01
1.7	.0855	206.	20.24	83.33	0.73E-03	0.15E-03	0.48E+01
1.7	.0849	211.	20.66	83.33	0.68E-03	0.15E-03	0.46E+01
1.8	.0842	215.	21.08	83.33	0.64E-03	0.14E-03	0.45E+01
1.8	.0836	219.	21.49	83.33	0.60E-03	0.14E-03	0.44E+01
1.9	.0831	223.	21.91	83.33	0.56E-03	0.13E-03	0.43E+01
1.9	.0825	228.	22.32	83.33	0.53E-03	0.13E-03	0.42E+01
2.0	.0820	232.	22.74	83.33	0.50E-03	0.12E-03	0.41E+01
2.0	.0815	236.	23.15	83.33	0.47E-03	0.12E-03	0.40E+01
2.1	.0810	240.	23.56	83.33	0.44E-03	0.11E-03	0.39E+01
4.1	.0695	412.	40.40	83.33	0.79E-04	0.39E-04	0.20E+01

DEPTH 99. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3720	14.	1.40	0.40	0.40E+02	0.13E-02	0.30E+05
0.3	.3643	21.	2.01	0.33	0.21E+02	0.13E-02	0.16E+05
0.5	.3558	26.	2.50	0.40	0.14E+02	0.31E-02	0.46E+04
0.7	.3465	29.	2.80	0.42	0.12E+02	0.33E-02	0.37E+04
0.9	.3372	31.	3.04	0.43	0.13E+02	0.49E-02	0.26E+04
1.1	.3247	33.	3.26	0.45	0.85E+01	0.67E-02	0.13E+04
1.4	.3040	36.	3.50	0.47	0.93E+01	0.11E-01	0.88E+03
1.7	.2760	38.	3.73	0.53	0.52E+01	0.15E-01	0.35E+03
2.2	.2541	40.	3.91	0.63	0.39E+01	0.94E-02	0.42E+03
2.7	.2416	41.	4.04	0.67	0.10E+01	0.11E-01	0.91E+02
3.2	.2322	42.	4.12	0.67	0.17E+01	0.16E-01	0.11E+03
3.7	.2248	43.	4.17	0.67	0.16E+01	0.14E-01	0.11E+03
4.7	.2223	43.	4.25	0.69	0.35E+01	0.91E-01	0.38E+02

6.2	.2001	44.	4.29	0.70	0.81E+00	0.25E-01	0.32E+02
8.7	.1887	44.	4.34	0.69	0.57E+00	0.25E-01	0.22E+02
15.0	.1762	47.	4.57	0.68	0.12E+00	0.34E-02	0.35E+02
25.0	.1639	51.	4.96	0.63	0.25E+00	0.28E-02	0.92E+02
35.0	.1558	53.	5.20	0.62	0.13E+00	0.53E-02	0.24E+02
50.0	.1491	55.	5.40	0.62	0.60E-01	0.24E-02	0.25E+02
70.0	.1440	58.	5.64	0.60	0.57E-01	0.18E-02	0.32E+02
90.0	.1420	59.	5.81	0.57	0.21E-01	0.33E-03	0.64E+02

DEPTH 114. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3960	6.	0.60	0.40	0.41E+02	0.12E-02	0.33E+05
0.3	.3910	9.	0.87	0.27	0.28E+02	0.99E-03	0.28E+05
0.5	.3856	13.	1.32	0.17	0.38E+02	0.17E-02	0.22E+05
0.7	.3793	17.	1.70	0.20	0.28E+02	0.22E-02	0.13E+05
0.9	.3723	20.	1.98	0.22	0.29E+02	0.33E-02	0.87E+04
1.1	.3629	23.	2.23	0.23	0.21E+02	0.45E-02	0.46E+04
1.4	.3472	26.	2.50	0.25	0.22E+02	0.73E-02	0.30E+04
1.7	.3193	29.	2.85	0.34	0.11E+02	0.89E-02	0.13E+04
2.2	.2894	33.	3.22	0.47	0.65E+01	0.81E-02	0.81E+03
2.7	.2664	36.	3.49	0.60	0.19E+01	0.11E-01	0.18E+03
3.2	.2472	37.	3.66	0.72	0.21E+01	0.13E-01	0.16E+03
3.7	.2300	38.	3.76	0.79	0.18E+01	0.23E-01	0.79E+02
1.4	.1074	99.	9.74	83.33	0.54E-02	0.66E-03	0.81E+01
1.4	.1047	104.	10.16	83.33	0.48E-02	0.61E-03	0.79E+01
1.5	.1021	108.	10.59	83.33	0.43E-02	0.56E-03	0.76E+01
1.5	.0997	112.	11.02	83.33	0.38E-02	0.52E-03	0.74E+01
1.6	.0974	117.	11.47	83.33	0.35E-02	0.48E-03	0.71E+01
1.6	.0953	122.	11.92	83.33	0.31E-02	0.45E-03	0.69E+01
1.7	.0932	126.	12.38	83.33	0.28E-02	0.42E-03	0.67E+01
1.7	.0913	131.	12.85	83.33	0.26E-02	0.39E-03	0.65E+01
1.8	.0895	136.	13.32	83.33	0.23E-02	0.37E-03	0.64E+01
1.8	.0877	141.	13.81	83.33	0.21E-02	0.34E-03	0.62E+01
1.9	.0860	146.	14.30	83.33	0.19E-02	0.32E-03	0.60E+01
1.9	.0844	151.	14.81	83.33	0.18E-02	0.30E-03	0.59E+01
2.0	.0829	156.	15.32	83.33	0.16E-02	0.28E-03	0.57E+01
2.0	.0814	162.	15.84	83.33	0.15E-02	0.27E-03	0.56E+01
2.1	.0800	167.	16.37	83.33	0.14E-02	0.25E-03	0.55E+01
2.1	.0787	173.	16.92	83.33	0.13E-02	0.23E-03	0.53E+01
2.2	.0774	178.	17.47	83.33	0.12E-02	0.22E-03	0.52E+01
2.2	.0762	184.	18.04	83.33	0.11E-02	0.21E-03	0.51E+01
2.3	.0750	190.	18.61	83.33	0.98E-03	0.20E-03	0.50E+01
2.3	.0739	196.	19.20	83.33	0.90E-03	0.19E-03	0.49E+01
2.4	.0728	202.	19.80	83.33	0.84E-03	0.17E-03	0.48E+01
2.4	.0717	208.	20.41	83.33	0.77E-03	0.17E-03	0.47E+01
2.5	.0707	215.	21.04	83.33	0.72E-03	0.16E-03	0.46E+01
2.5	.0697	221.	21.67	83.33	0.67E-03	0.15E-03	0.45E+01
2.6	.0687	228.	22.32	83.33	0.62E-03	0.14E-03	0.44E+01
2.6	.0678	234.	22.99	83.33	0.57E-03	0.13E-03	0.43E+01
2.7	.0669	241.	23.67	83.33	0.53E-03	0.13E-03	0.43E+01
2.7	.0661	248.	24.36	83.33	0.50E-03	0.12E-03	0.42E+01
2.8	.0652	256.	25.07	83.33	0.46E-03	0.11E-03	0.41E+01
2.8	.0644	263.	25.79	83.33	0.43E-03	0.11E-03	0.40E+01
2.9	.0636	271.	26.53	83.33	0.40E-03	0.10E-03	0.40E+01
2.9	.0629	278.	27.29	83.33	0.38E-03	0.96E-04	0.39E+01
3.0	.0621	286.	28.06	83.33	0.35E-03	0.91E-04	0.38E+01
3.0	.0614	294.	28.85	83.33	0.33E-03	0.87E-04	0.38E+01
3.1	.0607	303.	29.66	83.33	0.31E-03	0.82E-04	0.37E+01

DEPTH 130. CM SITE A-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3921	2.	0.23	0.17	0.40E+02	0.34E-03	0.12E+06
0.7	.3909	6.	0.57	0.15	0.39E+02	0.36E-03	0.11E+06
0.9	.3896	6.	0.54	0.17	0.39E+02	0.62E-03	0.63E+05
1.1	.3880	9.	0.92	0.18	0.29E+02	0.56E-03	0.52E+05
1.4	.3857	13.	1.26	0.20	0.31E+02	0.10E-02	0.30E+05
1.7	.3768	17.	1.68	0.20	0.23E+02	0.29E-02	0.77E+04
2.2	.3584	22.	2.17	0.20	0.19E+02	0.55E-02	0.34E+04
2.7	.3362	26.	2.59	0.27	0.69E+01	0.56E-02	0.12E+04
3.2	.3141	31.	3.00	0.43	0.49E+01	0.63E-02	0.78E+03
3.7	.2907	34.	3.29	0.60	0.35E+01	0.13E-01	0.28E+03
4.2	.2663	36.	3.50	0.73	0.67E+00	0.12E-01	0.57E+02
4.7	.2423	38.	3.68	0.83	0.43E+01	0.16E-01	0.26E+03
6.2	.2174	39.	3.84	0.92	0.83E+00	0.15E-01	0.57E+02
8.7	.1964	41.	4.02	1.02	0.53E+00	0.95E-02	0.56E+02
15.0	.1794	44.	4.28	1.07	0.12E+00	0.50E-02	0.25E+02
25.0	.1674	48.	4.71	1.22	0.15E+00	0.13E-02	0.12E+03
35.0	.1620	52.	5.11	1.45	0.64E-01	0.15E-02	0.44E+02
50.0	.1566	55.	5.39	1.60	0.29E-01	0.23E-02	0.13E+02
70.0	.1504	59.	5.74	1.83	0.22E-01	0.12E-02	0.18E+02
90.0	.1501	62.	6.10	2.07	0.41E-02	-.16E-02	-.26E+01

DOERING 1-STEP DATA

5.1	.1495	63.	6.20	83.33	0.43E-02	0.16E-02	0.27E+01
7.2	.1196	90.	8.79	83.33	0.16E-02	0.82E-03	0.20E+01
11.2	.0923	140.	13.75	83.33	0.46E-03	0.36E-03	0.13E+01
15.2	.0791	189.	18.55	83.33	0.20E-03	0.20E-03	0.95E+00
19.2	.0713	236.	23.13	83.33	0.10E-03	0.14E-03	0.76E+00
23.2	.0662	281.	27.52	83.33	0.63E-04	0.98E-04	0.64E+00
27.2	.0625	323.	31.70	83.33	0.42E-04	0.76E-04	0.55E+00
31.2	.0598	364.	35.68	83.33	0.30E-04	0.61E-04	0.49E+00
35.2	.0576	403.	39.48	83.33	0.22E-04	0.50E-04	0.44E+00
39.2	.0559	440.	43.10	83.33	0.17E-04	0.43E-04	0.40E+00
43.2	.0545	475.	46.56	83.33	0.13E-04	0.37E-04	0.36E+00

SITE B (HECLA SERIES)

Site B was located in the nonirrigated corner of a center-pivot irrigated potato field, and was covered with a young cover-crop of winter barley. The location and description are summarized on Table 1. According to the La Moure County (ND) Soil Survey Report (USDA, 1971) the Hecla soil series consists of "deep, moderately well drained, level to gently undulating soils on sandy lake plains and on sandy uplands and terraces in the James River Valley". They were "formed in coarse-textured deposits left by glacial melt water and reworked by wind". Hecla soils are associated with Hamar, Maddock, and Ulen soils. The specific site measured (location Fig. 2) was located on a slightly elevated position associated at close distance with a Hamar soils.

In-situ measurements and site descriptions were made during late September and October, 1984. Temperatures were frequently below freezing at night, and to sustain measurements, 6 mil polyethylene tents were constructed over the site and were heated at night with portable propane heaters. The measurment period was concurrent with sites A and C which were located nearby. Soil samples and soil profile descriptions were made approximately two weeks after the completion of soil hydraulic measurements. Although measurements were made for more than two weeks, drainage was nearly complete at 7 days.

SITE B, REPLICATION 1

Table B-1.1 Soil morphologic data for Site B replication 1.

Site and location: B-1 Heimbuch site, Oakes aquifer 280 feet south and 170 feet west of the east quarter corner of Section 26, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/84 by M. D. Sweeney (NDAES, Fargo, ND) and W. M. Schuh and R. Cline (NDSWC, Bismarck, ND).

Soil type and classification: Hecla loamy sand ; sandy, mixed aquic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Moderately well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: B-1 east side of pit.

Alp 0-4 inches (0-10 cm), black (lOYR 2/1) loamy sand (sand); weak medium and fine subangular block structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; abrupt smooth boundary.

A12 4-13 inches (10-34 cm), black (lOYR 2/1) loamy sand (sand); moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and non plastic; common very fine roots; clear wavy boundary.

Bw 13-23 inches (34-60 cm), very dark grayish brown (lOYR 3/2) sand; weak coarse and medium prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; clear wavy boundary.

C 23-34 inches (60-86 cm), light olive brown (2.5Y 4/4) sand (fine sand) with few fine distinct dark yellowish brown (lOYR 4/4) mottles which increase to common with depth; weak, coarse and medium prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; gradual wavy boundary.

Cg 34-60 inches (86-150 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with common medium distinct dark brown (7.5YR 3/4) and common fine distinct very dark brown (lOYR 2/2) mottles; weak coarse and medium prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots.

Table B-1.2 HECLA SERIES SITE B-1 NDSWC:1984
particle-size, bulk density, and organic carbon
data and indices

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	4.8	3.3	2.7	9.1	47.1	30.8	2.2	0.0
23.	3.3	3.3	1.8	8.0	47.8	33.0	2.7	0.0
38.	4.4	0.0	3.2	8.2	48.5	33.2	2.5	0.0
53.	2.5	0.7	4.5	9.7	51.0	29.1	2.4	0.0
69.	4.3	0.0	2.4	8.0	51.5	31.8	1.9	0.0
84.	2.9	2.5	1.1	7.5	51.6	32.8	1.5	0.0
99.	0.0	4.7	0.7	6.5	51.4	35.7	1.4	0.0
114.	2.2	1.1	1.9	5.7	48.3	39.2	1.7	0.0
130.	1.1	2.2	1.8	7.5	54.0	32.3	1.2	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	89.2	6.0	4.8	A 1 6	6 = p
23.	91.6	5.1	3.3	A 1 2	7 = w
38.	92.4	3.2	4.4	B 7	8 = g
53.	92.3	5.2	2.5	B 7	
69.	93.3	2.4	4.3	C	
84.	93.5	3.6	2.9	C	
99.	95.0	5.4	0.0	C 8	
114.	94.8	3.0	2.2	C 8	
130.	95.0	4.0	1.0	C 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	14.867	0.1443	3.9	0.0369	0.934	1.58	0.64
23.	17.941	0.1638	3.4	0.0484	1.038	1.58	0.31
38.	28.875	0.1650	3.5	0.0474	1.097	1.56	0.31
53.	17.731	0.1674	2.9	0.0579	1.098	1.54	0.12
69.	38.833	0.1653	3.4	0.0488	1.181	1.49	0.08
84.	25.944	0.1704	3.1	0.0552	1.190	1.53	0.20
99.	17.593	0.1913	2.2	0.0859	1.551	1.57	0.04
114.	31.633	0.1932	2.7	0.0706	1.279	1.57	0.08
130.	23.750	0.1843	2.4	0.0766	1.296	1.63	0.02

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER CM/DAY-KPA		K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR	
cm	GOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.349	3.167	-1.2110	2.5868	-12.11	1.21
23.	1.265	3.988	-1.2489	2.6535	-12.49	1.27
38.	1.048	4.187	-1.2734	2.6796	-12.73	1.30
53.	1.276	5.017	-1.2580	2.6738	-12.58	1.29
69.	0.935	5.798	-1.2897	2.7028	-12.90	1.32
84.	1.104	4.939	-1.2849	2.7086	-12.85	1.33
99.	1.293	8.958	-1.2960	2.7550	-12.96	1.37
114.	1.030	6.329	-1.3097	2.7521	-13.10	1.37
130.	1.153	7.995	-1.3048	2.7550	-13.05	1.37

Table B-1.3. Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site B replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
	Saturation Extract Soluble Ions meq/l							
0 - 15	2.3	1.1	0.7	0.3	-	3.0	0.23	1.2
15 - 30	1.7	1.6	0.5	0.2	-	2.6	0.10	1.5
30 - 46	1.7	1.3	0.7	0.2	-	1.4	0.13	2.5
46 - 61	1.0	0.9	0.6	0.2	-	0.8	0.12	1.8
61 - 76	0.9	0.7	0.6	0.1	-	0.6	0.15	1.7
76 - 91	1.1	0.6	0.6	0.2	-	1.1	0.13	1.4
91 - 106	1.0	0.6	0.6	0.1	-	0.7	0.15	1.6
106 - 122	0.8	0.6	0.6	0.1	-	0.8	0.10	1.3
122 - 137	0.9	0.5	0.7	0.1	-	0.6	0.15	1.5

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.37	0.6	29	7.3	-	s	4.6
15 - 30	0.34	0.4	26	7.1	3.4	s	3.8
30 - 46	0.30	0.6	24	7.2	1.9	s	2.8
46 - 61	0.23	0.7	21	7.5	1.2	fs	2.8
61 - 76	0.16	0.7	21	7.3	1.7	fs	2.7
76 - 91	0.21	0.7	22	7.3	2.4	fs	3.1
91 - 106	0.19	0.7	18	7.6	2.9	fs	2.9
106 - 122	0.18	0.7	20	7.2	2.9	s	2.7
122 - 137	0.19	0.8	22	7.4	2.4	fs	3.0

Table B-1.4 HECLA SERIES SITE B-1 NDSWC:84

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	23.			38.			53.			69.	
CM	CC/CC	SE									
10.	0.3418	0.0048	10.	0.3616	0.0115	10.	0.3293	******	10.	0.3392	0.0104
20.	0.3284	0.0048	20.	0.3480	0.0125	20.	0.3162	******	20.	0.3298	0.0077
40.	0.2556	0.0017	40.	0.2239	0.0048	40.	0.2098	******	40.	0.2062	0.0029
60.	0.2028	0.0013	60.	0.1680	0.0057	60.	0.1486	******	60.	0.1344	0.0002
80.	0.1709	0.0008	80.	0.1369	0.0051	80.	0.1166	******	80.	0.1017	0.0000
100.	0.1501	0.0002	100.	0.1203	0.0051	100.	0.1020	******	100.	0.0854	0.0001
120.	0.1360	0.0003	120.	0.1097	0.0050	120.	0.0918	******	120.	0.0776	0.0004
180.	0.1152	0.0004	180.	0.0946	0.0050	180.	0.0758	******	180.	0.0669	0.0007
340.	0.0944	0.0004	340.	0.0787	0.0044	340.	0.0641	******	340.	0.0590	0.0000
534.	0.0847	0.0009	534.	0.0726	0.0034	534.	0.0612	******	534.	0.0555	0.0004
800.	0.0817	0.0009	800.	0.0673	0.0039	800.	0.0583	******	800.	0.0533	0.0002
BD =	1.58			1.58			1.54			1.49	
N =	2			2			1			2	

DEPTH (CM)

	84.			99.			114.			130.	
10.	0.3473	******	10.	0.3427	0.0100	10.	0.3202	******	10.	0.3482	0.0041
20.	0.3326	******	20.	0.3324	0.0110	20.	0.3100	******	20.	0.3413	0.0024
40.	0.2266	******	40.	0.2228	0.0040	40.	0.2125	******	40.	0.2365	0.0018
60.	0.1472	******	60.	0.1480	0.0001	60.	0.1353	******	60.	0.1515	0.0015
80.	0.1163	******	80.	0.1140	0.0003	80.	0.1033	******	80.	0.1149	0.0055
100.	0.1030	******	100.	0.0984	0.0009	100.	0.0888	******	100.	0.0980	0.0042
120.	0.0927	******	120.	0.0895	0.0000	120.	0.0815	******	120.	0.0896	0.0047
180.	0.0795	******	180.	0.0777	0.0010	180.	0.0699	******	180.	0.0796	0.0030
340.	0.0677	******	340.	0.0673	0.0009	340.	0.0626	******	340.	0.0720	0.0018
534.	0.0633	******	534.	0.0651	0.0004	534.	0.0582	******	534.	0.0674	0.0018
800.	0.0618	******	800.	0.0636	0.0004	800.	0.0582	******	800.	0.0674	0.0018
BD =	1.53			1.57			1.55			1.63	
N =	1			2			1			2	

Table B-1.5 HECLA SANDY LOAM SITE B-1 (NDSWC 1984)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 7. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3904	23.	2.24	0.75	0.22E+01	0.27E-02	0.80E+03
0.7	.3757	30.	2.99	0.82	0.69E+00	0.11E-02	0.64E+03
0.9	.3632	36.	3.49	0.75	0.18E+01	0.58E-02	0.30E+03
0.9	.3471	38.	3.69	0.77	0.14E+01	0.15E-01	0.98E+02
1.0	.3355	39.	3.84	0.77	0.86E+00	0.44E-02	0.20E+03
1.2	.3282	41.	3.99	0.75	0.59E+00	0.59E-02	0.10E+03
1.3	.3216	42.	4.14	0.71	0.50E+00	0.36E-02	0.14E+03
1.4	.3151	44.	4.31	0.65	0.45E+00	0.39E-02	0.12E+03
1.6	.3080	47.	4.56	0.54	0.38E+00	0.24E-02	0.16E+03
1.9	.3019	49.	4.81	0.46	0.33E+00	0.27E-02	0.12E+03
2.1	.2979	51.	4.96	0.43	0.27E+00	0.26E-02	0.11E+03
2.4	.2931	52.	5.11	0.39	0.44E+00	0.39E-02	0.12E+03
2.7	.2828	54.	5.26	0.38	0.57E+00	0.98E-02	0.59E+02
3.2	.2707	55.	5.39	0.39	0.36E+00	0.96E-02	0.38E+02
3.7	.2640	56.	5.49	0.38	0.15E+00	0.38E-02	0.39E+02
4.2	.2612	57.	5.56	0.37	0.76E-01	0.38E-02	0.20E+02
4.7	.2567	58.	5.66	0.33	0.32E+00	0.46E-02	0.68E+02
7.5	.2438	60.	5.86	0.30	0.96E-01	0.76E-02	0.13E+02
12.5	.2268	63.	6.16	0.29	0.78E-01	0.43E-02	0.18E+02
17.5	.2136	66.	6.49	0.31	0.55E-01	0.38E-02	0.15E+02
22.5	.2042	69.	6.79	0.34	0.33E-01	0.25E-02	0.13E+02
27.5	.1979	72.	7.06	0.36	0.21E-01	0.20E-02	0.11E+02
35.0	.1932	75.	7.34	0.37	0.88E-02	0.15E-02	0.60E+01
43.0	.1904	77.	7.59	0.41	0.38E-02	0.63E-03	0.61E+01
53.0	.1889	80.	7.89	0.36	0.28E-02	0.47E-03	0.60E+01
65.0	.1870	84.	8.19	0.27	0.52E-02	0.94E-03	0.55E+01
75.0	.1857	85.	8.36	0.26	0.18E-02	0.42E-03	0.44E+01
85.0	.1832	87.	8.49	0.25	0.13E-01	0.44E-02	0.29E+01
95.0	.1798	88.	8.61	0.25	0.74E-02	0.17E-02	0.44E+01
105.0	.1776	89.	8.71	0.26	0.55E-02	0.38E-02	0.15E+01
115.0	.1760	90.	8.79	0.27	0.35E-02	0.13E-02	0.28E+01
125.0	.1741	91.	8.89	0.27	0.69E-02	0.25E-02	0.28E+01
135.0	.1716	92.	9.01	0.29	0.65E-02	0.17E-02	0.39E+01

DEPTH 22. CM SITE B-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3787	20.	1.97	0.75	0.58E+01	0.14E-02	0.41E+04
0.7	.3677	29.	2.83	0.82	0.21E+01	0.13E-02	0.16E+04
0.9	.3571	34.	3.29	0.75	0.49E+01	0.45E-02	0.11E+04
0.9	.3443	36.	3.51	0.77	0.40E+01	0.97E-02	0.42E+03
1.0	.3340	37.	3.66	0.77	0.25E+01	0.49E-02	0.52E+03
1.2	.3268	39.	3.80	0.75	0.18E+01	0.59E-02	0.30E+03
1.3	.3196	40.	3.92	0.71	0.16E+01	0.56E-02	0.29E+03
1.4	.3120	41.	4.04	0.65	0.14E+01	0.68E-02	0.21E+03
1.6	.3019	43.	4.21	0.54	0.14E+01	0.53E-02	0.26E+03
1.9	.2926	45.	4.40	0.46	0.11E+01	0.43E-02	0.26E+03
2.1	.2861	46.	4.52	0.43	0.11E+01	0.61E-02	0.18E+03
2.4	.2792	47.	4.64	0.39	0.14E+01	0.49E-02	0.28E+03
2.7	.2701	49.	4.79	0.38	0.16E+01	0.73E-02	0.22E+03
3.2	.2601	50.	4.92	0.39	0.10E+01	0.79E-02	0.13E+03
3.7	.2538	51.	5.01	0.38	0.49E+00	0.57E-02	0.86E+02
4.2	.2499	52.	5.08	0.37	0.27E+00	0.57E-02	0.47E+02
4.7	.2462	53.	5.15	0.33	0.85E+00	0.56E-02	0.15E+03
7.5	.2325	54.	5.32	0.30	0.31E+00	0.85E-02	0.36E+02

DEPTH	22.	CM	(CONT)				
12.5	.2135	57.	5.61	0.29	0.24E+00	0.47E-02	0.50E+02
17.5	.2003	61.	5.95	0.31	0.16E+00	0.31E-02	0.52E+02
22.5	.1914	64.	6.28	0.34	0.97E-01	0.23E-02	0.42E+02
27.5	.1854	67.	6.57	0.36	0.63E-01	0.18E-02	0.35E+02
35.0	.1815	70.	6.86	0.37	0.23E-01	0.94E-03	0.25E+02
43.0	.1795	73.	7.14	0.41	0.12E-01	0.50E-03	0.23E+02
53.0	.1776	75.	7.40	0.36	0.94E-02	0.91E-03	0.10E+02
65.0	.1755	78.	7.63	0.27	0.15E-01	0.78E-03	0.19E+02
75.0	.1743	80.	7.79	0.26	0.65E-02	0.75E-03	0.86E+01
85.0	.1724	81.	7.92	0.25	0.34E-01	0.23E-02	0.15E+02
95.0	.1694	82.	8.05	0.25	0.24E-01	0.25E-02	0.95E+01
105.0	.1672	83.	8.15	0.26	0.15E-01	0.17E-02	0.88E+01
115.0	.1658	84.	8.23	0.27	0.11E-01	0.16E-02	0.72E+01
125.0	.1639	85.	8.33	0.27	0.20E-01	0.22E-02	0.91E+01
135.0	.1619	86.	8.47	0.29	0.18E-01	0.11E-02	0.17E+02

DEPTH	38.	CM	SITE B-1				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3583	18.	1.73	0.89	0.65E+01	0.62E-03	0.10E+05
0.7	.3528	24.	2.38	0.61	0.46E+01	0.13E-02	0.34E+04
0.9	.3457	28.	2.76	0.57	0.92E+01	0.27E-02	0.34E+04
0.9	.3363	31.	3.00	0.59	0.82E+01	0.61E-02	0.13E+04
1.0	.3277	32.	3.18	0.62	0.50E+01	0.37E-02	0.14E+04
1.2	.3207	34.	3.35	0.67	0.35E+01	0.50E-02	0.71E+03
1.3	.3118	36.	3.53	0.76	0.28E+01	0.51E-02	0.54E+03
1.4	.3026	38.	3.68	0.86	0.20E+01	0.82E-02	0.24E+03
1.6	.2904	39.	3.83	0.92	0.16E+01	0.82E-02	0.20E+03
1.9	.2772	41.	4.01	0.99	0.11E+01	0.67E-02	0.17E+03
2.1	.2676	42.	4.13	1.02	0.97E+00	0.92E-02	0.11E+03
2.4	.2590	43.	4.23	1.02	0.95E+00	0.81E-02	0.12E+03
2.7	.2497	45.	4.38	1.03	0.95E+00	0.55E-02	0.17E+03
3.2	.2414	46.	4.51	1.02	0.61E+00	0.85E-02	0.72E+02
3.7	.2353	47.	4.59	1.01	0.35E+00	0.67E-02	0.51E+02
4.2	.2303	47.	4.65	1.01	0.21E+00	0.11E-01	0.20E+02
4.7	.2266	48.	4.68	1.01	0.40E+00	0.17E-01	0.24E+02
7.5	.2133	49.	4.81	0.98	0.16E+00	0.97E-02	0.17E+02
12.5	.1940	52.	5.06	0.92	0.13E+00	0.61E-02	0.20E+02
17.5	.1809	55.	5.34	0.84	0.10E+00	0.34E-02	0.30E+02
22.5	.1722	58.	5.64	0.78	0.68E-01	0.23E-02	0.30E+02
27.5	.1663	60.	5.90	0.73	0.53E-01	0.23E-02	0.24E+02
35.0	.1625	63.	6.15	0.67	0.18E-01	0.75E-03	0.24E+02
43.0	.1609	65.	6.36	0.56	0.14E-01	0.72E-03	0.20E+02
53.0	.1589	67.	6.58	0.56	0.11E-01	0.10E-02	0.11E+02
65.0	.1569	70.	6.81	0.62	0.99E-02	0.72E-03	0.14E+02
75.0	.1555	71.	6.95	0.61	0.60E-02	0.16E-02	0.38E+01
85.0	.1537	72.	7.06	0.58	0.21E-01	0.16E-02	0.13E+02
95.0	.1515	73.	7.16	0.55	0.19E-01	0.30E-02	0.64E+01
105.0	.1496	74.	7.24	0.53	0.11E-01	0.17E-02	0.65E+01
115.0	.1479	75.	7.31	0.49	0.12E-01	0.29E-02	0.41E+01
125.0	.1460	76.	7.41	0.49	0.17E-01	0.13E-02	0.13E+02
135.0	.1446	77.	7.55	0.48	0.16E-01	0.84E-03	0.19E+02

DOERING 1-STEP DATA

0.4	.1616	61.	5.94	83.33	0.18E-01	0.16E-02	0.11E+02
0.4	.1581	63.	6.16	83.33	0.15E-01	0.15E-02	0.10E+02
0.5	.1552	65.	6.36	83.33	0.13E-01	0.14E-02	0.90E+01
0.5	.1525	67.	6.55	83.33	0.11E-01	0.13E-02	0.82E+01
0.6	.1502	69.	6.73	83.33	0.94E-02	0.12E-02	0.76E+01
0.6	.1481	70.	6.90	83.33	0.83E-02	0.12E-02	0.70E+01
0.7	.1462	72.	7.06	83.33	0.74E-02	0.11E-02	0.65E+01
0.7	.1445	74.	7.21	83.33	0.67E-02	0.11E-02	0.61E+01

DOERING 1-STEP DATA (CONT)

0.8	.1429	75.	7.35	83.33	0.60E-02	0.11E-02	0.57E+01
0.8	.1414	76.	7.49	83.33	0.55E-02	0.10E-02	0.54E+01
0.9	.1401	78.	7.63	83.33	0.50E-02	0.98E-03	0.51E+01
0.9	.1388	79.	7.76	83.33	0.46E-02	0.95E-03	0.49E+01
1.0	.1376	80.	7.88	83.33	0.43E-02	0.92E-03	0.46E+01
1.0	.1365	82.	8.00	83.33	0.40E-02	0.89E-03	0.44E+01
1.1	.1355	83.	8.12	83.33	0.37E-02	0.87E-03	0.42E+01

DEPTH 38. CM SITE B-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.1	.1345	84.	8.23	83.33	0.34E-02	0.85E-03	0.41E+01
1.2	.1335	85.	8.34	83.33	0.32E-02	0.82E-03	0.39E+01
1.2	.1326	86.	8.45	83.33	0.30E-02	0.80E-03	0.38E+01
1.3	.1318	87.	8.55	83.33	0.29E-02	0.79E-03	0.36E+01
1.3	.1310	88.	8.66	83.33	0.27E-02	0.77E-03	0.35E+01
1.4	.1302	89.	8.76	83.33	0.25E-02	0.75E-03	0.34E+01
1.4	.1295	90.	8.85	83.33	0.24E-02	0.74E-03	0.33E+01
1.5	.1288	91.	8.95	83.33	0.23E-02	0.72E-03	0.32E+01
1.5	.1281	92.	9.04	83.33	0.22E-02	0.71E-03	0.31E+01
1.6	.1274	93.	9.13	83.33	0.21E-02	0.69E-03	0.30E+01
1.6	.1268	94.	9.22	83.33	0.20E-02	0.68E-03	0.29E+01
1.7	.1262	95.	9.31	83.33	0.19E-02	0.67E-03	0.28E+01
1.7	.1256	96.	9.39	83.33	0.18E-02	0.66E-03	0.28E+01
1.8	.1251	97.	9.48	83.33	0.17E-02	0.64E-03	0.27E+01
1.8	.1245	98.	9.56	83.33	0.17E-02	0.63E-03	0.26E+01
1.9	.1240	98.	9.64	83.33	0.16E-02	0.62E-03	0.26E+01
1.9	.1235	99.	9.72	83.33	0.15E-02	0.61E-03	0.25E+01
2.0	.1230	100.	9.80	83.33	0.15E-02	0.60E-03	0.24E+01
4.0	.1106	126.	12.32	83.33	0.50E-03	0.39E-03	0.13E+01
8.0	.1004	158.	15.52	83.33	0.17E-03	0.25E-03	0.70E+00
12.0	.0952	182.	17.88	83.33	0.95E-04	0.19E-03	0.50E+00
16.0	.0918	202.	19.82	83.33	0.61E-04	0.16E-03	0.39E+00
20.0	.0893	219.	21.52	83.33	0.44E-04	0.13E-03	0.33E+00
24.0	.0874	235.	23.04	83.33	0.33E-04	0.12E-03	0.29E+00
28.0	.0858	249.	24.44	83.33	0.26E-04	0.10E-03	0.25E+00
32.0	.0845	263.	25.75	83.33	0.22E-04	0.94E-04	0.23E+00
36.0	.0834	275.	26.97	83.33	0.18E-04	0.86E-04	0.21E+00
40.0	.0824	287.	28.14	83.33	0.15E-04	0.79E-04	0.20E+00
44.0	.0815	298.	29.24	83.33	0.13E-04	0.73E-04	0.18E+00
48.0	.0808	309.	30.31	83.33	0.12E-04	0.68E-04	0.17E+00
52.0	.0801	320.	31.33	83.33	0.10E-04	0.64E-04	0.16E+00
122.0	.0735	468.	45.93	83.33	0.31E-05	0.31E-04	0.10E+00

DEPTH 53. CM SITE B-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3516	19.	1.81	1.19	0.55E+01	0.79E-03	0.69E+04
0.7	.3469	23.	2.27	1.26	0.29E+01	0.14E-02	0.20E+04
0.9	.3408	27.	2.61	1.22	0.53E+01	0.24E-02	0.22E+04
0.9	.3322	29.	2.83	1.19	0.54E+01	0.66E-02	0.82E+03
1.0	.3246	31.	3.01	1.16	0.35E+01	0.27E-02	0.13E+04
1.2	.3174	32.	3.18	1.11	0.33E+01	0.73E-02	0.46E+03
1.3	.3081	34.	3.35	1.00	0.31E+01	0.42E-02	0.74E+03
1.4	.2995	36.	3.53	0.94	0.27E+01	0.60E-02	0.45E+03
1.6	.2881	38.	3.70	0.90	0.26E+01	0.68E-02	0.38E+03
1.9	.2747	40.	3.89	0.85	0.23E+01	0.77E-02	0.30E+03
2.1	.2659	41.	4.01	0.82	0.18E+01	0.62E-02	0.29E+03
2.4	.2560	42.	4.11	0.81	0.20E+01	0.15E-01	0.13E+03
2.7	.2426	43.	4.23	0.78	0.17E+01	0.82E-02	0.21E+03
3.2	.2321	44.	4.35	0.77	0.11E+01	0.10E-01	0.11E+03
3.7	.2250	45.	4.43	0.78	0.70E+00	0.72E-02	0.97E+02

DEPTH	53.	CM					
4.2	.2190	46.	4.50	0.78	0.46E+00	0.11E-01	0.42E+02
4.7	.2143	46.	4.54	0.81	0.64E+00	0.11E-01	0.57E+02
7.5	.2014	48.	4.69	0.85	0.27E+00	0.88E-02	0.31E+02
12.5	.1842	50.	4.92	0.90	0.18E+00	0.56E-02	0.32E+02
17.5	.1729	53.	5.16	0.92	0.13E+00	0.40E-02	0.32E+02
22.5	.1653	55.	5.40	0.90	0.79E-01	0.22E-02	0.35E+02
27.5	.1600	57.	5.62	0.90	0.63E-01	0.25E-02	0.25E+02
35.0	.1555	60.	5.84	0.92	0.18E-01	0.17E-02	0.10E+02
43.0	.1531	61.	5.99	0.95	0.12E-01	0.13E-02	0.93E+01
53.0	.1511	63.	6.20	0.94	0.10E-01	0.87E-03	0.12E+02
65.0	.1485	66.	6.44	0.88	0.10E-01	0.15E-02	0.68E+01
75.0	.1465	67.	6.57	0.89	0.71E-02	0.17E-02	0.41E+01
85.0	.1443	68.	6.66	0.89	0.18E-01	0.36E-02	0.49E+01
95.0	.1421	69.	6.72	0.87	0.16E-01	0.34E-02	0.46E+01
105.0	.1400	69.	6.77	0.86	0.98E-02	0.55E-02	0.18E+01
115.0	.1378	70.	6.82	0.87	0.11E-01	0.29E-02	0.37E+01
125.0	.1356	71.	6.91	0.85	0.13E-01	0.21E-02	0.62E+01
135.0	.1339	72.	7.02	0.83	0.12E-01	0.12E-02	0.96E+01

DEPTH	68.	CM	SITE B-1				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3527	20.	1.97	1.02	0.70E+01	0.67E-03	0.10E+05
0.7	.3486	25.	2.44	0.95	0.46E+01	0.14E-02	0.31E+04
0.9	.3432	28.	2.72	0.92	0.82E+01	0.26E-02	0.32E+04
0.9	.3371	30.	2.89	0.88	0.87E+01	0.59E-02	0.15E+04
1.0	.3303	31.	3.02	0.85	0.59E+01	0.51E-02	0.12E+04
1.2	.3231	32.	3.12	0.82	0.59E+01	0.14E-01	0.44E+03
1.3	.3153	33.	3.22	0.82	0.50E+01	0.59E-02	0.84E+03
1.4	.3067	34.	3.35	0.82	0.40E+01	0.74E-02	0.54E+03
1.6	.2943	36.	3.52	0.86	0.37E+01	0.69E-02	0.53E+03
1.9	.2812	38.	3.68	0.87	0.31E+01	0.13E-01	0.25E+03
2.1	.2726	39.	3.78	0.87	0.22E+01	0.61E-02	0.36E+03
2.4	.2626	40.	3.89	0.89	0.27E+01	0.14E-01	0.20E+03
2.7	.2499	41.	4.01	0.92	0.19E+01	0.81E-02	0.23E+03
3.2	.2388	42.	4.14	0.95	0.12E+01	0.93E-02	0.12E+03
3.7	.2300	43.	4.25	0.98	0.78E+00	0.73E-02	0.11E+03
4.2	.2221	44.	4.34	0.99	0.56E+00	0.13E-01	0.44E+02
4.7	.2166	45.	4.41	1.00	0.63E+00	0.46E-02	0.14E+03
7.5	.2034	47.	4.59	1.02	0.29E+00	0.76E-02	0.38E+02
12.5	.1862	49.	4.83	0.98	0.20E+00	0.63E-02	0.32E+02
17.5	.1757	51.	5.05	0.92	0.16E+00	0.39E-02	0.40E+02
22.5	.1686	54.	5.28	0.94	0.92E-01	0.21E-02	0.43E+02
27.5	.1643	56.	5.50	0.94	0.75E-01	0.16E-02	0.47E+02
35.0	.1606	58.	5.73	0.94	0.23E-01	0.17E-02	0.14E+02
43.0	.1578	60.	5.92	0.95	0.16E-01	0.13E-02	0.13E+02
53.0	.1542	62.	6.10	0.92	0.15E-01	0.25E-02	0.59E+01
65.0	.1495	64.	6.26	0.87	0.16E-01	0.36E-02	0.44E+01
75.0	.1466	65.	6.36	0.83	0.11E-01	0.19E-02	0.58E+01
85.0	.1449	66.	6.43	0.80	0.24E-01	0.34E-02	0.69E+01
95.0	.1430	66.	6.48	0.80	0.21E-01	0.42E-02	0.50E+01
105.0	.1413	67.	6.52	0.81	0.14E-01	0.45E-02	0.31E+01
115.0	.1399	67.	6.59	0.81	0.15E-01	0.12E-02	0.12E+02
125.0	.1383	68.	6.67	0.82	0.17E-01	0.29E-02	0.60E+01
135.0	.1369	69.	6.78	0.85	0.13E-01	0.61E-03	0.21E+02

DEPTH	83.	CM	SITE B-1				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3426	22.	2.11	1.16	0.66E+01	0.58E-03	0.11E+05
0.7	.3403	25.	2.47	1.09	0.44E+01	0.77E-03	0.57E+04
0.9	.3374	28.	2.71	1.07	0.77E+01	0.19E-02	0.40E+04

DEPTH 83. CM (CONT)

0.9	.3341	29.	2.84	1.04	0.80E+01	0.42E-02	0.19E+04
1.0	.3291	30.	2.92	1.02	0.60E+01	0.70E-02	0.85E+03
1.2	.3231	31.	3.00	1.02	0.56E+01	0.98E-02	0.57E+03
1.3	.3163	31.	3.09	1.00	0.49E+01	0.70E-02	0.70E+03
1.4	.3073	33.	3.20	0.97	0.43E+01	0.96E-02	0.45E+03
1.6	.2952	34.	3.36	0.92	0.43E+01	0.66E-02	0.65E+03
1.9	.2829	36.	3.50	0.88	0.39E+01	0.19E-01	0.20E+03
2.1	.2733	36.	3.58	0.86	0.28E+01	0.88E-02	0.32E+03
2.4	.2648	38.	3.68	0.82	0.37E+01	0.81E-02	0.45E+03
2.7	.2556	39.	3.81	0.80	0.26E+01	0.64E-02	0.41E+03
3.2	.2450	40.	3.94	0.78	0.18E+01	0.10E-01	0.18E+03
3.7	.2351	41.	4.05	0.75	0.14E+01	0.89E-02	0.15E+03
4.2	.2261	42.	4.15	0.75	0.10E+01	0.91E-02	0.12E+03
4.7	.2203	43.	4.26	0.80	0.92E+00	0.28E-02	0.33E+03
7.5	.2075	46.	4.49	0.85	0.43E+00	0.64E-02	0.68E+02
12.5	.1887	48.	4.74	0.89	0.26E+00	0.11E-01	0.23E+02
17.5	.1755	50.	4.91	0.88	0.20E+00	0.55E-02	0.36E+02
22.5	.1680	52.	5.11	0.84	0.12E+00	0.20E-02	0.60E+02
27.5	.1639	54.	5.32	0.82	0.10E+00	0.20E-02	0.51E+02
35.0	.1592	56.	5.53	0.80	0.36E-01	0.24E-02	0.15E+02
43.0	.1553	58.	5.70	0.76	0.27E-01	0.22E-02	0.12E+02
53.0	.1518	60.	5.83	0.72	0.26E-01	0.29E-02	0.90E+01
65.0	.1482	61.	5.95	0.71	0.26E-01	0.33E-02	0.79E+01
75.0	.1457	61.	6.02	0.71	0.16E-01	0.44E-02	0.37E+01
85.0	.1430	62.	6.07	0.71	0.32E-01	0.63E-02	0.51E+01
95.0	.1405	62.	6.11	0.71	0.28E-01	0.47E-02	0.58E+01
105.0	.1394	63.	6.17	0.72	0.18E-01	0.48E-03	0.36E+02
115.0	.1391	64.	6.25	0.73	0.18E-01	0.30E-03	0.60E+02
125.0	.1388	65.	6.35	0.75	0.21E-01	0.32E-03	0.68E+02
135.0	.1384	66.	6.52	0.79	0.15E-01	0.14E-03	0.11E+03

DEPTH 98. CM SITE B-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3521	24.	2.35	1.16	0.81E+01	0.11E-01	0.76E+03
0.7	.3393	26.	2.55	1.02	0.52E+01	0.22E-02	0.24E+04
0.9	.3357	28.	2.73	0.95	0.91E+01	0.19E-02	0.48E+04
0.9	.3311	29.	2.84	0.97	0.93E+01	0.84E-02	0.11E+04
1.0	.3264	30.	2.93	0.99	0.69E+01	0.30E-02	0.23E+04
1.2	.3208	31.	3.01	1.00	0.67E+01	0.11E-01	0.61E+03
1.3	.3125	32.	3.11	1.04	0.56E+01	0.68E-02	0.83E+03
1.4	.3026	33.	3.22	1.06	0.49E+01	0.13E-01	0.37E+03
1.6	.2889	34.	3.36	1.08	0.44E+01	0.84E-02	0.52E+03
1.9	.2770	36.	3.49	1.10	0.37E+01	0.11E-01	0.35E+03
2.1	.2680	36.	3.57	1.13	0.26E+01	0.12E-01	0.23E+03
2.4	.2599	37.	3.66	1.15	0.30E+01	0.70E-02	0.42E+03
2.7	.2489	39.	3.78	1.17	0.21E+01	0.95E-02	0.23E+03
3.2	.2409	40.	3.91	1.17	0.13E+01	0.60E-03	0.22E+04
3.7	.2337	41.	3.98	1.15	0.12E+01	0.23E-01	0.52E+02
4.2	.2230	41.	4.06	1.12	0.92E+00	0.84E-02	0.11E+03
4.7	.2180	42.	4.15	1.05	0.78E+00	0.25E-02	0.31E+03
7.5	.2029	45.	4.43	1.07	0.41E+00	0.58E-02	0.71E+02
12.5	.1815	48.	4.75	1.12	0.25E+00	0.11E-01	0.23E+02
17.5	.1691	50.	4.89	1.10	0.19E+00	0.61E-02	0.31E+02
22.5	.1625	52.	5.07	1.09	0.10E+00	0.20E-02	0.51E+02
27.5	.1573	54.	5.26	1.10	0.89E-01	0.33E-02	0.27E+02
35.0	.1512	56.	5.46	1.10	0.34E-01	0.28E-02	0.12E+02
43.0	.1477	57.	5.61	1.12	0.23E-01	0.12E-02	0.19E+02
53.0	.1459	58.	5.72	1.13	0.20E-01	0.22E-02	0.92E+01
65.0	.1432	59.	5.83	1.12	0.21E-01	0.30E-02	0.69E+01
75.0	.1402	60.	5.93	1.16	0.14E-01	0.32E-02	0.43E+01
85.0	.1372	61.	6.02	1.22	0.22E-01	0.28E-02	0.79E+01
95.0	.1348	62.	6.12	1.30	0.17E-01	0.21E-02	0.82E+01

DEPTH	98.	CM	(CONT)				
105.0	.1336	63.	6.21	1.34	0.99E-02	0.67E-03	0.15E+02
115.0	.1331	64.	6.31	1.35	0.10E-01	0.32E-03	0.32E+02
125.0	.1328	65.	6.41	1.34	0.12E-01	0.28E-03	0.45E+02
135.0	.1326	67.	6.55	1.26	0.99E-02	0.00E+00	

DOERING 1-STEP DATA

15.3	.1086	83.	8.09	83.33	0.68E-03	0.82E-03	0.82E+00
19.3	.1007	94.	9.20	83.33	0.40E-03	0.60E-03	0.66E+00
23.3	.0953	104.	10.20	83.33	0.26E-03	0.47E-03	0.55E+00
27.3	.0913	113.	11.13	83.33	0.18E-03	0.38E-03	0.48E+00
31.3	.0883	122.	11.99	83.33	0.13E-03	0.31E-03	0.42E+00
35.3	.0859	131.	12.79	83.33	0.10E-03	0.27E-03	0.38E+00
39.3	.0840	138.	13.56	83.33	0.79E-04	0.23E-03	0.34E+00
43.3	.0824	146.	14.28	83.33	0.64E-04	0.20E-03	0.31E+00
47.3	.0810	153.	14.98	83.33	0.52E-04	0.18E-03	0.29E+00
51.3	.0799	160.	15.64	83.33	0.44E-04	0.16E-03	0.27E+00
55.3	.0789	166.	16.28	83.33	0.37E-04	0.15E-03	0.25E+00
122.0	.0713	250.	24.53	83.33	0.73E-05	0.54E-04	0.13E+00
194.0	.0687	314.	30.81	83.33	0.32E-05	0.31E-04	0.10E+00
266.0	.0674	364.	35.73	83.33	0.20E-05	0.21E-04	0.92E-01

SITE B, REPLICATION 2

Table B-2.1 Soil morphologic data for Site B replication 2.

Site and location: B-2 Heimbuch Site, Oakes aquifer 280 feet south and 170 feet west of the east quarter corner of Section 26, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/84 by M. D. Sweeney (NDAES, Fargo, ND) and W. M. Schuh and R. Cline (NDSWC, Bismarck, ND).

Soil type and classification: Hecla loamy sand ; sandy, mixed aquic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Moderately well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: B-2 west side of pit.

Alp 0-5 inches (0-12 cm), black (lOYR 2/1) loamy sand; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; abrupt smooth boundary.

A12 5-13 inches (12-33 cm), black (lOYR 2/1) loamy sand (sand); moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; clear wavy boundary.

Bw 13-20 inches (33-52 cm), very dark grayish brown (lOYR 3/2) sand; weak coarse and medium prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; gradual wavy boundary.

C 20-29 inches (52-73 cm), light olive brown (2.5Y 5/4) sand (fine sand) with few fine distinct dark yellowish brown (lOYR 4/4) mottles which increase to common with depth; weak coarse and medium prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; gradual wavy boundary.

Cg 29-60 inches (73-150 cm), light olive brown (2.5Y 5/4) sand (fine sand and sand) with many medium distinct dark brown (7.5YR 3/4) and common fine distinct very dark brown (lOYR 2/2) mottles; weak coarse and medium prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots.

Table B-2.2 HECLA SERIES SITE B-2 NDSWC:1984
particle-size, bulk density, and organic carbon data and indices

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	3.7	4.1	5.5	10.5	43.0	30.5	2.7	0.0
23.	1.8	6.6	2.9	8.8	44.5	32.4	3.0	0.0
38.	2.6	2.5	3.9	8.7	47.6	32.0	2.6	0.0
53.	3.3	2.2	1.1	8.8	50.7	31.5	2.4	0.0
69.	2.2	1.8	2.8	8.7	50.4	32.0	2.2	0.0
84.	3.2	3.6	0.9	7.4	50.9	32.5	1.5	0.0
99.	3.9	2.1	1.4	7.4	52.3	31.4	1.4	0.0
114.	2.9	2.2	1.2	7.2	52.3	32.6	1.7	0.0
130.	2.5	3.5	0.0	6.3	48.3	37.4	1.9	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON		
8.	86.7	9.6	3.7	A 1	6	6=P
23.	88.7	9.5	1.8	A 1	2	7=W
38.	91.0	6.4	2.6	B	7	8=G
53.	93.4	3.3	3.3	C		
69.	93.2	2.2	4.6	C		
84.	92.3	4.5	3.2	C	8	
99.	92.6	3.5	3.9	C	8	
114.	93.8	3.3	2.9	C	8	
130.	94.0	3.5	2.5	C	8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	9.031	0.1418	3.7	0.0384	0.814	1.63	1.22
23.	9.337	0.1574	3.2	0.0489	0.901	1.63	0.87
38.	14.203	0.1654	3.1	0.0531	1.007	1.54	0.39
53.	28.303	0.1667	3.2	0.0517	1.136	1.54	0.20
69.	20.283	0.1471	3.6	0.0411	1.034	1.56	0.16
84.	20.511	0.1628	3.3	0.0494	1.128	1.56	0.16
99.	26.429	0.1610	3.4	0.0473	1.165	1.56	0.04
114.	27.588	0.1716	3.1	0.0562	1.215	1.55	0.12
130.	26.829	0.1813	3.0	0.0595	1.211	1.58	0.12

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.637	2.548	-1.1533	2.5143	-11.53	1.13
23.	1.625	2.897	-1.1820	2.5723	-11.82	1.19
38.	1.386	3.713	-1.2323	2.6361	-12.32	1.26
53.	1.065	4.723	-1.2868	2.7086	-12.87	1.33
69.	1.200	4.498	-1.2772	2.7057	-12.77	1.33
84.	1.204	4.895	-1.2639	2.6767	-12.64	1.30
99.	1.088	6.378	-1.2730	2.6825	-12.73	1.30
114.	1.079	5.567	-1.2918	2.7202	-12.92	1.34
130.	1.093	5.545	-1.2926	2.7231	-12.93	1.34

Table B-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site B replication 2.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
			Saturation Extract Soluble Ions meq/l					
0 - 15	3.1	1.6	0.9	0.5	-	4.8	0.15	1.2
15 - 30	1.1	1.3	0.7	0.2	-	1.7	0.50	1.3
30 - 46	1.2	1.2	0.6	0.1	-	1.5	0.18	1.6
46 - 61	1.4	0.5	0.6	0.2	-	1.1	0.15	1.6
61 - 76	1.4	0.5	0.7	0.3	-	1.3	0.15	1.6
76 - 91	1.3	0.6	0.6	0.2	-	1.0	0.20	1.6
91 - 106	1.1	0.5	0.6	0.2	-	0.8	0.13	1.6
106 - 122	1.1	0.8	0.6	0.1	-	0.9	0.18	1.7
122 - 137	1.0	0.8	0.7	0.1	-	0.6	0.15	2.0

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.50	0.6	29	7.7	2.8	ls	4.9
15 - 30	0.26	0.7	26	7.0	2.4	s	4.4
30 - 46	0.21	0.6	20	7.2	3.4	s	3.1
46 - 61	0.22	0.7	18	7.4	2.5	fs	2.7
61 - 76	0.25	0.7	19	7.5	3.2	fs	3.0
76 - 91	0.23	0.7	19	7.7	2.3	fs	3.1
91 - 106	0.21	0.7	20	7.3	2.5	fs	3.0
106 - 122	0.21	0.7	22	7.4	2.0	fs	2.9
122 - 137	0.20	0.7	20	7.2	1.5	s	2.9

Table B-2.4 HECLA SERIES SITE B-2 NDSWC:85

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

CM	23. CC/CC	SE	CM	38.		CM	53.		CM	69.	
10.	0.3613	0.0298	10.	0.3647	0.0002	10.	0.3407	0.0041	10.	0.3549	******
20.	0.3444	0.0290	20.	0.3526	0.0046	20.	0.3237	0.0025	20.	0.3474	******
40.	0.2721	0.0250	40.	0.2226	0.0032	40.	0.2197	0.0006	40.	0.2145	******
60.	0.2064	0.0163	60.	0.1651	0.0014	60.	0.1512	0.0011	60.	0.1420	******
80.	0.1769	0.0138	80.	0.1330	0.0013	80.	0.1158	0.0012	80.	0.1072	******
100.	0.1578	0.0125	100.	0.1143	0.0021	100.	0.0981	0.0002	100.	0.0906	******
120.	0.1467	0.0108	120.	0.1046	0.0017	120.	0.0870	0.0003	120.	0.0800	******
180.	0.1253	0.0090	180.	0.0911	0.0019	180.	0.0708	0.0002	180.	0.0710	******
340.	0.1083	0.0061	340.	0.0762	0.0011	340.	0.0605	0.0002	340.	0.0604	******
534.	0.0951	0.0080	534.	0.0710	0.0006	534.	0.0560	0.0002	534.	0.0574	******
834.	0.0885	0.0064	834.	0.0680	0.0006	834.	0.0560	0.0002	834.	0.0559	******
BD =	1.63			1.54			1.54			1.56	
N =	2			2			2			1	

DEPTH (CM)

CM	84.		CM	99.		CM	114.		CM	130.	
10.	0.3767	0.0017	10.	0.3876	0.0106	10.	0.3322	0.0010	10.	0.3354	0.0075
20.	0.3669	0.0008	20.	0.3767	0.0083	20.	0.3219	0.0010	20.	0.3211	0.0056
40.	0.2211	0.0005	40.	0.2244	0.0015	40.	0.2146	0.0035	40.	0.2022	0.0033
60.	0.1421	0.0003	60.	0.1421	0.0004	60.	0.1413	0.0028	60.	0.1369	0.0026
80.	0.1084	0.0011	80.	0.1090	0.0015	80.	0.1125	0.0023	80.	0.1083	0.0021
100.	0.0922	0.0010	100.	0.0929	0.0012	100.	0.0969	0.0028	100.	0.0955	0.0024
120.	0.0830	0.0017	120.	0.0844	0.0019	120.	0.0881	0.0017	120.	0.0880	0.0011
180.	0.0728	0.0016	180.	0.0737	0.0021	180.	0.0762	0.0017	180.	0.0767	0.0004
340.	0.0641	0.0020	340.	0.0660	0.0022	340.	0.0673	0.0017	340.	0.0691	0.0003
534.	0.0611	0.0020	534.	0.0629	0.0022	534.	0.0636	0.0022	534.	0.0669	0.0003
834.	0.0580	0.0015	834.	0.0591	0.0018	834.	0.0651	0.0009	834.	0.0654	0.0003
BD =	1.56			1.56			1.55			1.58	
N =	3			2			2			2	

Table B-2.5 HECLA SANDY LOAM SITE B-2 (NDSWC 1984)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 15. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3437	35.	3.42	1.06	0.96E+00	0.71E-03	0.13E+04
0.3	.3307	47.	4.62	0.86	0.11E+01	0.25E-02	0.44E+03
0.5	.3196	51.	4.97	0.85	0.87E+00	0.49E-02	0.18E+03
0.7	.3083	53.	5.17	0.86	0.74E+00	0.64E-02	0.12E+03
1.0	.2978	54.	5.32	0.86	0.72E+00	0.83E-02	0.88E+02
1.5	.2860	57.	5.57	0.84	0.22E+01	0.34E-01	0.65E+02
2.2	.2689	59.	5.77	0.82	0.97E+00	0.26E-01	0.37E+02
2.7	.2523	60.	5.84	0.81	0.25E+00	0.13E-01	0.19E+02
3.5	.2471	60.	5.88	0.83	0.69E-01	0.19E-01	0.36E+01
4.5	.2328	61.	5.98	0.86	0.43E+00	0.14E-01	0.31E+02
6.2	.2174	62.	6.12	0.88	0.42E-01	0.61E-02	0.68E+01
8.7	.2078	63.	6.22	0.90	0.88E-01	0.13E-01	0.66E+01
17.5	.1837	67.	6.53	0.93	0.33E-01	0.75E-03	0.44E+02
25.0	.1756	76.	7.41	0.74	0.11E-01	0.15E-02	0.79E+01
40.0	.1700	79.	7.79	0.73	0.59E-02	0.16E-02	0.37E+01
60.0	.1648	83.	8.12	0.71	0.50E-02	0.16E-02	0.32E+01
80.0	.1600	86.	8.42	0.70	0.51E-02	0.16E-02	0.32E+01
100.0	.1555	88.	8.67	0.69	0.46E-02	0.21E-02	0.22E+01
120.0	.1513	91.	8.91	0.67	0.48E-02	0.15E-02	0.31E+01

DOERING 1-STEP DATA

0.1	.1986	65.	6.38	83.33	0.89E-01	0.15E-02	0.59E+02
0.2	.1739	86.	8.44	83.33	0.38E-01	0.92E-03	0.41E+02
0.2	.1582	107.	10.45	83.33	0.20E-01	0.63E-03	0.32E+02
0.3	.1471	127.	12.45	83.33	0.12E-01	0.47E-03	0.26E+02
0.3	.1388	148.	14.47	83.33	0.77E-02	0.36E-03	0.22E+02
0.4	.1321	168.	16.51	83.33	0.53E-02	0.28E-03	0.19E+02
0.4	.1267	190.	18.59	83.33	0.38E-02	0.23E-03	0.16E+02
0.5	.1221	211.	20.73	83.33	0.28E-02	0.19E-03	0.15E+02
0.5	.1182	234.	22.92	83.33	0.21E-02	0.16E-03	0.13E+02
0.6	.1149	257.	25.18	83.33	0.16E-02	0.14E-03	0.12E+02
0.6	.1119	281.	27.50	83.33	0.13E-02	0.12E-03	0.11E+02
0.7	.1093	305.	29.91	83.33	0.10E-02	0.10E-03	0.10E+02
0.7	.1069	330.	32.39	83.33	0.84E-03	0.87E-04	0.96E+01
0.8	.1048	357.	34.97	83.33	0.68E-03	0.76E-04	0.90E+01
0.8	.1028	384.	37.64	83.33	0.57E-03	0.67E-04	0.85E+01
0.9	.1011	412.	40.42	83.33	0.47E-03	0.59E-04	0.80E+01
0.9	.0994	442.	43.31	83.33	0.39E-03	0.52E-04	0.76E+01
1.0	.0979	472.	46.31	83.33	0.33E-03	0.46E-04	0.72E+01
1.0	.0965	504.	49.44	83.33	0.28E-03	0.41E-04	0.68E+01

DEPTH 45. CM SITE B-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3386	35.	3.43	1.06	0.27E+01	0.81E-03	0.33E+04
0.3	.3282	45.	4.39	0.86	0.31E+01	0.22E-02	0.14E+04
0.5	.3183	48.	4.73	0.85	0.26E+01	0.44E-02	0.60E+03
0.7	.3057	50.	4.94	0.86	0.24E+01	0.77E-02	0.31E+03
1.0	.2938	52.	5.09	0.86	0.22E+01	0.85E-02	0.26E+03
1.5	.2760	54.	5.32	0.84	0.60E+01	0.26E-01	0.23E+03
2.2	.2563	56.	5.49	0.82	0.27E+01	0.32E-01	0.83E+02
2.7	.2426	57.	5.54	0.81	0.81E+00	0.16E-01	0.50E+02
3.5	.2346	57.	5.61	0.83	0.28E+00	0.92E-02	0.31E+02

DEPTH 45. CM (CONT)

4.5	.2216	59.	5.76	0.86	0.12E+01	0.85E-02	0.14E+03
6.2	.2087	61.	5.93	0.88	0.14E+00	0.60E-02	0.23E+02
8.7	.1994	62.	6.07	0.90	0.25E+00	0.74E-02	0.34E+02
17.5	.1784	65.	6.41	0.93	0.97E-01	0.12E-02	0.83E+02
25.0	.1688	71.	7.01	0.74	0.44E-01	0.25E-02	0.17E+02
40.0	.1605	75.	7.36	0.73	0.19E-01	0.22E-02	0.87E+01
60.0	.1549	78.	7.66	0.71	0.15E-01	0.15E-02	0.10E+02
80.0	.1505	81.	7.95	0.70	0.15E-01	0.16E-02	0.96E+01
100.0	.1471	83.	8.18	0.69	0.12E-01	0.13E-02	0.93E+01
120.0	.1433	86.	8.39	0.67	0.15E-01	0.23E-02	0.66E+01

DOERING 1-STEP DATA

4.1	.1269	88.	8.62	83.33	0.15E-02	0.86E-03	0.17E+01
8.1	.1137	106.	10.43	83.33	0.54E-03	0.60E-03	0.90E+00
12.1	.1075	118.	11.55	83.33	0.30E-03	0.49E-03	0.62E+00
16.1	.1037	126.	12.37	83.33	0.21E-03	0.43E-03	0.48E+00
20.1	.1010	133.	13.00	83.33	0.15E-03	0.39E-03	0.39E+00
24.1	.0991	138.	13.52	83.33	0.12E-03	0.36E-03	0.34E+00
28.1	.0975	142.	13.96	83.33	0.10E-03	0.34E-03	0.30E+00
32.1	.0962	146.	14.34	83.33	0.85E-04	0.32E-03	0.26E+00
36.1	.0951	150.	14.67	83.33	0.74E-04	0.31E-03	0.24E+00
40.1	.0942	153.	14.97	83.33	0.65E-04	0.30E-03	0.22E+00
44.1	.0934	155.	15.23	83.33	0.58E-04	0.29E-03	0.20E+00
48.1	.0927	158.	15.47	83.33	0.53E-04	0.28E-03	0.19E+00
52.1	.0921	160.	15.69	83.33	0.48E-04	0.27E-03	0.18E+00
122.0	.0866	183.	17.93	83.33	0.20E-04	0.21E-03	0.97E-01
194.0	.0844	194.	19.04	83.33	0.14E-04	0.19E-03	0.76E-01
266.0	.0831	201.	19.74	83.33	0.12E-04	0.17E-03	0.70E-01

DEPTH 68. CM SITE B-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3341	35.	3.41	0.77	0.52E+01	0.10E-02	0.52E+04
0.3	.3264	40.	3.95	0.70	0.53E+01	0.23E-02	0.23E+04
0.5	.3181	43.	4.26	0.68	0.49E+01	0.32E-02	0.15E+04
0.7	.3068	46.	4.51	0.71	0.45E+01	0.59E-02	0.77E+03
1.0	.2951	48.	4.70	0.77	0.38E+01	0.70E-02	0.54E+03
1.5	.2727	50.	4.95	0.81	0.81E+01	0.13E-01	0.63E+03
2.2	.2484	52.	5.07	0.80	0.37E+01	0.49E-01	0.76E+02
2.7	.2377	52.	5.10	0.79	0.13E+01	0.26E-01	0.50E+02
3.5	.2282	53.	5.19	0.78	0.55E+00	0.65E-02	0.85E+02
4.5	.2174	55.	5.38	0.76	0.18E+01	0.53E-02	0.35E+03
6.2	.2072	57.	5.55	0.73	0.27E+00	0.70E-02	0.38E+02
8.7	.1981	58.	5.70	0.70	0.47E+00	0.54E-02	0.86E+02
12.5	.1885	60.	5.89	0.69	0.23E+00	0.45E-02	0.50E+02
17.5	.1793	62.	6.10	0.69	0.19E+00	0.47E-02	0.41E+02
25.0	.1680	65.	6.36	0.65	0.90E-01	0.40E-02	0.23E+02
40.0	.1567	69.	6.74	0.71	0.31E-01	0.21E-02	0.14E+02
60.0	.1501	72.	7.08	0.80	0.20E-01	0.17E-02	0.12E+02
80.0	.1457	75.	7.33	0.76	0.20E-01	0.18E-02	0.11E+02
100.0	.1421	77.	7.54	0.75	0.16E-01	0.15E-02	0.10E+02
120.0	.1377	79.	7.70	0.73	0.22E-01	0.46E-02	0.49E+01

DOERING 1-STEP DATA

4.1	.1074	115.	11.32	83.33	0.79E-03	0.50E-03	0.16E+01
8.1	.0934	152.	14.86	83.33	0.25E-03	0.30E-03	0.84E+00
12.1	.0867	178.	17.45	83.33	0.13E-03	0.22E-03	0.59E+00
16.1	.0824	200.	19.57	83.33	0.81E-04	0.17E-03	0.46E+00
20.1	.0795	218.	21.40	83.33	0.56E-04	0.15E-03	0.38E+00
24.1	.0772	235.	23.02	83.33	0.42E-04	0.13E-03	0.33E+00
28.1	.0754	250.	24.49	83.33	0.33E-04	0.11E-03	0.29E+00

DOERING 1-STEP DATA (CONT)

32.1	.0739	264.	25.84	83.33	0.27E-04	0.10E-03	0.26E+00
36.1	.0727	276.	27.10	83.33	0.22E-04	0.93E-04	0.24E+00
40.1	.0716	288.	28.28	83.33	0.19E-04	0.86E-04	0.22E+00
44.1	.0706	300.	29.39	83.33	0.16E-04	0.80E-04	0.20E+00
48.1	.0698	311.	30.45	83.33	0.14E-04	0.74E-04	0.19E+00
52.1	.0691	321.	31.46	83.33	0.13E-04	0.70E-04	0.18E+00
122.0	.0624	455.	44.59	83.33	0.38E-05	0.36E-04	0.11E+00

DEPTH 83. CM SITE B-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3311	35.	3.44	1.27	0.35E+01	0.99E-03	0.35E+04
0.3	.3246	40.	3.89	1.22	0.35E+01	0.24E-02	0.15E+04
0.5	.3187	42.	4.16	1.17	0.32E+01	0.21E-02	0.15E+04
0.7	.3121	45.	4.38	1.10	0.34E+01	0.38E-02	0.90E+03
1.0	.2987	47.	4.56	1.04	0.38E+01	0.15E-01	0.26E+03
1.5	.2795	49.	4.81	1.00	0.72E+01	0.98E-02	0.73E+03
2.2	.2528	51.	4.98	1.08	0.31E+01	0.17E-01	0.19E+03
2.7	.2421	52.	5.06	1.16	0.11E+01	0.11E-01	0.11E+03
3.5	.2312	53.	5.19	1.21	0.49E+00	0.78E-02	0.64E+02
4.5	.2182	54.	5.33	1.17	0.13E+01	0.11E-01	0.13E+03
6.2	.2079	55.	5.43	1.10	0.22E+00	0.10E-01	0.21E+02
8.7	.1998	57.	5.54	1.08	0.35E+00	0.56E-02	0.62E+02
12.5	.1911	58.	5.71	1.05	0.17E+00	0.50E-02	0.35E+02
17.5	.1821	60.	5.88	1.02	0.16E+00	0.53E-02	0.30E+02
25.0	.1709	63.	6.17	1.09	0.72E-01	0.33E-02	0.22E+02
40.0	.1599	67.	6.58	1.07	0.27E-01	0.21E-02	0.13E+02
60.0	.1538	71.	6.93	1.00	0.19E-01	0.13E-02	0.15E+02
80.0	.1494	73.	7.17	1.02	0.18E-01	0.26E-02	0.70E+01
100.0	.1434	75.	7.37	1.02	0.15E-01	0.33E-02	0.45E+01
120.0	.1374	77.	7.53	1.04	0.20E-01	0.44E-02	0.45E+01

DOERING 1-STEP DATA

2.1	.1261	83.	8.16	83.33	0.28E-02	0.85E-03	0.33E+01
4.1	.1091	109.	10.68	83.33	0.90E-03	0.51E-03	0.18E+01
8.1	.0964	140.	13.75	83.33	0.31E-03	0.32E-03	0.96E+00
12.1	.0904	162.	15.87	83.33	0.17E-03	0.24E-03	0.68E+00
16.1	.0867	179.	17.52	83.33	0.11E-03	0.20E-03	0.54E+00
20.1	.0841	193.	18.89	83.33	0.79E-04	0.18E-03	0.45E+00
24.1	.0821	205.	20.05	83.33	0.61E-04	0.16E-03	0.39E+00
28.1	.0805	215.	21.08	83.33	0.50E-04	0.14E-03	0.35E+00
32.1	.0793	224.	21.99	83.33	0.42E-04	0.13E-03	0.32E+00
36.1	.0782	233.	22.82	83.33	0.36E-04	0.12E-03	0.29E+00
40.1	.0773	240.	23.58	83.33	0.32E-04	0.12E-03	0.28E+00
44.1	.0765	248.	24.27	83.33	0.28E-04	0.11E-03	0.26E+00
48.1	.0758	254.	24.92	83.33	0.26E-04	0.10E-03	0.25E+00
52.1	.0752	260.	25.52	83.33	0.23E-04	0.99E-04	0.23E+00
122.0	.0696	330.	32.37	83.33	0.11E-04	0.63E-04	0.18E+00

DEPTH 98. CM SITE B-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3341	39.	3.81	1.21	0.40E+01	0.18E-02	0.23E+04
0.3	.3286	42.	4.09	1.04	0.46E+01	0.23E-02	0.20E+04
0.5	.3239	44.	4.28	0.99	0.42E+01	0.28E-02	0.15E+04
0.7	.3170	45.	4.44	0.97	0.44E+01	0.55E-02	0.80E+03
1.0	.3037	47.	4.58	0.99	0.53E+01	0.17E-01	0.31E+03
1.5	.2848	49.	4.81	1.00	0.77E+01	0.91E-02	0.85E+03
2.2	.2606	52.	5.05	1.01	0.37E+01	0.11E-01	0.33E+03
2.7	.2480	53.	5.19	1.01	0.16E+01	0.76E-02	0.21E+03
3.5	.2336	55.	5.34	1.00	0.83E+00	0.11E-01	0.78E+02

DEPTH 98. CM (CONT)

4.5	.2183	56.	5.49	1.04	0.17E+01	0.10E-01	0.16E+03
6.2	.2080	57.	5.61	1.14	0.25E+00	0.63E-02	0.40E+02
8.7	.1997	59.	5.76	1.21	0.36E+00	0.50E-02	0.72E+02
12.5	.1910	60.	5.93	1.25	0.17E+00	0.53E-02	0.31E+02
17.5	.1821	62.	6.10	1.29	0.15E+00	0.48E-02	0.30E+02
25.0	.1713	65.	6.38	1.21	0.81E-01	0.33E-02	0.24E+02
40.0	.1604	68.	6.71	1.11	0.32E-01	0.34E-02	0.95E+01
60.0	.1539	71.	6.97	1.05	0.21E-01	0.15E-02	0.14E+02
80.0	.1494	73.	7.20	1.02	0.22E-01	0.26E-02	0.85E+01
100.0	.1435	75.	7.40	1.01	0.20E-01	0.34E-02	0.59E+01
120.0	.1375	77.	7.56	1.00	0.25E-01	0.42E-02	0.59E+01

DOERING 1-STEP DATA

7.5	.1337	83.	8.13	83.33	0.26E-02	0.97E-03	0.27E+01
11.5	.0869	191.	18.76	83.33	0.34E-03	0.19E-03	0.18E+01
15.5	.0673	397.	38.89	83.33	0.63E-04	0.47E-04	0.13E+01

DEPTH 114. CM SITE B-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3458	37.	3.66	0.62	0.83E+01	0.19E-02	0.45E+04
0.3	.3405	39.	3.85	0.67	0.79E+01	0.36E-02	0.22E+04
0.5	.3316	41.	4.01	0.69	0.68E+01	0.86E-02	0.80E+03
0.7	.3190	43.	4.19	0.72	0.68E+01	0.65E-02	0.11E+04
1.0	.3083	44.	4.35	0.73	0.84E+01	0.68E-02	0.12E+04
1.2	.2989	46.	4.48	0.73	0.52E+00	0.79E-02	0.66E+02
1.5	.2878	47.	4.62	0.75	0.11E+02	0.81E-02	0.14E+04
1.9	.2781	48.	4.72	0.74	0.62E+00	0.10E-01	0.60E+02
2.2	.2662	49.	4.82	0.70	0.59E+01	0.14E-01	0.41E+03
2.7	.2526	50.	4.91	0.65	0.31E+01	0.15E-01	0.20E+03
3.5	.2371	51.	5.03	0.62	0.18E+01	0.11E-01	0.16E+03
4.5	.2211	53.	5.22	0.63	0.31E+01	0.66E-02	0.47E+03
6.2	.2101	55.	5.40	0.61	0.55E+00	0.54E-02	0.10E+03
8.7	.2011	57.	5.54	0.54	0.91E+00	0.66E-02	0.14E+03
12.5	.1915	59.	5.74	0.54	0.44E+00	0.38E-02	0.12E+03
17.5	.1808	61.	5.96	0.56	0.39E+00	0.67E-02	0.58E+02
25.0	.1683	63.	6.20	0.57	0.21E+00	0.44E-02	0.47E+02
40.0	.1572	66.	6.47	0.61	0.70E-01	0.36E-02	0.19E+02
60.0	.1503	68.	6.71	0.62	0.40E-01	0.21E-02	0.19E+02
80.0	.1465	71.	6.92	0.64	0.40E-01	0.14E-02	0.28E+02
100.0	.1424	73.	7.12	0.64	0.39E-01	0.30E-02	0.13E+02
120.0	.1375	74.	7.27	0.64	0.45E-01	0.36E-02	0.13E+02

DEPTH 130. CM SITE B-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3629	31.	3.06	0.62	0.87E+01	0.91E-03	0.96E+04
0.3	.3588	34.	3.29	0.62	0.93E+01	0.27E-02	0.35E+04
0.5	.3502	36.	3.49	0.65	0.85E+01	0.64E-02	0.13E+04
0.7	.3383	38.	3.70	0.67	0.84E+01	0.50E-02	0.17E+04
1.0	.3284	40.	3.89	0.69	0.98E+01	0.60E-02	0.16E+04
1.2	.3187	41.	4.03	0.70	0.15E+01	0.79E-02	0.18E+03
1.5	.3065	43.	4.18	0.70	0.13E+02	0.85E-02	0.15E+04
1.9	.2924	44.	4.28	0.70	0.16E+01	0.31E-01	0.52E+02
2.2	.2725	45.	4.37	0.72	0.66E+01	0.21E-01	0.31E+03
2.7	.2536	45.	4.44	0.76	0.32E+01	0.37E-01	0.85E+02
3.5	.2392	46.	4.55	0.77	0.18E+01	0.82E-02	0.22E+03
4.5	.2227	49.	4.75	0.77	0.29E+01	0.83E-02	0.35E+03
6.2	.2098	50.	4.92	0.78	0.50E+00	0.66E-02	0.75E+02
8.7	.2009	51.	5.04	0.80	0.69E+00	0.94E-02	0.73E+02
12.5	.1904	53.	5.20	0.75	0.36E+00	0.51E-02	0.70E+02

DEPTH	130.	CM	(CONT)				
17.5	.1792	55.	5.40	0.72	0.36E+00	0.62E-02	0.58E+02
25.0	.1674	58.	5.64	0.72	0.19E+00	0.39E-02	0.49E+02
40.0	.1573	61.	5.93	0.70	0.70E-01	0.29E-02	0.24E+02
60.0	.1508	63.	6.17	0.69	0.43E-01	0.25E-02	0.17E+02
80.0	.1451	65.	6.38	0.67	0.44E-01	0.28E-02	0.15E+02
100.0	.1399	67.	6.56	0.66	0.44E-01	0.29E-02	0.15E+02
120.0	.1372	68.	6.70	0.64	0.47E-01	0.43E-03	0.11E+03

SITE C (HECLA SERIES)

Site C was located in the nonirrigated corner of a center-pivot irrigated potato field, and was covered with a young cover-crop of winter barley. The location and description are summarized on Table 1. According to the La Moure County (ND) Soil Survey Report (USDA, 1971) the Hecla soil series consists of "deep, moderately well drained, level to gently undulating soils on sandy lake plains and on sandy uplands and terraces in the James River Valley". They were "formed in coarse-textured deposits left by glacial melt water and reworked by wind". Hecla soils are associated with Hamar, Maddock, and Ulen soils. The specific site measured (location Fig. 2) consisted of a slightly elevated position associated at close distance with site B, and separated by a very slight depression (also mapped Hecla).

In-situ measurements and site descriptions were made during late September and October, 1984. Temperatures were frequently below freezing at night, and to sustain measurements, 6 mil polyethylene tents were constructed over the site and were heated at night with portable propane heaters. The measurement period was concurrent with sites A and B which were located nearby. Soil samples and soil profile descriptions were made approximately two weeks after the completion of soil hydraulic measurements. Although measurements were made for more than two weeks, drainage was approximately complete at 7 days.

SITE C, REPLICATION 1

Table C-1.1 Soil morphologic data for Site C, replication 1.

Site and location: C-l Heimbuch site, Oakes aquifer 285 feet south and 360 feet west of the east quarter corner of Section 26, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/84 by M. D. Sweeney (NDAES, Fargo, ND) and W. M. Schuh and R. Cline (NDSWC, Bismarck, ND).

Soil type and classification: Hecla sandy loam; sandy, mixed aquic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Moderately well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: C-l north side of pit.

Alp 0-3 inches (0-9 cm), black (l0YR 2/1) sandy loam (loamy sand); moderate coarse and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; abrupt smooth boundary.

A12 3-10 inches (9-26 cm), black (l0YR 2/1) sandy loam (loamy sand); moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; clear wavy boundary.

A13 10-22 inches (26-56 cm), black (l0YR 2/1) loamy sand; moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; clear wavy boundary.

Bw 22-32 inches (56-82 cm), dark brown (l0YR 3/3) loamy sand (sand); weak coarse and medium prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; clear wavy boundary.

C 32-39 inches (82-100 cm), light olive brown (2.5Y 5/4) sand with few fine distinct dark yellowish brown (l0YR 3/4) mottles which increase to common with depth; weak coarse and medium prismatic structure; soft, very friable to loose; nonsticky and nonplastic; few very fine roots; clear wavy boundary.

Cg 39-55 inches (100-140 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with many medium distinct brown (7.5YR 4/4) and few fine distinct dark brown (7.5YR 3/2) mottles; weak, coarse and medium prismatic structure; soft, very friable to loose, ncnsticky and non- plastic; few very fine roots.

Table C-1.2 HECLA SERIES SITE C-1 NDSWC:1984
particle-size, bulk density, and organic carbon data and indices

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	10.4	1.1	4.7	11.3	41.4	28.6	2.4	0.1
23.	5.2	4.1	5.0	10.0	42.3	31.0	2.6	0.0
38.	4.4	5.9	5.0	11.4	42.6	28.1	2.5	0.0
53.	4.4	6.2	5.0	13.4	44.3	24.9	1.7	0.0
69.	3.6	4.7	3.1	9.4	45.4	31.1	2.5	0.1
84.	3.3	4.0	1.2	9.6	50.3	29.5	2.1	0.0
99.	5.7	0.0	7.6	7.1	49.2	28.6	1.6	0.1
114.	3.6	2.9	1.2	7.9	46.5	35.0	2.9	0.0
130.	3.2	2.5	2.1	6.8	40.0	41.4	3.6	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	83.8	5.8	10.4	A 1 6	6=p
23.	85.7	9.1	5.2	A 1 2	7=w
38.	84.7	10.9	4.4	A 1 3	8=g
53.	84.4	11.2	4.4	A 1 3	
69.	88.6	7.8	3.6	B 7	
84.	91.5	5.2	3.3	B 0	
99.	86.6	7.7	5.7	C 8	
114.	92.3	4.1	3.6	C 8	
130.	92.1	4.7	3.2	C 0 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	14.448	0.1079	5.7	0.0188	0.740	1.42	1.50
23.	9.440	0.1327	4.2	0.0316	0.787	1.50	1.50
38.	7.761	0.1277	4.1	0.0315	0.751	1.44	0.87
53.	7.527	0.1201	4.0	0.0301	0.752	1.44	0.81
69.	11.346	0.1479	3.7	0.0405	0.890	1.51	0.47
84.	17.596	0.1542	3.4	0.0456	1.038	1.53	0.39
99.	11.395	0.1388	4.0	0.0347	0.972	1.54	0.20
114.	22.512	0.1676	3.4	0.0486	1.056	1.53	0.16
130.	19.957	0.1838	3.4	0.0546	1.027	1.55	0.12

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.315	2.340	-1.1367	2.4302	-11.37	1.05
23.	1.602	2.401	-1.1453	2.4911	-11.45	1.11
38.	1.730	2.612	-1.1157	2.4534	-11.16	1.07
53.	1.750	2.649	-1.1096	2.4447	-11.10	1.06
69.	1.502	3.257	-1.1899	2.5665	-11.90	1.19
84.	1.275	3.806	-1.2482	2.6535	-12.48	1.27
99.	1.487	4.089	-1.1645	2.5114	-11.65	1.13
114.	1.159	4.591	-1.2664	2.6767	-12.66	1.30
130.	1.216	4.695	-1.2562	2.6622	-12.56	1.28

Table C-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site C, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	1.4	0.9	0.5	0.6	-	1.6	0.20	1.7
15 - 30	1.9	1.0	0.7	0.4	-	0.9	0.15	3.1
30 - 46	2.1	0.8	0.7	0.4	-	1.9	0.20	2.0
46 - 61	15.9	8.4	2.22	0.6	-	3.8	0.25	23.1
61 - 76	1.2	0.9	1.0	0.3	-	1.1	0.19	2.2
76 - 91	1.1	1.0	0.8	0.1	-	1.0	0.21	1.9
91 - 106	1.2	0.7	0.7	0.1	-	0.9	0.15	1.8
106 - 122	0.9	0.8	0.7	0.1	-	1.0	0.17	1.5
122 - 137	1.1	0.7	0.6	0.1	-	0.9	0.15	1.5

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.29	0.5	28	6.8	3.4	ls	5.2
15 - 30	0.37	0.6	32	7.3	3.2	ls	5.7
30 - 46	0.33	0.6	29	7.2	3.4	ls	4.7
46 - 61	1.80	0.6	26	6.1	2.6	ls	3.4
61 - 76	0.26	1.0	21	7.3	2.2	s	3.2
76 - 91	0.21	0.8	23	7.4	3.2	fs	2.8
91 - 106	0.20	0.8	20	7.4	1.9	ls	2.9
106 - 122	0.21	0.8	21	7.4	3.2	s	3.2
122 - 137	0.20	0.6	21	7.5	2.5	s	3.4

Table C-1.4 HECLA SERIES SITE C-1 NDSWC:84

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			8.			23.			38.	
CM	CC/CC	SE									
24.	0.4769	******	24.	0.3504	******	10.	0.4192	0.0144	24.	0.3499	0.0032
40.	0.3726	******	40.	0.3504	******	20.	0.4076	0.0116	40.	0.2932	0.0021
50.	0.3279	******	50.	0.3366	******	40.	0.3303	0.0079	50.	0.2463	0.0005
62.	0.2981	******	62.	0.3152	******	60.	0.2718	0.0129	62.	0.2183	0.0004
70.	0.2799	******	70.	0.3029	******	80.	0.2372	0.0128	70.	0.2022	0.0009
82.	0.2567	******	82.	0.2830	******	100.	0.2126	0.0131	82.	0.1848	0.0004
98.	0.2418	******	98.	0.2601	******	120.	0.1949	0.0117	98.	0.1708	0.0013
150.	0.2120	******	150.	0.2157	******	180.	0.1642	0.0099	150.	0.1435	0.0008
340.	0.1755	******	340.	0.1759	******	340.	0.1336	0.0070	340.	0.1127	0.0007
503.	0.1590	******	503.	0.1652	******	534.	0.1205	0.0067	503.	0.1029	0.0007
800.	0.1441	******	800.	0.1515	******	800.	0.1144	0.0056	800.	0.0952	0.0012
BD =	1.42			1.50			1.50			1.44	
N =	1			1			2			2	

DEPTH (CM)

	53.			69.			84.			99.	
10.	0.3592	0.0007	10.	0.3978	0.0060	10.	0.4025	0.0001	24.	0.3699	0.0087
20.	0.3613	0.0012	20.	0.3817	0.0064	20.	0.3855	0.0004	40.	0.2607	0.0007
40.	0.2504	0.0036	40.	0.2401	0.0013	40.	0.2671	0.0084	50.	0.1908	0.0018
60.	0.1998	0.0039	60.	0.1808	0.0015	60.	0.1905	0.0096	62.	0.1500	0.0009
80.	0.1690	0.0035	80.	0.1470	0.0013	80.	0.1508	0.0107	70.	0.1263	0.0001
100.	0.1498	0.0036	100.	0.1293	0.0007	100.	0.1324	0.0123	82.	0.1108	0.0002
120.	0.1348	0.0027	120.	0.1193	0.0012	120.	0.1126	0.0055	98.	0.0982	0.0015
180.	0.1170	0.0028	180.	0.0993	0.0011	180.	0.0956	0.0040	150.	0.0828	0.0000
340.	0.0971	0.0024	340.	0.0839	0.0010	340.	0.0780	0.0020	340.	0.0704	0.0006
534.	0.0882	0.0020	534.	0.0777	0.0010	534.	0.0714	0.0004	503.	0.0671	0.0009
800.	0.0841	0.0020	800.	0.0746	0.0010	800.	0.0670	0.0004	800.	0.0654	0.0010
BD =	1.44			1.51			1.53			1.54	
N =	2			2			2			2	

DEPTH (CM)

	114.			130.	
10.	0.3685	0.0138	10.	0.3877	0.0055
20.	0.3552	0.0074	20.	0.3581	0.0010
40.	0.2068	0.0022	40.	0.1926	0.0025
60.	0.1401	0.0003	60.	0.1328	0.0033
80.	0.1093	0.0005	80.	0.1080	0.0023
100.	0.0954	0.0009	100.	0.0955	0.0023
120.	0.0880	0.0002	120.	0.0878	0.0024
180.	0.0785	0.0002	180.	0.0769	0.0013
340.	0.0697	0.0009	340.	0.0684	0.0008
534.	0.0660	0.0004	534.	0.0645	0.0014
800.	0.0631	0.0005	800.	0.0621	0.0008
BD =	1.53			1.55	
N =	2			2	

Table C-1.5 HECLA SERIES SITE C1 (NDSWC 1984)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3641	25.	2.47	1.23	0.63E-01	0.19E-03	0.34E+03
0.4	.3613	34.	3.32	1.07	0.13E+00	0.59E-03	0.21E+03
0.6	.3570	40.	3.97	0.93	0.14E+00	0.72E-03	0.19E+03
0.9	.3420	46.	4.52	0.77	0.12E+01	0.63E-02	0.20E+03
1.1	.3250	50.	4.87	0.70	0.48E+00	0.30E-02	0.16E+03
1.4	.3151	53.	5.17	0.63	0.43E+00	0.36E-02	0.12E+03
1.6	.3051	56.	5.52	0.53	0.44E+00	0.23E-02	0.19E+03
1.9	.2978	59.	5.82	0.43	0.47E+00	0.27E-02	0.18E+03
2.2	.2922	61.	5.97	0.40	0.37E+00	0.58E-02	0.63E+02
2.4	.2881	62.	6.09	0.37	0.17E+00	0.16E-02	0.10E+03
2.8	.2837	64.	6.24	0.32	0.38E+00	0.42E-02	0.90E+02
3.2	.2787	65.	6.37	0.30	0.20E+00	0.39E-02	0.51E+02
3.7	.2758	66.	6.47	0.32	0.92E-01	0.19E-02	0.48E+02
4.2	.2719	67.	6.57	0.33	0.26E+00	0.58E-02	0.46E+02
4.7	.2662	68.	6.67	0.37	0.24E+00	0.57E-02	0.41E+02
6.2	.2588	69.	6.77	0.42	0.66E-01	0.91E-02	0.73E+01
8.7	.2483	71.	6.92	0.42	0.87E-01	0.60E-02	0.15E+02
12.5	.2388	73.	7.17	0.40	0.27E-01	0.24E-02	0.11E+02
17.5	.2316	77.	7.57	0.37	0.29E-01	0.14E-02	0.21E+02
25.0	.2229	83.	8.17	0.37	0.22E-01	0.15E-02	0.15E+02
35.0	.2141	89.	8.72	0.37	0.15E-01	0.18E-02	0.83E+01
50.0	.2075	94.	9.22	0.33	0.70E-02	0.10E-02	0.68E+01
70.0	.2030	100.	9.77	0.30	0.36E-02	0.57E-03	0.63E+01
90.0	.2014	105.	10.27	0.23	0.77E-03	0.94E-04	0.81E+01

DEPTH 23. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3834	27.	2.60	1.23	0.43E+00	0.11E-02	0.37E+03
0.4	.3735	34.	3.36	1.07	0.61E+00	0.17E-02	0.37E+03
0.6	.3621	40.	3.91	0.93	0.62E+00	0.25E-02	0.24E+03
0.9	.3457	44.	4.34	0.77	0.35E+01	0.57E-02	0.61E+03
1.1	.3305	47.	4.64	0.70	0.15E+01	0.42E-02	0.37E+03
1.4	.3200	50.	4.88	0.63	0.13E+01	0.42E-02	0.30E+03
1.6	.3107	53.	5.15	0.53	0.13E+01	0.26E-02	0.48E+03
1.9	.3047	55.	5.38	0.43	0.13E+01	0.28E-02	0.47E+03
2.2	.3005	56.	5.50	0.40	0.10E+01	0.44E-02	0.23E+03
2.4	.2967	57.	5.60	0.37	0.55E+00	0.32E-02	0.18E+03
2.8	.2911	58.	5.71	0.32	0.12E+01	0.64E-02	0.19E+03
3.2	.2852	59.	5.82	0.30	0.59E+00	0.39E-02	0.15E+03
3.7	.2817	61.	5.93	0.32	0.34E+00	0.25E-02	0.13E+03
4.2	.2777	62.	6.05	0.33	0.75E+00	0.48E-02	0.16E+03
4.7	.2730	63.	6.17	0.37	0.67E+00	0.30E-02	0.22E+03
6.2	.2605	64.	6.32	0.42	0.28E+00	0.16E-01	0.17E+02
8.7	.2495	66.	6.47	0.42	0.18E+00	0.81E-03	0.23E+03
12.5	.2444	68.	6.70	0.40	0.88E-01	0.29E-02	0.30E+02
17.5	.2364	72.	7.07	0.37	0.89E-01	0.16E-02	0.56E+02
25.0	.2276	78.	7.67	0.37	0.65E-01	0.14E-02	0.47E+02
35.0	.2182	84.	8.23	0.37	0.47E-01	0.24E-02	0.19E+02
50.0	.2105	89.	8.70	0.33	0.22E-01	0.11E-02	0.19E+02
70.0	.2056	94.	9.22	0.30	0.11E-01	0.63E-03	0.17E+02
90.0	.2036	99.	9.67	0.23	0.35E-02	0.26E-03	0.13E+02

DOERING 1-STEP DATA

0.0	.2006	106.	10.44	83.33	0.22E-01	0.75E-03	0.29E+02
0.0	.1976	111.	10.84	83.33	0.20E-01	0.71E-03	0.29E+02
0.0	.1946	115.	11.27	83.33	0.19E-01	0.66E-03	0.28E+02
0.0	.1916	120.	11.73	83.33	0.17E-01	0.62E-03	0.28E+02
0.1	.1886	125.	12.22	83.33	0.16E-01	0.58E-03	0.28E+02
0.1	.1856	130.	12.75	83.33	0.15E-01	0.54E-03	0.28E+02
0.1	.1826	136.	13.32	83.33	0.14E-01	0.50E-03	0.28E+02
0.1	.1796	142.	13.93	83.33	0.13E-01	0.46E-03	0.28E+02
0.1	.1766	149.	14.59	83.33	0.12E-01	0.43E-03	0.28E+02
0.1	.1736	156.	15.30	83.33	0.11E-01	0.40E-03	0.28E+02
0.1	.1706	164.	16.08	83.33	0.10E-01	0.36E-03	0.28E+02
0.1	.1676	173.	16.92	83.33	0.93E-02	0.33E-03	0.28E+02
0.1	.1646	182.	17.84	83.33	0.85E-02	0.31E-03	0.28E+02
0.1	.1616	192.	18.85	83.33	0.78E-02	0.28E-03	0.28E+02
0.2	.1586	204.	19.95	83.33	0.71E-02	0.25E-03	0.28E+02
0.2	.1556	216.	21.17	83.33	0.64E-02	0.23E-03	0.28E+02
0.2	.1526	230.	22.52	83.33	0.58E-02	0.21E-03	0.28E+02
0.2	.1496	245.	24.01	83.33	0.53E-02	0.19E-03	0.28E+02
0.2	.1466	262.	25.69	83.33	0.47E-02	0.17E-03	0.28E+02
0.2	.1436	281.	27.56	83.33	0.42E-02	0.15E-03	0.29E+02
0.2	.1406	303.	29.68	83.33	0.38E-02	0.13E-03	0.29E+02
0.2	.1376	327.	32.08	83.33	0.33E-02	0.11E-03	0.29E+02
0.2	.1346	355.	34.84	83.33	0.29E-02	0.10E-03	0.29E+02
0.3	.1316	388.	38.01	83.33	0.26E-02	0.86E-04	0.30E+02
0.3	.1286	425.	41.69	83.33	0.22E-02	0.74E-04	0.30E+02
0.3	.1256	469.	46.01	83.33	0.19E-02	0.63E-04	0.30E+02

DEPTH 38. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3980	26.	2.52	0.64	0.24E+01	0.30E-02	0.80E+03
0.4	.3823	32.	3.10	0.60	0.27E+01	0.25E-02	0.11E+04
0.6	.3659	36.	3.56	0.60	0.22E+01	0.59E-02	0.38E+03
0.9	.3502	39.	3.83	0.57	0.69E+01	0.54E-02	0.13E+04
1.1	.3383	41.	4.06	0.54	0.35E+01	0.51E-02	0.68E+03
1.4	.3280	44.	4.28	0.57	0.24E+01	0.42E-02	0.57E+03
1.6	.3198	46.	4.49	0.57	0.18E+01	0.39E-02	0.45E+03
1.9	.3153	47.	4.61	0.54	0.16E+01	0.32E-02	0.49E+03
2.2	.3116	48.	4.71	0.54	0.12E+01	0.42E-02	0.28E+03
2.4	.3074	49.	4.79	0.54	0.73E+00	0.83E-02	0.87E+02
2.8	.2999	49.	4.85	0.52	0.14E+01	0.15E-01	0.99E+02
3.2	.2916	50.	4.93	0.50	0.64E+00	0.56E-02	0.11E+03
3.7	.2865	51.	5.03	0.47	0.48E+00	0.46E-02	0.10E+03
4.2	.2824	52.	5.13	0.44	0.87E+00	0.36E-02	0.24E+03
4.7	.2792	54.	5.27	0.42	0.85E+00	0.17E-02	0.52E+03
6.2	.2663	56.	5.44	0.42	0.60E+00	0.13E-01	0.46E+02
8.7	.2530	57.	5.62	0.45	0.20E+00	0.22E-02	0.94E+02
12.5	.2471	60.	5.86	0.47	0.13E+00	0.27E-02	0.48E+02
17.5	.2407	63.	6.18	0.44	0.12E+00	0.14E-02	0.85E+02
25.0	.2298	69.	6.72	0.37	0.12E+00	0.23E-02	0.53E+02
35.0	.2160	74.	7.25	0.34	0.95E-01	0.35E-02	0.27E+02
50.0	.2074	78.	7.65	0.27	0.47E-01	0.14E-02	0.34E+02
70.0	.2023	83.	8.10	0.20	0.28E-01	0.83E-03	0.34E+02
90.0	.2000	87.	8.50	0.20	0.89E-02	0.35E-03	0.25E+02

DOERING 1-STEP DATA

0.2	.2281	60.	5.86	83.33	0.71E-01	0.19E-02	0.37E+02
0.2	.2139	68.	6.66	83.33	0.44E-01	0.16E-02	0.28E+02
0.3	.2037	75.	7.35	83.33	0.30E-01	0.13E-02	0.23E+02
0.3	.1960	81.	7.97	83.33	0.22E-01	0.11E-02	0.19E+02
0.4	.1898	87.	8.53	83.33	0.17E-01	0.10E-02	0.16E+02

0.4	.1847	92.	9.04	83.33	0.13E-01	0.93E-03	0.14E+02
0.5	.1804	97.	9.52	83.33	0.11E-01	0.85E-03	0.13E+02
0.5	.1767	102.	9.96	83.33	0.91E-02	0.78E-03	0.12E+02
0.6	.1735	106.	10.38	83.33	0.78E-02	0.73E-03	0.11E+02
0.6	.1706	110.	10.77	83.33	0.67E-02	0.69E-03	0.98E+01
0.7	.1681	114.	11.15	83.33	0.58E-02	0.65E-03	0.91E+01
0.7	.1658	117.	11.51	83.33	0.52E-02	0.61E-03	0.84E+01
0.8	.1637	121.	11.85	83.33	0.46E-02	0.58E-03	0.79E+01
0.8	.1618	124.	12.17	83.33	0.41E-02	0.56E-03	0.74E+01
0.9	.1601	127.	12.49	83.33	0.37E-02	0.53E-03	0.70E+01
0.9	.1585	130.	12.79	83.33	0.34E-02	0.51E-03	0.66E+01
1.0	.1570	133.	13.08	83.33	0.31E-02	0.49E-03	0.63E+01
1.0	.1556	136.	13.36	83.33	0.28E-02	0.47E-03	0.60E+01
1.1	.1543	139.	13.64	83.33	0.26E-02	0.46E-03	0.57E+01
1.1	.1531	142.	13.90	83.33	0.24E-02	0.44E-03	0.55E+01

DEPTH 38. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.1519	144.	14.16	83.33	0.23E-02	0.43E-03	0.53E+01
1.2	.1509	147.	14.41	83.33	0.21E-02	0.42E-03	0.50E+01
1.3	.1498	149.	14.65	83.33	0.20E-02	0.40E-03	0.49E+01
1.3	.1489	152.	14.89	83.33	0.18E-02	0.39E-03	0.47E+01
1.4	.1480	154.	15.12	83.33	0.17E-02	0.38E-03	0.45E+01
1.4	.1471	157.	15.34	83.33	0.16E-02	0.37E-03	0.44E+01
1.5	.1463	159.	15.56	83.33	0.15E-02	0.36E-03	0.42E+01
1.5	.1455	161.	15.78	83.33	0.15E-02	0.36E-03	0.41E+01
1.6	.1447	163.	15.99	83.33	0.14E-02	0.35E-03	0.40E+01
1.6	.1440	165.	16.19	83.33	0.13E-02	0.34E-03	0.38E+01
1.7	.1433	167.	16.39	83.33	0.12E-02	0.33E-03	0.37E+01
1.7	.1427	169.	16.59	83.33	0.12E-02	0.33E-03	0.36E+01
1.8	.1420	171.	16.78	83.33	0.11E-02	0.32E-03	0.35E+01
1.8	.1414	173.	16.97	83.33	0.11E-02	0.31E-03	0.34E+01
1.9	.1408	175.	17.16	83.33	0.10E-02	0.31E-03	0.33E+01
1.9	.1402	177.	17.34	83.33	0.99E-03	0.30E-03	0.33E+01
2.0	.1397	179.	17.52	83.33	0.95E-03	0.30E-03	0.32E+01
2.0	.1392	180.	17.69	83.33	0.91E-03	0.29E-03	0.31E+01
2.1	.1387	182.	17.87	83.33	0.88E-03	0.29E-03	0.30E+01
4.1	.1260	237.	23.25	83.33	0.29E-03	0.18E-03	0.16E+01
8.1	.1164	302.	29.57	83.33	0.10E-03	0.12E-03	0.86E+00
12.1	.1118	344.	33.76	83.33	0.58E-04	0.97E-04	0.60E+00
16.1	.1089	377.	36.93	83.33	0.39E-04	0.83E-04	0.47E+00
20.1	.1069	403.	39.49	83.33	0.29E-04	0.74E-04	0.39E+00
24.1	.1053	425.	41.65	83.33	0.23E-04	0.68E-04	0.34E+00
28.1	.1041	444.	43.51	83.33	0.19E-04	0.63E-04	0.30E+00
32.1	.1030	460.	45.15	83.33	0.16E-04	0.59E-04	0.27E+00
36.1	.1022	475.	46.61	83.33	0.14E-04	0.56E-04	0.24E+00
40.1	.1015	489.	47.93	83.33	0.12E-04	0.53E-04	0.23E+00
44.1	.1008	501.	49.14	83.33	0.11E-04	0.51E-04	0.21E+00

DEPTH 53. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3755	24.	2.32	1.07	0.24E+01	0.27E-02	0.88E+03
0.4	.3642	28.	2.74	0.90	0.29E+01	0.26E-02	0.11E+04
0.6	.3514	32.	3.12	0.80	0.27E+01	0.46E-02	0.58E+03
0.9	.3393	34.	3.35	0.77	0.63E+01	0.68E-02	0.93E+03
1.1	.3299	36.	3.52	0.73	0.35E+01	0.43E-02	0.81E+03
1.4	.3199	38.	3.75	0.70	0.27E+01	0.45E-02	0.60E+03
1.6	.3103	40.	3.95	0.70	0.20E+01	0.52E-02	0.37E+03
1.9	.3043	42.	4.07	0.73	0.15E+01	0.41E-02	0.37E+03

DEPTH 53. CM (CONT)

2.2	.2992	43.	4.17	0.73	0.12E+01	0.61E-02	0.20E+03
2.4	.2944	43.	4.26	0.75	0.78E+00	0.45E-02	0.17E+03
2.8	.2879	44.	4.34	0.78	0.15E+01	0.13E-01	0.11E+03
3.2	.2798	45.	4.41	0.77	0.65E+00	0.11E-01	0.60E+02
3.7	.2742	46.	4.47	0.76	0.48E+00	0.70E-02	0.68E+02
4.2	.2702	46.	4.55	0.77	0.64E+00	0.36E-02	0.18E+03
4.7	.2667	48.	4.69	0.78	0.58E+00	0.19E-02	0.30E+03
6.2	.2595	50.	4.86	0.78	0.45E+00	0.63E-02	0.72E+02
8.7	.2458	52.	5.05	0.77	0.20E+00	0.82E-02	0.25E+02
12.5	.2320	54.	5.29	0.75	0.12E+00	0.40E-02	0.30E+02
17.5	.2235	57.	5.55	0.70	0.96E-01	0.24E-02	0.40E+02
25.0	.2116	61.	5.98	0.62	0.12E+00	0.29E-02	0.40E+02
35.0	.1981	66.	6.44	0.57	0.82E-01	0.30E-02	0.27E+02
50.0	.1898	70.	6.82	0.60	0.30E-01	0.17E-02	0.18E+02
70.0	.1839	74.	7.23	0.62	0.14E-01	0.11E-02	0.12E+02
90.0	.1809	78.	7.61	0.58	0.51E-02	0.44E-03	0.12E+02

DOERING 1-STEP DATA

4.3	.1657	93.	9.15	83.33	0.12E-02	0.81E-03	0.14E+01
8.3	.1495	117.	11.50	83.33	0.44E-03	0.56E-03	0.79E+00
12.3	.1414	133.	13.06	83.33	0.25E-03	0.46E-03	0.55E+00
16.3	.1364	145.	14.24	83.33	0.17E-03	0.40E-03	0.43E+00
20.3	.1327	155.	15.19	83.33	0.13E-03	0.36E-03	0.36E+00
24.3	.1299	163.	15.98	83.33	0.10E-03	0.33E-03	0.31E+00
28.3	.1277	170.	16.67	83.33	0.83E-04	0.31E-03	0.27E+00
32.3	.1259	176.	17.27	83.33	0.70E-04	0.29E-03	0.24E+00
36.3	.1243	182.	17.81	83.33	0.61E-04	0.28E-03	0.22E+00
40.3	.1230	187.	18.30	83.33	0.54E-04	0.26E-03	0.20E+00
44.3	.1218	191.	18.74	83.33	0.48E-04	0.25E-03	0.19E+00
48.3	.1208	195.	19.15	83.33	0.43E-04	0.24E-03	0.18E+00
122.0	.1115	240.	23.57	83.33	0.16E-04	0.17E-03	0.94E-01
194.0	.1078	263.	25.77	83.33	0.12E-04	0.15E-03	0.76E-01
266.0	.1057	278.	27.24	83.33	0.99E-05	0.14E-03	0.72E-01

DEPTH 69. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3506	28.	2.76	1.58	0.20E+01	********	********
0.4	.3452	27.	2.63	0.94	0.35E+01	********	********
0.6	.3369	27.	2.67	0.60	0.46E+01	0.50E-02	0.92E+03
0.9	.3276	29.	2.81	0.54	0.10E+02	0.87E-02	0.12E+04
1.1	.3190	30.	2.93	0.50	0.64E+01	0.57E-02	0.11E+04
1.4	.3061	31.	3.08	0.44	0.60E+01	0.11E-01	0.53E+03
1.6	.2926	33.	3.24	0.39	0.47E+01	0.57E-02	0.83E+03
1.9	.2852	34.	3.36	0.35	0.42E+01	0.64E-02	0.65E+03
2.2	.2793	35.	3.45	0.34	0.36E+01	0.70E-02	0.52E+03
2.4	.2743	36.	3.55	0.34	0.22E+01	0.29E-02	0.77E+03
2.8	.2689	37.	3.64	0.32	0.47E+01	0.11E-01	0.44E+03
3.2	.2621	38.	3.69	0.31	0.22E+01	0.16E-01	0.14E+03
3.7	.2567	38.	3.76	0.33	0.16E+01	0.56E-02	0.28E+03
4.2	.2522	39.	3.84	0.32	0.19E+01	0.54E-02	0.35E+03
4.7	.2477	40.	3.93	0.25	0.23E+01	0.40E-02	0.58E+03
6.2	.2378	41.	4.04	0.17	0.26E+01	0.15E-01	0.17E+03
8.7	.2224	43.	4.17	0.12	0.22E+01	0.92E-02	0.23E+03
12.5	.2076	45.	4.37	0.08	0.15E+01	0.60E-02	0.25E+03
17.5	.1965	47.	4.61	0.10	0.89E+00	0.35E-02	0.25E+03
25.0	.1860	51.	5.00	0.12	0.81E+00	0.23E-02	0.34E+03
35.0	.1761	55.	5.41	0.10	0.59E+00	0.25E-02	0.23E+03
50.0	.1690	60.	5.84	0.13	0.17E+00	0.12E-02	0.14E+03

DEPTH 84. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3467	30.	2.97	0.67	0.51E+01	********	********
0.4	.3430	28.	2.78	1.27	0.29E+01	********	********
0.6	.3364	28.	2.76	1.54	0.21E+01	0.90E-02	0.23E+03
0.9	.3275	29.	2.87	1.54	0.41E+01	0.89E-02	0.45E+03
1.1	.3188	30.	2.97	1.54	0.25E+01	0.84E-02	0.30E+03
1.4	.3055	32.	3.12	1.63	0.22E+01	0.81E-02	0.27E+03
1.6	.2903	34.	3.30	1.71	0.14E+01	0.81E-02	0.17E+03
1.9	.2808	35.	3.41	1.73	0.11E+01	0.90E-02	0.12E+03
2.2	.2736	36.	3.50	1.74	0.91E+00	0.77E-02	0.12E+03
2.4	.2671	37.	3.59	1.73	0.55E+00	0.70E-02	0.78E+02
2.8	.2591	37.	3.66	1.71	0.11E+01	0.21E-01	0.50E+02
3.2	.2504	38.	3.71	1.71	0.51E+00	0.13E-01	0.39E+02
3.7	.2446	38.	3.77	1.69	0.39E+00	0.67E-02	0.59E+02
4.2	.2401	39.	3.84	1.68	0.43E+00	0.81E-02	0.54E+02
4.7	.2360	40.	3.89	1.68	0.43E+00	0.81E-02	0.53E+02
6.2	.2241	40.	3.96	1.71	0.31E+00	0.20E-01	0.16E+02
8.7	.2072	42.	4.07	1.73	0.20E+00	0.11E-01	0.18E+02
12.5	.1951	43.	4.23	1.71	0.96E-01	0.51E-02	0.19E+02
17.5	.1859	46.	4.47	1.69	0.68E-01	0.30E-02	0.23E+02
25.0	.1756	50.	4.94	1.81	0.62E-01	0.18E-02	0.36E+02
35.0	.1651	55.	5.40	1.88	0.38E-01	0.44E-02	0.87E+01
50.0	.1581	58.	5.69	1.64	0.17E-01	0.15E-02	0.11E+02
70.0	.1536	62.	6.11	1.38	0.10E-01	0.84E-03	0.12E+02
90.0	.1502	67.	6.61	1.11	0.56E-02	0.56E-03	0.10E+02

DOERING 1-STEP DATA

1.6	.1443	100.	9.77	83.33	0.39E-02	0.75E-03	0.52E+01
1.6	.1431	101.	9.92	83.33	0.37E-02	0.73E-03	0.50E+01
1.7	.1420	103.	10.07	83.33	0.35E-02	0.71E-03	0.49E+01
1.7	.1409	104.	10.22	83.33	0.33E-02	0.70E-03	0.47E+01
1.8	.1399	106.	10.36	83.33	0.31E-02	0.68E-03	0.46E+01
1.8	.1390	107.	10.51	83.33	0.30E-02	0.66E-03	0.45E+01
1.9	.1380	109.	10.64	83.33	0.28E-02	0.65E-03	0.44E+01
1.9	.1371	110.	10.78	83.33	0.27E-02	0.63E-03	0.43E+01
2.0	.1354	113.	11.05	83.33	0.25E-02	0.61E-03	0.41E+01
2.1	.1339	115.	11.30	83.33	0.23E-02	0.58E-03	0.39E+01
8.2	.1030	203.	19.92	83.33	0.24E-03	0.21E-03	0.11E+01
12.2	.0972	233.	22.88	83.33	0.13E-03	0.17E-03	0.77E+00
16.2	.0938	255.	25.04	83.33	0.87E-04	0.14E-03	0.61E+00
24.2	.0898	287.	28.12	83.33	0.51E-04	0.12E-03	0.44E+00
28.2	.0884	299.	29.28	83.33	0.42E-04	0.11E-03	0.39E+00
32.2	.0874	309.	30.29	83.33	0.36E-04	0.10E-03	0.35E+00
36.2	.0865	318.	31.16	83.33	0.31E-04	0.97E-04	0.32E+00
40.2	.0857	326.	31.94	83.33	0.28E-04	0.93E-04	0.30E+00
44.2	.0851	333.	32.64	83.33	0.25E-04	0.90E-04	0.28E+00
48.2	.0845	339.	33.27	83.33	0.23E-04	0.87E-04	0.27E+00
122.0	.0798	403.	39.48	83.33	0.12E-04	0.64E-04	0.19E+00

DEPTH 99. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3526	26.	2.59	0.80	0.46E+01	0.19E-02	0.24E+04
0.4	.3482	29.	2.84	0.80	0.51E+01	0.17E-02	0.31E+04
0.6	.3413	31.	3.07	0.83	0.44E+01	0.58E-02	0.76E+03
0.9	.3334	33.	3.22	0.90	0.76E+01	0.46E-02	0.16E+04
1.1	.3266	34.	3.37	0.97	0.46E+01	0.44E-02	0.10E+04
1.4	.3165	37.	3.58	0.94	0.46E+01	0.51E-02	0.90E+03
1.6	.3031	39.	3.78	0.88	0.35E+01	0.99E-02	0.35E+03
1.9	.2921	40.	3.90	0.87	0.29E+01	0.85E-02	0.34E+03
2.2	.2815	41.	3.98	0.85	0.25E+01	0.17E-01	0.15E+03

DEPTH 99. CM (CONT)

2.4	.2706	41.	4.05	0.83	0.16E+01	0.18E-01	0.88E+02
2.8	.2595	42.	4.10	0.83	0.28E+01	0.27E-01	0.10E+03
3.2	.2485	42.	4.15	0.83	0.13E+01	0.17E-01	0.78E+02
3.7	.2415	43.	4.20	0.83	0.99E+00	0.11E-01	0.90E+02
4.2	.2366	43.	4.25	0.83	0.10E+01	0.85E-02	0.12E+03
4.7	.2329	44.	4.32	0.87	0.95E+00	0.31E-02	0.31E+03
6.2	.2229	45.	4.45	0.90	0.72E+00	0.11E-01	0.64E+02
8.7	.2070	47.	4.57	0.90	0.48E+00	0.15E-01	0.33E+02
12.5	.1949	48.	4.72	0.90	0.22E+00	0.48E-02	0.45E+02
17.5	.1858	50.	4.92	0.87	0.16E+00	0.42E-02	0.38E+02
25.0	.1755	55.	5.34	0.68	0.19E+00	0.18E-02	0.11E+03
35.0	.1652	59.	5.76	0.57	0.15E+00	0.57E-02	0.26E+02
50.0	.1578	61.	5.94	0.67	0.48E-01	0.32E-02	0.15E+02
70.0	.1522	63.	6.19	0.73	0.24E-01	0.16E-02	0.15E+02
90.0	.1478	66.	6.48	0.72	0.12E-01	0.15E-02	0.85E+01

DOERING 1-STEP DATA

4.4	.1255	115.	11.29	83.33	0.11E-02	0.63E-03	0.18E+01
8.4	.1077	152.	14.89	83.33	0.36E-03	0.37E-03	0.95E+00
12.4	.0993	178.	17.42	83.33	0.18E-03	0.28E-03	0.66E+00
16.4	.0943	198.	19.40	83.33	0.12E-03	0.23E-03	0.51E+00
20.4	.0908	215.	21.04	83.33	0.83E-04	0.20E-03	0.42E+00
24.4	.0881	229.	22.44	83.33	0.62E-04	0.17E-03	0.36E+00
28.4	.0861	241.	23.66	83.33	0.50E-04	0.16E-03	0.32E+00
32.4	.0844	252.	24.74	83.33	0.41E-04	0.14E-03	0.28E+00
36.4	.0830	262.	25.72	83.33	0.34E-04	0.13E-03	0.26E+00
40.4	.0819	271.	26.61	83.33	0.29E-04	0.13E-03	0.23E+00
44.4	.0808	280.	27.42	83.33	0.26E-04	0.12E-03	0.22E+00
48.4	.0800	287.	28.17	83.33	0.23E-04	0.11E-03	0.20E+00
52.4	.0792	294.	28.87	83.33	0.20E-04	0.11E-03	0.19E+00
122.0	.0724	372.	36.50	83.33	0.71E-05	0.69E-04	0.10E+00
194.0	.0697	415.	40.71	83.33	0.45E-05	0.57E-04	0.80E-01
266.0	.0682	444.	43.50	83.33	0.36E-05	0.50E-04	0.73E-01

DEPTH 114. CM SITE C-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3621	24.	2.35	0.87	0.45E+01	0.67E-03	0.66E+04
0.4	.3598	28.	2.70	1.01	0.43E+01	0.63E-03	0.69E+04
0.6	.3562	31.	3.00	1.07	0.38E+01	0.24E-02	0.16E+04
0.9	.3519	32.	3.18	1.04	0.70E+01	0.25E-02	0.28E+04
1.1	.3485	34.	3.33	0.97	0.50E+01	0.20E-02	0.25E+04
1.4	.3416	35.	3.47	0.91	0.54E+01	0.77E-02	0.71E+03
1.6	.3311	37.	3.62	0.91	0.40E+01	0.65E-02	0.61E+03
1.9	.3217	38.	3.74	0.92	0.34E+01	0.11E-01	0.30E+03
2.2	.3084	39.	3.83	0.94	0.31E+01	0.18E-01	0.17E+03
2.4	.2942	40.	3.92	0.99	0.18E+01	0.14E-01	0.13E+03
2.8	.2807	41.	3.99	1.02	0.28E+01	0.23E-01	0.12E+03
3.2	.2666	42.	4.08	1.07	0.13E+01	0.11E-01	0.12E+03
3.7	.2566	43.	4.18	1.14	0.91E+00	0.86E-02	0.11E+03
4.2	.2488	44.	4.26	1.19	0.86E+00	0.95E-02	0.91E+02
4.7	.2425	45.	4.36	1.19	0.80E+00	0.44E-02	0.18E+03
6.2	.2318	46.	4.49	1.16	0.65E+00	0.13E-01	0.51E+02
8.7	.2145	47.	4.63	1.17	0.45E+00	0.12E-01	0.37E+02
12.5	.2001	49.	4.79	1.19	0.19E+00	0.58E-02	0.32E+02
17.5	.1910	51.	4.95	1.17	0.14E+00	0.54E-02	0.26E+02
25.0	.1812	53.	5.23	1.16	0.13E+00	0.27E-02	0.48E+02
35.0	.1715	57.	5.55	1.14	0.85E-01	0.39E-02	0.22E+02

DOERING 1-STEP DATA NEXT PAGE (114 CM DEPTH)

DOERING 1-STEP DATA

0.1	.1824	52.	5.09	83.33	0.15E+00	0.22E-02	0.67E+02
0.2	.1544	68.	6.67	83.33	0.67E-01	0.14E-02	0.49E+02
0.2	.1363	84.	8.26	83.33	0.36E-01	0.91E-03	0.39E+02
0.3	.1235	101.	9.89	83.33	0.21E-01	0.65E-03	0.32E+02
0.3	.1139	118.	11.57	83.33	0.13E-01	0.49E-03	0.28E+02
0.4	.1063	136.	13.31	83.33	0.91E-02	0.38E-03	0.24E+02
0.4	.1002	154.	15.11	83.33	0.64E-02	0.30E-03	0.21E+02
0.5	.0951	173.	16.98	83.33	0.46E-02	0.24E-03	0.19E+02
0.5	.0908	193.	18.94	83.33	0.34E-02	0.19E-03	0.18E+02
0.6	.0871	214.	20.99	83.33	0.26E-02	0.16E-03	0.16E+02
0.6	.0839	236.	23.14	83.33	0.20E-02	0.13E-03	0.15E+02
0.7	.0811	259.	25.39	83.33	0.16E-02	0.11E-03	0.14E+02
0.7	.0785	283.	27.76	83.33	0.12E-02	0.96E-04	0.13E+02
0.8	.0763	309.	30.27	83.33	0.99E-03	0.81E-04	0.12E+02
0.8	.0743	336.	32.91	83.33	0.80E-03	0.70E-04	0.11E+02
0.9	.0724	364.	35.70	83.33	0.65E-03	0.60E-04	0.11E+02
0.9	.0707	394.	38.66	83.33	0.53E-03	0.52E-04	0.10E+02
1.0	.0692	426.	41.81	83.33	0.43E-03	0.45E-04	0.97E+01
1.0	.0678	461.	45.15	83.33	0.36E-03	0.39E-04	0.93E+01
1.1	.0665	497.	48.71	83.33	0.30E-03	0.34E-04	0.88E+01

SITE C, REPLICATION 2

Table C-2.1 Soil morphologic data for Site C, replication 2.

Site and location: C-2 Heimbuch site, Oakes aquifer 285 feet south and 360f eet west of the east quarter corner of Section 26, Town-ship 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/84 by M. D. Sweeney (NDAES, Fargo, ND) and W. M. Schuh andR. Cline (NDSWC, Bismarck, ND).

Soil type and classification: Hecla sandy loam sandy, mixed aquic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in theGlacial Lake Dakota Basin which has beenreworked by wind to some extent.

Drainage: Moderately well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: C-2 south side of pit.

Alp 0-3 inches (0-9 cm), black (10YR 2/1) sandy loam (loamy sand); moderate coarse and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; abrupt smooth boundary.

A12 3-12 inches (9-30 cm), black (10YR 2/1) sandy loam (loamy sand); moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; clear wavy boundary.

A13 12-21 inches (30-53 cm), black (10YR 2/1) loamy sand; moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; clear wavy boundary.

Bw 21-33 inches (53-85 cm), very dark grayish brown (10YR 3/2) loamy sand (sand), weak coarse and medium prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; clear wavy boundary.

C 33-39 inches (85-100 cm), light olive brown (2.5Y 5/4) sand (fine sand) with few fine distinct dark yellowish brown (10YR 3/4) mottles which increase to common with depth; weak coarse and medium prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; clear wavy boundary.

Cg 39-55 inches (100-140 cm), light yellowish brown to light olive brown (2.5Y 5.5/4) sand with many medium distinct dark yellowish brown (10YR 4/4) and few fine distinct dark brown (7.5YR 3/2) mottles; weak coarse and medium prismatic structure; soft, very friable to loose, nonsticky, and nonplastic; few very fine roots.

Table C-2.2 HECLA SERIES SITE C-2 NDSWC:1984
particle-size, bulk density, and organic carbon
data and indices

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	4.9	6.8	5.1	11.3	40.7	29.0	2.2	0.0
23.	5.9	5.1	4.8	11.1	41.5	28.9	2.6	0.0
38.	6.2	4.0	3.6	10.4	43.3	30.1	2.3	0.0
53.	5.1	4.0	3.7	10.2	43.0	31.1	2.8	0.0
69.	4.3	3.6	3.6	10.2	46.2	29.6	2.3	0.0
84.	4.0	2.2	1.8	7.8	52.6	30.0	1.6	0.0
99.	3.6	1.8	0.5	8.2	52.0	31.4	2.2	0.1
114.	2.1	3.2	2.5	6.6	44.3	38.9	2.4	0.0
130.	2.7	2.2	25.6	4.7	32.4	30.6	1.7	0.1

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	83.2	11.9	4.9	A 1 6	6=p
23.	84.2	9.9	5.9	A 1 2	7=w
38.	86.2	7.6	6.2	A 1 3	8=g
53.	87.2	7.7	5.1	A 1 3	
69.	88.5	7.2	4.3	B 0 7	
84.	92.0	4.0	4.0	B 0 7	
99.	94.1	2.3	3.6	C 0 0	
114.	92.2	5.7	2.1	C 0 8	
130.	69.5	27.8	2.7	C 0 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	6.992	0.1214	4.3	0.0283	0.710	1.42	1.70
23.	8.495	0.1224	4.5	0.0272	0.733	1.53	1.40
38.	11.329	0.1281	4.5	0.0285	0.801	1.53	0.75
53.	11.312	0.1376	4.1	0.0332	0.822	1.51	0.64
69.	12.264	0.1428	3.8	0.0377	0.888	1.54	0.43
84.	23.000	0.1567	3.5	0.0454	1.130	1.57	0.20
99.	40.826	0.1688	3.3	0.0515	1.206	1.53	0.08
114.	16.175	0.1818	3.0	0.0610	1.070	1.52	0.04
130.	2.500	0.1182	3.6	0.0327	0.948	1.51	0.04

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.797	2.247	-1.0898	2.4128	-10.90	1.03
23.	1.663	2.361	-1.1150	2.4389	-11.15	1.06
38.	1.487	2.783	-1.1575	2.4969	-11.58	1.12
53.	1.495	2.913	-1.1709	2.5259	-11.71	1.15
69.	1.455	3.308	-1.1908	2.5607	-11.91	1.18
84.	1.147	4.698	-1.2628	2.6680	-12.63	1.29
99.	0.924	5.934	-1.3001	2.7231	-13.00	1.34
114.	1.323	5.806	-1.2549	2.6738	-12.55	1.29
130.	2.659	5.108	-0.7979	2.0155	-7.98	0.64

Table C-2.3. Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site A, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
			Saturation Extract Soluble Ions meq/l					
0 - 15	1.4	0.5	0.4	1.5	-	1.9	0.13	1.8
15 - 30	2.2	0.7	0.7	0.6	-	2.7	0.20	1.3
30 - 46	1.7	0.9	0.8	0.2	-	1.2	0.18	2.3
46 - 61	1.4	0.8	0.7	0.2	-	1.1	0.25	1.7
61 - 76	2.0	0.7	0.8	0.3	-	2.7	0.30	0.9
76 - 91	1.4	0.9	0.8	0.1	-	1.6	0.13	1.7
91 - 106	0.9	0.7	0.6	0.1	-	0.9	0.20	1.3
106 - 122	1.3	1.0	0.7	0.1	-	1.5	0.18	1.5
122 - 137	1.1	0.8	0.7	0.1	-	1.1	0.20	1.4

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.32	0.4	32	6.9	1.8	ls	5.6
15 - 30	0.39	0.6	30	7.2	-	ls	5.1
30 - 46	0.32	0.7	26	7.2	1.7	ls	4.4
46 - 61	0.24	0.7	24	7.1	2.0	ls	3.5
61 - 76	0.40	0.7	21	7.6	-	s	4.0
76 - 91	0.30	0.8	22	7.4	2.4	fs	3.5
91 - 106	0.21	0.7	19	7.2	-	fs	3.2
106 - 122	0.20	0.7	20	7.7	2.0	s	3.2
122 - 137	0.20	0.7	19	7.7	-	fsl	3.3

Table C-2.4 HECLA SERIES SITE C-2 NDSWC:84

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			38.			53.			69.	
CM	CC/CC	SE									
24.	0.3421	0.0027	24.	0.3394	0.0010	10.	0.3633	0.0010	10.	0.3752	0.0026
40.	0.3111	0.0003	40.	0.2882	0.0031	20.	0.3574	0.0010	20.	0.3781	0.0016
50.	0.2699	0.0001	50.	0.2363	0.0005	40.	0.2571	0.0033	40.	0.2474	0.0012
62.	0.2452	0.0014	62.	0.2070	0.0005	60.	0.1992	0.0026	60.	0.1806	0.0021
70.	0.2301	0.0011	70.	0.1902	0.0000	80.	0.1633	0.0031	80.	0.1468	0.0023
82.	0.2129	0.0012	82.	0.1719	0.0005	100.	0.1428	0.0030	100.	0.1270	0.0019
98.	0.1978	0.0009	98.	0.1587	0.0005	120.	0.1318	0.0014	120.	0.1152	0.0030
150.	0.1696	0.0009	150.	0.1339	0.0005	180.	0.1135	0.0008	180.	0.0991	0.0020
340.	0.1339	0.0011	340.	0.1053	0.0000	340.	0.0945	0.0008	340.	0.0829	0.0021
503.	0.1230	0.0019	503.	0.0965	0.0000	534.	0.0864	0.0002	534.	0.0778	0.0006
834.	0.1141	0.0022	834.	0.0892	0.0000	800.	0.0813	0.0008	834.	0.0741	0.0011
BD =	1.46			1.53			1.51			1.54	
N =	2			2			2			2	

DEPTH (CM)

	84.			99.			114.			130.	
24.	0.3173	0.0030	10.	0.3335	******	10.	0.3417	******	10.	0.3480	******
40.	0.2831	0.0057	20.	0.3249	******	20.	0.3283	******	20.	0.3345	******
50.	0.2374	0.0046	40.	0.2238	******	40.	0.1991	******	40.	0.2049	******
62.	0.2100	0.0024	60.	0.1473	******	60.	0.1352	******	60.	0.1461	******
70.	0.1933	0.0024	80.	0.1184	******	80.	0.1055	******	80.	0.1160	******
82.	0.1743	0.0018	100.	0.0967	******	100.	0.0921	******	100.	0.1024	******
98.	0.1575	0.0018	120.	0.0910	******	120.	0.0862	******	120.	0.0949	******
150.	0.1263	0.0012	180.	0.0765	******	180.	0.0758	******	180.	0.0814	******
340.	0.0867	0.0001	340.	0.0664	******	340.	0.0669	******	340.	0.0723	******
503.	0.0746	0.0010	534.	0.0621	******	534.	0.0639	******	534.	0.0693	******
834.	0.0647	0.0015	800.	0.0621	******	800.	0.0624	******	800.	0.0663	******
BD =	1.57			1.53			1.52			1.51	
N =	2			1			1			1	

Table C-2.5 HECLA SERIES SITE C-2 (NDSWC 1984)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3865	14.	1.42	1.87	0.32E+00	0.19E-02	0.16E+03
0.3	.3761	22.	2.12	1.77	0.28E+00	0.13E-02	0.22E+03
0.5	.3634	32.	3.12	1.50	0.32E+00	0.13E-02	0.25E+03
0.7	.3512	40.	3.97	1.22	0.36E+00	0.17E-02	0.22E+03
0.9	.3419	46.	4.52	1.07	0.25E+00	0.18E-02	0.14E+03
1.1	.3349	50.	4.94	0.95	0.28E+00	0.15E-02	0.18E+03
1.4	.3270	54.	5.29	0.83	0.27E+00	0.36E-02	0.76E+02
1.6	.3188	57.	5.57	0.75	0.25E+00	0.25E-02	0.10E+03
1.9	.3132	60.	5.84	0.63	0.24E+00	0.16E-02	0.15E+03
2.2	.3080	62.	6.09	0.52	0.31E+00	0.25E-02	0.12E+03
2.4	.3024	64.	6.27	0.47	0.26E+00	0.49E-02	0.54E+02
2.8	.2971	65.	6.37	0.47	0.24E+00	0.58E-02	0.41E+02
3.2	.2910	66.	6.47	0.48	0.20E+00	0.63E-02	0.31E+02
3.7	.2859	67.	6.57	0.50	0.12E+00	0.39E-02	0.30E+02
4.2	.2825	68.	6.66	0.49	0.90E-01	0.36E-02	0.25E+02
4.7	.2808	68.	6.71	0.51	0.14E-01	0.24E-02	0.60E+01
6.2	.2746	69.	6.74	0.58	0.63E-01	0.24E-01	0.26E+01
8.7	.2638	70.	6.89	0.63	0.46E-01	0.38E-02	0.12E+02
15.0	.2519	75.	7.37	0.60	0.18E-01	0.20E-02	0.89E+01
25.0	.2390	83.	8.12	0.55	0.16E-01	0.14E-02	0.11E+02
35.0	.2295	89.	8.77	0.50	0.12E-01	0.15E-02	0.76E+01
50.0	.2238	96.	9.37	0.42	0.35E-02	0.54E-03	0.64E+01
70.0	.2182	102.	9.97	0.35	0.82E-02	0.15E-02	0.54E+01
90.0	.2118	106.	10.42	0.32	0.62E-02	0.13E-02	0.48E+01

DEPTH 23. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3843	20.	1.95	1.87	0.81E+00	0.11E-02	0.74E+03
0.3	.3763	26.	2.59	1.77	0.80E+00	0.14E-02	0.59E+03
0.5	.3656	35.	3.45	1.50	0.89E+00	0.13E-02	0.69E+03
0.7	.3560	42.	4.12	1.22	0.10E+01	0.18E-02	0.56E+03
0.9	.3476	47.	4.57	1.07	0.76E+00	0.21E-02	0.37E+03
1.1	.3407	50.	4.90	0.95	0.82E+00	0.20E-02	0.41E+03
1.4	.3329	53.	5.17	0.83	0.82E+00	0.45E-02	0.18E+03
1.6	.3250	55.	5.38	0.75	0.73E+00	0.31E-02	0.24E+03
1.9	.3197	57.	5.56	0.63	0.69E+00	0.25E-02	0.28E+03
2.2	.3150	58.	5.72	0.52	0.90E+00	0.32E-02	0.28E+03
2.4	.3091	60.	5.85	0.47	0.86E+00	0.61E-02	0.14E+03
2.8	.3022	61.	5.95	0.47	0.80E+00	0.78E-02	0.10E+03
3.2	.2940	62.	6.07	0.48	0.67E+00	0.68E-02	0.98E+02
3.7	.2886	63.	6.18	0.50	0.31E+00	0.24E-02	0.13E+03
4.2	.2864	64.	6.26	0.49	0.24E+00	0.30E-02	0.81E+02
4.7	.2848	65.	6.33	0.51	0.65E-01	0.20E-02	0.32E+02
6.2	.2764	66.	6.42	0.58	0.21E+00	0.13E-01	0.17E+02
8.7	.2638	67.	6.61	0.63	0.14E+00	0.38E-02	0.36E+02
15.0	.2519	72.	7.05	0.60	0.54E-01	0.22E-02	0.25E+02
25.0	.2390	79.	7.76	0.55	0.47E-01	0.15E-02	0.32E+02
35.0	.2300	86.	8.38	0.50	0.33E-01	0.15E-02	0.23E+02
50.0	.2243	91.	8.91	0.42	0.11E-01	0.76E-03	0.15E+02
70.0	.2192	97.	9.46	0.35	0.22E-01	0.11E-02	0.20E+02
90.0	.2128	101.	9.89	0.32	0.21E-01	0.20E-02	0.11E+02

DOERING 1-STEP DATA

0.3	.2334	74.	7.26	83.33	0.20E-01	0.14E-02	0.14E+02
0.3	.2280	78.	7.67	83.33	0.15E-01	0.13E-02	0.12E+02
0.4	.2235	82.	8.03	83.33	0.12E-01	0.12E-02	0.10E+02
0.4	.2197	85.	8.36	83.33	0.10E-01	0.11E-02	0.92E+01
0.5	.2165	88.	8.66	83.33	0.84E-02	0.10E-02	0.82E+01
0.5	.2136	91.	8.94	83.33	0.72E-02	0.97E-03	0.74E+01
0.6	.2111	94.	9.20	83.33	0.63E-02	0.93E-03	0.68E+01
0.6	.2089	96.	9.44	83.33	0.56E-02	0.89E-03	0.63E+01
0.7	.2068	99.	9.67	83.33	0.50E-02	0.85E-03	0.58E+01
0.7	.2049	101.	9.89	83.33	0.45E-02	0.82E-03	0.54E+01
0.8	.2032	103.	10.10	83.33	0.40E-02	0.79E-03	0.51E+01
0.8	.2016	105.	10.30	83.33	0.37E-02	0.77E-03	0.48E+01
0.9	.2002	107.	10.49	83.33	0.34E-02	0.75E-03	0.45E+01
0.9	.1988	109.	10.67	83.33	0.31E-02	0.72E-03	0.43E+01
1.0	.1975	111.	10.85	83.33	0.29E-02	0.70E-03	0.41E+01
1.0	.1963	112.	11.02	83.33	0.27E-02	0.69E-03	0.39E+01
1.1	.1952	114.	11.18	83.33	0.25E-02	0.67E-03	0.37E+01
1.1	.1941	116.	11.34	83.33	0.23E-02	0.65E-03	0.36E+01
1.2	.1931	117.	11.50	83.33	0.22E-02	0.64E-03	0.34E+01
1.2	.1921	119.	11.64	83.33	0.21E-02	0.63E-03	0.33E+01
1.3	.1912	120.	11.79	83.33	0.19E-02	0.61E-03	0.32E+01
1.3	.1903	122.	11.93	83.33	0.18E-02	0.60E-03	0.31E+01
1.4	.1895	123.	12.07	83.33	0.17E-02	0.59E-03	0.30E+01
1.4	.1887	124.	12.20	83.33	0.17E-02	0.58E-03	0.29E+01

DEPTH 23. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.5	.1879	126.	12.34	83.33	0.16E-02	0.57E-03	0.28E+01
1.5	.1872	127.	12.46	83.33	0.15E-02	0.56E-03	0.27E+01
1.6	.1865	128.	12.59	83.33	0.14E-02	0.55E-03	0.26E+01
1.6	.1858	130.	12.71	83.33	0.14E-02	0.54E-03	0.25E+01
1.7	.1851	131.	12.83	83.33	0.13E-02	0.53E-03	0.25E+01
1.7	.1845	132.	12.95	83.33	0.13E-02	0.52E-03	0.24E+01
1.8	.1839	133.	13.06	83.33	0.12E-02	0.52E-03	0.23E+01
1.8	.1833	134.	13.18	83.33	0.12E-02	0.51E-03	0.23E+01
1.9	.1827	136.	13.29	83.33	0.11E-02	0.50E-03	0.22E+01
1.9	.1822	137.	13.40	83.33	0.11E-02	0.49E-03	0.22E+01
2.0	.1816	138.	13.50	83.33	0.10E-02	0.49E-03	0.21E+01
2.0	.1811	139.	13.61	83.33	0.99E-03	0.48E-03	0.21E+01
2.1	.1806	140.	13.71	83.33	0.96E-03	0.48E-03	0.20E+01
4.1	.1674	173.	16.98	83.33	0.36E-03	0.33E-03	0.11E+01
8.1	.1560	214.	20.98	83.33	0.14E-03	0.23E-03	0.60E+00
12.1	.1500	243.	23.81	83.33	0.80E-04	0.19E-03	0.42E+00
16.1	.1459	266.	26.06	83.33	0.54E-04	0.16E-03	0.33E+00
20.1	.1430	285.	27.97	83.33	0.40E-04	0.14E-03	0.28E+00
24.1	.1406	302.	29.64	83.33	0.31E-04	0.13E-03	0.24E+00
28.1	.1387	318.	31.13	83.33	0.26E-04	0.12E-03	0.21E+00
32.1	.1371	331.	32.50	83.33	0.21E-04	0.11E-03	0.19E+00
36.1	.1357	344.	33.75	83.33	0.18E-04	0.11E-03	0.18E+00
40.1	.1345	356.	34.92	83.33	0.16E-04	0.99E-04	0.16E+00
44.1	.1334	367.	36.02	83.33	0.14E-04	0.94E-04	0.15E+00
48.1	.1324	378.	37.05	83.33	0.13E-04	0.90E-04	0.14E+00
52.1	.1315	388.	38.03	83.33	0.12E-04	0.86E-04	0.13E+00

DEPTH 38. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3869	27.	2.65	0.92	0.22E+01	0.49E-03	0.45E+04
0.3	.3801	32.	3.17	0.89	0.26E+01	0.17E-02	0.15E+04

DEPTH 38. CM (CONT)

0.5	.3701	38.	3.74	0.84	0.24E+01	0.19E-02	0.13E+04
0.7	.3614	42.	4.13	0.79	0.25E+01	0.27E-02	0.91E+03
0.9	.3532	45.	4.42	0.74	0.19E+01	0.30E-02	0.62E+03
1.1	.3454	47.	4.64	0.70	0.19E+01	0.40E-02	0.47E+03
1.4	.3367	49.	4.83	0.72	0.16E+01	0.54E-02	0.29E+03
1.6	.3281	51.	4.98	0.72	0.13E+01	0.61E-02	0.21E+03
1.9	.3225	52.	5.08	0.72	0.99E+00	0.46E-02	0.21E+03
2.2	.3183	53.	5.16	0.72	0.10E+01	0.66E-02	0.16E+03
2.4	.3128	54.	5.24	0.70	0.10E+01	0.61E-02	0.17E+03
2.8	.3063	55.	5.34	0.70	0.92E+00	0.68E-02	0.13E+03
3.2	.2989	56.	5.44	0.67	0.85E+00	0.80E-02	0.11E+03
3.7	.2929	57.	5.54	0.64	0.39E+00	0.39E-02	0.10E+03
4.2	.2884	57.	5.62	0.64	0.35E+00	0.10E-01	0.35E+02
4.7	.2827	58.	5.68	0.62	0.24E+00	0.87E-02	0.28E+02
6.2	.2711	59.	5.79	0.57	0.38E+00	0.11E-01	0.35E+02
8.7	.2579	61.	5.97	0.52	0.28E+00	0.44E-02	0.65E+02
15.0	.2453	65.	6.38	0.50	0.11E+00	0.26E-02	0.43E+02
25.0	.2324	72.	7.05	0.50	0.85E-01	0.14E-02	0.61E+02
35.0	.2238	78.	7.61	0.47	0.57E-01	0.19E-02	0.30E+02
50.0	.2177	82.	8.04	0.42	0.21E-01	0.11E-02	0.19E+02
70.0	.2126	87.	8.52	0.39	0.30E-01	0.11E-02	0.29E+02
90.0	.2068	91.	8.91	0.37	0.33E-01	0.20E-02	0.16E+02

DOERING 1-STEP DATA

0.3	.1911	84.	8.25	83.33	0.18E-01	0.12E-02	0.15E+02
0.4	.1867	88.	8.63	83.33	0.14E-01	0.11E-02	0.13E+02
0.4	.1829	92.	8.97	83.33	0.12E-01	0.10E-02	0.11E+02
0.5	.1797	95.	9.29	83.33	0.10E-01	0.98E-03	0.10E+02
0.5	.1768	98.	9.58	83.33	0.87E-02	0.92E-03	0.94E+01
0.6	.1743	100.	9.85	83.33	0.76E-02	0.88E-03	0.86E+01
0.6	.1721	103.	10.11	83.33	0.67E-02	0.84E-03	0.80E+01
0.7	.1701	106.	10.35	83.33	0.60E-02	0.80E-03	0.74E+01
0.7	.1682	108.	10.58	83.33	0.54E-02	0.77E-03	0.69E+01

DEPTH 38. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.1666	110.	10.79	83.33	0.49E-02	0.74E-03	0.65E+01
0.8	.1650	112.	11.00	83.33	0.44E-02	0.72E-03	0.62E+01
0.9	.1636	114.	11.20	83.33	0.41E-02	0.70E-03	0.58E+01
0.9	.1623	116.	11.39	83.33	0.37E-02	0.68E-03	0.55E+01
1.0	.1610	118.	11.57	83.33	0.35E-02	0.66E-03	0.53E+01
1.0	.1599	120.	11.75	83.33	0.32E-02	0.64E-03	0.50E+01
1.1	.1588	122.	11.91	83.33	0.30E-02	0.62E-03	0.48E+01
1.1	.1577	123.	12.08	83.33	0.28E-02	0.61E-03	0.46E+01
1.2	.1568	125.	12.24	83.33	0.26E-02	0.59E-03	0.44E+01
1.2	.1559	126.	12.39	83.33	0.25E-02	0.58E-03	0.42E+01
1.3	.1550	128.	12.54	83.33	0.23E-02	0.57E-03	0.41E+01
1.3	.1542	129.	12.68	83.33	0.22E-02	0.56E-03	0.39E+01
1.4	.1534	131.	12.82	83.33	0.21E-02	0.55E-03	0.38E+01
1.4	.1526	132.	12.95	83.33	0.20E-02	0.54E-03	0.37E+01
1.5	.1519	133.	13.09	83.33	0.19E-02	0.53E-03	0.36E+01
1.5	.1512	135.	13.22	83.33	0.18E-02	0.52E-03	0.34E+01
1.6	.1506	136.	13.34	83.33	0.17E-02	0.51E-03	0.33E+01
1.6	.1500	137.	13.46	83.33	0.16E-02	0.50E-03	0.32E+01
1.7	.1494	139.	13.58	83.33	0.15E-02	0.49E-03	0.32E+01
1.7	.1488	140.	13.70	83.33	0.15E-02	0.48E-03	0.31E+01
1.8	.1482	141.	13.81	83.33	0.14E-02	0.48E-03	0.30E+01
1.8	.1477	142.	13.92	83.33	0.14E-02	0.47E-03	0.29E+01
1.9	.1472	143.	14.03	83.33	0.13E-02	0.46E-03	0.28E+01
1.9	.1467	144.	14.14	83.33	0.13E-02	0.46E-03	0.28E+01
2.0	.1462	145.	14.25	83.33	0.12E-02	0.45E-03	0.27E+01

DEPTH 38. CM CONT

4.0	.1341	177.	17.38	83.33	0.44E-03	0.31E-03	0.14E+01
8.0	.1247	213.	20.83	83.33	0.17E-03	0.23E-03	0.74E+00
12.0	.1201	235.	23.03	83.33	0.97E-04	0.19E-03	0.51E+00
16.0	.1171	251.	24.65	83.33	0.66E-04	0.17E-03	0.40E+00
20.0	.1150	265.	25.95	83.33	0.50E-04	0.15E-03	0.33E+00
24.0	.1134	276.	27.03	83.33	0.39E-04	0.14E-03	0.28E+00
28.0	.1121	285.	27.96	83.33	0.33E-04	0.13E-03	0.24E+00
32.0	.1110	293.	28.77	83.33	0.28E-04	0.13E-03	0.22E+00
36.0	.1101	301.	29.49	83.33	0.24E-04	0.12E-03	0.20E+00
40.0	.1093	307.	30.14	83.33	0.21E-04	0.12E-03	0.18E+00
44.0	.1086	313.	30.73	83.33	0.19E-04	0.11E-03	0.17E+00
48.0	.1080	319.	31.28	83.33	0.17E-04	0.11E-03	0.16E+00
52.0	.1075	324.	31.78	83.33	0.16E-04	0.11E-03	0.15E+00
122.0	.1024	379.	37.19	83.33	0.63E-05	0.80E-04	0.79E-01
194.0	.1002	409.	40.14	83.33	0.41E-05	0.69E-04	0.60E-01
266.0	.0988	430.	42.12	83.33	0.33E-05	0.64E-04	0.52E-01
338.0	.0979	445.	43.61	83.33	0.29E-05	0.60E-04	0.48E-01
410.0	.0972	457.	44.79	83.33	0.27E-05	0.57E-04	0.48E-01

DEPTH 53. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3888	28.	2.72	1.17	0.25E+01	0.33E-02	0.75E+03
0.3	.3762	32.	3.14	1.07	0.31E+01	0.28E-02	0.11E+04
0.5	.3621	37.	3.61	0.98	0.29E+01	0.34E-02	0.85E+03
0.7	.3501	40.	3.93	0.93	0.29E+01	0.45E-02	0.64E+03
0.9	.3403	42.	4.14	0.88	0.22E+01	0.47E-02	0.48E+03
1.1	.3316	44.	4.30	0.83	0.24E+01	0.61E-02	0.39E+03
1.4	.3227	45.	4.45	0.77	0.21E+01	0.58E-02	0.36E+03
1.6	.3137	47.	4.59	0.75	0.18E+01	0.75E-02	0.24E+03
1.9	.3072	48.	4.69	0.75	0.13E+01	0.49E-02	0.27E+03
2.2	.3027	49.	4.76	0.75	0.13E+01	0.72E-02	0.19E+03
2.4	.2977	49.	4.85	0.77	0.13E+01	0.46E-02	0.28E+03
2.8	.2935	51.	4.95	0.77	0.11E+01	0.39E-02	0.29E+03
3.2	.2894	52.	5.05	0.80	0.95E+00	0.41E-02	0.23E+03
3.7	.2842	52.	5.14	0.82	0.50E+00	0.84E-02	0.59E+02
4.2	.2768	53.	5.21	0.82	0.53E+00	0.12E-01	0.46E+02
4.7	.2666	54.	5.29	0.85	0.50E+00	0.16E-01	0.32E+02
6.2	.2534	55.	5.38	0.87	0.36E+00	0.15E-01	0.25E+02
8.7	.2407	56.	5.53	0.87	0.24E+00	0.55E-02	0.44E+02
15.0	.2269	60.	5.90	0.83	0.96E-01	0.30E-02	0.32E+02
25.0	.2133	66.	6.48	0.72	0.82E-01	0.17E-02	0.48E+02
35.0	.2043	71.	6.93	0.62	0.61E-01	0.27E-02	0.23E+02
50.0	.1975	75.	7.30	0.58	0.23E-01	0.13E-02	0.17E+02
70.0	.1915	79.	7.74	0.57	0.27E-01	0.14E-02	0.19E+02
90.0	.1863	83.	8.14	0.60	0.28E-01	0.12E-02	0.24E+02

DOERING 1-STEP DATA

0.7	.1670	86.	8.39	83.33	0.11E-01	0.91E-03	0.12E+02
0.7	.1636	89.	8.77	83.33	0.92E-02	0.84E-03	0.11E+02
0.8	.1606	93.	9.14	83.33	0.80E-02	0.79E-03	0.10E+02
0.8	.1578	97.	9.49	83.33	0.71E-02	0.74E-03	0.96E+01
0.9	.1553	100.	9.83	83.33	0.63E-02	0.70E-03	0.90E+01
0.9	.1530	104.	10.17	83.33	0.56E-02	0.66E-03	0.85E+01
1.0	.1509	107.	10.49	83.33	0.51E-02	0.63E-03	0.81E+01
1.0	.1489	110.	10.80	83.33	0.46E-02	0.60E-03	0.77E+01
1.1	.1471	113.	11.11	83.33	0.42E-02	0.57E-03	0.74E+01
1.1	.1454	116.	11.41	83.33	0.38E-02	0.54E-03	0.70E+01
1.2	.1438	119.	11.70	83.33	0.35E-02	0.52E-03	0.67E+01

DEPTH 53. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.1424	122.	11.98	83.33	0.33E-02	0.50E-03	0.65E+01
1.3	.1410	125.	12.26	83.33	0.30E-02	0.48E-03	0.62E+01
1.3	.1397	128.	12.53	83.33	0.28E-02	0.47E-03	0.60E+01
1.4	.1384	130.	12.79	83.33	0.26E-02	0.45E-03	0.58E+01
1.4	.1373	133.	13.05	83.33	0.24E-02	0.44E-03	0.56E+01
1.5	.1361	136.	13.30	83.33	0.23E-02	0.42E-03	0.54E+01
1.5	.1351	138.	13.55	83.33	0.21E-02	0.41E-03	0.52E+01
1.6	.1341	141.	13.79	83.33	0.20E-02	0.40E-03	0.51E+01
1.6	.1331	143.	14.03	83.33	0.19E-02	0.39E-03	0.49E+01
1.7	.1322	146.	14.27	83.33	0.18E-02	0.38E-03	0.48E+01
1.7	.1314	148.	14.50	83.33	0.17E-02	0.37E-03	0.46E+01
1.8	.1305	150.	14.72	83.33	0.16E-02	0.36E-03	0.45E+01
1.8	.1297	152.	14.94	83.33	0.15E-02	0.35E-03	0.44E+01
1.9	.1290	155.	15.16	83.33	0.15E-02	0.34E-03	0.43E+01
1.9	.1282	157.	15.38	83.33	0.14E-02	0.33E-03	0.42E+01
2.0	.1275	159.	15.59	83.33	0.13E-02	0.32E-03	0.41E+01
2.0	.1268	161.	15.79	83.33	0.13E-02	0.32E-03	0.40E+01
2.1	.1262	163.	16.00	83.33	0.12E-02	0.31E-03	0.39E+01
2.1	.1256	165.	16.20	83.33	0.12E-02	0.30E-03	0.38E+01
2.2	.1249	167.	16.40	83.33	0.11E-02	0.30E-03	0.37E+01
4.2	.1103	232.	22.73	83.33	0.34E-03	0.17E-03	0.20E+01
8.2	.0997	309.	30.28	83.33	0.12E-03	0.11E-03	0.11E+01
12.2	.0950	359.	35.20	83.33	0.64E-04	0.84E-04	0.76E+00
16.2	.0921	396.	38.84	83.33	0.43E-04	0.71E-04	0.60E+00
20.2	.0901	426.	41.72	83.33	0.32E-04	0.64E-04	0.50E+00
24.2	.0886	450.	44.09	83.33	0.25E-04	0.58E-04	0.43E+00
28.2	.0875	470.	46.09	83.33	0.21E-04	0.54E-04	0.38E+00
32.2	.0866	488.	47.83	83.33	0.18E-04	0.51E-04	0.35E+00

DEPTH 68. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3721	29.	2.87	1.02	0.43E+01	0.49E-02	0.87E+03
0.3	.3611	32.	3.17	0.97	0.45E+01	0.29E-02	0.16E+04
0.5	.3497	36.	3.53	0.90	0.41E+01	0.38E-02	0.11E+04
0.7	.3400	38.	3.77	0.85	0.41E+01	0.44E-02	0.94E+03
0.9	.3319	40.	3.92	0.82	0.32E+01	0.74E-02	0.42E+03
1.1	.3245	41.	4.00	0.77	0.34E+01	0.99E-02	0.35E+03
1.4	.3169	42.	4.08	0.73	0.28E+01	0.10E-01	0.26E+03
1.6	.3080	42.	4.15	0.67	0.27E+01	0.11E-01	0.24E+03
1.9	.3006	43.	4.22	0.62	0.21E+01	0.14E-01	0.16E+03
2.2	.2941	44.	4.27	0.60	0.22E+01	0.10E-01	0.22E+03
2.4	.2849	44.	4.34	0.55	0.25E+01	0.17E-01	0.15E+03
2.8	.2745	45.	4.40	0.50	0.22E+01	0.17E-01	0.14E+03
3.2	.2656	46.	4.47	0.44	0.21E+01	0.74E-02	0.29E+03
3.7	.2596	46.	4.54	0.40	0.14E+01	0.12E-01	0.12E+03
4.2	.2541	47.	4.59	0.36	0.18E+01	0.11E-01	0.16E+03
4.7	.2457	47.	4.64	0.30	0.25E+01	0.19E-01	0.13E+03
6.2	.2278	48.	4.73	0.29	0.15E+01	0.20E-01	0.74E+02
8.7	.2145	50.	4.92	0.34	0.73E+00	0.48E-03	0.15E+04
15.0	.2056	54.	5.33	0.43	0.25E+00	0.29E-02	0.86E+02
25.0	.1916	60.	5.87	0.48	0.16E+00	0.23E-02	0.69E+02
35.0	.1821	64.	6.23	0.44	0.11E+00	0.37E-02	0.30E+02
50.0	.1752	66.	6.48	0.32	0.56E-01	0.20E-02	0.28E+02
70.0	.1693	69.	6.80	0.19	0.10E+00	0.16E-02	0.66E+02
90.0	.1665	73.	7.20	0.15	0.12E+00	0.49E-04	0.25E+04

DEPTH 84. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3540	27.	2.68	0.75	0.70E+01	0.12E-02	0.58E+04
0.3	.3503	30.	2.94	0.73	0.69E+01	0.14E-02	0.48E+04
0.5	.3447	33.	3.27	0.76	0.57E+01	0.22E-02	0.26E+04
0.7	.3388	36.	3.52	0.83	0.49E+01	0.25E-02	0.20E+04
0.9	.3319	38.	3.71	0.91	0.34E+01	0.60E-02	0.58E+03
1.1	.3245	39.	3.84	1.01	0.32E+01	0.59E-02	0.53E+03
1.4	.3139	40.	3.96	1.11	0.23E+01	0.11E-01	0.21E+03
1.6	.3015	42.	4.08	1.22	0.19E+01	0.10E-01	0.20E+03
1.9	.2926	43.	4.17	1.30	0.14E+01	0.10E-01	0.13E+03
2.2	.2851	43.	4.22	1.32	0.13E+01	0.17E-01	0.78E+02
2.4	.2747	44.	4.26	1.33	0.15E+01	0.33E-01	0.45E+02
2.8	.2626	44.	4.31	1.37	0.11E+01	0.19E-01	0.59E+02
3.2	.2513	45.	4.38	1.41	0.86E+00	0.14E-01	0.60E+02
3.7	.2432	45.	4.45	1.45	0.50E+00	0.87E-02	0.57E+02
4.2	.2376	46.	4.50	1.50	0.56E+00	0.99E-02	0.57E+02
4.7	.2312	46.	4.56	1.56	0.66E+00	0.13E-01	0.51E+02
6.2	.2166	47.	4.64	1.57	0.37E+00	0.18E-01	0.21E+02
8.7	.2050	49.	4.82	1.51	0.17E+00	0.53E-03	0.32E+03
15.0	.1956	53.	5.20	1.37	0.95E-01	0.34E-02	0.28E+02
25.0	.1811	58.	5.69	1.26	0.74E-01	0.25E-02	0.29E+02
35.0	.1716	61.	6.02	1.26	0.47E-01	0.38E-02	0.13E+02
50.0	.1641	64.	6.25	1.32	0.18E-01	0.30E-02	0.59E+01
70.0	.1574	67.	6.52	1.39	0.17E-01	0.19E-02	0.90E+01
90.0	.1542	70.	6.86	1.34	0.14E-01	0.19E-03	0.74E+02

DOERING 1-STEP DATA

0.8	.1482	111.	10.84	83.33	0.57E-02	0.74E-03	0.77E+01
0.9	.1461	114.	11.13	83.33	0.51E-02	0.70E-03	0.72E+01
0.9	.1441	116.	11.42	83.33	0.46E-02	0.67E-03	0.68E+01
1.0	.1422	119.	11.69	83.33	0.42E-02	0.64E-03	0.65E+01
1.0	.1405	122.	11.96	83.33	0.38E-02	0.62E-03	0.62E+01
1.1	.1389	125.	12.22	83.33	0.35E-02	0.59E-03	0.59E+01
1.1	.1374	127.	12.47	83.33	0.32E-02	0.57E-03	0.56E+01
1.2	.1360	130.	12.72	83.33	0.30E-02	0.55E-03	0.54E+01
1.2	.1347	132.	12.96	83.33	0.28E-02	0.53E-03	0.52E+01
1.3	.1335	135.	13.19	83.33	0.26E-02	0.51E-03	0.50E+01
1.3	.1323	137.	13.42	83.33	0.24E-02	0.50E-03	0.48E+01
1.4	.1312	139.	13.64	83.33	0.22E-02	0.48E-03	0.46E+01
1.4	.1301	141.	13.86	83.33	0.21E-02	0.47E-03	0.45E+01
1.5	.1291	144.	14.08	83.33	0.20E-02	0.45E-03	0.43E+01
1.5	.1281	146.	14.29	83.33	0.19E-02	0.44E-03	0.42E+01
1.6	.1272	148.	14.49	83.33	0.17E-02	0.43E-03	0.41E+01
1.6	.1263	150.	14.70	83.33	0.17E-02	0.42E-03	0.39E+01
1.7	.1255	152.	14.90	83.33	0.16E-02	0.41E-03	0.38E+01
1.7	.1247	154.	15.09	83.33	0.15E-02	0.40E-03	0.37E+01
1.8	.1239	156.	15.28	83.33	0.14E-02	0.39E-03	0.36E+01

DEPTH 84. CM (DOERING 1-STEP CONTINUED) SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.8	.1232	158.	15.47	83.33	0.13E-02	0.38E-03	0.35E+01
1.9	.1225	160.	15.66	83.33	0.13E-02	0.37E-03	0.34E+01
1.9	.1218	162.	15.84	83.33	0.12E-02	0.36E-03	0.33E+01
2.0	.1211	163.	16.02	83.33	0.12E-02	0.36E-03	0.33E+01
2.0	.1205	165.	16.20	83.33	0.11E-02	0.35E-03	0.32E+01
4.1	.1049	224.	21.98	83.33	0.32E-03	0.20E-03	0.16E+01
8.1	.0934	300.	29.45	83.33	0.99E-04	0.12E-03	0.86E+00
12.1	.0879	356.	34.88	83.33	0.50E-04	0.84E-04	0.60E+00
16.1	.0846	401.	39.29	83.33	0.31E-04	0.68E-04	0.46E+00

DEPTH 84. CM (CONT)

20.1	.0822	439.	43.05	83.33	0.22E-04	0.57E-04	0.38E+00
24.1	.0804	473.	46.36	83.33	0.16E-04	0.50E-04	0.33E+00

DEPTH 99. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3463	25.	2.43	0.91	0.60E+01	0.13E-02	0.48E+04
0.3	.3432	27.	2.65	0.87	0.63E+01	0.14E-02	0.44E+04
0.5	.3382	30.	2.95	0.80	0.59E+01	0.20E-02	0.29E+04
0.7	.3326	33.	3.20	0.73	0.62E+01	0.25E-02	0.25E+04
0.9	.3256	35.	3.42	0.70	0.53E+01	0.38E-02	0.14E+04
1.1	.3182	37.	3.63	0.70	0.53E+01	0.36E-02	0.15E+04
1.4	.3068	39.	3.81	0.68	0.49E+01	0.89E-02	0.54E+03
1.6	.2925	41.	3.99	0.65	0.46E+01	0.75E-02	0.62E+03
1.9	.2820	42.	4.12	0.63	0.36E+01	0.77E-02	0.47E+03
2.2	.2717	43.	4.20	0.63	0.36E+01	0.26E-01	0.14E+03
2.4	.2597	43.	4.25	0.63	0.40E+01	0.22E-01	0.18E+03
2.8	.2495	44.	4.31	0.61	0.32E+01	0.13E-01	0.25E+03
3.2	.2406	45.	4.38	0.58	0.26E+01	0.11E-01	0.23E+03
3.7	.2341	46.	4.47	0.56	0.16E+01	0.45E-02	0.35E+03
4.2	.2301	47.	4.57	0.56	0.18E+01	0.36E-02	0.50E+03
4.7	.2268	48.	4.67	0.56	0.21E+01	0.31E-02	0.69E+03
6.2	.2185	49.	4.81	0.61	0.11E+01	0.77E-02	0.15E+03
8.7	.2066	51.	4.99	0.68	0.42E+00	0.59E-02	0.71E+02
15.0	.1913	54.	5.27	0.70	0.23E+00	0.50E-02	0.45E+02
25.0	.1756	58.	5.66	0.68	0.16E+00	0.30E-02	0.53E+02
35.0	.1662	61.	5.95	0.63	0.11E+00	0.38E-02	0.30E+02
50.0	.1587	63.	6.19	0.58	0.51E-01	0.27E-02	0.19E+02
70.0	.1515	66.	6.48	0.54	0.53E-01	0.22E-02	0.24E+02
90.0	.1460	69.	6.77	0.52	0.39E-01	0.15E-02	0.26E+02

DEPTH 114. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3493	24.	2.31	0.93	0.59E+01	********	********
0.3	.3501	27.	2.60	1.06	0.53E+01	********	********
0.5	.3502	31.	3.02	1.28	0.39E+01	0.30E-03	0.13E+05
0.7	.3458	34.	3.32	1.41	0.36E+01	0.38E-02	0.95E+03
0.9	.3417	36.	3.50	1.38	0.29E+01	0.45E-03	0.65E+04
1.1	.3411	37.	3.63	1.29	0.31E+01	0.37E-03	0.84E+04
1.4	.3334	38.	3.73	1.19	0.34E+01	0.19E-01	0.18E+03
1.6	.3175	39.	3.82	1.10	0.34E+01	0.19E-01	0.18E+03
1.9	.3014	40.	3.90	1.05	0.30E+01	0.22E-01	0.14E+03
2.4	.2749	41.	4.00	1.00	0.38E+01	0.11E+00	0.34E+02
2.8	.2483	41.	4.04	0.99	0.24E+01	0.32E-01	0.77E+02
3.2	.2358	42.	4.07	0.98	0.18E+01	0.36E-01	0.51E+02
3.7	.2277	42.	4.12	0.95	0.11E+01	0.73E-02	0.15E+03
4.2	.2237	43.	4.21	0.93	0.12E+01	0.26E-02	0.45E+03
4.7	.2211	44.	4.30	0.91	0.14E+01	0.35E-02	0.40E+03
6.2	.2117	45.	4.44	0.87	0.90E+00	0.82E-02	0.11E+03
8.7	.1985	47.	4.63	0.83	0.42E+00	0.50E-02	0.85E+02
15.0	.1841	50.	4.93	0.83	0.23E+00	0.47E-02	0.48E+02
25.0	.1689	54.	5.33	0.87	0.15E+00	0.29E-02	0.51E+02
35.0	.1593	57.	5.62	0.91	0.90E-01	0.43E-02	0.21E+02
50.0	.1527	60.	5.86	0.96	0.35E-01	0.19E-02	0.19E+02
70.0	.1468	63.	6.16	0.99	0.34E-01	0.21E-02	0.16E+02
90.0	.1422	66.	6.45	1.01	0.23E-01	0.10E-02	0.22E+02

DOERING 1-STEP DATA

0.9	.1295	86.	8.40	83.33	0.59E-02	0.83E-03	0.71E+01
1.0	.1280	87.	8.57	83.33	0.54E-02	0.79E-03	0.68E+01
1.0	.1267	89.	8.74	83.33	0.50E-02	0.77E-03	0.65E+01

DOERING 1-STEP DATA (CONT)

1.1	.1254	91.	8.91	83.33	0.46E-02	0.74E-03	0.62E+01
1.1	.1243	92.	9.06	83.33	0.43E-02	0.72E-03	0.59E+01
1.2	.1232	94.	9.22	83.33	0.40E-02	0.69E-03	0.57E+01
1.2	.1221	96.	9.37	83.33	0.37E-02	0.67E-03	0.55E+01
1.3	.1211	97.	9.51	83.33	0.35E-02	0.66E-03	0.53E+01
1.3	.1202	98.	9.65	83.33	0.32E-02	0.64E-03	0.51E+01
1.4	.1193	100.	9.79	83.33	0.31E-02	0.62E-03	0.49E+01
1.4	.1185	101.	9.92	83.33	0.29E-02	0.61E-03	0.48E+01
1.5	.1177	103.	10.05	83.33	0.27E-02	0.59E-03	0.46E+01
1.5	.1169	104.	10.18	83.33	0.26E-02	0.58E-03	0.45E+01
1.6	.1162	105.	10.31	83.33	0.25E-02	0.56E-03	0.43E+01
1.6	.1155	106.	10.43	83.33	0.23E-02	0.55E-03	0.42E+01
1.7	.1148	108.	10.55	83.33	0.22E-02	0.54E-03	0.41E+01
1.7	.1142	109.	10.67	83.33	0.21E-02	0.53E-03	0.40E+01
1.8	.1136	110.	10.78	83.33	0.20E-02	0.52E-03	0.39E+01
1.8	.1130	111.	10.90	83.33	0.19E-02	0.51E-03	0.38E+01
1.9	.1124	112.	11.01	83.33	0.19E-02	0.50E-03	0.37E+01

DEPTH 114. CM (DOERING 1-STEP CONTINUED) SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.9	.1119	113.	11.12	83.33	0.18E-02	0.49E-03	0.36E+01
2.0	.1113	114.	11.22	83.33	0.17E-02	0.48E-03	0.35E+01
2.0	.1108	116.	11.33	83.33	0.16E-02	0.47E-03	0.35E+01
4.1	.0983	149.	14.61	83.33	0.55E-03	0.30E-03	0.19E+01
8.1	.0889	189.	18.50	83.33	0.20E-03	0.19E-03	0.11E+01
12.1	.0844	215.	21.12	83.33	0.12E-03	0.15E-03	0.78E+00
16.1	.0816	236.	23.13	83.33	0.80E-04	0.13E-03	0.63E+00
20.1	.0796	253.	24.78	83.33	0.61E-04	0.11E-03	0.55E+00
24.1	.0781	267.	26.17	83.33	0.49E-04	0.10E-03	0.49E+00
28.1	.0769	279.	27.39	83.33	0.42E-04	0.92E-04	0.45E+00
32.1	.0760	290.	28.47	83.33	0.36E-04	0.85E-04	0.43E+00
36.1	.0751	300.	29.44	83.33	0.33E-04	0.80E-04	0.41E+00
40.1	.0744	309.	30.33	83.33	0.30E-04	0.76E-04	0.39E+00
44.1	.0738	318.	31.14	83.33	0.28E-04	0.72E-04	0.38E+00
48.1	.0733	325.	31.89	83.33	0.26E-04	0.69E-04	0.38E+00

DEPTH 130. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.3	.3987	22.	2.18	0.43	0.17E+02	0.10E-01	0.17E+04
0.7	.3801	30.	2.90	0.10	0.54E+02	0.98E-03	0.55E+05
0.9	.3782	32.	3.12	0.17	0.25E+02	0.93E-03	0.27E+05
1.1	.3762	33.	3.27	0.26	0.16E+02	0.24E-02	0.66E+04
1.4	.3672	35.	3.42	0.42	0.12E+02	0.99E-02	0.12E+04
1.6	.3509	37.	3.59	0.60	0.77E+01	0.11E-01	0.73E+03
1.9	.3353	38.	3.74	0.75	0.58E+01	0.12E-01	0.50E+03
2.4	.3150	41.	4.01	1.02	0.57E+01	0.27E-01	0.21E+03
2.8	.2895	43.	4.18	1.20	0.25E+01	0.73E-02	0.34E+03
3.2	.2755	44.	4.36	1.42	0.15E+01	0.76E-02	0.20E+03
3.7	.2629	46.	4.52	1.62	0.79E+00	0.65E-02	0.12E+03
4.2	.2528	48.	4.70	1.77	0.71E+00	0.44E-02	0.16E+03
4.7	.2440	50.	4.86	1.90	0.76E+00	0.59E-02	0.13E+03
6.2	.2276	52.	5.05	2.03	0.44E+00	0.96E-02	0.46E+02
15.0	.1939	55.	5.39	1.85	0.12E+00	0.18E-02	0.65E+02
25.0	.1794	62.	6.07	2.22	0.66E-01	0.26E-02	0.25E+02
35.0	.1695	66.	6.43	2.25	0.42E-01	0.34E-02	0.12E+02
50.0	.1626	69.	6.72	2.28	0.17E-01	0.16E-02	0.10E+02
70.0	.1571	72.	7.08	2.33	0.16E-01	0.14E-02	0.11E+02
90.0	.1524	76.	7.42	2.38	0.11E-01	0.13E-02	0.83E+01

130 CM DOERING 1-STEP DATA NEXT PAGE

DOERING 1-STEP DATA

1.0	.1466	75.	7.38	83.33	0.12E-01	0.11E-02	0.11E+02
1.0	.1430	79.	7.73	83.33	0.10E-01	0.99E-03	0.11E+02
1.1	.1396	82.	8.07	83.33	0.92E-02	0.91E-03	0.10E+02
1.1	.1366	86.	8.41	83.33	0.82E-02	0.84E-03	0.97E+01
1.2	.1337	89.	8.75	83.33	0.73E-02	0.79E-03	0.93E+01
1.2	.1311	93.	9.09	83.33	0.65E-02	0.73E-03	0.89E+01
1.3	.1287	96.	9.43	83.33	0.59E-02	0.69E-03	0.85E+01
1.3	.1264	100.	9.77	83.33	0.53E-02	0.64E-03	0.82E+01
1.4	.1242	103.	10.11	83.33	0.48E-02	0.61E-03	0.79E+01
1.4	.1222	107.	10.44	83.33	0.44E-02	0.57E-03	0.76E+01
1.5	.1203	110.	10.78	83.33	0.40E-02	0.54E-03	0.74E+01
1.5	.1185	113.	11.11	83.33	0.36E-02	0.51E-03	0.71E+01
1.6	.1169	117.	11.44	83.33	0.33E-02	0.48E-03	0.69E+01
1.6	.1153	120.	11.78	83.33	0.31E-02	0.46E-03	0.67E+01
1.7	.1138	123.	12.11	83.33	0.28E-02	0.44E-03	0.65E+01

DEPTH 130. CM SITE C-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.7	.1123	127.	12.44	83.33	0.26E-02	0.41E-03	0.63E+01
1.8	.1110	130.	12.77	83.33	0.24E-02	0.40E-03	0.61E+01
1.8	.1097	134.	13.10	83.33	0.23E-02	0.38E-03	0.60E+01
1.9	.1084	137.	13.43	83.33	0.21E-02	0.36E-03	0.58E+01
1.9	.1072	140.	13.76	83.33	0.20E-02	0.35E-03	0.57E+01
2.0	.1061	144.	14.08	83.33	0.18E-02	0.33E-03	0.55E+01
2.0	.1050	147.	14.41	83.33	0.17E-02	0.32E-03	0.54E+01
2.1	.1040	150.	14.74	83.33	0.16E-02	0.30E-03	0.53E+01
2.1	.1030	154.	15.06	83.33	0.15E-02	0.29E-03	0.51E+01
2.2	.1020	157.	15.39	83.33	0.14E-02	0.28E-03	0.50E+01
2.2	.1011	160.	15.71	83.33	0.13E-02	0.27E-03	0.49E+01
2.3	.1002	164.	16.04	83.33	0.13E-02	0.26E-03	0.48E+01
4.3	.0800	297.	29.14	83.33	0.23E-03	0.88E-04	0.26E+01

SITE D (HECLA SERIES)

Site D was located in a nonirrigated wheat field. The location and description are summarized on Table 1. According to the La Moure County (ND) Soil Survey Report (USDA, 1971) the Hecla soil series consists of "deep, moderately well drained, level to gently undulating soils on sandy lake plains and on sandy uplands and terraces in the James River Valley". They were "formed in coarse-textured deposits left by glacial melt water and reworked by wind". Hecla soils are associated with Hamar, Maddock, and Ulen soils. The specific site measured (location Fig. 2) consisted of a near crest position of a lengthy toposequence, which included a Ulen soil (site E) at toeslope and an Arveson soil (site F) in the depression.

In-situ measurements and site descriptions were made during late June and July, 1985. The measurment period was concurrent with sites E and F which were located nearby, and also site G which was located approximately 3.25 miles (7.23 km) northeast of the field location. Soil samples and soil profile descriptions were made approximately 4 weeks after hydraulic measurements were completed. Although measurements were made for more than two weeks, drainage was approximately complete at 7 days.

Infiltration and soil-water and suction profiles during wetting were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

SITE D, REPLICATION 1

Table D-1.1. Soil morphologic data for Site D, replication 1.

Site and location: D-1 Hecla, Oakes Aquifer 66 feet south and 450 feet west of the east quarter corner of Section 9, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 07/31/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Hecla loamy sand; sandy, mixed Aquic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Moderately well.

Notes: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: D-1 west side of pit.

Alp 0-5 inches (0-13 cm) black (lOYR 2/1) loamy sand (loamy fine sand), dark gray (lOYR 4/1, dry); weak coarse and medium granular structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; abrupt smooth boundary.

A12 5-15 inches (13-38 cm) black (lOYR 2/1) loamy sand (loamy fine sand), dark gray (lOYR 4/1, dry); weak medium prismatic parting to weak fine and very fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; gradual wavy boundary.

Bw 15-25 inches (38-64 cm) very dark grayish brown (lOYR 3/2) loamy sand (fine sand), grayish brown (lOYR 5/2, dry); weak medium prismatic parting to weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; 5 inch crotovina; gradual wavy boundary.

Clg 25-34 inches (64-87cm) dark grayish brown to grayish brown (2.5Y 4.5/2) sand (fine sand), light brownish gray (2.5Y 6/2, dry) with many medium distinct dark brown (lOYR 3/3) mottles; single grain structure; loose, nonsticky and nonplastic; few very fine roots; gra- dual wavy boundary.

C2g 34-48 inches (87-122 cm) grayish brown (2.5Y 5/2) sand (fine sand), light gray (2.5Y 7/2, dry) with many fine prominent very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; gradual wavy boundary.

C3g 48-59 inches (122-151 cm) grayish brown (2.5Y 5/2) sand, light gray (2.5Y 7/2, dry) with many medium prominent very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; clear wavy boundary.

Ck 59-70 inches (151-178 cm) light brownish gray (2.5Y 6/2) sand, white (2.5Y 8/2, dry) with common medium prominent very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; strong to violent effervescence.

Table D-1.2 HECLA SERIES SITE D-1 NDSWC:1985

Soil partile-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.0	4.7	5.6	4.5	20.2	42.3	18.2	4.4	0.1
23.0	5.8	5.2	3.7	21.7	43.8	15.8	3.9	0.0
38.1	1.7	7.0	4.7	25.8	47.6	10.5	2.6	0.0
53.3	4.3	3.3	2.8	22.0	47.2	15.7	4.6	0.1
76.2	2.8	6.2	0.0	26.3	52.7	9.6	2.4	0.0
106.7	2.4	2.6	3.6	24.6	51.8	11.5	3.4	0.0
137.0	3.1	4.4	2.9	17.7	40.3	20.6	10.9	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	85.2	10.1	4.7	A 1 6	6=p
23.	85.3	8.9	5.8	A 1 2	7=w
38.1	86.6	11.7	1.7	A 1 2	8=g
53.3	89.6	6.1	4.3	B 0 7	
76.2	91.0	6.2	2.8	C 1 8	
106.7	91.4	6.2	2.4	C 2 8	
137.0	89.6	7.3	3.1	C 3 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	8.436	0.1131	4.1	0.0279	0.747	1.37	1.22
23.	9.573	0.1053	4.3	0.0246	0.777	1.38	1.16
38.1	7.393	0.1109	3.0	0.0370	0.919	1.43	0.58
53.3	14.689	0.1226	3.7	0.0333	0.925	1.49	0.43
76.2	14.444	0.1134	3.2	0.0358	1.117	1.49	0.23
106.7	14.726	0.1266	2.9	0.0434	1.090	1.56	0.16
137.0	12.260	0.1490	3.7	0.0405	0.794	1.60	0.08

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER CM/DAY-KPA		K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.675	2.446	-1.1292	2.4708	-11.29	1.09
23.	1.589	2.516	-1.1367	2.4708	-11.37	1.09
38.1	1.773	3.186	-1.1373	2.5085	-11.37	1.13
53.3	1.358	3.410	-1.2160	2.5984	-12.16	1.22
76.2	1.376	3.020	-1.2343	2.6390	-12.34	1.26
106.7	1.369	4.734	-1.2391	2.6477	-12.39	1.27
137.0	1.462	3.930	-1.2070	2.5955	-12.07	1.22

Table D-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site D, replication 1.

			Saturation Extract Soluble Ions					
Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
				meq/l				
0 - 15	3.01	5.03	0.88	0.38	-	5.44	0.35	3.51
15 - 30	3.01	1.89	0.57	0.23	-	3.84	0.18	1.67
30 - 46	2.49	1.18	0.44	0.18	-	2.96	0.12	1.21
46 - 61	2.02	1.16	0.42	0.16	-	2.48	0.13	1.15
61 - 91	1.51	1.15	0.42	0.10	-	1.92	0.17	1.08
91 - 122	1.51	1.15	0.42	0.09	-	1.44	0.20	1.52
122 - 152	1.46	1.07	0.44	0.06	-	1.72	0.20	1.11

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.67	0.44	32	7.7	-	lfs	4.79
15 - 30	0.41	0.36	31	7.6	-	lfs	5.24
30 - 46	0.32	0.33	30	7.9	-	lfs	4.23
46 - 61	0.30	0.33	28	7.8	-	fs	3.84
61 - 91	0.22	0.36	26	7.8	-	fs	3.51
91 - 122	0.22	0.36	24	7.9	-	fs	3.38
122 - 152	0.24	0.39	23	8.0	-	s	3.75

Table D-1.4 HECLA SERIES SITE D-1 NDSWC:1985
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
24.	0.5172	0.0278	24.	0.4983	0.0099	24.	0.3611	0.0034	24.	0.3943	0.0060
40.	0.3986	0.0192	40.	0.4392	0.0039	40.	0.3212	0.0030	40.	0.3547	0.0055
50.	0.3199	0.0113	50.	0.3391	0.0002	50.	0.2763	0.0030	50.	0.2806	0.0039
62.	0.2864	0.0086	62.	0.2855	0.0008	62.	0.2379	0.0036	62.	0.2350	0.0033
70.	0.2643	0.0063	70.	0.2483	0.0000	70.	0.2151	0.0023	70.	0.2035	0.0022
82.	0.2356	0.0037	82.	0.2134	0.0013	82.	0.1887	0.0026	82.	0.1728	0.0017
98.	0.2185	0.0038	98.	0.1940	0.0017	98.	0.1681	0.0028	98.	0.1534	0.0017
150.	0.1769	0.0021	150.	0.1591	0.0020	150.	0.1367	0.0015	150.	0.1205	0.0006
340.	0.1426	0.0011	340.	0.1281	0.0017	340.	0.1083	0.0032	340.	0.0965	0.0016
503.	0.1303	0.0002	503.	0.1203	0.0005	503.	0.0997	0.0011	503.	0.0890	0.0006
834.	0.1198	0.0005	834.	0.1094	0.0004	834.	0.0968	0.0000	834.	0.0823	0.0011
BD =	1.37			1.38			1.43			1.49	
N =	2			2			2			2	

DEPTH (CM)

	76.			99.			137.	
10.	0.4065	0.0061	24.	0.3874	0.0035	10.	0.3922	0.0060
20.	0.4021	0.0061	40.	0.3563	0.0007	20.	0.3867	0.0043
30.	0.3873	0.0059	50.	0.3133	0.0041	30.	0.3606	0.0019
40.	0.3520	0.0053	62.	0.2618	0.0049	40.	0.3146	0.0035
50.	0.3315	0.0081	70.	0.2119	0.0045	50.	0.2747	0.0042
60.	0.2443	0.0015	82.	0.1660	0.0036	60.	0.2187	0.0041
70.	0.2370	0.0005	98.	0.1333	0.0018	70.	0.2080	0.0040
80.	0.1840	0.0014	150.	0.1005	0.0012	80.	0.1712	0.0035
100.	0.1538	0.0013	340.	0.0834	0.0004	100.	0.1512	0.0022
120.	0.1310	0.0001	503.	0.0795	0.0001	120.	0.1351	0.0026
180.	0.1008	0.0000	834.	0.0787	0.0005	180.	0.1120	0.0013
334.	0.0861	0.0003				334.	0.0967	0.0011
534.	0.0810	0.0002				534.	0.0929	0.0027
834.	0.0743	0.0004				834.	0.0852	0.0015
BD =	1.49			1.56			1.60	
N =	2			2			2	

Table D-1.5 HECLA SERIES SITE D-1 (NDSWC 1989)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.5064	5.	0.52	0.33	0.53E+00	0.39E-03	0.14E+04
0.9	.4836	17.	1.67	0.30	0.10E+02	0.37E-02	0.28E+04
1.1	.4399	29.	2.87	0.50	0.35E+01	0.36E-02	0.99E+03
1.3	.3971	40.	3.92	0.57	0.26E+01	0.49E-02	0.54E+03
1.5	.3609	48.	4.67	0.70	0.12E+01	0.47E-02	0.25E+03
1.9	.3345	52.	5.12	0.90	0.56E+00	0.10E-01	0.56E+02
2.2	.3139	55.	5.37	1.03	0.31E+00	0.70E-02	0.44E+02
2.7	.2985	57.	5.62	1.07	0.14E+00	0.49E-02	0.28E+02
3.2	.2903	59.	5.82	1.03	0.10E+00	0.34E-02	0.29E+02
3.7	.2825	61.	5.97	0.98	0.13E+00	0.87E-02	0.15E+02
4.2	.2734	62.	6.07	0.95	0.15E+00	0.96E-02	0.16E+02
4.7	.2626	63.	6.17	0.93	0.19E+00	0.12E-01	0.16E+02
6.2	.2488	65.	6.37	0.95	0.50E-01	0.52E-02	0.96E+01
8.7	.2328	68.	6.67	0.98	0.50E-01	0.54E-02	0.93E+01
12.5	.2205	71.	6.99	1.02	0.13E-01	0.24E-02	0.52E+01
17.5	.2115	75.	7.37	1.05	0.14E-01	0.24E-02	0.58E+01
22.5	.2037	80.	7.79	1.07	0.87E-02	0.14E-02	0.64E+01
27.5	.1990	84.	8.22	1.07	0.47E-02	0.83E-03	0.57E+01
40.0	.1943	90.	8.87	0.93	0.25E-02	0.68E-03	0.37E+01
60.0	.1889	98.	9.57	0.80	0.22E-02	0.94E-03	0.24E+01
80.0	.1849	102.	10.02	0.80	0.16E-02	0.83E-03	0.19E+01
100.0	.1820	106.	10.37	0.82	0.11E-02	0.79E-03	0.14E+01
120.0	.1797	109.	10.67	0.85	0.11E-02	0.79E-03	0.13E+01
150.0	.1782	112.	10.99	0.95	0.94E-04	0.13E-03	0.70E+00
185.0	.1763	116.	11.34	0.98	0.85E-03	0.94E-03	0.90E+00
225.0	.1742	119.	11.62	0.93	0.15E-03	0.47E-03	0.33E+00
325.0	.1678	123.	12.07	0.87	0.69E-03	0.17E-02	0.41E+00
450.0	.1603	129.	12.62	0.77	0.33E-03	0.83E-03	0.40E+00
650.0	.1532	137.	13.47	0.62	0.45E-03	0.84E-03	0.53E+00
850.0	.1460	145.	14.24	0.47	0.54E-03	0.13E-02	0.41E+00

DEPTH 23. CM SITE D-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.4817	0.	0.02	0.33	0.16E+01	0.51E-03	0.31E+04
0.9	.4650	12.	1.15	0.30	0.28E+02	0.21E-02	0.13E+05
1.1	.4337	24.	2.36	0.50	0.96E+01	0.25E-02	0.38E+04
1.3	.4042	36.	3.55	0.57	0.70E+01	0.29E-02	0.24E+04
1.5	.3783	45.	4.42	0.70	0.34E+01	0.32E-02	0.11E+04
1.9	.3559	51.	5.04	0.90	0.16E+01	0.50E-02	0.32E+03
2.2	.3393	55.	5.39	1.03	0.85E+00	0.45E-02	0.19E+03
2.7	.3259	58.	5.67	1.07	0.44E+00	0.56E-02	0.78E+02
3.2	.3155	60.	5.84	1.03	0.34E+00	0.64E-02	0.53E+02
3.7	.3049	61.	5.96	0.98	0.45E+00	0.15E-01	0.29E+02
4.2	.2935	62.	6.03	0.95	0.49E+00	0.15E-01	0.33E+02
4.7	.2819	62.	6.12	0.93	0.59E+00	0.12E-01	0.49E+02
6.2	.2677	65.	6.33	0.95	0.15E+00	0.50E-02	0.30E+02
8.7	.2507	68.	6.65	0.98	0.15E+00	0.54E-02	0.28E+02
12.5	.2362	71.	7.00	1.02	0.43E-01	0.30E-02	0.14E+02
17.5	.2257	76.	7.40	1.05	0.41E-01	0.22E-02	0.18E+02

DEPTH 23. CM (CONT)

22.5	.2173	80.	7.84	1.07	0.28E-01	0.16E-02	0.17E+02
27.5	.2112	84.	8.26	1.07	0.17E-01	0.12E-02	0.13E+02
40.0	.2046	90.	8.81	0.93	0.84E-02	0.12E-02	0.71E+01
60.0	.1974	96.	9.41	0.80	0.74E-02	0.12E-02	0.60E+01
80.0	.1923	101.	9.86	0.80	0.51E-02	0.10E-02	0.50E+01
100.0	.1891	104.	10.23	0.82	0.33E-02	0.73E-03	0.45E+01
120.0	.1871	108.	10.55	0.85	0.29E-02	0.51E-03	0.56E+01
150.0	.1847	112.	10.95	0.95	0.81E-03	0.65E-03	0.12E+01
185.0	.1811	116.	11.33	0.98	0.28E-02	0.15E-02	0.18E+01
225.0	.1786	118.	11.57	0.93	0.42E-03	0.35E-03	0.12E+01
325.0	.1736	122.	11.96	0.87	0.19E-02	0.15E-02	0.13E+01
450.0	.1677	127.	12.44	0.77	0.92E-03	0.74E-03	0.12E+01
650.0	.1630	134.	13.16	0.62	0.12E-02	0.61E-03	0.19E+01
850.0	.1579	141.	13.83	0.47	0.16E-02	0.17E-02	0.98E+00

DOERING 1-STEP DATA

0.4	.1492	188.	18.45	83.33	0.55E-02	0.31E-03	0.18E+02
0.5	.1419	216.	21.16	83.33	0.36E-02	0.23E-03	0.16E+02
0.5	.1357	248.	24.31	83.33	0.24E-02	0.17E-03	0.14E+02
0.6	.1302	286.	28.07	83.33	0.16E-02	0.12E-03	0.13E+02
0.6	.1255	333.	32.68	83.33	0.10E-02	0.85E-04	0.12E+02
0.7	.1213	393.	38.52	83.33	0.66E-03	0.59E-04	0.11E+02
0.7	.1175	472.	46.26	83.33	0.40E-03	0.39E-04	0.10E+02

DEPTH 38. CM SITE D-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.9	.4287	8.	0.75	1.17	0.97E+01	0.69E-03	0.14E+05
1.1	.4165	20.	1.95	0.91	0.74E+01	0.12E-02	0.62E+04
1.3	.4036	31.	3.07	0.77	0.69E+01	0.13E-02	0.54E+04
1.5	.3867	40.	3.94	0.67	0.54E+01	0.26E-02	0.21E+04
1.9	.3672	48.	4.66	0.60	0.38E+01	0.32E-02	0.12E+04
2.2	.3513	52.	5.12	0.62	0.22E+01	0.38E-02	0.58E+03
2.7	.3370	56.	5.45	0.65	0.13E+01	0.55E-02	0.23E+03
3.2	.3252	58.	5.64	0.70	0.95E+00	0.74E-02	0.13E+03
3.7	.3146	59.	5.77	0.77	0.10E+01	0.10E-01	0.99E+02
4.2	.3038	60.	5.87	0.84	0.96E+00	0.11E-01	0.84E+02
4.7	.2914	61.	5.97	0.87	0.11E+01	0.13E-01	0.80E+02
6.2	.2755	63.	6.16	0.82	0.31E+00	0.67E-02	0.45E+02
8.7	.2580	66.	6.43	0.72	0.36E+00	0.60E-02	0.59E+02
12.5	.2431	69.	6.74	0.64	0.13E+00	0.38E-02	0.33E+02
* 17.5	.2319	73.	7.11	0.57	0.13E+00	0.23E-02	0.56E+02
22.5	.2234	77.	7.51	0.50	0.11E+00	0.20E-02	0.53E+02
27.5	.2163	81.	7.91	0.47	0.74E-01	0.15E-02	0.48E+02
40.0	.2081	86.	8.41	0.54	0.28E-01	0.17E-02	0.16E+02
60.0	.1994	91.	8.94	0.57	0.19E-01	0.16E-02	0.12E+02
80.0	.1930	95.	9.34	0.50	0.15E-01	0.16E-02	0.98E+01
100.0	.1885	99.	9.66	0.44	0.11E-01	0.12E-02	0.96E+01
120.0	.1856	102.	9.96	0.37	0.11E-01	0.79E-03	0.14E+02
150.0	.1827	106.	10.37	0.29	0.69E-02	0.63E-03	0.11E+02
185.0	.1776	109.	10.72	0.22	0.26E-01	0.39E-02	0.65E+01
225.0	.1737	112.	10.96	0.27	0.24E-02	0.32E-03	0.77E+01
325.0	.1707	116.	11.36	0.34	0.72E-02	0.10E-02	0.69E+01
450.0	.1671	120.	11.76	0.34	0.31E-02	0.63E-03	0.49E+01
650.0	.1648	126.	12.39	0.35	0.28E-02	0.29E-03	0.95E+01
850.0	.1624	132.	12.97	0.39	0.30E-02	0.11E-02	0.28E+01

DOERING 1-STEP DATA

0.2	.2306	59.	5.82	83.33	0.99E-01	0.28E-02	0.36E+02
0.2	.2276	61.	5.93	83.33	0.11E+00	0.27E-02	0.41E+02
0.2	.2253	61.	6.02	83.33	0.11E+00	0.26E-02	0.43E+02
0.2	.2000	73.	7.17	83.33	0.59E-01	0.18E-02	0.33E+02
0.3	.1822	85.	8.34	83.33	0.35E-01	0.13E-02	0.27E+02
0.3	.1686	97.	9.54	83.33	0.22E-01	0.95E-03	0.23E+02
0.4	.1579	110.	10.80	83.33	0.15E-01	0.73E-03	0.20E+02
0.5	.1419	139.	13.58	83.33	0.70E-02	0.44E-03	0.16E+02
0.5	.1357	154.	15.14	83.33	0.50E-02	0.35E-03	0.14E+02
0.6	.1255	191.	18.75	83.33	0.26E-02	0.22E-03	0.12E+02
0.7	.1213	213.	20.87	83.33	0.19E-02	0.17E-03	0.11E+02
0.8	.1141	265.	26.02	83.33	0.10E-02	0.11E-03	0.98E+01
0.8	.1110	298.	29.23	83.33	0.77E-03	0.83E-04	0.92E+01
0.9	.1082	337.	33.02	83.33	0.55E-03	0.64E-04	0.87E+01
0.9	.1056	384.	37.60	83.33	0.40E-03	0.48E-04	0.82E+01
1.0	.1033	441.	43.28	83.33	0.28E-03	0.35E-04	0.78E+01

DEPTH 53. CM SITE D-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.4198	2.	0.21	1.10	0.69E+00	0.66E-04	0.10E+05
0.9	.4180	8.	0.77	1.07	0.12E+02	0.32E-03	0.36E+05
1.1	.4127	19.	1.90	1.00	0.75E+01	0.68E-03	0.11E+05
1.3	.4036	30.	2.90	1.00	0.61E+01	0.13E-02	0.45E+04
1.5	.3854	38.	3.77	1.10	0.44E+01	0.27E-02	0.16E+04
1.9	.3648	47.	4.56	1.27	0.25E+01	0.26E-02	0.95E+03
2.2	.3520	52.	5.08	1.32	0.13E+01	0.23E-02	0.57E+03
2.7	.3321	55.	5.41	1.28	0.11E+01	0.13E-01	0.86E+02
3.2	.3092	57.	5.61	1.25	0.87E+00	0.91E-02	0.95E+02
3.7	.2955	59.	5.76	1.22	0.90E+00	0.91E-02	0.99E+02
4.2	.2848	60.	5.89	1.18	0.96E+00	0.79E-02	0.12E+03
4.7	.2742	61.	5.99	1.15	0.11E+01	0.15E-01	0.76E+02
6.2	.2608	63.	6.13	1.13	0.31E+00	0.78E-02	0.40E+02
8.7	.2442	65.	6.34	1.15	0.31E+00	0.78E-02	0.40E+02

DOERING 1-STEP DATA

0.1	.2327	60.	5.87	83.33	0.19E+00	0.33E-02	0.58E+02
0.2	.2010	72.	7.04	83.33	0.91E-01	0.22E-02	0.42E+02
0.2	.1803	83.	8.13	83.33	0.51E-01	0.16E-02	0.33E+02
0.3	.1655	94.	9.20	83.33	0.32E-01	0.12E-02	0.27E+02
0.3	.1541	105.	10.26	83.33	0.21E-01	0.93E-03	0.23E+02
0.4	.1451	116.	11.33	83.33	0.15E-01	0.74E-03	0.20E+02
0.4	.1377	127.	12.41	83.33	0.11E-01	0.60E-03	0.18E+02
0.5	.1315	138.	13.52	83.33	0.79E-02	0.50E-03	0.16E+02
0.5	.1262	150.	14.66	83.33	0.60E-02	0.41E-03	0.14E+02
0.6	.1216	162.	15.85	83.33	0.46E-02	0.35E-03	0.13E+02
0.6	.1176	174.	17.10	83.33	0.36E-02	0.29E-03	0.12E+02
0.7	.1140	188.	18.40	83.33	0.28E-02	0.25E-03	0.11E+02
0.7	.1108	202.	19.78	83.33	0.22E-02	0.21E-03	0.11E+02
0.8	.1079	217.	21.25	83.33	0.18E-02	0.18E-03	0.10E+02
0.8	.1052	233.	22.81	83.33	0.14E-02	0.15E-03	0.94E+01
0.9	.1028	250.	24.49	83.33	0.12E-02	0.13E-03	0.89E+01
0.9	.1006	268.	26.29	83.33	0.93E-03	0.11E-03	0.84E+01
1.0	.0986	288.	28.25	83.33	0.75E-03	0.94E-04	0.80E+01
1.0	.0967	310.	30.39	83.33	0.61E-03	0.80E-04	0.76E+01
1.1	.0949	334.	32.73	83.33	0.49E-03	0.68E-04	0.73E+01

DOERING 1-STEP DATA (CONT)

1.1	.0933	360.	35.33	83.33	0.40E-03	0.57E-04	0.70E+01
1.2	.0918	390.	38.22	83.33	0.32E-03	0.48E-04	0.67E+01
1.2	.0903	423.	41.47	83.33	0.26E-03	0.40E-04	0.64E+01
1.3	.0890	461.	45.17	83.33	0.20E-03	0.33E-04	0.62E+01

DEPTH 76. CM SITE D-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.4159	2.	0.22	1.22	0.62E-01	********	********
0.8	.4170	3.	0.25	1.07	0.58E+00	********	********
0.9	.4170	6.	0.62	0.82	0.16E+02	0.49E-03	0.32E+05
1.1	.4136	10.	1.01	0.52	0.16E+02	0.69E-03	0.23E+05
1.3	.4077	17.	1.68	0.37	0.19E+02	0.93E-03	0.21E+05
1.5	.3959	28.	2.74	0.39	0.16E+02	0.14E-02	0.12E+05
1.9	.3821	39.	3.82	0.44	0.93E+01	0.14E-02	0.66E+04
2.7	.3820	49.	4.84	0.51	0.56E+01	0.14E-01	0.41E+03
3.2	.3592	51.	5.02	0.51	0.35E+01	0.12E-01	0.29E+03
3.7	.3320	52.	5.12	0.49	0.50E+01	0.52E-01	0.95E+02
4.2	.3064	53.	5.19	0.48	0.35E+01	0.16E-01	0.21E+03
4.7	.2902	54.	5.34	0.52	0.40E+01	0.10E-01	0.40E+03
6.2	.2684	58.	5.67	0.65	0.85E+00	0.55E-02	0.15E+03
8.7	.2461	63.	6.20	0.84	0.65E+00	0.35E-02	0.18E+03
12.5	.2283	68.	6.65	0.96	0.19E+00	0.53E-02	0.36E+02
17.5	.2160	71.	6.91	0.96	0.15E+00	0.40E-02	0.38E+02
22.5	.2079	73.	7.19	0.94	0.11E+00	0.21E-02	0.53E+02
27.5	.2026	76.	7.47	0.93	0.77E-01	0.15E-02	0.50E+02
40.0	.1943	80.	7.83	0.91	0.38E-01	0.27E-02	0.14E+02
60.0	.1843	84.	8.25	0.88	0.29E-01	0.21E-02	0.14E+02
80.0	.1779	87.	8.57	0.86	0.21E-01	0.18E-02	0.11E+02
100.0	.1740	90.	8.85	0.85	0.14E-01	0.10E-02	0.14E+02
120.0	.1706	93.	9.11	0.82	0.13E-01	0.16E-02	0.83E+01
150.0	.1670	95.	9.36	0.79	0.46E-02	0.12E-02	0.37E+01
185.0	.1623	97.	9.52	0.78	0.19E-01	0.85E-02	0.22E+01
225.0	.1579	99.	9.69	0.76	0.27E-02	0.86E-03	0.32E+01
325.0	.1540	103.	10.10	0.72	0.52E-02	0.99E-03	0.52E+01
450.0	.1503	107.	10.48	0.70	0.24E-02	0.95E-03	0.25E+01
650.0	.1471	111.	10.87	0.70	0.20E-02	0.75E-03	0.27E+01
850.0	.1440	115.	11.23	0.70	0.24E-02	0.17E-02	0.14E+01

DOERING 1-STEP DATA

0.2	.2178	73.	7.15	83.33	0.68E-01	0.31E-02	0.22E+02
0.3	.2085	76.	7.46	83.33	0.51E-01	0.28E-02	0.19E+02
0.3	.2012	79.	7.73	83.33	0.40E-01	0.25E-02	0.16E+02
0.4	.1951	81.	7.98	83.33	0.33E-01	0.23E-02	0.14E+02
0.4	.1900	84.	8.20	83.33	0.27E-01	0.22E-02	0.13E+02
0.5	.1856	86.	8.41	83.33	0.23E-01	0.20E-02	0.11E+02
0.5	.1818	88.	8.60	83.33	0.20E-01	0.19E-02	0.10E+02
0.6	.1784	90.	8.78	83.33	0.17E-01	0.18E-02	0.95E+01
0.6	.1754	91.	8.94	83.33	0.15E-01	0.17E-02	0.88E+01
0.7	.1726	93.	9.10	83.33	0.14E-01	0.17E-02	0.82E+01
0.7	.1702	94.	9.25	83.33	0.12E-01	0.16E-02	0.77E+01
0.8	.1679	96.	9.39	83.33	0.11E-01	0.15E-02	0.72E+01
0.8	.1658	97.	9.52	83.33	0.10E-01	0.15E-02	0.68E+01
0.9	.1639	98.	9.65	83.33	0.92E-02	0.14E-02	0.64E+01
0.9	.1621	100.	9.78	83.33	0.85E-02	0.14E-02	0.61E+01
1.0	.1605	101.	9.89	83.33	0.78E-02	0.13E-02	0.58E+01
1.0	.1589	102.	10.01	83.33	0.73E-02	0.13E-02	0.55E+01

DEPTH	76.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
1.1	.1575	103.	10.12	83.33	0.68E-02	0.13E-02	0.53E+01
1.1	.1561	104.	10.22	83.33	0.63E-02	0.12E-02	0.51E+01
1.2	.1548	105.	10.33	83.33	0.59E-02	0.12E-02	0.49E+01
1.2	.1536	106.	10.43	83.33	0.55E-02	0.12E-02	0.47E+01
1.3	.1524	107.	10.52	83.33	0.52E-02	0.12E-02	0.45E+01
1.3	.1514	108.	10.62	83.33	0.49E-02	0.11E-02	0.44E+01
1.4	.1503	109.	10.71	83.33	0.47E-02	0.11E-02	0.42E+01
1.4	.1493	110.	10.80	83.33	0.44E-02	0.11E-02	0.41E+01
1.5	.1484	111.	10.88	83.33	0.42E-02	0.11E-02	0.39E+01
1.5	.1475	112.	10.97	83.33	0.40E-02	0.10E-02	0.38E+01
1.6	.1466	113.	11.05	83.33	0.38E-02	0.10E-02	0.37E+01
1.6	.1458	114.	11.13	83.33	0.36E-02	0.10E-02	0.36E+01
1.7	.1450	114.	11.21	83.33	0.35E-02	0.98E-03	0.35E+01
1.7	.1442	115.	11.29	83.33	0.33E-02	0.97E-03	0.34E+01
1.8	.1435	116.	11.36	83.33	0.32E-02	0.95E-03	0.33E+01
1.8	.1428	117.	11.43	83.33	0.30E-02	0.94E-03	0.32E+01
1.9	.1421	117.	11.51	83.33	0.29E-02	0.92E-03	0.32E+01
1.9	.1414	118.	11.58	83.33	0.28E-02	0.91E-03	0.31E+01
2.0	.1408	119.	11.65	83.33	0.27E-02	0.89E-03	0.30E+01
2.0	.1402	119.	11.71	83.33	0.26E-02	0.88E-03	0.29E+01
2.1	.1396	120.	11.78	83.33	0.25E-02	0.87E-03	0.29E+01
2.1	.1390	121.	11.85	83.33	0.24E-02	0.86E-03	0.28E+01
2.2	.1385	121.	11.91	83.33	0.23E-02	0.84E-03	0.27E+01
4.2	.1242	142.	13.92	83.33	0.85E-03	0.57E-03	0.15E+01
8.2	.1129	166.	16.29	83.33	0.31E-03	0.38E-03	0.82E+00
12.2	.1073	183.	17.89	83.33	0.17E-03	0.30E-03	0.58E+00
16.2	.1038	195.	19.14	83.33	0.12E-03	0.26E-03	0.45E+00
20.2	.1012	206.	20.18	83.33	0.84E-04	0.22E-03	0.38E+00
24.2	.0993	215.	21.07	83.33	0.65E-04	0.20E-03	0.32E+00
28.2	.0978	223.	21.86	83.33	0.52E-04	0.18E-03	0.29E+00
32.2	.0965	230.	22.57	83.33	0.43E-04	0.17E-03	0.26E+00
36.2	.0954	237.	23.22	83.33	0.37E-04	0.16E-03	0.24E+00
40.2	.0945	243.	23.81	83.33	0.32E-04	0.15E-03	0.22E+00
44.2	.0937	249.	24.36	83.33	0.28E-04	0.14E-03	0.20E+00
48.2	.0930	254.	24.88	83.33	0.25E-04	0.13E-03	0.19E+00
52.2	.0923	259.	25.37	83.33	0.22E-04	0.13E-03	0.18E+00
122.0	.0866	318.	31.23	83.33	0.80E-05	0.74E-04	0.11E+00
194.0	.0841	357.	35.04	83.33	0.52E-05	0.56E-04	0.93E-01

DEPTH	107.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.9	.3900	5.	0.54	1.08	0.12E+02	0.48E-03	0.26E+05
1.1	.3882	8.	0.78	1.21	0.72E+01	0.68E-03	0.10E+05
1.3	.3852	13.	1.26	1.20	0.66E+01	0.56E-03	0.12E+05
1.5	.3812	21.	2.03	1.02	0.73E+01	0.55E-03	0.13E+05
1.9	.3760	28.	2.74	0.79	0.63E+01	0.10E-02	0.61E+04
2.7	.3862	37.	3.59	0.64	0.64E+01	0.34E-02	0.19E+04
3.2	.3791	39.	3.81	0.66	0.37E+01	0.33E-02	0.11E+04
3.7	.3603	40.	3.94	0.69	0.67E+01	0.42E-01	0.16E+03
4.2	.3398	41.	4.04	0.73	0.32E+01	0.74E-02	0.43E+03
4.7	.3261	43.	4.24	0.73	0.45E+01	0.66E-02	0.68E+03
6.2	.3064	47.	4.58	0.63	0.13E+01	0.50E-02	0.26E+03
8.7	.2881	52.	5.06	0.44	0.17E+01	0.25E-02	0.69E+03
12.5	.2713	57.	5.54	0.35	0.81E+00	0.51E-02	0.16E+03
17.5	.2567	60.	5.91	0.42	0.50E+00	0.32E-02	0.15E+03

DEPTH	107.	CM	(CONT)				
22.5	.2471	64.	6.28	0.48	0.31E+00	0.23E-02	0.14E+03
27.5	.2396	67.	6.60	0.51	0.21E+00	0.26E-02	0.80E+02
40.0	.2275	71.	6.96	0.54	0.11E+00	0.38E-02	0.28E+02
60.0	.2143	75.	7.38	0.56	0.69E-01	0.25E-02	0.28E+02
80.0	.2067	79.	7.70	0.57	0.46E-01	0.24E-02	0.19E+02
*100.0	.2026	81.	7.92	0.55	0.29E-01	0.12E-02	0.25E+02
120.0	.2002	82.	8.08	0.51	0.31E-01	0.19E-02	0.16E+02
150.0	.1951	84.	8.19	0.46	0.17E-01	0.68E-02	0.25E+01
185.0	.1873	84.	8.28	0.41	0.53E-01	0.13E-01	0.41E+01
225.0	.1822	85.	8.38	0.38	0.92E-02	0.16E-02	0.58E+01
325.0	.1780	89.	8.72	0.38	0.13E-01	0.11E-02	0.11E+02
450.0	.1728	93.	9.11	0.40	0.65E-02	0.21E-02	0.30E+01
650.0	.1672	98.	9.56	0.43	0.46E-02	0.98E-03	0.47E+01
850.0	.1629	102.	9.97	0.47	0.47E-02	0.17E-02	0.28E+01

DOERING 1-STEP DATA

0.5	.2077	73.	7.15	83.33	0.59E-01	0.35E-02	0.17E+02
0.5	.1982	76.	7.43	83.33	0.47E-01	0.31E-02	0.15E+02
0.6	.1901	79.	7.70	83.33	0.39E-01	0.28E-02	0.14E+02
0.6	.1829	81.	7.96	83.33	0.33E-01	0.25E-02	0.13E+02
0.7	.1766	84.	8.22	83.33	0.28E-01	0.23E-02	0.12E+02
0.7	.1710	86.	8.47	83.33	0.24E-01	0.21E-02	0.11E+02
0.8	.1659	89.	8.71	83.33	0.20E-01	0.19E-02	0.10E+02
0.8	.1613	91.	8.95	83.33	0.18E-01	0.18E-02	0.98E+01
0.9	.1571	94.	9.19	83.33	0.15E-01	0.17E-02	0.92E+01
0.9	.1533	96.	9.43	83.33	0.14E-01	0.15E-02	0.88E+01
1.0	.1497	99.	9.66	83.33	0.12E-01	0.14E-02	0.83E+01
1.0	.1465	101.	9.89	83.33	0.11E-01	0.13E-02	0.79E+01

DEPTH	107.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
1.1	.1434	103.	10.12	83.33	0.95E-02	0.13E-02	0.76E+01
1.1	.1406	106.	10.35	83.33	0.85E-02	0.12E-02	0.72E+01
1.2	.1380	108.	10.58	83.33	0.76E-02	0.11E-02	0.69E+01
1.2	.1355	110.	10.80	83.33	0.69E-02	0.10E-02	0.67E+01
1.3	.1332	113.	11.03	83.33	0.62E-02	0.97E-03	0.64E+01
1.3	.1310	115.	11.26	83.33	0.56E-02	0.91E-03	0.62E+01
1.4	.1289	117.	11.49	83.33	0.51E-02	0.86E-03	0.60E+01
1.4	.1270	120.	11.72	83.33	0.47E-02	0.81E-03	0.58E+01
1.5	.1251	122.	11.95	83.33	0.43E-02	0.77E-03	0.56E+01
1.5	.1233	124.	12.18	83.33	0.39E-02	0.73E-03	0.54E+01
1.6	.1217	127.	12.41	83.33	0.36E-02	0.69E-03	0.52E+01
1.6	.1201	129.	12.64	83.33	0.33E-02	0.65E-03	0.51E+01
1.7	.1186	131.	12.88	83.33	0.30E-02	0.62E-03	0.49E+01
1.7	.1171	134.	13.12	83.33	0.28E-02	0.58E-03	0.48E+01

DEPTH	137.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.9	.3575	10.	1.02	1.31	0.10E+02	0.46E-03	0.23E+05
1.1	.3558	15.	1.43	1.20	0.76E+01	0.54E-03	0.14E+05
1.3	.3537	18.	1.80	1.10	0.76E+01	0.76E-03	0.10E+05
1.5	.3510	22.	2.15	1.04	0.75E+01	0.76E-03	0.99E+04
1.9	.3477	25.	2.46	1.00	0.54E+01	0.18E-02	0.31E+04
2.7	.3358	31.	3.02	0.96	0.47E+01	0.29E-02	0.16E+04

DEPTH	137.	CM	(CONT)				
3.2	.3310	33.	3.22	0.93	0.29E+01	0.17E-02	0.17E+04
3.7	.3279	34.	3.35	0.90	0.63E+01	0.36E-02	0.18E+04
4.2	.3235	35.	3.45	0.87	0.32E+01	0.51E-02	0.62E+03
4.7	.3174	36.	3.56	0.81	0.49E+01	0.53E-02	0.93E+03
6.2	.3092	38.	3.71	0.78	0.13E+01	0.56E-02	0.23E+03
8.7	.2624	40.	3.92	0.75	0.18E+01	0.34E-01	0.54E+02
17.5	.2664	47.	4.57	0.66	0.42E+00	0.25E-02	0.16E+03
22.5	.2571	51.	5.03	0.67	0.29E+00	0.16E-02	0.19E+03
27.5	.2428	57.	5.54	0.77	0.25E+00	0.41E-02	0.60E+02
40.0	.2304	64.	6.29	1.00	0.73E-01	0.41E-03	0.18E+03
*60.0	.2232	71.	6.98	1.15	0.47E-01	0.30E-02	0.16E+02
80.0	.2148	74.	7.27	1.13	0.31E-01	0.28E-02	0.11E+02
100.0	.2097	76.	7.47	1.13	0.18E-01	0.22E-02	0.85E+01
120.0	.2072	78.	7.61	1.15	0.16E-01	0.12E-02	0.14E+02
150.0	.2038	79.	7.71	1.20	0.11E-01	0.49E-02	0.22E+01
225.0	.1917	72.	7.05	0.70	0.71E-02	0.12E-02	0.60E+01
325.0	.1866	76.	7.47	0.75	0.84E-02	0.12E-02	0.70E+01
450.0	.1806	81.	7.93	0.79	0.50E-02	0.17E-02	0.29E+01
650.0	.1753	87.	8.50	0.84	0.32E-02	0.71E-03	0.45E+01
850.0	.1715	92.	9.01	0.87	0.30E-02	0.12E-02	0.26E+01

DOERING 1-STEP DATA

0.3	.1973	70.	6.88	83.33	0.57E-01	0.21E-02	0.28E+02
0.3	.1956	71.	6.96	83.33	0.52E-01	0.20E-02	0.26E+02
0.4	.1820	79.	7.71	83.33	0.36E-01	0.16E-02	0.22E+02
0.4	.1710	86.	8.45	83.33	0.26E-01	0.13E-02	0.20E+02

DEPTH	137.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.5	.1619	94.	9.21	83.33	0.19E-01	0.11E-02	0.18E+02
0.5	.1541	102.	9.99	83.33	0.14E-01	0.90E-03	0.16E+02
0.6	.1474	110.	10.79	83.33	0.11E-01	0.76E-03	0.15E+02
0.6	.1416	118.	11.61	83.33	0.87E-02	0.64E-03	0.14E+02
0.7	.1364	127.	12.46	83.33	0.69E-02	0.55E-03	0.13E+02
0.7	.1318	136.	13.35	83.33	0.55E-02	0.47E-03	0.12E+02
0.8	.1277	146.	14.28	83.33	0.45E-02	0.40E-03	0.11E+02
0.8	.1240	156.	15.25	83.33	0.36E-02	0.35E-03	0.10E+02
0.9	.1206	166.	16.28	83.33	0.30E-02	0.30E-03	0.98E+01
0.9	.1175	177.	17.36	83.33	0.24E-02	0.26E-03	0.93E+01
1.0	.1146	189.	18.51	83.33	0.20E-02	0.23E-03	0.88E+01
1.0	.1120	201.	19.73	83.33	0.17E-02	0.20E-03	0.84E+01
1.1	.1096	215.	21.04	83.33	0.14E-02	0.17E-03	0.80E+01
1.1	.1073	229.	22.44	83.33	0.11E-02	0.15E-03	0.77E+01
1.2	.1052	244.	23.96	83.33	0.94E-03	0.13E-03	0.74E+01
1.2	.1032	261.	25.60	83.33	0.78E-03	0.11E-03	0.71E+01
1.3	.1014	279.	27.39	83.33	0.64E-03	0.94E-04	0.68E+01
1.3	.0996	299.	29.34	83.33	0.53E-03	0.81E-04	0.66E+01
1.4	.0980	321.	31.50	83.33	0.44E-03	0.69E-04	0.63E+01
1.4	.0964	346.	33.89	83.33	0.36E-03	0.59E-04	0.61E+01
1.5	.0950	373.	36.57	83.33	0.29E-03	0.49E-04	0.59E+01
1.5	.0936	404.	39.59	83.33	0.24E-03	0.41E-04	0.57E+01
1.6	.0922	439.	43.03	83.33	0.19E-03	0.34E-04	0.56E+01
1.6	.0910	479.	47.00	83.33	0.15E-03	0.28E-04	0.54E+01
1.7	.0898	527.	51.63	83.33	0.12E-03	0.23E-04	0.52E+01
1.7	.0886	583.	57.12	83.33	0.93E-04	0.18E-04	0.51E+01
1.8	.0875	650.	63.77	83.33	0.71E-04	0.14E-04	0.50E+01

DEPTH	137.	CM	(CONT)				
1.8	.0865	734.	72.00	83.33	0.53E-04	0.11E-04	0.48E+01
1.9	.0855	842.	82.52	83.33	0.38E-04	0.80E-05	0.47E+01
1.9	.0845	984.	96.52	83.33	0.26E-04	0.57E-05	0.46E+01

DEPTH 168. CM SITE D-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.9	.3543	21.	2.03	1.31	0.11E+02	0.67E-03	0.16E+05
1.1	.3534	22.	2.14	1.27	0.73E+01	0.10E-02	0.73E+04
1.3	.3517	23.	2.27	1.22	0.71E+01	0.19E-02	0.37E+04
1.5	.3492	25.	2.44	1.16	0.70E+01	0.14E-02	0.51E+04
1.9	.3458	27.	2.66	1.13	0.51E+01	0.19E-02	0.27E+04
2.2	.3398	30.	2.91	1.13	0.24E+00	0.27E-02	0.87E+02
2.7	.3311	32.	3.16	1.13	0.44E+01	0.46E-02	0.96E+03
3.2	.3227	34.	3.33	1.15	0.26E+01	0.51E-02	0.51E+03
3.7	.3152	35.	3.45	1.17	0.51E+01	0.82E-02	0.63E+03
4.2	.3064	36.	3.55	1.20	0.27E+01	0.91E-02	0.30E+03
4.7	.2961	37.	3.66	1.26	0.36E+01	0.86E-02	0.42E+03
6.2	.2834	39.	3.79	1.28	0.90E+00	0.98E-02	0.92E+02
8.7	.2335	41.	4.00	1.31	0.18E+01	0.31E-01	0.59E+02
17.5	.2400	46.	4.55	1.32	0.25E+00	0.35E-02	0.74E+02
22.5	.2306	50.	4.90	1.23	0.20E+00	0.23E-02	0.87E+02
27.5	.2164	54.	5.32	1.07	0.29E+00	0.45E-02	0.65E+02
40.0	.2060	61.	5.95	0.77	0.10E+00	0.19E-03	0.53E+03
60.0	.2007	67.	6.52	0.56	0.12E+00	0.33E-02	0.38E+02
80.0	.1938	69.	6.74	0.54	0.81E-01	0.27E-02	0.30E+02
100.0	.1893	70.	6.90	0.52	0.52E-01	0.28E-02	0.18E+02
120.0	.1861	72.	7.05	0.50	0.42E-01	0.14E-02	0.30E+02
225.0	.2009	68.	6.67	1.03	0.59E-02	0.47E-03	0.13E+02
325.0	.1974	72.	7.06	0.97	0.80E-02	0.11E-02	0.70E+01
450.0	.1926	76.	7.41	0.87	0.59E-02	0.19E-02	0.31E+01
650.0	.1881	80.	7.82	0.72	0.46E-02	0.80E-03	0.57E+01
850.0	.1848	84.	8.19	0.60	0.51E-02	0.14E-02	0.36E+01

DEPTH 198. CM SITE D-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.9	.3391	23.	2.30	0.84	0.17E+02	0.49E-02	0.34E+04
1.1	.3375	24.	2.32	0.83	0.12E+02	0.58E-02	0.20E+04
1.3	.3353	24.	2.34	0.82	0.11E+02	0.27E-01	0.40E+03
1.5	.3320	24.	2.38	0.80	0.11E+02	0.53E-02	0.20E+04
1.9	.3274	25.	2.48	0.75	0.83E+01	0.38E-02	0.22E+04
2.2	.3205	27.	2.63	0.70	0.11E+01	0.43E-02	0.26E+03
2.7	.3124	29.	2.80	0.65	0.85E+01	0.51E-02	0.17E+04
3.2	.3043	30.	2.96	0.62	0.57E+01	0.48E-02	0.12E+04
3.7	.2961	32.	3.10	0.61	0.11E+02	0.81E-02	0.13E+04
4.2	.2871	33.	3.23	0.60	0.64E+01	0.57E-02	0.11E+04
4.7	.2766	35.	3.41	0.59	0.89E+01	0.63E-02	0.14E+04
6.2	.2639	37.	3.60	0.60	0.22E+01	0.72E-02	0.31E+03
8.7	.2493	39.	3.85	0.59	0.51E+01	0.49E-02	0.10E+04
17.5	.2181	44.	4.33	0.54	0.74E+00	0.61E-02	0.12E+03
22.5	.2075	46.	4.49	0.51	0.61E+00	0.69E-02	0.87E+02
27.5	.1989	47.	4.64	0.49	0.79E+00	0.46E-02	0.17E+03
40.0	.1896	49.	4.80	0.47	0.19E+00	0.68E-02	0.28E+02
60.0	.1796	51.	4.99	0.43	0.19E+00	0.36E-02	0.53E+02
80.0	.1735	53.	5.16	0.42	0.12E+00	0.34E-02	0.36E+02
100.0	.1693	54.	5.26	0.40	0.83E-01	0.54E-02	0.15E+02

DEPTH	198.	CM	(CONT)					
120.0	.1660	55.	5.34	0.37	0.66E-01	0.26E-02	0.25E+02	
185.0	.1842	56.	5.46	0.34	0.12E+00	0.27E-02	0.43E+02	
225.0	.1824	57.	5.63	0.32	0.21E-01	0.38E-03	0.56E+02	
325.0	.1791	61.	5.96	0.34	0.26E-01	0.14E-02	0.18E+02	
450.0	.1746	64.	6.23	0.37	0.17E-01	0.33E-02	0.50E+01	
650.0	.1696	65.	6.37	0.34	0.11E-01	0.33E-02	0.34E+01	
850.0	.1652	66.	6.50	0.30	0.12E-01	0.29E-02	0.42E+01	

DEPTH	228.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.6	.3455	15.	1.49	0.68	0.18E-01	0.50E-02	0.35E+01
0.8	.3449	15.	1.50	0.68	0.60E+00	0.76E-02	0.80E+02
0.9	.3437	15.	1.51	0.68	0.22E+02	0.15E-01	0.15E+04
1.1	.3420	16.	1.52	0.68	0.14E+02	0.20E-01	0.72E+03
1.3	.3398	16.	1.53	0.68	0.14E+02	0.25E-01	0.56E+03
1.5	.3368	16.	1.54	0.68	0.13E+02	0.35E-01	0.37E+03
1.9	.3331	16.	1.57	0.67	0.99E+01	0.87E-02	0.11E+04
2.2	.3276	16.	1.62	0.65	0.19E+01	0.11E-01	0.18E+03
2.7	.3210	17.	1.67	0.63	0.94E+01	0.91E-02	0.10E+04
3.2	.3032	18.	1.74	0.60	0.78E+01	0.35E-01	0.22E+03
3.7	.2853	19.	1.84	0.58	0.12E+02	0.48E-02	0.24E+04
4.2	.2781	20.	1.99	0.59	0.75E+01	0.56E-02	0.13E+04
4.7	.2687	22.	2.14	0.59	0.99E+01	0.69E-02	0.14E+04
6.2	.2570	24.	2.35	0.59	0.25E+01	0.53E-02	0.48E+03
8.7	.2414	27.	2.61	0.59	0.54E+01	0.72E-02	0.75E+03
17.5	.2056	31.	3.06	0.62	0.77E+00	0.63E-02	0.12E+03
22.5	.1926	36.	3.51	0.81	0.46E+00	0.19E-02	0.24E+03
27.5	.1820	41.	4.05	1.07	0.41E+00	0.24E-02	0.17E+03
40.0	.1702	44.	4.29	1.14	0.94E-01	0.19E-01	0.50E+01
60.0	.1590	45.	4.41	1.13	0.83E-01	0.47E-02	0.18E+02
80.0	.1519	47.	4.58	1.14	0.52E-01	0.40E-02	0.13E+02
100.0	.1470	48.	4.68	1.15	0.34E-01	0.76E-02	0.45E+01
120.0	.1438	48.	4.73	1.15	0.25E-01	0.52E-02	0.48E+01
185.0	.1365	50.	4.87	1.20	0.35E-01	0.66E-03	0.53E+02
225.0	.1339	51.	5.02	1.20	0.70E-02	0.29E-02	0.25E+01
325.0	.1279	55.	5.34	1.18	0.86E-02	0.15E-02	0.56E+01
450.0	.1232	58.	5.65	1.18	0.59E-02	0.19E-02	0.31E+01
650.0	.1194	60.	5.84	1.25	0.36E-02	0.18E-02	0.20E+01
850.0	.1159	61.	6.02	1.32	0.31E-02	0.22E-02	0.14E+01

DEPTH	259.	CM	SITE D-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
3.2	.3313	16.	1.57	1.26	0.51E+01	0.58E-01	0.89E+02
3.7	.3144	17.	1.65	1.26	0.58E+01	0.51E-02	0.11E+04
4.2	.3082	18.	1.77	1.23	0.40E+01	0.57E-02	0.70E+03
4.7	.2998	19.	1.90	1.22	0.53E+01	0.78E-02	0.68E+03
6.2	.2872	21.	2.06	1.18	0.14E+01	0.89E-02	0.16E+03
8.7	.2684	23.	2.26	1.14	0.30E+01	0.11E-01	0.27E+03
17.5	.2311	27.	2.65	1.08	0.52E+00	0.69E-02	0.76E+02
22.5	.2158	31.	3.08	0.89	0.51E+00	0.22E-02	0.23E+03
27.5	.2020	37.	3.63	0.66	0.77E+00	0.28E-02	0.28E+03
40.0	.1856	40.	3.96	0.65	0.21E+00	0.10E-01	0.20E+02
60.0	.1694	43.	4.17	0.71	0.15E+00	0.60E-02	0.25E+02
80.0	.1591	44.	4.36	0.72	0.96E-01	0.49E-02	0.20E+02
100.0	.1528	46.	4.49	0.72	0.62E-01	0.54E-02	0.12E+02

DEPTH	259.	CM	(CONT)				
120.0	.1489	47.	4.56	0.74	0.45E-01	0.51E-02	0.90E+01
185.0	.1387	49.	4.80	0.75	0.60E-01	0.22E-02	0.27E+02
225.0	.1341	50.	4.94	0.74	0.15E-01	0.60E-02	0.26E+01
325.0	.1284	53.	5.21	0.72	0.16E-01	0.14E-02	0.11E+02
450.0	.1235	57.	5.58	0.77	0.10E-01	0.12E-02	0.82E+01
650.0	.1192	62.	6.05	0.88	0.57E-02	0.79E-03	0.72E+01
850.0	.1157	66.	6.52	0.99	0.47E-02	0.72E-03	0.65E+01

SITE D, REPLICATION 2

Table D-2.1. Soil morphologic data for Site D, replication 2.

Site and location: D-2 Hecla, Oakes Aquifer 66 feet south and 445 feet west of the east quarter corner of Section 9, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 07/31/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Hecla loamy sand; sandy, mixed Aquic Haploboroll

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Moderately well.

Notes: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. aboratory texture in parenthesis if different from field tex- tures

Soil profile: D-2 east side of pit.

Alp 0-4 inches (0-10 cm) black (lOYR 2/1) loamy sand (loamy fine sand) dark gray (lOYR 4/1, dry); weak coarse and medium granular structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; abrupt smooth boundary.

A12 4-19 (10-48 cm) black (lOYR 2/1) loamy sand (loamy find sand), dark gray (lOYR 4/1, dry); weak medium prismatic parting to weak fine and very fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; gradual wavy boundary.

Bw 19-26 inches (48-66 cm) very dark grayish brown (lOYR 3/2) loamy sand (fine sand), grayish brown (lOYR 5/2, dry); weak medium prismatic parting to weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; gradual wavy boundary.

Clg 26-34 inches (66-86 cm) dark grayish brown to grayish brown (2.5Y 4.5/2) sand (fine sand), light brownish gray (2.5Y 6/2, dry) with many medium distinct dark brown (lOYR 3/3) mottles; single grain structure; loose, nonsticky and nonplastic; few very fine roots; gradual wavy boundary.

C2g 34-46 inches (86-117 cm) grayish brown (2.5Y 5/2) sand (fine sand), light gray (2.5Y 7/2, dry) with many fine prominent very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; gradual wavy boundary.

C3g 46-57 inches (117-145 cm) grayish brown (2.5Y 5/2) sand (loamy sand), light gray (2.5Y 7/2, dry) with many medium prominent very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; clear wavy boundary.

Ck 57-70 inches (145-178 cm) light brownish gray (2.5Y 6/2) sand, white (2.5Y 8/2, dry) with common medium prominent very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; strong to violent effervescence.

Table D-2.2 HECLA SERIES SITE D-2 NDSWC:1985
Soil partile-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
			PARTICLE SIZE CLASSES			(MICRON/PERCENT)		
8.	5.4	3.7	5.2	23.1	45.3	14.5	2.8	0.0
23.	4.3	4.5	4.8	21.1	46.3	16.0	3.1	0.0
38.	5.0	4.4	4.2	24.1	47.9	11.9	2.6	0.0
53.	5.0	2.2	5.1	25.8	49.9	9.7	2.2	0.1
76.	4.3	2.9	1.4	24.9	52.2	11.9	2.3	0.1
107.	3.9	2.9	1.2	27.6	52.7	9.7	1.9	0.0
137.	5.3	5.5	3.6	18.6	39.0	19.0	8.8	0.2
168.	2.8	5.1	3.6	5.0	35.2	22.9	25.4	0.1

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	85.7	8.9	5.4	A 1 6	6=p
23.	86.4	9.3	4.3	A 1 2	7=w
38.	86.4	8.6	5.0	A 1 2	8=g
53.	87.7	7.3	5.0	B 0 7	10=k
76.	91.4	4.3	4.3	C 1 8	
107.	92.0	4.1	3.9	C 2 8	
137.	85.6	9.1	5.3	C 3 8	
168.	88.5	8.7	2.8	C 0 10	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	9.629	0.1051	4.0	0.0264	0.826	1.47	1.04
23.	9.301	0.1130	3.7	0.0303	0.828	1.40	0.87
38.	10.058	0.1035	3.8	0.0271	0.879	1.39	0.58
53.	12.014	0.1049	3.6	0.0289	0.974	1.47	0.35
76.	21.256	0.1162	3.5	0.0336	1.103	1.44	0.23
107.	22.415	0.1137	3.3	0.0347	1.189	1.51	0.12
137.	9.407	0.1216	4.5	0.0273	0.696	1.53	0.12
168.	10.184	0.2051	4.0	0.0514	0.751	1.56	0.04

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.588	2.654	-1.1437	2.4853	-11.44	1.11
23.	1.616	2.756	-1.1524	2.5085	-11.52	1.13
38.	1.564	3.100	-1.1568	2.5085	-11.57	1.13
53.	1.462	3.694	-1.1818	2.5433	-11.82	1.16
76.	1.180	4.470	-1.2525	2.6506	-12.53	1.27
107.	1.159	5.440	-1.2608	2.6651	-12.61	1.28
137.	1.603	3.343	-1.1411	2.4824	-11.41	1.10
168.	1.569	4.075	-1.1856	2.5694	-11.86	1.19

Table D-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site D, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
	Saturation Extract Soluble Ions meq/l							
0 - 15	5.59	2.94	0.74	0.32	-	6.28	0.45	2.85
15 - 30	3.23	1.88	0.69	0.23	-	3.76	0.30	1.96
30 - 46	2.37	1.51	0.48	0.15	-	2.80	0.20	1.51
46 - 61	1.94	1.33	0.55	0.10	-	2.36	0.25	1.30
61 - 91	1.51	0.74	0.42	0.07	-	1.46	0.20	1.07
91 - 122	1.51	1.15	0.42	0.07	-	1.68	0.17	1.29
122 - 152	2.15	1.32	0.65	0.03	-	2.68	0.16	1.31
152 - 183	1.94	0.92	0.57	0.02	-	2.08	0.18	1.18

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.70	0.36	31	7.9	-	lfs	4.62
15 - 30	0.42	0.43	28	7.5	-	lfs	4.58
30 - 46	0.32	0.35	28	7.7	-	lfs	4.17
46 - 61	0.28	0.43	25	7.9	-	fs	3.92
61 - 91	0.24	0.40	26	7.6	-	fs	3.52
91 - 122	0.25	0.36	24	7.7	-	fs	3.37
122 - 152	0.34	0.49	26	8.0	-	ls	4.84
152 - 183	0.27	0.47	25	7.9	-	s	3.86

Table D-2.4 HECLA SERIES SITE D-2 NDSWC:1985
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
10.	0.4928	0.0180	24.	0.3780	0.0305	24.	0.3520	0.0014	24.	0.4000	0.0037
20.	0.4920	0.0174	40.	0.3291	0.0143	40.	0.3090	0.0019	40.	0.3539	0.0020
30.	0.4811	0.0160	50.	0.2965	0.0068	50.	0.2659	0.0024	50.	0.2866	0.0008
40.	0.4256	0.0074	62.	0.2608	0.0078	62.	0.2278	0.0035	62.	0.2374	0.0004
50.	0.3889	0.0015	70.	0.2357	0.0075	70.	0.2060	0.0050	70.	0.2117	0.0016
60.	0.3100	0.0121	82.	0.2113	0.0058	82.	0.1827	0.0074	82.	0.1822	0.0011
70.	0.2895	0.0181	98.	0.1891	0.0056	98.	0.1608	0.0070	98.	0.1618	0.0004
80.	0.2494	0.0148	150.	0.1548	0.0056	150.	0.1256	0.0040	150.	0.1293	0.0002
100.	0.2072	0.0066	334.	0.1219	0.0056	334.	0.0988	0.0040	334.	0.1043	0.0003
120.	0.1856	0.0049	503.	0.1119	0.0053	503.	0.0910	0.0035	503.	0.0991	0.0008
180.	0.1624	0.0045	800.	0.1068	0.0037	800.	0.0896	0.0015	800.	0.0953	0.0013
334.	0.1408	0.0028									
534.	0.1284	0.0032									
834.	0.1169	0.0018									
BD =	1.47			1.40			1.39			1.47	
N =	2			2			2			2	

DEPTH (CM)

	76.			107.			137.			168.	
24.	0.3759	0.0001	10.	0.4225	0.0028	10.	0.3862	0.0054	10.	0.3667	0.0034
40.	0.3377	0.0003	20.	0.4143	0.0012	20.	0.3767	0.0048	20.	0.3449	0.0026
50.	0.2784	0.0004	30.	0.3955	0.0004	30.	0.3523	0.0032	30.	0.2978	0.0016
62.	0.2424	0.0003	40.	0.3685	0.0012	40.	0.2926	0.0014	40.	0.2027	0.0018
70.	0.2049	0.0020	50.	0.3362	0.0014	50.	0.2829	0.0116	50.	0.1729	0.0016
82.	0.1696	0.0009	60.	0.2559	0.0011	60.	0.2468	0.0154	60.	0.1432	0.0014
98.	0.1456	0.0027	70.	0.2241	0.0141	70.	0.2152	0.0007	70.	0.1368	0.0021
150.	0.1060	0.0015	80.	0.2336	0.0083	80.	0.2005	0.0006	80.	0.1280	0.0021
334.	0.0869	0.0019	100.	0.1599	0.0011	100.	0.1857	0.0016	100.	0.1192	0.0021
503.	0.0820	0.0014	120.	0.1419	0.0052	120.	0.1754	0.0016	120.	0.1127	0.0017
800.	0.0792	0.0014	180.	0.1043	0.0006	180.	0.1614	0.0021	180.	0.1031	0.0022
			334.	0.0923	0.0017	334.	0.1496	0.0010	334.	0.0926	0.0021
			534.	0.0886	0.0031	534.	0.1408	0.0020	534.	0.0862	0.0016
			834.	0.0773	0.0003	834.	0.1349	0.0020	834.	0.0804	0.0007
BD =	1.44			1.51			1.53			1.56	
N =	2			2			2			2	

Table D-2.5 HECLA SERIES SITE D-2 (NDSWC 1989)

In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.5061	8.	0.77	0.87	0.54E+00	0.65E-03	0.83E+03
0.9	.4900	25.	2.42	0.53	0.29E+01	0.14E-02	0.20E+04
1.1	.4537	36.	3.52	0.57	0.35E+01	0.66E-02	0.54E+03
1.3	.4024	43.	4.22	0.77	0.25E+01	0.83E-02	0.30E+03
1.5	.3647	49.	4.82	0.77	0.13E+01	0.42E-02	0.30E+03
1.7	.3434	55.	5.37	0.70	0.92E+00	0.34E-02	0.27E+03
1.9	.3280	59.	5.77	0.63	0.83E+00	0.46E-02	0.18E+03
2.2	.3142	61.	6.02	0.63	0.55E+00	0.69E-02	0.80E+02
2.4	.3024	63.	6.22	0.65	0.38E+00	0.49E-02	0.78E+02
2.7	.2954	65.	6.34	0.63	0.26E+00	0.87E-02	0.30E+02
2.9	.2924	65.	6.42	0.62	0.90E-01	0.15E-02	0.62E+02
3.2	.2888	67.	6.54	0.57	0.16E+00	0.39E-02	0.40E+02
3.7	.2820	68.	6.67	0.52	0.23E+00	0.77E-02	0.29E+02
4.2	.2734	69.	6.77	0.48	0.30E+00	0.96E-02	0.31E+02
4.7	.2638	71.	6.92	0.47	0.31E+00	0.48E-02	0.65E+02
6.2	.2521	73.	7.12	0.50	0.84E-01	0.69E-02	0.12E+02
8.7	.2371	75.	7.37	0.53	0.92E-01	0.54E-02	0.17E+02
12.5	.2250	78.	7.62	0.60	0.20E-01	0.39E-02	0.52E+01
17.5	.2198	81.	7.92	0.66	0.54E-02	0.60E-03	0.90E+01
25.0	.2127	87.	8.52	0.70	0.13E-01	0.15E-02	0.87E+01
35.0	.2016	93.	9.07	0.73	0.11E-01	0.35E-02	0.31E+01
45.0	.1936	96.	9.37	0.70	0.62E-02	0.19E-02	0.33E+01
60.0	.1882	100.	9.77	0.67	0.30E-02	0.10E-02	0.29E+01
80.0	.1841	104.	10.22	0.65	0.17E-02	0.71E-03	0.23E+01
100.0	.1818	108.	10.57	0.65	0.11E-02	0.63E-03	0.18E+01
120.0	.1804	111.	10.87	0.68	0.53E-03	0.31E-03	0.17E+01
150.0	.1797	114.	11.22	0.72	0.13E-03	0.12E-03	0.11E+01
180.0	.1785	117.	11.47	0.75	0.96E-03	0.19E-02	0.51E+00
245.0	.1730	122.	11.92	0.70	0.89E-03	0.11E-02	0.79E+00
400.0	.1662	131.	12.84	0.62	0.29E-03	0.45E-03	0.65E+00
600.0	.1626	139.	13.64	0.58	0.15E-03	0.43E-03	0.36E+00
800.0	.1605	145.	14.19	0.55	0.13E-03	0.34E-03	0.38E+00

DOERING 1-STEP DATA

8.3	.1490	241.	23.67	83.33	0.24E-03	0.20E-03	0.12E+01
12.3	.1410	290.	28.39	83.33	0.11E-03	0.14E-03	0.81E+00
16.3	.1362	330.	32.33	83.33	0.65E-04	0.10E-03	0.63E+00
20.3	.1330	365.	35.78	83.33	0.43E-04	0.81E-04	0.53E+00
24.3	.1307	397.	38.87	83.33	0.31E-04	0.68E-04	0.45E+00
28.3	.1289	425.	41.71	83.33	0.23E-04	0.58E-04	0.40E+00
32.3	.1274	452.	44.33	83.33	0.18E-04	0.50E-04	0.36E+00
36.3	.1262	477.	46.79	83.33	0.15E-04	0.45E-04	0.33E+00
40.3	.1252	501.	49.10	83.33	0.12E-04	0.40E-04	0.31E+00

DEPTH	23.	CM	SITE D-2				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.2	.4948	-4.	-0.43	1.06	0.14E+00	0.28E-02	0.52E+02
0.6	.4926	-3.	-0.25	1.10	0.21E+00	0.60E-03	0.36E+03
0.8	.4860	7.	0.67	0.87	0.16E+01	0.73E-03	0.22E+04
0.9	.4730	20.	1.95	0.53	0.78E+01	0.12E-02	0.66E+04
1.1	.4467	32.	3.13	0.57	0.96E+01	0.37E-02	0.26E+04
1.3	.4079	41.	4.03	0.77	0.69E+01	0.60E-02	0.11E+04
1.5	.3759	47.	4.63	0.77	0.38E+01	0.45E-02	0.83E+03
1.7	.3556	52.	5.13	0.70	0.27E+01	0.35E-02	0.78E+03
1.9	.3415	56.	5.49	0.63	0.24E+01	0.50E-02	0.48E+03
2.2	.3293	59.	5.74	0.63	0.16E+01	0.48E-02	0.33E+03
2.4	.3190	61.	5.95	0.65	0.11E+01	0.49E-02	0.22E+03
2.7	.3124	62.	6.06	0.63	0.81E+00	0.93E-02	0.86E+02
2.9	.3086	62.	6.12	0.62	0.36E+00	0.39E-02	0.92E+02
3.2	.3035	63.	6.21	0.57	0.51E+00	0.73E-02	0.69E+02
3.7	.2961	64.	6.30	0.52	0.67E+00	0.97E-02	0.69E+02
4.2	.2872	65.	6.37	0.48	0.94E+00	0.14E-01	0.66E+02
4.7	.2768	66.	6.50	0.47	0.96E+00	0.51E-02	0.19E+03
6.2	.2653	69.	6.73	0.50	0.25E+00	0.52E-02	0.48E+02
8.7	.2502	72.	7.01	0.53	0.28E+00	0.57E-02	0.49E+02
12.5	.2363	75.	7.31	0.60	0.68E-01	0.35E-02	0.19E+02
17.5	.2277	78.	7.66	0.66	0.26E-01	0.16E-02	0.16E+02
25.0	.2180	84.	8.28	0.70	0.40E-01	0.15E-02	0.26E+02
35.0	.2074	90.	8.86	0.73	0.30E-01	0.28E-02	0.11E+02
45.0	.2008	93.	9.14	0.70	0.18E-01	0.20E-02	0.89E+01
60.0	.1955	97.	9.51	0.67	0.92E-02	0.11E-02	0.81E+01
80.0	.1906	102.	9.95	0.65	0.57E-02	0.11E-02	0.53E+01
100.0	.1872	105.	10.30	0.65	0.39E-02	0.87E-03	0.44E+01
120.0	.1851	108.	10.62	0.68	0.18E-02	0.44E-03	0.42E+01
150.0	.1842	112.	11.00	0.72	0.34E-03	0.83E-04	0.41E+01
180.0	.1834	115.	11.28	0.75	0.25E-02	0.94E-03	0.27E+01
245.0	.1799	119.	11.68	0.70	0.23E-02	0.83E-03	0.28E+01
400.0	.1753	128.	12.54	0.62	0.80E-03	0.35E-03	0.23E+01
600.0	.1726	136.	13.32	0.58	0.42E-03	0.34E-03	0.13E+01
800.0	.1710	141.	13.85	0.55	0.37E-03	0.29E-03	0.13E+01

DOERING 1-STEP DATA

1.3	.1710	125.	12.25	83.33	0.30E-02	0.58E-03	0.53E+01
1.4	.1697	127.	12.47	83.33	0.28E-02	0.56E-03	0.51E+01
1.4	.1685	129.	12.68	83.33	0.26E-02	0.54E-03	0.49E+01
1.5	.1674	132.	12.89	83.33	0.25E-02	0.52E-03	0.47E+01
1.5	.1663	134.	13.10	83.33	0.23E-02	0.51E-03	0.46E+01

DEPTH	23.	CM	SITE D-2				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
1.6	.1653	136.	13.30	83.33	0.22E-02	0.49E-03	0.45E+01
1.6	.1643	138.	13.50	83.33	0.21E-02	0.48E-03	0.43E+01
1.7	.1634	140.	13.69	83.33	0.20E-02	0.47E-03	0.42E+01
1.7	.1625	142.	13.88	83.33	0.19E-02	0.46E-03	0.41E+01
1.8	.1616	144.	14.07	83.33	0.18E-02	0.44E-03	0.40E+01
1.8	.1608	145.	14.25	83.33	0.17E-02	0.43E-03	0.39E+01
1.9	.1600	147.	14.44	83.33	0.16E-02	0.42E-03	0.38E+01
1.9	.1592	149.	14.62	83.33	0.15E-02	0.41E-03	0.37E+01
2.0	.1585	151.	14.79	83.33	0.14E-02	0.40E-03	0.36E+01
2.0	.1578	153.	14.97	83.33	0.14E-02	0.39E-03	0.35E+01

DEPTH	23.	CM	(CONT)				
2.1	.1571	154.	15.14	83.33	0.13E-02	0.39E-03	0.34E+01
2.1	.1564	156.	15.31	83.33	0.13E-02	0.38E-03	0.33E+01
2.2	.1558	158.	15.48	83.33	0.12E-02	0.37E-03	0.33E+01
2.2	.1552	160.	15.64	83.33	0.12E-02	0.36E-03	0.32E+01
4.3	.1398	216.	21.16	83.33	0.35E-03	0.21E-03	0.17E+01
8.3	.1282	291.	28.52	83.33	0.11E-03	0.12E-03	0.93E+00
12.3	.1227	346.	33.95	83.33	0.55E-04	0.84E-04	0.65E+00
16.3	.1194	391.	38.36	83.33	0.34E-04	0.67E-04	0.51E+00
20.3	.1170	430.	42.13	83.33	0.23E-04	0.56E-04	0.42E+00
24.3	.1152	464.	45.45	83.33	0.17E-04	0.48E-04	0.36E+00
28.3	.1139	494.	48.43	83.33	0.14E-04	0.43E-04	0.32E+00

DEPTH 38. CM SITE D-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.4424	4.	0.43	0.81	0.25E+01	0.50E-03	0.51E+04
0.9	.4370	13.	1.30	0.57	0.99E+01	0.63E-03	0.16E+05
1.1	.4262	24.	2.35	0.47	0.16E+02	0.12E-02	0.13E+05
1.3	.4086	35.	3.46	0.50	0.15E+02	0.25E-02	0.59E+04
1.5	.3883	42.	4.13	0.57	0.82E+01	0.40E-02	0.21E+04
1.7	.3687	47.	4.61	0.60	0.52E+01	0.43E-02	0.12E+04
1.9	.3535	50.	4.94	0.64	0.39E+01	0.52E-02	0.75E+03
2.2	.3413	53.	5.24	0.70	0.23E+01	0.32E-02	0.70E+03
2.4	.3308	56.	5.49	0.74	0.16E+01	0.64E-02	0.25E+03
2.7	.3232	57.	5.59	0.74	0.12E+01	0.11E-01	0.11E+03
2.9	.3176	58.	5.66	0.75	0.72E+00	0.72E-02	0.10E+03
3.2	.3098	59.	5.76	0.82	0.68E+00	0.82E-02	0.82E+02
3.7	.3010	60.	5.90	0.94	0.61E+00	0.49E-02	0.12E+03
4.2	.2926	61.	6.02	1.04	0.73E+00	0.95E-02	0.77E+02
4.7	.2825	63.	6.17	1.07	0.71E+00	0.53E-02	0.13E+03
6.2	.2697	65.	6.38	1.02	0.20E+00	0.67E-02	0.30E+02
8.7	.2541	68.	6.63	0.96	0.26E+00	0.58E-02	0.45E+02
12.5	.2397	71.	6.97	0.94	0.82E-01	0.32E-02	0.25E+02
17.5	.2289	75.	7.35	0.91	0.44E-01	0.25E-02	0.18E+02
25.0	.2180	81.	7.96	0.87	0.55E-01	0.14E-02	0.38E+02
35.0	.2088	87.	8.55	0.84	0.39E-01	0.22E-02	0.18E+02
*45.0	.2028	89.	8.74	0.77	0.27E-01	0.44E-02	0.62E+01
60.0	.1957	92.	9.04	0.70	0.16E-01	0.17E-02	0.94E+01
80.0	.1895	96.	9.44	0.67	0.11E-01	0.14E-02	0.75E+01
100.0	.1853	100.	9.78	0.65	0.74E-02	0.10E-02	0.73E+01
120.0	.1831	103.	10.09	0.60	0.37E-02	0.39E-03	0.95E+01
150.0	.1817	107.	10.44	0.54	0.11E-02	0.38E-03	0.29E+01
180.0	.1801	109.	10.71	0.50	0.59E-02	0.11E-02	0.53E+01
245.0	.1770	113.	11.07	0.49	0.49E-02	0.80E-03	0.61E+01
400.0	.1734	121.	11.82	0.42	0.17E-02	0.28E-03	0.62E+01
600.0	.1712	128.	12.53	0.37	0.10E-02	0.35E-03	0.29E+01
800.0	.1694	133.	13.02	0.35	0.93E-03	0.37E-03	0.25E+01

DOERING 1-STEP DATA

0.7	.1538	108.	10.55	83.33	0.11E-01	0.68E-03	0.16E+02
0.8	.1479	117.	11.48	83.33	0.84E-02	0.58E-03	0.15E+02
0.8	.1426	127.	12.45	83.33	0.68E-02	0.50E-03	0.14E+02
0.9	.1378	137.	13.47	83.33	0.55E-02	0.43E-03	0.13E+02
0.9	.1335	148.	14.53	83.33	0.45E-02	0.37E-03	0.12E+02
1.0	.1296	160.	15.65	83.33	0.37E-02	0.32E-03	0.12E+02
1.0	.1260	172.	16.83	83.33	0.31E-02	0.28E-03	0.11E+02

DEPTH	38.	CM	SITE D-2				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
1.1	.1228	184.	18.06	83.33	0.25E-02	0.24E-03	0.10E+02
1.1	.1197	197.	19.36	83.33	0.21E-02	0.21E-03	0.10E+02
1.2	.1170	211.	20.73	83.33	0.18E-02	0.19E-03	0.96E+01
1.2	.1144	226.	22.18	83.33	0.15E-02	0.16E-03	0.92E+01
1.3	.1120	242.	23.72	83.33	0.13E-02	0.14E-03	0.88E+01
1.3	.1097	259.	25.34	83.33	0.11E-02	0.13E-03	0.85E+01
1.4	.1076	276.	27.07	83.33	0.92E-03	0.11E-03	0.82E+01
1.4	.1057	295.	28.91	83.33	0.78E-03	0.98E-04	0.79E+01
1.5	.1038	315.	30.87	83.33	0.66E-03	0.87E-04	0.76E+01
1.5	.1021	336.	32.96	83.33	0.57E-03	0.77E-04	0.74E+01
1.6	.1004	359.	35.19	83.33	0.48E-03	0.68E-04	0.72E+01
1.6	.0989	383.	37.59	83.33	0.41E-03	0.60E-04	0.69E+01
1.7	.0974	410.	40.18	83.33	0.35E-03	0.52E-04	0.67E+01
1.7	.0960	438.	42.96	83.33	0.30E-03	0.46E-04	0.65E+01
1.8	.0947	469.	45.96	83.33	0.26E-03	0.40E-04	0.64E+01
1.8	.0934	502.	49.22	83.33	0.22E-03	0.36E-04	0.62E+01
0.1	.1609	98.	9.62	83.33	0.14E-01	0.81E-03	0.17E+02
0.1	.1579	102.	10.00	83.33	0.12E-01	0.75E-03	0.16E+02
0.1	.1549	106.	10.40	83.33	0.10E-01	0.70E-03	0.15E+02
0.2	.1519	111.	10.84	83.33	0.88E-02	0.65E-03	0.14E+02
0.2	.1489	115.	11.32	83.33	0.76E-02	0.59E-03	0.13E+02
0.2	.1459	121.	11.83	83.33	0.66E-02	0.55E-03	0.12E+02

DEPTH	53.	CM	SITE D-2				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.8	.4230	3.	0.26	0.97	0.23E+01	0.21E-04	0.11E+06
0.9	.4221	9.	0.86	0.83	0.74E+01	0.23E-03	0.32E+05
1.1	.4180	19.	1.83	0.80	0.11E+02	0.53E-03	0.20E+05
1.3	.4107	30.	2.92	0.77	0.11E+02	0.97E-03	0.12E+05
1.5	.3998	37.	3.64	0.77	0.79E+01	0.25E-02	0.32E+04
1.7	.3801	42.	4.14	0.77	0.63E+01	0.57E-02	0.11E+04
1.9	.3589	46.	4.52	0.80	0.45E+01	0.55E-02	0.83E+03
2.2	.3432	50.	4.87	0.80	0.28E+01	0.38E-02	0.75E+03
2.4	.3296	53.	5.18	0.83	0.21E+01	0.61E-02	0.34E+03
2.7	.3201	54.	5.30	0.87	0.16E+01	0.14E-01	0.12E+03
2.9	.3134	55.	5.38	0.87	0.11E+01	0.64E-02	0.18E+03
3.2	.3044	56.	5.51	0.85	0.11E+01	0.67E-02	0.16E+03
3.7	.2938	58.	5.71	0.82	0.10E+01	0.42E-02	0.24E+03
4.2	.2842	60.	5.93	0.83	0.13E+01	0.48E-02	0.26E+03
4.7	.2731	63.	6.13	0.87	0.13E+01	0.62E-02	0.21E+03
6.2	.2594	65.	6.34	0.92	0.33E+00	0.67E-02	0.49E+02
8.7	.2436	68.	6.64	1.05	0.33E+00	0.44E-02	0.76E+02
12.5	.2277	72.	7.02	1.13	0.11E+00	0.38E-02	0.27E+02
17.5	.2161	75.	7.34	1.08	0.60E-01	0.35E-02	0.17E+02
25.0	.2061	79.	7.78	0.88	0.76E-01	0.18E-02	0.42E+02
35.0	.1976	84.	8.24	0.75	0.54E-01	0.21E-02	0.26E+02
45.0	.1919	86.	8.44	0.82	0.38E-01	0.38E-02	0.10E+02
60.0	.1850	89.	8.71	0.85	0.20E-01	0.20E-02	0.10E+02
80.0	.1789	93.	9.07	0.83	0.13E-01	0.13E-02	0.96E+01
100.0	.1749	96.	9.39	0.82	0.90E-02	0.12E-02	0.75E+01
120.0	.1725	98.	9.62	0.77	0.43E-02	0.83E-03	0.53E+01
150.0	.1701	101.	9.86	0.68	0.22E-02	0.11E-02	0.19E+01
180.0	.1671	103.	10.09	0.65	0.72E-02	0.16E-02	0.44E+01
245.0	.1628	106.	10.41	0.62	0.50E-02	0.12E-02	0.40E+01
400.0	.1574	113.	11.05	0.55	0.18E-02	0.57E-03	0.32E+01

DEPTH	53.	CM	(CONT)				
600.0	.1536	119.	11.68	0.48	0.12E-02	0.67E-03	0.17E+01
800.0	.1514	123.	12.09	0.40	0.11E-02	0.41E-03	0.28E+01

DEPTH 76. CM SITE D-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.8	.4159	1.	0.13	0.93	0.24E+01	0.79E-04	0.31E+05
0.9	.4154	6.	0.61	0.94	0.68E+01	0.75E-04	0.90E+05
1.1	.4131	15.	1.51	0.87	0.10E+02	0.44E-03	0.23E+05
1.3	.4089	24.	2.36	0.75	0.12E+02	0.60E-03	0.20E+05
1.5	.4040	31.	3.00	0.70	0.99E+01	0.11E-02	0.93E+04
1.7	.3928	35.	3.48	0.69	0.10E+02	0.38E-02	0.27E+04
1.9	.3791	40.	3.88	0.69	0.73E+01	0.29E-02	0.25E+04
2.2	.3682	43.	4.25	0.70	0.46E+01	0.30E-02	0.15E+04
2.4	.3581	47.	4.58	0.70	0.36E+01	0.32E-02	0.11E+04
2.7	.3507	49.	4.77	0.72	0.29E+01	0.60E-02	0.48E+03
2.9	.3452	50.	4.90	0.75	0.21E+01	0.33E-02	0.64E+03
3.2	.3360	52.	5.12	0.81	0.18E+01	0.49E-02	0.37E+03
3.7	.3220	55.	5.41	0.89	0.16E+01	0.48E-02	0.33E+03
4.2	.3056	58.	5.69	0.92	0.19E+01	0.74E-02	0.26E+03
4.7	.2867	61.	5.95	0.95	0.20E+01	0.71E-02	0.28E+03
6.2	.2668	64.	6.22	0.96	0.49E+00	0.74E-02	0.66E+02
8.7	.2459	67.	6.57	0.93	0.57E+00	0.50E-02	0.11E+03
12.5	.2264	71.	6.95	0.88	0.22E+00	0.54E-02	0.41E+02
17.5	.2133	74.	7.22	0.88	0.12E+00	0.39E-02	0.30E+02
25.0	.2028	77.	7.55	0.90	0.11E+00	0.29E-02	0.37E+02
35.0	.1924	80.	7.86	0.87	0.65E-01	0.42E-02	0.15E+02
45.0	.1853	82.	8.07	0.85	0.53E-01	0.25E-02	0.21E+02
60.0	.1791	85.	8.34	0.83	0.30E-01	0.21E-02	0.14E+02
80.0	.1730	88.	8.64	0.80	0.21E-01	0.19E-02	0.11E+02
100.0	.1684	91.	8.90	0.77	0.15E-01	0.16E-02	0.94E+01
120.0	.1652	93.	9.10	0.77	0.75E-02	0.16E-02	0.47E+01
150.0	.1612	95.	9.28	0.77	0.55E-02	0.28E-02	0.19E+01
*180.0	.1572	97.	9.51	0.79	0.96E-02	0.95E-03	0.10E+02
245.0	.1539	100.	9.83	0.81	0.51E-02	0.11E-02	0.48E+01
400.0	.1487	106.	10.40	0.79	0.21E-02	0.82E-03	0.26E+01
600.0	.1444	112.	10.95	0.77	0.11E-02	0.68E-03	0.16E+01
800.0	.1421	115.	11.30	0.77	0.89E-03	0.61E-03	0.15E+01

DOERING 1-STEP DATA

1.7	.1590	83.	8.15	83.33	0.68E-02	0.14E-02	0.47E+01
1.8	.1578	84.	8.23	83.33	0.65E-02	0.14E-02	0.46E+01
1.8	.1567	85.	8.31	83.33	0.62E-02	0.14E-02	0.45E+01
1.9	.1556	86.	8.39	83.33	0.59E-02	0.13E-02	0.44E+01
1.9	.1546	86.	8.46	83.33	0.56E-02	0.13E-02	0.43E+01
2.0	.1536	87.	8.54	83.33	0.53E-02	0.13E-02	0.42E+01
2.0	.1526	88.	8.61	83.33	0.51E-02	0.13E-02	0.41E+01
2.1	.1517	89.	8.69	83.33	0.49E-02	0.12E-02	0.40E+01
2.1	.1508	89.	8.76	83.33	0.47E-02	0.12E-02	0.39E+01
4.2	.1293	113.	11.08	83.33	0.14E-02	0.68E-03	0.21E+01
8.2	.1142	142.	13.96	83.33	0.43E-03	0.39E-03	0.11E+01
12.2	.1074	163.	15.98	83.33	0.22E-03	0.28E-03	0.79E+00

DEPTH 76. CM (DOERING 1-STEP CONTINUED) SITE D-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
16.2	.1034	179.	17.57	83.33	0.14E-03	0.22E-03	0.62E+00
20.2	.1006	193.	18.91	83.33	0.95E-04	0.18E-03	0.52E+00
24.2	.0986	205.	20.08	83.33	0.72E-04	0.16E-03	0.45E+00
28.2	.0970	215.	21.11	83.33	0.56E-04	0.14E-03	0.40E+00
32.2	.0958	225.	22.04	83.33	0.46E-04	0.13E-03	0.36E+00
36.2	.0947	233.	22.89	83.33	0.39E-04	0.12E-03	0.33E+00
40.2	.0938	241.	23.67	83.33	0.33E-04	0.11E-03	0.31E+00
44.2	.0931	249.	24.40	83.33	0.29E-04	0.99E-04	0.29E+00
48.2	.0924	256.	25.08	83.33	0.26E-04	0.92E-04	0.28E+00
122.0	.0869	340.	33.33	83.33	0.96E-05	0.46E-04	0.21E+00

DEPTH 107. CM SITE D-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.4170	3.	0.27	1.40	********	********	********
0.6	.4174	3.	0.32	1.38	********	********	********
0.8	.4175	6.	0.55	1.35	********	********	********
0.9	.4175	8.	0.82	1.22	0.54E+01	0.75E-04	0.72E+05
1.1	.4164	15.	1.47	1.07	0.88E+01	0.31E-03	0.29E+05
1.3	.4147	21.	2.02	0.99	0.98E+01	0.35E-03	0.28E+05
1.5	.4124	25.	2.44	0.90	0.84E+01	0.73E-03	0.11E+05
1.7	.4093	28.	2.78	0.83	0.10E+02	0.12E-02	0.90E+04
1.9	.4063	31.	3.04	0.74	0.81E+01	0.11E-02	0.77E+04
2.2	.4026	34.	3.33	0.69	0.58E+01	0.14E-02	0.42E+04
2.4	.3853	37.	3.60	0.66	0.68E+01	0.13E-01	0.51E+03
2.7	.3686	39.	3.77	0.63	0.45E+01	0.27E-02	0.17E+04
2.9	.3658	40.	3.89	0.59	0.37E+01	0.18E-02	0.20E+04
3.2	.3606	42.	4.09	0.54	0.40E+01	0.27E-02	0.15E+04
3.7	.3524	45.	4.41	0.48	0.43E+01	0.24E-02	0.18E+04
4.2	.3414	48.	4.71	0.47	0.58E+01	0.55E-02	0.11E+04
4.7	.3271	51.	5.01	0.47	0.63E+01	0.43E-02	0.15E+04
6.2	.3096	54.	5.33	0.48	0.15E+01	0.73E-02	0.21E+03
8.7	.2882	58.	5.66	0.49	0.16E+01	0.61E-02	0.27E+03
12.5	.2681	61.	5.99	0.51	0.59E+00	0.64E-02	0.93E+02
17.5	.2539	64.	6.26	0.50	0.33E+00	0.43E-02	0.75E+02
25.0	.2408	67.	6.58	0.48	0.28E+00	0.38E-02	0.74E+02
35.0	.2286	70.	6.87	0.49	0.17E+00	0.53E-02	0.32E+02
45.0	.2205	72.	7.03	0.48	0.13E+00	0.46E-02	0.29E+02
60.0	.2125	74.	7.28	0.48	0.76E-01	0.26E-02	0.30E+02
80.0	.2050	77.	7.56	0.50	0.50E-01	0.31E-02	0.16E+02
100.0	.1996	79.	7.79	0.50	0.36E-01	0.18E-02	0.20E+02
120.0	.1960	82.	8.01	0.51	0.19E-01	0.16E-02	0.12E+02
150.0	.1899	83.	8.15	0.49	0.20E-01	0.74E-02	0.27E+01
180.0	.1839	85.	8.31	0.43	0.27E-01	0.14E-02	0.19E+02
245.0	.1796	89.	8.73	0.48	0.11E-01	0.87E-03	0.13E+02
400.0	.1735	96.	9.40	0.55	0.48E-02	0.10E-02	0.47E+01
600.0	.1678	101.	9.91	0.54	0.26E-02	0.13E-02	0.20E+01
800.0	.1626	104.	10.24	0.53	0.24E-02	0.21E-02	0.12E+01

DOERING 1-STEP DATA

1.3	.1790	91.	8.89	83.33	0.64E-02	0.15E-02	0.43E+01
1.3	.1776	92.	8.98	83.33	0.61E-02	0.14E-02	0.42E+01
1.4	.1763	92.	9.07	83.33	0.57E-02	0.14E-02	0.41E+01
1.4	.1751	93.	9.15	83.33	0.54E-02	0.14E-02	0.39E+01
1.5	.1739	94.	9.24	83.33	0.51E-02	0.14E-02	0.38E

DEPTH 107. CM (DOERING 1-STEP CONTINUED) SITE D-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.5	.1728	95.	9.32	83.33	0.49E-02	0.13E-02	0.37E+01
1.6	.1717	96.	9.40	83.33	0.47E-02	0.13E-02	0.36E+01
1.6	.1707	97.	9.48	83.33	0.44E-02	0.13E-02	0.35E+01
1.7	.1697	97.	9.56	83.33	0.42E-02	0.13E-02	0.34E+01
1.7	.1687	98.	9.63	83.33	0.41E-02	0.12E-02	0.33E+01
1.8	.1678	99.	9.71	83.33	0.39E-02	0.12E-02	0.32E+01
1.8	.1669	100.	9.78	83.33	0.37E-02	0.12E-02	0.31E+01
1.9	.1661	100.	9.85	83.33	0.36E-02	0.12E-02	0.30E+01
1.9	.1652	101.	9.92	83.33	0.34E-02	0.12E-02	0.30E+01
2.0	.1644	102.	9.99	83.33	0.33E-02	0.11E-02	0.29E+01
2.0	.1636	103.	10.06	83.33	0.32E-02	0.11E-02	0.28E+01
4.1	.1443	124.	12.15	83.33	0.11E-02	0.73E-03	0.15E+01
8.1	.1291	150.	14.66	83.33	0.40E-03	0.48E-03	0.82E+00
12.1	.1216	167.	16.39	83.33	0.22E-03	0.38E-03	0.58E+00
16.1	.1168	181.	17.75	83.33	0.14E-03	0.31E-03	0.46E+00
20.1	.1134	193.	18.90	83.33	0.10E-03	0.27E-03	0.38E+00
24.1	.1108	203.	19.89	83.33	0.81E-04	0.24E-03	0.33E+00
28.1	.1087	212.	20.78	83.33	0.65E-04	0.22E-03	0.30E+00
32.1	.1070	220.	21.58	83.33	0.54E-04	0.20E-03	0.27E+00
36.1	.1055	228.	22.32	83.33	0.46E-04	0.19E-03	0.25E+00
40.1	.1042	235.	23.00	83.33	0.40E-04	0.18E-03	0.23E+00
44.1	.1031	241.	23.64	83.33	0.35E-04	0.17E-03	0.21E+00
48.1	.1021	247.	24.23	83.33	0.31E-04	0.16E-03	0.20E+00
122.0	.0932	325.	31.85	83.33	0.11E-04	0.85E-04	0.13E+00
194.0	.0897	374.	36.64	83.33	0.76E-05	0.62E-04	0.12E+00

DEPTH 137. CM SITE D-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.3952	12.	1.22	1.26	********	********	********
0.8	.3950	14.	1.38	1.24	0.19E+01	0.97E-04	0.19E+05
0.9	.3944	16.	1.56	1.19	0.57E+01	0.13E-02	0.44E+04
1.1	.3937	18.	1.77	1.12	0.86E+01	0.23E-03	0.38E+05
1.3	.3925	21.	2.06	1.04	0.95E+01	0.78E-03	0.12E+05
1.5	.3905	23.	2.29	0.99	0.81E+01	0.95E-03	0.85E+04
1.7	.3878	26.	2.50	0.98	0.93E+01	0.18E-02	0.52E+04
1.9	.3849	27.	2.66	0.99	0.66E+01	0.17E-02	0.38E+04
2.2	.3814	29.	2.85	0.96	0.47E+01	0.19E-02	0.24E+04
2.4	.3645	31.	3.02	0.93	0.81E+01	0.24E-01	0.34E+03
2.7	.3480	32.	3.14	0.92	0.36E+01	0.35E-02	0.10E+04
2.9	.3453	33.	3.22	0.93	0.27E+01	0.23E-02	0.11E+04
3.2	.3416	34.	3.34	0.92	0.28E+01	0.38E-02	0.73E+03
3.7	.3367	36.	3.49	0.86	0.29E+01	0.24E-02	0.12E+04
4.2	.3318	37.	3.65	0.79	0.42E+01	0.38E-02	0.11E+04
4.7	.3255	39.	3.85	0.73	0.50E+01	0.25E-02	0.20E+04
6.2	.3164	42.	4.11	0.69	0.13E+01	0.45E-02	0.29E+03
8.7	.3021	45.	4.38	0.64	0.16E+01	0.57E-02	0.29E+03
12.5	.2845	47.	4.65	0.59	0.70E+00	0.73E-02	0.97E+02
17.5	.2707	50.	4.90	0.59	0.38E+00	0.38E-02	0.10E+03
25.0	.2566	53.	5.22	0.60	0.31E+00	0.47E-02	0.67E+02
35.0	.2447	56.	5.53	0.60	0.17E+00	0.24E-02	0.73E+02
45.0	.2389	58.	5.71	0.62	0.14E+00	0.46E-02	0.30E+02
60.0	.2303	61.	5.96	0.62	0.84E-01	0.30E-02	0.28E+02
80.0	.2218	64.	6.23	0.60	0.58E-01	0.32E-02	0.18E+02
100.0	.2163	66.	6.47	0.61	0.41E-01	0.17E-02	0.24E+02

DEPTH	137.	CM	(CONT)				
120.0	.2121	68.	6.71	0.62	0.24E-01	0.18E-02	0.13E+02
150.0	.2066	70.	6.88	0.64	0.25E-01	0.61E-02	0.42E+01
180.0	.2010	72.	7.07	0.72	0.23E-01	0.14E-02	0.16E+02
245.0	.1957	77.	7.54	0.70	0.10E-01	0.10E-02	0.10E+02
400.0	.1883	84.	8.24	0.67	0.56E-02	0.11E-02	0.50E+01
600.0	.1814	90.	8.80	0.70	0.31E-02	0.15E-02	0.21E+01
800.0	.1761	93.	9.15	0.74	0.28E-02	0.16E-02	0.18E+01
DOERING 1-STEP DATA							
0.5	.2036	86.	8.42	83.33	0.11E-01	0.91E-03	0.12E+02
0.5	.1999	90.	8.84	83.33	0.87E-02	0.82E-03	0.11E+02

DEPTH	137.	CM	SITE D-2				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.1966	94.	9.25	83.33	0.72E-02	0.75E-03	0.96E+01
0.6	.1936	98.	9.65	83.33	0.61E-02	0.69E-03	0.89E+01
0.7	.1910	102.	10.04	83.33	0.52E-02	0.64E-03	0.82E+01
0.7	.1886	106.	10.42	83.33	0.45E-02	0.59E-03	0.77E+01
0.8	.1865	110.	10.79	83.33	0.40E-02	0.55E-03	0.72E+01
0.8	.1845	114.	11.16	83.33	0.35E-02	0.51E-03	0.68E+01
0.9	.1827	117.	11.52	83.33	0.31E-02	0.48E-03	0.64E+01
0.9	.1810	121.	11.87	83.33	0.28E-02	0.45E-03	0.61E+01
1.0	.1794	125.	12.22	83.33	0.25E-02	0.43E-03	0.58E+01
1.0	.1779	128.	12.57	83.33	0.22E-02	0.40E-03	0.55E+01
1.1	.1766	132.	12.92	83.33	0.20E-02	0.38E-03	0.53E+01
1.1	.1753	135.	13.26	83.33	0.18E-02	0.36E-03	0.51E+01
1.2	.1741	139.	13.60	83.33	0.17E-02	0.34E-03	0.48E+01
1.2	.1729	142.	13.93	83.33	0.15E-02	0.33E-03	0.47E+01
1.3	.1718	146.	14.27	83.33	0.14E-02	0.31E-03	0.45E+01
1.3	.1708	149.	14.60	83.33	0.13E-02	0.30E-03	0.43E+01
1.4	.1698	152.	14.94	83.33	0.12E-02	0.28E-03	0.42E+01
1.4	.1689	156.	15.27	83.33	0.11E-02	0.27E-03	0.40E+01
1.5	.1680	159.	15.60	83.33	0.10E-02	0.26E-03	0.39E+01
1.5	.1671	162.	15.93	83.33	0.94E-03	0.25E-03	0.38E+01
1.6	.1663	166.	16.26	83.33	0.88E-03	0.24E-03	0.37E+01
1.6	.1655	169.	16.59	83.33	0.82E-03	0.23E-03	0.36E+01
1.7	.1647	173.	16.91	83.33	0.77E-03	0.22E-03	0.35E+01
1.7	.1640	176.	17.24	83.33	0.72E-03	0.21E-03	0.34E+01
1.8	.1633	179.	17.57	83.33	0.67E-03	0.20E-03	0.33E+01
1.8	.1627	183.	17.90	83.33	0.63E-03	0.20E-03	0.32E+01
1.9	.1620	186.	18.23	83.33	0.59E-03	0.19E-03	0.31E+01
1.9	.1614	189.	18.56	83.33	0.56E-03	0.18E-03	0.31E+01
2.0	.1608	193.	18.89	83.33	0.53E-03	0.18E-03	0.30E+01
2.0	.1602	196.	19.22	83.33	0.50E-03	0.17E-03	0.29E+01
2.1	.1596	199.	19.56	83.33	0.47E-03	0.16E-03	0.29E+01
4.1	.1454	356.	34.86	83.33	0.78E-04	0.51E-04	0.15E+01

SITE E (ULEN SERIES)

Site E was located in an unirrigated wheat field. The location and description are summarized on Table 1. According to the La Moure County (ND) Soil Survey Report (USDA, 1971) the Ulen soil series consists of "somewhat poorly drained, calcareous soils." that occur in "slight depressions on lake plains." They were "formed in moderately coarse-textured and coarse-textured deposits left by glacial melt waters". Ulen soils are associated with Hamar, Maddock, and Hecla soils. The specific site measured (location Fig. 2) consisted of a toeslope position of a toposequence, which included a Hecla soil (site D) at crest and an Arveson soil (site F) in the depression.

In-situ measurements and site descriptions were made during late June and July, 1985. The measurment period was concurrent with sites D and F which were located nearby, and also site G which was located approximately 3.25 miles (7 km) northeast of the field location. Soil samples and soil profile descriptions were collected approximately 4 weeks after hydraulic measurements were completed. Although measurements were made for more than two weeks, drainage was approximately complete at 7 days.

Infiltration and soil-water suction profiles during wetting were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation

SITE E, REPLICATION 1

Table E-1.1. Soil morphologic data for Site E, replication 1.

Site and location: E-l Ulen, Oakes Aquifer 350 feet south and 465 feet west of the east quarter corner of Section 9, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 08/02/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Ulen sandy loam; sandy, frigid Aeric Calciaquoll

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Somewhat poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: E-l north side of pit.

Alp 0-7 inches (0-18 cm) black (lOYR 2/1) sandy loam (loamy fine sand),dark gray (lOYR 4/1, dry); weak coarse and medium granular structure;slightly hard, very friable, slightly sticky and slightly plastic;common very fine roots; slight effervescence; abrupt smooth boundary.

A12 7-16 inches (18-41 cm) very dark grayish brown (lOYR 3/2) loamy sand(loamy fine sand), gray (lOYR 5/1, dry); weak coarse prismatic structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; slight to strong effervescence with depth; gradual wavy boundary.

Bk 16-22 inches (14-56 cm) grayish brown (2.5Y 5/2) loamy sand (fine sand), light gray (2.5Y 7/2, dry); weak very coarse prismatic structure;soft, very friable, slightly sticky and nonplastic; few very fine roots; strong to violent effervescence; gradual wavy boundary.

BCk 22-30 inches (56-76 cm) light brownish gray (2.5 6/2) loamy sand (fine sand), light gray (2.5Y 7/2, dry); weak very coarse prismaticstructure; soft, very friable, slightly sticky and nonplastic; few very fine roots; strong to violent effervescence; gradual wavy boundary.

Clg 30-40 inches (76-102 cm) grayish brown (2.5Y 5/2) loamy sand (fine sand), light gray (2.5Y 7/2, dry) with common fine distinct very dark brown (lOYR 2/2) mottles; very weak very coarse prismatic structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; strong effervescence; clear wavy boundary.

C2g 40-60 inches (102-152 cm) brown to pale brown (lOYR 5.5/3) sand, very pale brown (lOYR 7/3, dry) with many medium prominent yellowish red (5YR 4/8) and very dark brown (lOYR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; few very fine roots; slighteffervescence.

Table E-1.2 ULEN SERIES SITE E-1 NDSWC:1985
Soil partile-size, bulk density, and organic carbon data and indices.

DEPTH	PARTICLE SIZE CLASSES					(MICRON/PERCENT)		
cm	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	5.5	6.0	6.9	18.5	44.8	14.9	3.3	0.1
23.	6.9	4.8	6.1	20.6	45.8	12.8	2.8	0.1
38.	4.2	4.4	3.5	21.4	54.1	10.9	1.5	0.1
53.	4.6	1.8	3.0	22.3	58.0	8.9	1.1	0.2
76.	4.9	1.5	2.1	19.6	61.9	8.8	1.1	0.1
107.	0.2	3.6	4.5	11.8	36.1	37.6	5.7	0.4
137.	0.2	0.4	2.4	1.0	17.4	74.5	3.9	0.1

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	81.6	12.9	5.5	A 1 6	6=p
23.	82.2	10.9	6.9	A 1 2	8=g
38.	87.9	7.9	4.2	A 1 2	10=k
53.	90.6	4.8	4.6	B 0 10	
76.	91.5	3.6	4.9	BC0 10	
107.	91.7	8.1	0.2	C 1 8	
137.	97.0	2.8	0.2	C 2 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	6.326	0.1005	4.2	0.0237	0.705	1.32	1.10
23.	7.532	0.0942	4.5	0.0209	0.739	1.60	0.99
38.	11.139	0.1093	3.5	0.0311	0.967	1.57	0.20
53.	18.854	0.1133	3.4	0.0333	1.130	1.53	0.16
76.	25.417	0.1162	3.4	0.0338	1.204	1.55	0.12
107.	11.309	0.1929	2.6	0.0755	0.926	1.61	0.04
137.	34.607	0.3064	1.8	0.1677	1.987	1.54	0.04

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS (JAYNE & TYLER) CM/DAY-KPA		CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	1.864	2.428	-1.0611	2.3664	-10.61	0.99
23.	1.736	2.530	-1.0807	2.3809	-10.81	1.00
38.	1.510	4.071	-1.1822	2.5520	-11.82	1.17
53.	1.233	4.902	-1.2368	2.6245	-12.37	1.24
76.	1.097	5.512	-1.2583	2.6535	-12.58	1.27
107.	1.520	4.985	-1.2314	2.6564	-12.31	1.28
137.	1.009	12.339	-1.3390	2.8101	-13.39	1.43

Table E-1.3 Soil saturation extract water chemistry data, gravimetric water content atsaturation and at 15 bar, pH, texture class, and carbonate clay fraction for site E, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	3.44	2.77	0.65	0.12	-	3.52	0.20	2.76
15 - 30	2.58	2.93	0.65	0.08	-	3.76	0.15	2.33
30 - 46	1.08	2.60	0.59	0.02	-	2.68	0.11	1.49
46 - 61	0.99	2.48	0.65	0.03	-	2.80	0.14	1.21
61 - 91	0.86	2.49	0.67	0.02	-	2.56	0.13	1.35
91 - 122	0.90	2.16	0.80	0.03	-	2.28	0.12	1.49
122 - 152	0.77	1.71	0.42	0.02	-	1.80	0.15	0.98

Depth (cm)	ECE mmhos/cm	SAR*	H_2O at Sat. %	pH	CO3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.60	0.39	33	7.9	-	lfs	6.05
15 - 30	0.53	0.39	32	8.0	-	lfs	6.08
30 - 46	0.34	0.43	29	8.1	-	fs	3.80
46 - 61	0.33	0.49	28	8.2	-	fs	3.32
61 - 91	0.31	0.52	28	8.2	-	fs	3.09
91 - 122	0.30	0.65	21	7.9	-	s	2.62
122 - 152	0.23	0.38	23	7.9	-	s	0.91

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
10.	0.4182	0.0801	24.	0.3911	0.0535	24.	0.3555	0.0093	24.	0.3655	0.0028
20.	0.4026	0.0717	40.	0.3755	0.0435	40.	0.3351	0.0050	40.	0.3360	0.0007
30.	0.3453	0.0526	50.	0.3255	0.0250	50.	0.3043	0.0025	50.	0.2919	0.0025
40.	0.3106	0.0538	62.	0.2943	0.0189	62.	0.2646	0.0007	62.	0.2405	0.0015
50.	0.2774	0.0579	70.	0.2712	0.0165	70.	0.2436	0.0001	70.	0.2155	0.0015
60.	0.2290	0.0545	82.	0.2458	0.0135	82.	0.2056	0.0015	82.	0.1750	0.0020
70.	0.2177	0.0508	98.	0.2326	0.0181	98.	0.1718	0.0011	98.	0.1471	0.0010
80.	0.1912	0.0501	150.	0.1882	0.0156	150.	0.1299	0.0013	150.	0.1132	0.0010
100.	0.1732	0.0460	340.	0.1540	0.0163	340.	0.1031	0.0011	340.	0.0912	0.0000
120.	0.1589	0.0419	503.	0.1450	0.0169	503.	0.0956	0.0013	503.	0.0853	0.0000
180.	0.1351	0.0380	834.	0.1350	0.0158	834.	0.0904	0.0009	834.	0.0809	0.0000
334.	0.1156	0.0336									
534.	0.1058	0.0302									
834.	0.0961	0.0267									
BD =	1.32			1.60			1.57			1.53	
N =	2			2			2			2	

DEPTH (CM)

	76.			107.			137.	
10.	0.3444	0.0020	10.	0.3728	0.0159	24.	0.3223	0.0021
20.	0.3366	0.0019	20.	0.3635	0.0153	40.	0.0914	0.0024
30.	0.3254	0.0014	30.	0.3508	0.0213	50.	0.0702	0.0009
40.	0.3135	0.0024	40.	0.3403	0.0328	62.	0.0577	0.0004
50.	0.3024	0.0029	50.	0.3241	0.0422	70.	0.0541	0.0001
60.	0.2657	0.0004	60.	0.2917	0.0600	82.	0.0497	0.0001
70.	0.2480	0.0001	70.	0.2839	0.0615	98.	0.0453	0.0001
80.	0.2191	0.0006	80.	0.2548	0.0628	150.	0.0402	0.0006
100.	0.1909	0.0009	100.	0.2305	0.0596	340.	0.0336	0.0011
120.	0.1679	0.0003	120.	0.2099	0.0579	503.	0.0322	0.0001
180.	0.1404	0.0001	180.	0.1757	0.0526	834.	0.0351	0.0010
334.	0.1194	0.0009	334.	0.1500	0.0454			
534.	0.1076	0.0008	534.	0.1371	0.0403			
834.	0.0945	0.0007	834.	0.1329	0.0422			
BD =	1.55			1.54			1.54	
N =	2			2			2	

Table E-1.5 ULEN SERIES SITE E-1 (NDSWC 1985)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3787	4.	0.42	2.07	0.95E-01	0.26E-03	0.37E+03
0.4	.3756	12.	1.22	1.93	0.14E+00	0.60E-03	0.24E+03
0.4	.3718	19.	1.82	1.80	0.17E+00	0.68E-03	0.25E+03
0.7	.3588	32.	3.17	1.60	0.21E+00	0.10E-02	0.20E+03
1.2	.3412	49.	4.82	1.37	0.15E+00	0.11E-02	0.13E+03
1.7	.3290	60.	5.87	1.17	0.14E+00	0.12E-02	0.12E+03
2.5	.3161	70.	6.82	0.90	0.12E+00	0.15E-02	0.84E+02
3.5	.3044	77.	7.54	0.67	0.10E+00	0.20E-02	0.51E+02
4.5	.2956	80.	7.84	0.57	0.12E+00	0.58E-02	0.20E+02
5.5	.2907	82.	7.99	0.55	0.13E-01	0.65E-03	0.21E+02
6.7	.2891	83.	8.17	0.53	0.23E-01	0.12E-02	0.19E+02
11.2	.2749	89.	8.69	0.48	0.54E-01	0.31E-02	0.18E+02
17.5	.2571	94.	9.22	0.50	0.29E-01	0.48E-02	0.61E+01
22.5	.2503	96.	9.42	0.57	0.11E-01	0.20E-02	0.54E+01
32.5	.2435	100.	9.82	0.57	0.85E-02	0.16E-02	0.54E+01
45.0	.2364	105.	10.32	0.48	0.75E-02	0.12E-02	0.63E+01
60.0	.2305	110.	10.77	0.38	0.70E-02	0.14E-02	0.50E+01
80.0	.2245	114.	11.22	0.30	0.60E-02	0.12E-02	0.51E+01
100.0	.2216	118.	11.57	0.25	0.18E-02	0.39E-03	0.46E+01
120.0	.2204	121.	11.82	0.25	0.18E-02	0.59E-03	0.30E+01
145.0	.2174	123.	12.02	0.30	0.40E-02	0.24E-02	0.17E+01
175.0	.2151	126.	12.32	0.27	0.45E-04	0.12E-04	0.38E+01
195.0	.2150	128.	12.54	0.22	0.17E-03	0.95E-04	0.18E+01
225.0	.2150	128.	12.59	0.27	0.27E-04	0.95E-04	0.29E+00
300.0	.2144	131.	12.82	0.28	0.28E-03	0.26E-03	0.11E+01
400.0	.2137	135.	13.22	0.22	0.17E-03	0.12E-03	0.14E+01
550.0	.2119	139.	13.67	0.12	0.10E-02	0.61E-03	0.16E+01

DEPTH 23. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3737	5.	0.47	2.13	0.34E+00	0.39E-03	0.88E+03
0.2	.3714	12.	1.22	2.07	0.27E+00	0.26E-03	0.11E+04
0.4	.3690	18.	1.76	1.93	0.38E+00	0.51E-03	0.75E+03
0.4	.3662	24.	2.33	1.80	0.48E+00	0.61E-03	0.78E+03
0.7	.3556	35.	3.45	1.60	0.59E+00	0.95E-03	0.62E+03
1.2	.3402	52.	5.06	1.37	0.45E+00	0.12E-02	0.36E+03
1.7	.3283	61.	5.98	1.17	0.42E+00	0.14E-02	0.30E+03
2.5	.3174	69.	6.73	0.90	0.35E+00	0.15E-02	0.23E+03
3.5	.3071	74.	7.29	0.67	0.31E+00	0.27E-02	0.12E+03
4.5	.2990	77.	7.51	0.57	0.33E+00	0.68E-02	0.48E+02
5.5	.2906	78.	7.65	0.55	0.16E+00	0.57E-02	0.29E+02
6.7	.2847	80.	7.81	0.53	0.64E-01	0.13E-02	0.50E+02
11.2	.2703	85.	8.29	0.48	0.17E+00	0.33E-02	0.51E+02
17.5	.2515	90.	8.83	0.50	0.91E-01	0.43E-02	0.21E+02
22.5	.2442	93.	9.09	0.57	0.32E-01	0.16E-02	0.21E+02
32.5	.2372	97.	9.48	0.57	0.26E-01	0.18E-02	0.14E+02
45.0	.2299	101.	9.92	0.48	0.22E-01	0.15E-02	0.15E+02
60.0	.2240	105.	10.29	0.38	0.21E-01	0.17E-02	0.13E+02

DEPTH	8.	CM (CONT)					
80.0	.2183	109.	10.68	0.30	0.17E-01	0.12E-02	0.14E+02
100.0	.2157	112.	10.99	0.25	0.49E-02	0.30E-03	0.16E+02
120.0	.2149	115.	11.24	0.25	0.49E-02	0.37E-03	0.13E+02
145.0	.2127	117.	11.48	0.30	0.11E-01	0.14E-02	0.78E+01
175.0	.2103	120.	11.75	0.27	0.12E-02	0.40E-03	0.31E+01
195.0	.2095	122.	11.94	0.22	0.21E-02	0.66E-03	0.31E+01
225.0	.2088	123.	12.03	0.27	0.61E-03	0.97E-03	0.63E+00
300.0	.2067	125.	12.26	0.28	0.14E-02	0.83E-03	0.17E+01
400.0	.2043	129.	12.61	0.22	0.92E-03	0.51E-03	0.18E+01
550.0	.2021	132.	12.98	0.12	0.29E-02	0.64E-03	0.45E+01

DOERING 1-STEP DATA

4.0	.1946	148.	14.47	83.33	0.53E-03	0.46E-03	0.12E+01
8.0	.1797	189.	18.49	83.33	0.20E-03	0.29E-03	0.68E+00
12.0	.1715	222.	21.74	83.33	0.11E-03	0.21E-03	0.51E+00
16.0	.1659	252.	24.66	83.33	0.70E-04	0.17E-03	0.42E+00
20.0	.1617	279.	27.40	83.33	0.50E-04	0.14E-03	0.37E+00
24.0	.1583	306.	30.03	83.33	0.38E-04	0.11E-03	0.33E+00
28.0	.1555	333.	32.61	83.33	0.30E-04	0.98E-04	0.30E+00
32.0	.1531	359.	35.16	83.33	0.24E-04	0.85E-04	0.28E+00
36.0	.1511	385.	37.71	83.33	0.20E-04	0.75E-04	0.27E+00
40.0	.1492	411.	40.26	83.33	0.17E-04	0.66E-04	0.25E+00
44.0	.1476	437.	42.84	83.33	0.14E-04	0.59E-04	0.24E+00
48.0	.1461	464.	45.46	83.33	0.12E-04	0.52E-04	0.24E+00
52.0	.1448	491.	48.12	83.33	0.11E-04	0.47E-04	0.23E+00

DEPTH 38. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3722	4.	0.43	1.54	0.47E+00	0.14E-03	0.33E+04
0.2	.3710	16.	1.57	1.41	0.70E+00	0.20E-03	0.34E+04
0.2	.3697	22.	2.14	1.21	0.71E+00	0.26E-03	0.28E+04
0.4	.3683	27.	2.69	1.11	0.94E+00	0.28E-03	0.33E+04
0.4	.3668	32.	3.09	1.11	0.11E+01	0.51E-03	0.22E+04
0.7	.3593	40.	3.93	0.91	0.16E+01	0.91E-03	0.17E+04
1.2	.3467	52.	5.13	0.70	0.14E+01	0.14E-02	0.99E+03
1.7	.3354	59.	5.81	0.60	0.14E+01	0.21E-02	0.65E+03
2.5	.3239	64.	6.31	0.54	0.92E+00	0.25E-02	0.36E+03
3.5	.3123	68.	6.70	0.55	0.64E+00	0.38E-02	0.17E+03
4.5	.3044	70.	6.90	0.62	0.45E+00	0.43E-02	0.10E+03
5.5	.2913	72.	7.07	0.67	0.48E+00	0.10E-01	0.46E+02
6.7	.2781	74.	7.24	0.70	0.10E+00	0.37E-02	0.28E+02
11.2	.2606	78.	7.67	0.69	0.20E+00	0.41E-02	0.49E+02
17.5	.2400	83.	8.17	0.60	0.13E+00	0.48E-02	0.28E+02
22.5	.2319	86.	8.43	0.55	0.56E-01	0.16E-02	0.36E+02
32.5	.2242	90.	8.77	0.49	0.52E-01	0.26E-02	0.20E+02
45.0	.2159	93.	9.09	0.40	0.46E-01	0.27E-02	0.17E+02
60.0	.2101	95.	9.35	0.35	0.37E-01	0.19E-02	0.20E+02
80.0	.2050	99.	9.66	0.34	0.25E-01	0.13E-02	0.19E+02
100.0	.2023	101.	9.92	0.32	0.65E-02	0.63E-03	0.10E+02
120.0	.2010	104.	10.14	0.29	0.69E-02	0.52E-03	0.13E+02
*145.0	.1994	106.	10.38	0.23	0.20E-01	0.85E-03	0.24E+02
175.0	.1975	108.	10.58	0.17	0.63E-02	0.11E-02	0.57E+01
195.0	.1962	109.	10.69	0.12	0.13E-01	0.13E-02	0.10E+02
225.0	.1948	110.	10.77	0.07	0.89E-02	0.19E-02	0.47E+01

DOERING 1-STEP DATA

1.0	.1332	206.	20.15	83.33	0.42E-02	0.31E-03	0.14E+02
1.0	.1277	225.	22.05	83.33	0.34E-02	0.26E-03	0.13E+02
1.1	.1227	246.	24.09	83.33	0.27E-02	0.22E-03	0.12E+02
1.1	.1182	268.	26.28	83.33	0.22E-02	0.19E-03	0.12E+02
1.2	.1140	292.	28.63	83.33	0.18E-02	0.16E-03	0.11E+02
1.2	.1101	318.	31.18	83.33	0.15E-02	0.14E-03	0.11E+02
1.3	.1065	346.	33.93	83.33	0.12E-02	0.12E-03	0.11E+02
1.3	.1032	377.	36.91	83.33	0.10E-02	0.10E-03	0.10E+02
1.4	.1001	410.	40.16	83.33	0.84E-03	0.86E-04	0.97E+01
1.4	.0973	446.	43.69	83.33	0.70E-03	0.74E-04	0.94E+01
1.5	.0946	485.	47.55	83.33	0.58E-03	0.63E-04	0.91E+01

DEPTH 53. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3784	10.	0.96	0.67	0.13E+01	0.64E-04	0.20E+05
0.2	.3778	17.	1.65	0.67	0.17E+01	0.19E-03	0.87E+04
0.2	.3770	21.	2.05	0.67	0.16E+01	0.19E-03	0.81E+04
0.4	.3763	25.	2.48	0.63	0.19E+01	0.17E-03	0.11E+05
0.4	.3754	29.	2.86	0.60	0.24E+01	0.34E-03	0.70E+04
0.7	.3696	36.	3.57	0.60	0.30E+01	0.87E-03	0.34E+04
1.2	.3596	47.	4.58	0.57	0.23E+01	0.13E-02	0.18E+04
1.7	.3507	53.	5.19	0.57	0.19E+01	0.18E-02	0.11E+04
2.5	.3411	57.	5.59	0.50	0.13E+01	0.32E-02	0.42E+03
3.5	.3302	60.	5.90	0.38	0.14E+01	0.39E-02	0.35E+03
4.5	.3200	64.	6.22	0.48	0.81E+00	0.26E-02	0.32E+03
5.5	.3070	67.	6.52	0.60	0.10E+01	0.82E-02	0.12E+03
6.7	.2916	69.	6.75	0.63	0.28E+00	0.58E-02	0.47E+02
11.2	.2669	73.	7.18	0.65	0.31E+00	0.56E-02	0.56E+02
17.5	.2421	78.	7.60	0.63	0.19E+00	0.74E-02	0.26E+02
22.5	.2320	79.	7.78	0.58	0.78E-01	0.31E-02	0.25E+02
32.5	.2231	82.	8.03	0.52	0.72E-01	0.38E-02	0.19E+02
45.0	.2139	84.	8.26	0.48	0.57E-01	0.49E-02	0.12E+02
60.0	.2072	86.	8.44	0.43	0.42E-01	0.29E-02	0.14E+02
80.0	.2010	89.	8.67	0.35	0.34E-01	0.22E-02	0.15E+02
100.0	.1972	91.	8.87	0.28	0.13E-01	0.15E-02	0.86E+01
120.0	.1949	92.	9.06	0.27	0.12E-01	0.11E-02	0.11E+02
145.0	.1916	94.	9.23	0.23	0.28E-01	0.30E-02	0.92E+01
175.0	.1883	95.	9.36	0.20	0.10E-01	0.21E-02	0.47E+01
195.0	.1866	96.	9.45	0.22	0.15E-01	0.16E-02	0.93E+01
225.0	.1850	97.	9.52	0.25	0.48E-02	0.28E-02	0.17E+01
300.0	.1811	99.	9.67	0.28	0.68E-02	0.25E-02	0.27E+01
400.0	.1763	100.	9.84	0.27	0.41E-02	0.38E-02	0.11E+01
550.0	.1727	104.	10.17	0.18	0.45E-02	0.62E-03	0.73E+01

DOERING 1-STEP DATA

4.1	.1599	95.	9.27	83.33	0.26E-02	0.13E-02	0.20E+01
4.2	.1569	97.	9.50	83.33	0.25E-02	0.12E-02	0.20E+01
4.3	.1539	99.	9.75	83.33	0.24E-02	0.12E-02	0.21E+01
4.5	.1509	102.	10.01	83.33	0.23E-02	0.11E-02	0.21E+01
4.6	.1479	105.	10.29	83.33	0.21E-02	0.10E-02	0.21E+01

DEPTH 53. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
4.8	.1449	108.	10.60	83.33	0.20E-02	0.93E-03	0.22E+01
4.9	.1419	111.	10.93	83.33	0.19E-02	0.86E-03	0.22E+01
5.1	.1389	115.	11.28	83.33	0.18E-02	0.80E-03	0.23E+01
5.2	.1359	119.	11.66	83.33	0.17E-02	0.73E-03	0.23E+01
5.4	.1329	123.	12.08	83.33	0.16E-02	0.67E-03	0.23E+01
5.6	.1299	128.	12.54	83.33	0.15E-02	0.61E-03	0.24E+01
5.7	.1269	133.	13.05	83.33	0.14E-02	0.55E-03	0.24E+01
5.9	.1239	139.	13.61	83.33	0.12E-02	0.50E-03	0.25E+01
6.0	.1209	145.	14.23	83.33	0.11E-02	0.45E-03	0.25E+01
6.2	.1178	152.	14.95	83.33	0.94E-03	0.39E-03	0.24E+01
6.2	.1169	155.	15.17	83.33	0.90E-03	0.38E-03	0.24E+01
6.3	.1161	157.	15.39	83.33	0.86E-03	0.37E-03	0.23E+01
6.3	.1152	159.	15.62	83.33	0.82E-03	0.35E-03	0.23E+01
6.4	.1144	162.	15.85	83.33	0.79E-03	0.34E-03	0.23E+01
6.4	.1136	164.	16.09	83.33	0.75E-03	0.33E-03	0.23E+01
6.5	.1128	167.	16.33	83.33	0.72E-03	0.32E-03	0.23E+01
6.5	.1120	169.	16.58	83.33	0.69E-03	0.30E-03	0.23E+01
6.6	.1113	172.	16.84	83.33	0.66E-03	0.29E-03	0.22E+01
6.6	.1105	174.	17.10	83.33	0.63E-03	0.28E-03	0.22E+01
6.7	.1097	177.	17.37	83.33	0.60E-03	0.27E-03	0.22E+01
6.7	.1090	180.	17.64	83.33	0.57E-03	0.26E-03	0.22E+01
6.8	.1083	183.	17.92	83.33	0.54E-03	0.25E-03	0.22E+01
6.8	.1075	186.	18.21	83.33	0.52E-03	0.24E-03	0.22E+01
6.9	.1068	189.	18.51	83.33	0.49E-03	0.23E-03	0.21E+01
6.9	.1061	192.	18.81	83.33	0.47E-03	0.22E-03	0.21E+01
7.0	.1055	195.	19.12	83.33	0.45E-03	0.21E-03	0.21E+01
7.0	.1048	198.	19.44	83.33	0.43E-03	0.20E-03	0.21E+01
7.1	.1041	202.	19.77	83.33	0.41E-03	0.20E-03	0.21E+01
7.1	.1034	205.	20.11	83.33	0.39E-03	0.19E-03	0.21E+01
7.2	.1028	209.	20.45	83.33	0.37E-03	0.18E-03	0.21E+01
7.2	.1022	212.	20.81	83.33	0.35E-03	0.17E-03	0.20E+01
7.3	.1015	216.	21.18	83.33	0.33E-03	0.16E-03	0.20E+01
7.3	.1009	220.	21.56	83.33	0.32E-03	0.16E-03	0.20E+01
7.4	.1003	224.	21.96	83.33	0.30E-03	0.15E-03	0.20E+01
7.4	.0997	228.	22.36	83.33	0.29E-03	0.14E-03	0.20E+01
7.5	.0991	232.	22.78	83.33	0.27E-03	0.14E-03	0.20E+01
7.5	.0985	237.	23.21	83.33	0.26E-03	0.13E-03	0.20E+01
7.6	.0979	241.	23.66	83.33	0.24E-03	0.12E-03	0.20E+01
7.6	.0973	246.	24.13	83.33	0.23E-03	0.12E-03	0.19E+01
7.7	.0968	251.	24.61	83.33	0.22E-03	0.11E-03	0.19E+01
7.7	.0962	256.	25.11	83.33	0.21E-03	0.11E-03	0.19E+01
7.8	.0956	261.	25.63	83.33	0.19E-03	0.10E-03	0.19E+01
7.8	.0951	267.	26.17	83.33	0.18E-03	0.97E-04	0.19E+01
7.9	.0946	273.	26.73	83.33	0.17E-03	0.92E-04	0.19E+01
7.9	.0940	279.	27.32	83.33	0.16E-03	0.87E-04	0.19E+01
8.0	.0935	285.	27.93	83.33	0.15E-03	0.82E-04	0.19E+01
8.0	.0930	291.	28.57	83.33	0.14E-03	0.78E-04	0.18E+01
8.1	.0925	298.	29.23	83.33	0.13E-03	0.73E-04	0.18E+01
8.1	.0920	305.	29.93	83.33	0.13E-03	0.69E-04	0.18E+01

DEPTH 76. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3622	10.	0.96	1.14	0.86E+00	0.13E-03	0.68E+04
0.2	.3616	14.	1.34	0.94	0.14E+01	0.37E-03	0.37E+04
0.2	.3607	16.	1.57	0.84	0.15E+01	0.35E-03	0.43E+04
0.4	.3598	19.	1.82	0.75	0.18E+01	0.30E-03	0.60E+04
0.4	.3590	21.	2.03	0.67	0.24E+01	0.38E-03	0.64E+04
0.7	.3554	26.	2.54	0.55	0.39E+01	0.70E-03	0.55E+04
1.2	.3493	34.	3.29	0.42	0.39E+01	0.10E-02	0.39E+04
1.7	.3447	38.	3.77	0.34	0.39E+01	0.83E-03	0.47E+04
2.5	.3413	42.	4.07	0.31	0.26E+01	0.19E-02	0.14E+04
3.5	.3367	43.	4.26	0.29	0.24E+01	0.30E-02	0.81E+03
4.5	.3285	46.	4.54	0.22	0.29E+01	0.26E-02	0.11E+04
5.5	.3202	49.	4.80	0.15	0.55E+01	0.41E-02	0.13E+04
6.7	.3116	50.	4.94	0.09	0.39E+01	0.63E-02	0.62E+03
11.2	.2938	54.	5.33	0.06	0.49E+01	0.39E-02	0.12E+04
17.5	.2751	59.	5.76	0.06	0.31E+01	0.73E-02	0.43E+03
22.5	.2657	60.	5.91	0.06	0.12E+01	0.48E-02	0.26E+03
32.5	.2527	62.	6.10	0.05	0.13E+01	0.80E-02	0.16E+03
45.0	.2419	64.	6.29	0.04	0.82E+00	0.11E-02	0.73E+03
60.0	.2355	66.	6.46	0.05	0.59E+00	0.57E-02	0.10E+03
80.0	.2264	68.	6.65	0.06	0.32E+00	0.39E-02	0.82E+02
100.0	.2204	70.	6.82	0.07	0.12E+00	0.33E-02	0.38E+02
120.0	.2159	71.	6.98	0.06	0.12E+00	0.23E-02	0.53E+02
145.0	.2100	73.	7.14	0.06	0.20E+00	0.62E-02	0.31E+02
175.0	.2047	74.	7.26	0.07	0.60E-01	0.28E-02	0.21E+02
195.0	.2024	75.	7.36	0.07	0.98E-01	0.17E-02	0.59E+02
225.0	.2003	76.	7.44	0.06	0.40E-01	0.35E-02	0.11E+02
300.0	.1965	77.	7.58	0.03	0.93E-01	0.25E-02	0.37E+02
400.0	.1921	79.	7.74	0.04	0.47E-01	0.32E-02	0.15E+02
550.0	.1871	82.	8.01	0.03	0.42E-01	0.15E-02	0.29E+02

DEPTH 104. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.2978	17.	1.67	1.28	0.13E+01	0.20E-02	0.63E+03
0.4	.2960	18.	1.76	1.23	0.14E+01	0.31E-02	0.45E+03
0.4	.2943	19.	1.84	1.21	0.16E+01	0.19E-02	0.87E+03
0.7	.2867	22.	2.11	1.10	0.24E+01	0.30E-02	0.80E+03
1.2	.2750	25.	2.50	0.96	0.21E+01	0.33E-02	0.65E+03
1.7	.2676	28.	2.78	0.89	0.17E+01	0.18E-02	0.96E+03
3.5	.2650	34.	3.34	1.01	0.96E+00	0.55E-02	0.17E+03
4.5	.2532	36.	3.54	1.02	0.88E+00	0.65E-02	0.14E+03
5.5	.2472	37.	3.64	0.95	0.10E+01	0.65E-02	0.16E+03
6.7	.2419	38.	3.68	0.92	0.58E+00	0.24E-01	0.24E+02
11.2	.2320	40.	3.91	0.84	0.43E+00	0.27E-02	0.16E+03
17.5	.2218	43.	4.20	0.75	0.32E+00	0.63E-02	0.50E+02
22.5	.2158	44.	4.35	0.75	0.13E+00	0.23E-02	0.57E+02
32.5	.2047	46.	4.52	0.74	0.13E+00	0.12E-01	0.11E+02
45.0	.1954	48.	4.68	0.73	0.51E-01	0.41E-03	0.12E+03
60.0	.1901	49.	4.84	0.72	0.62E-01	0.65E-02	0.95E+01
80.0	.1821	51.	4.99	0.68	0.41E-01	0.41E-02	0.99E+01
100.0	.1765	52.	5.12	0.65	0.24E-01	0.40E-02	0.59E+01
120.0	.1725	53.	5.23	0.62	0.19E-01	0.31E-02	0.63E+01
145.0	.1687	55.	5.35	0.60	0.29E-01	0.30E-02	0.96E+01
175.0	.1655	56.	5.48	0.60	0.10E-01	0.19E-02	0.54E+01
195.0	.1637	57.	5.57	0.59	0.19E-01	0.22E-02	0.85E+01
300.0	.1602	59.	5.74	0.59	0.78E-02	0.33E-02	0.24E+01

DEPTH 104. CM (CONT)

400.0	.1561	61.	5.93	0.60	0.49E-02	0.13E-02	0.37E+01
550.0	.1518	63.	6.13	0.56	0.40E-02	0.30E-02	0.13E+01

DOERING 1-STEP DATA

1.2	.1299	*	*	83.33	0.59E-03	0.53E-04	0.11E+02
1.2	.1255	*	*	83.33	0.44E-03	0.42E-04	0.11E+02
1.3	.1214	*	*	83.33	0.33E-03	0.32E-04	0.10E+02
1.3	.1176	*	*	83.33	0.25E-03	0.25E-04	0.99E+01

DEPTH 135. CM SITE E-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.4	.2542	17.	1.63	0.77	0.29E+01	0.19E-01	0.15E+03
0.4	.2523	17.	1.67	0.77	0.33E+01	0.22E-02	0.15E+04
0.7	.2426	19.	1.82	0.77	0.47E+01	0.88E-02	0.54E+03
1.2	.2274	21.	2.02	0.77	0.36E+01	0.64E-02	0.56E+03
1.7	.2171	22.	2.20	0.76	0.26E+01	0.52E-02	0.50E+03
3.5	.2059	28.	2.76	0.69	0.22E+01	0.63E-02	0.35E+03
4.5	.1922	30.	2.96	0.69	0.17E+01	0.81E-02	0.21E+03
5.5	.1864	31.	3.04	0.72	0.15E+01	0.10E-01	0.14E+03
6.7	.1795	31.	3.08	0.73	0.98E+00	0.35E-01	0.28E+02
11.2	.1645	33.	3.26	0.75	0.56E+00	0.58E-02	0.98E+02
17.5	.1502	36.	3.52	0.79	0.37E+00	0.62E-02	0.60E+02
22.5	.1438	38.	3.70	0.80	0.15E+00	0.18E-02	0.87E+02
32.5	.1371	40.	3.90	0.83	0.15E+00	0.49E-02	0.31E+02
45.0	.1296	42.	4.08	0.85	0.56E-01	0.35E-02	0.16E+02
60.0	.1242	43.	4.23	0.85	0.66E-01	0.37E-02	0.18E+02
80.0	.1197	45.	4.38	0.87	0.40E-01	0.24E-02	0.17E+02
*100.0	.1165	46.	4.49	0.88	0.24E-01	0.52E-02	0.46E+01
120.0	.1144	46.	4.52	0.85	0.18E-01	0.60E-02	0.30E+01
175.0	.1114	46.	4.54	0.74	0.11E-01	0.14E-02	0.74E+01
195.0	.1100	47.	4.63	0.75	0.21E-01	0.19E-02	0.11E+02
300.0	.1077	50.	4.87	0.79	0.78E-02	0.18E-02	0.43E+01
400.0	.1047	52.	5.07	0.79	0.45E-02	0.96E-03	0.46E+01
550.0	.1024	53.	5.22	0.79	0.37E-02	0.21E-02	0.18E+01

DOERING 1-STEP DATA

4.9	.0719	71.	7.00	83.33	0.30E-02	0.10E-02	0.29E+01
8.9	.0514	105.	10.32	83.33	0.57E-03	0.35E-03	0.16E+01
12.9	.0433	139.	13.66	83.33	0.18E-03	0.16E-03	0.12E+01
16.9	.0390	177.	17.37	83.33	0.73E-04	0.81E-04	0.90E+00
20.9	.0363	223.	21.88	83.33	0.32E-04	0.43E-04	0.75E+00
24.9	.0344	284.	27.87	83.33	0.14E-04	0.22E-04	0.65E+00
28.9	.0331	377.	36.97	83.33	0.56E-05	0.98E-05	0.57E+00
32.9	.0320	558.	54.70	83.33	0.17E-05	0.33E-05	0.52E+00

SITE E, REPLICATION 2

Table E-2.1 Soil morphologic data for Site E, replication 2.

Site and location: E-2 Ulen, Oakes Aquifer 355 feet south and 465 feet west of the east quarter corner of Section 9, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 08/02/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Ulen sandy loam; sandy, frigid Aeric Calciaquoll

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Somewhat poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: E-2 south side of pit.

Alp 0-8 inches (0-20 cm) black (l0YR 2/1) sandy loam (loamy fine sand), dark gray (l0YR 4/1, dry); weak coarse and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; slight effervescence; abrupt smooth boundary.

A12 8-15 inches (20-38 cm) very dark grayish brown (l0YR 3/2) sandy loam (loamy fine sand), gray (l0YR 5/1, dry); weak coarse prismatic struc-ture; soft, very friable, slightly sticky and slightly plastic; com-mon very fine roots, slight to strong effervescence with depth; gradual wavy boundary.

Bk 15-23 inches (38-58 cm) gray (l0YR 5/1) loamy sand (loamy fine sand), light gray (l0YR 6/1, dry); weak very coarse prismatic structure; soft, very friable, slightly sticky and nonplastic; few very fine roots; strong to violent effervescence; gradual wavy boundary.

BCk 23-40 inches (58-102 cm) light brownish gray (2.5Y 6/2) loamy sand (fine sand), white (l0YR 8/1, dry); weak very coarse prismatic struc-ture; soft, very friable, slightly sticky and nonplastic; few very fine roots; strong to violent effervescence; clear broken boundary.

Ab 40-47 inches (102-119 cm) dark gray (l0YR 4/1) sandy loam (fine sandy loam), light brownish gray (2.5Y 6/2, dry); weak coarse prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; strong to violent effervescence; clear broken boundary. This horizon is discontinuous.

Cg 47-60 inches (119-152 cm) brown to pale brown (l0YR 5.5/3) sand (loamy sand), very pale brown (l0YR 7/3, dry) with many medium promi- nent yellowish red (5YR 4/8) and very dark brown (l0YR 2/2) mottles; single grain structure; loose, nonsticky and nonplastic; slight effervescence.

Table E-2.2 ULEN SERIES SITE E-2 NDSWC:1985
Soil partile-size, bulk density, and organic carbon data and indices.

DEPTH cm	PARTICLE SIZE CLASSES (MICRON/PERCENT) 2.	20.	50.	100.	250.	500.	1000.	2000.
8.	4.0	7.5	5.7	18.5	46.6	14.4	3.2	0.1
23.	1.3	7.0	5.5	18.4	50.6	14.4	2.8	0.1
38.	10.1	0.0	3.9	21.1	53.3	9.9	1.6	0.1
53.	6.1	2.9	3.8	20.1	55.5	10.0	1.6	0.0
76.	5.7	2.6	1.2	19.8	64.1	5.8	0.9	0.0
107.	6.0	5.1	4.4	10.7	38.8	25.2	8.5	1.2
107.	13.6	11.9	1.9	4.0	41.3	24.6	2.5	0.2
137.	4.2	5.1	4.3	2.1	28.1	49.5	6.1	0.4
167.	0.6	0.7	1.9	0.7	20.3	71.4	4.1	0.3

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	82.8	13.2	4.0	A 1 6	6=p
23.	86.2	12.5	1.3	A 1 2	8=g
38.	86.0	3.9	10.1	A 1 2	9=b
53.	87.2	6.7	6.1	B 10	10=k
76.	90.5	3.8	5.7	BC 10	
107.	84.5	9.5	6.0	A 9	
107.	72.6	13.8	13.6	A 9	
137.	86.4	9.4	4.2	C 8	
167.	96.8	2.6	0.6	C 8	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
3.	6.273	0.1057	3.9	0.0274	0.744	1.55	0.87
9.	6.904	0.1228	3.0	0.0415	0.878	1.65	0.37
15.	22.051	0.0902	5.0	0.0180	0.942	1.58	0.21
21.	13.015	0.1033	4.0	0.0260	0.967	1.53	0.17
30.	23.842	0.1064	3.7	0.0289	1.212	1.59	0.10
42.	8.884	0.1337	4.9	0.0276	0.666	1.60	0.10
42.	5.261	0.0735	7.5	0.0098	0.607	1.42	0.31
54.	9.170	0.1809	4.2	0.0428	0.941	1.55	0.06
66.	37.231	0.2954	2.0	0.1447	1.856	1.56	0.06

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
3.	1.877	2.599	-1.0760	2.4012	-10.76	1.02
9.	1.820	3.373	-1.1294	2.5027	-11.29	1.12
15.	1.105	3.944	-1.1794	2.4940	-11.79	1.11
21.	1.410	4.185	-1.1786	2.5288	-11.79	1.15
30.	1.117	5.737	-1.2445	2.6274	-12.44	1.25
42.	1.634	3.306	-1.1218	2.4476	-11.22	1.07
42.	1.947	2.702	-0.9295	2.1054	-9.29	0.73
54.	1.625	4.796	-1.1476	2.4998	-11.48	1.12
66.	0.980	10.457	-1.3388	2.8072	-13.39	1.43

Table E-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site E, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
	Saturation Extract Soluble Ions meq/l							
0 - 15	2.45	3.59	0.69	0.10	-	3.72	0.20	2.91
15 - 30	1.42	2.33	0.63	0.03	-	2.76	0.13	1.52
30 - 46	0.86	3.02	0.71	0.01	-	3.20	0.12	1.28
46 - 61	0.64	2.82	0.69	0.02	-	3.16	0.13	0.89
61 - 91	0.77	2.69	0.71	0.01	-	2.76	0.12	1.31
..91 - 122	1.08	2.68	0.92	0.00	-	3.20	0.15	1.33
..91 - 122	0.86	2.20	2.29	0.00	-	3.84	0.20	1.31
122 - 152	0.64	1.60	2.25	0.00	-	2.92	0.16	1.41
152 - 182	0.77	1.14	1.45	0.03	-	2.20	0.16	1.04

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.61	0.40	30	8.0	-	lfs	5.65
15 - 30	0.35	0.46	30	8.1	-	lfs	4.47
30 - 46	0.37	0.51	30	8.1	-	lfs	4.57
46 - 61	0.36	0.53	29	8.2	-	lfs	4.39
61 - 91	0.30	0.54	29	8.2	-	fs	3.51
91 - 122	0.38	0.67	28	8.2	-	ls	5.50
91 - 122	0.48	1.85	40	8.2	-	fsl	13.21
122 - 152	0.38	2.12	27	8.2	-	ls	6.66
152 - 182	0.28	1.48	21	8.0	-	s	1.12

Table E-2.4 ULEN SERIES SITE E-2 NDSWC:85
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

CM	8. CC/CC	SE	CM	23. CC/CC	SE	CM	38. CC/CC	SE	CM	107. CC/CC	SE
24.	0.3482	0.0069	10.	0.4225	0.0194	24.	0.3637	0.0032	24.	0.4755	0.0060
40.	0.3438	0.0089	20.	0.4170	0.0185	40.	0.3364	0.0002	40.	0.4365	0.0062
50.	0.3395	0.0130	30.	0.3893	0.0144	50.	0.3046	0.0007	50.	0.4183	0.0053
62.	0.3237	0.0141	40.	0.3707	0.0074	62.	0.2713	0.0005	62.	0.4053	0.0046
70.	0.3116	0.0137	50.	0.3501	0.0041	70.	0.2493	0.0001	70.	0.4001	0.0045
82.	0.2790	0.0121	60.	0.3076	0.0003	82.	0.2197	0.0009	82.	0.3915	0.0057
98.	0.2577	0.0104	70.	0.2943	0.0004	98.	0.1962	0.0005	98.	0.3863	0.0056
150.	0.2183	0.0091	80.	0.2701	0.0011	150.	0.1599	0.0007	150.	0.3724	0.0054
340.	0.1813	0.0095	100.	0.2459	0.0018	340.	0.1288	0.0003	340.	0.3490	0.0058
503.	0.1684	0.0086	120.	0.2211	0.0008	503.	0.1220	0.0020	503.	0.3352	0.0056
834.	0.1578	0.0093	180.	0.1877	0.0002	834.	0.1129	0.0009	834.	0.3222	0.0049
334.	0.1619	0.0005									
534.	0.1440	0.0009									
834.	0.1308	0.0001									
BD =	1.55			1.65			1.58			1.60	
N =	2			2			2			2	

DEPTH (CM)

CM	107. CC/CC	SE	CM	107. CC/CC	SE	CM	137. CC/CC	SE	CM	168. CC/CC	SE
24.	0.2938	0.0185	10.	0.3994	0.0019	24.	0.3255	0.0009	24.	0.3534	0.0034
40.	0.2654	0.0168	20.	0.3949	0.0019	40.	0.2254	0.0161	40.	0.1073	0.0042
50.	0.2380	0.0185	30.	0.3775	0.0002	50.	0.1932	0.0196	50.	0.0808	0.0013
62.	0.2160	0.0195	40.	0.3548	0.0020	62.	0.1768	0.0211	62.	0.0702	0.0012
70.	0.2050	0.0200	50.	0.3322	0.0021	70.	0.1689	0.0206	70.	0.0650	0.0017
82.	0.1907	0.0218	60.	0.2688	0.0023	82.	0.1632	0.0206	82.	0.0604	0.0016
98.	0.1862	0.0260	70.	0.2446	0.0034	98.	0.1568	0.0210	98.	0.0559	0.0027
150.	0.1646	0.0227	80.	0.2023	0.0036	150.	0.1460	0.0205	150.	0.0484	0.0026
340.	0.1459	0.0214	100.	0.1683	0.0042	340.	0.1296	0.0190	340.	0.0393	0.0014
503.	0.1382	0.0206	120.	0.1412	0.0022	503.	0.1217	0.0184	503.	0.0370	0.0020
834.	0.1297	0.0182	180.	0.1163	0.0017	834.	0.1160	0.0195	834.	0.0363	0.0014
334.	0.1004	0.0013									
534.	0.0929	0.0002									
834.	0.0868	0.0002									
BD =	1.51			1.60			1.55			1.56	
N =	2			2			2			2	

Table E-2.5 ULEN SERIES SITE E-2 (NDSWC 1985)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.4167	0.	0.02	1.07	0.76E+00	0.76E-03	0.10E+04
0.2	.4061	11.	1.07	0.97	0.83E+00	0.15E-02	0.55E+03
0.2	.3982	19.	1.82	1.00	0.40E+00	0.66E-03	0.61E+03
0.4	.3917	25.	2.47	1.00	0.59E+00	0.16E-02	0.38E+03
0.4	.3841	30.	2.97	1.00	0.55E+00	0.14E-02	0.38E+03
0.6	.3726	39.	3.87	0.90	0.45E+00	0.12E-02	0.37E+03
0.9	.3603	49.	4.77	0.83	0.39E+00	0.17E-02	0.23E+03
1.2	.3477	58.	5.67	0.77	0.33E+00	0.13E-02	0.26E+03
1.7	.3332	68.	6.62	0.70	0.27E+00	0.21E-02	0.13E+03
2.5	.3201	74.	7.22	0.73	0.14E+00	0.23E-02	0.62E+02
3.5	.3110	78.	7.67	0.73	0.46E-01	0.15E-02	0.31E+02
4.5	.3068	82.	8.02	0.77	0.39E-01	0.98E-03	0.40E+02
5.5	.3010	84.	8.27	0.82	0.73E-01	0.78E-02	0.93E+01
6.7	.2908	86.	8.47	0.82	0.78E-01	0.42E-02	0.19E+02
11.2	.2729	91.	8.97	0.83	0.28E-01	0.33E-02	0.85E+01
17.5	.2590	98.	9.57	0.80	0.91E-02	0.96E-03	0.95E+01
22.5	.2545	102.	10.02	0.73	0.89E-02	0.11E-02	0.83E+01
32.5	.2473	108.	10.57	0.67	0.76E-02	0.14E-02	0.53E+01
45.0	.2395	113.	11.07	0.58	0.74E-02	0.19E-02	0.39E+01
* 60.0	.2326	117.	11.47	0.53	0.57E-02	0.16E-02	0.36E+01
80.0	.2255	122.	11.92	0.48	0.48E-02	0.15E-02	0.31E+01
100.0	.2208	126.	12.32	0.43	0.29E-02	0.83E-03	0.35E+01
120.0	.2177	129.	12.62	0.43	0.25E-02	0.14E-02	0.18E+01
175.0	.2140	135.	13.19	0.38	0.31E-04	0.14E-04	0.23E+01
195.0	.2140	137.	13.42	0.23	0.15E-03	0.47E-04	0.33E+01
210.0	.2139	138.	13.49	0.25	0.72E-04	0.95E-04	0.76E+00
230.0	.2138	139.	13.59	0.27	0.34E-03	0.16E-03	0.21E+01
245.0	.2135	140.	13.69	0.28	0.63E-03	0.47E-03	0.13E+01
275.0	.2113	141.	13.87	0.32	0.20E-02	0.14E-02	0.14E+01
325.0	.2087	144.	14.11	0.32	0.45E-03	0.47E-03	0.96E+00
400.0	.2078	147.	14.44	0.27	0.27E-03	0.21E-03	0.13E+01
550.0	.2026	152.	14.94	0.28	0.13E-02	0.17E-02	0.74E+00
750.0	.1970	158.	15.51	0.27	0.24E-03	0.28E-03	0.86E+00
875.0	.1961	162.	15.89	0.18	0.20E-03	0.16E-03	0.12E+01

DOERING 1-STEP DATA

0.2	.1911	265.	26.02	83.33	0.43E-02	0.16E-03	0.26E+02
0.2	.1823	330.	32.38	83.33	0.24E-02	0.11E-03	0.21E+02
0.3	.1756	402.	39.40	83.33	0.14E-02	0.79E-04	0.18E+02
0.3	.1702	482.	47.26	83.33	0.91E-03	0.58E-04	0.16E+02

DEPTH 23. CM SITE E-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.4115	1.	0.07	1.07	0.23E+01	0.91E-03	0.25E+04
0.2	.4008	10.	0.97	0.97	0.25E+01	0.14E-02	0.18E+04
0.2	.3923	18.	1.78	1.00	0.13E+01	0.81E-03	0.16E+04
0.4	.3853	25.	2.46	1.00	0.18E+01	0.15E-02	0.12E+04

DEPTH 23. CM (CONT)

0.4	.3785	30.	2.96	1.00	0.16E+01	0.12E-02	0.13E+04
0.6	.3681	38.	3.75	0.90	0.13E+01	0.13E-02	0.10E+04
0.9	.3568	47.	4.63	0.83	0.12E+01	0.15E-02	0.79E+03
1.2	.3449	56.	5.46	0.77	0.97E+00	0.14E-02	0.72E+03
1.7	.3317	65.	6.38	0.70	0.78E+00	0.17E-02	0.46E+03
2.5	.3206	72.	7.01	0.73	0.40E+00	0.19E-02	0.21E+03
3.5	.3119	76.	7.46	0.73	0.15E+00	0.20E-02	0.78E+02
4.5	.3043	80.	7.84	0.77	0.17E+00	0.21E-02	0.82E+02
5.5	.2966	83.	8.13	0.82	0.20E+00	0.47E-02	0.43E+02
6.7	.2887	85.	8.33	0.82	0.22E+00	0.36E-02	0.60E+02
11.2	.2720	90.	8.83	0.83	0.85E-01	0.31E-02	0.27E+02
17.5	.2575	96.	9.41	0.80	0.29E-01	0.14E-02	0.21E+02
22.5	*.2516	100.	9.81	0.73	0.31E-01	0.15E-02	0.20E+02
32.5	.2430	105.	10.31	0.67	0.24E-01	0.18E-02	0.13E+02
45.0	.2347	110.	10.75	0.58	0.22E-01	0.21E-02	0.11E+02
60.0	.2280	113.	11.11	0.53	0.17E-01	0.17E-02	0.98E+01
80.0	.2222	118.	11.52	0.48	0.13E-01	0.10E-02	0.13E+02
100.0	.2189	121.	11.88	0.43	0.83E-02	0.81E-03	0.10E+02
120.0	.2164	124.	12.18	0.43	0.69E-02	0.85E-03	0.81E+01
195.0	.2112	131.	12.83	0.23	0.12E-02	0.26E-03	0.45E+01
210.0	.2110	132.	12.92	0.25	0.54E-03	0.35E-03	0.16E+01
230.0	.2106	133.	13.03	0.27	0.14E-02	0.31E-03	0.43E+01
245.0	.2102	134.	13.14	0.28	0.19E-02	0.32E-03	0.60E+01
275.0	.2088	136.	13.34	0.32	0.54E-02	0.84E-03	0.65E+01
325.0	.2070	139.	13.59	0.32	0.13E-02	0.47E-03	0.28E+01
400.0	.2056	142.	13.88	0.27	0.11E-02	0.47E-03	0.23E+01
550.0	.2008	147.	14.39	0.28	0.36E-02	0.12E-02	0.29E+01
750.0	.1960	153.	14.95	0.27	0.72E-03	0.35E-03	0.20E+01
875.0	.1949	156.	15.26	0.18	0.69E-03	0.28E-03	0.24E+01

DOERING 1-STEP DATA

0.0	.1760	235.	23.02	83.33	0.10E-01	0.24E-03	0.43E+02
0.0	.1730	248.	24.32	83.33	0.91E-02	0.22E-03	0.42E+02
0.0	.1700	263.	25.75	83.33	0.81E-02	0.20E-03	0.41E+02
0.0	.1670	279.	27.34	83.33	0.72E-02	0.18E-03	0.41E+02
0.1	.1640	297.	29.11	83.33	0.63E-02	0.16E-03	0.41E+02
0.1	.1610	317.	31.11	83.33	0.56E-02	0.14E-03	0.40E+02
0.1	.1580	340.	33.38	83.33	0.49E-02	0.12E-03	0.40E+02
0.1	.1550	367.	35.96	83.33	0.42E-02	0.11E-03	0.40E+02
0.1	.1520	397.	38.93	83.33	0.36E-02	0.92E-04	0.40E+02
0.1	.1490	432.	42.37	83.33	0.31E-02	0.79E-04	0.39E+02
0.1	.1460	473.	46.41	83.33	0.26E-02	0.67E-04	0.39E+02

DEPTH 38. CM SITE E-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3920	5.	0.48	1.48	0.26E+01	0.92E-03	0.28E+04
0.2	.3851	11.	1.11	1.21	0.31E+01	0.11E-02	0.28E+04
0.2	.3791	18.	1.77	0.97	0.23E+01	0.83E-03	0.27E+04
0.4	.3741	24.	2.34	0.84	0.32E+01	0.10E-02	0.31E+04
0.4	.3696	28.	2.79	0.77	0.31E+01	0.97E-03	0.32E+04
0.6	.3628	35.	3.46	0.70	0.25E+01	0.96E-03	0.26E+04
0.9	.3552	43.	4.24	0.65	0.23E+01	0.11E-02	0.22E+04
1.2	.3469	51.	5.03	0.65	0.17E+01	0.10E-02	0.17E+04
1.7	.3374	60.	5.88	0.64	0.13E+01	0.13E-02	0.10E+04
2.5	.3290	66.	6.48	0.57	0.78E+00	0.15E-02	0.51E+03
3.5	.3219	71.	6.96	0.60	0.33E+00	0.14E-02	0.23E+03

DEPTH	38.	CM	(CONT)					
4.5	.3115	76.	7.41	0.67	0.48E+00	0.30E-02	0.16E+03
5.5	.3001	79.	7.73	0.65	0.41E+00	0.61E-02	0.67E+02
11.2	.2771	86.	8.41	0.60	0.23E+00	0.59E-02	0.39E+02
17.5	.2530	91.	8.91	0.54	0.79E-01	0.24E-02	0.33E+02
22.5	.2459	94.	9.24	0.50	0.85E-01	0.20E-02	0.42E+02
32.5	.2370	98.	9.63	0.44	0.61E-01	0.24E-02	0.26E+02
45.0	.2288	102.	9.97	0.39	0.56E-01	0.25E-02	0.22E+02
60.0	.2222	105.	10.28	0.37	0.41E-01	0.19E-02	0.21E+02
80.0	.2166	108.	10.62	0.32	0.28E-01	0.13E-02	0.22E+02
100.0	.2131	111.	10.85	0.20	0.30E-01	0.18E-02	0.17E+02
120.0	.2107	113.	11.05	0.07	0.63E-01	0.59E-03	0.11E+03
DEPTH	46.	CM					
195.0	.2048	116.	11.40	0.44	0.35E-02	0.94E-03	0.37E+01
210.0	.2042	117.	11.48	0.43	0.14E-02	0.63E-03	0.22E+01
230.0	.2037	118.	11.57	0.41	0.24E-02	0.47E-03	0.51E+01
245.0	.2031	119.	11.67	0.39	0.41E-02	0.79E-03	0.52E+01
275.0	.2023	121.	11.83	0.35	0.70E-02	0.43E-03	0.16E+02
325.0	.2013	123.	12.03	0.32	0.25E-02	0.55E-03	0.45E+01
400.0	.1990	125.	12.26	0.31	0.33E-02	0.12E-02	0.28E+01
550.0	.1935	130.	12.75	0.28	0.66E-02	0.11E-02	0.58E+01
750.0	.1889	136.	13.33	0.30	0.13E-02	0.38E-03	0.36E+01

DOERING 1-STEP DATA

0.5	.1758	130.	12.76	83.33	0.10E-01	0.55E-03	0.18E+02
0.5	.1664	150.	14.68	83.33	0.69E-02	0.42E-03	0.17E+02
0.6	.1584	172.	16.84	83.33	0.49E-02	0.32E-03	0.15E+02
0.6	.1514	197.	19.28	83.33	0.34E-02	0.25E-03	0.14E+02
0.7	.1452	225.	22.07	83.33	0.25E-02	0.19E-03	0.13E+02
0.7	.1397	258.	25.29	83.33	0.18E-02	0.15E-03	0.12E+02
0.8	.1348	296.	29.05	83.33	0.13E-02	0.11E-03	0.11E+02
0.8	.1304	342.	33.50	83.33	0.90E-03	0.85E-04	0.11E+02
0.9	.1264	396.	38.84	83.33	0.64E-03	0.64E-04	0.10E+02

DEPTH 53. CM SITE E-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3860	6.	0.64	0.83	0.56E+01	0.56E-03	0.99E+04
0.2	.3831	12.	1.15	0.80	0.55E+01	0.65E-03	0.85E+04
0.2	.3808	16.	1.60	0.80	0.35E+01	0.41E-03	0.84E+04
0.4	.3789	21.	2.04	0.77	0.41E+01	0.51E-03	0.81E+04
0.4	.3766	24.	2.39	0.70	0.42E+01	0.81E-03	0.52E+04
0.6	.3725	28.	2.77	0.38	0.56E+01	0.11E-02	0.49E+04
0.9	.3681	35.	3.43	0.33	0.56E+01	0.37E-03	0.15E+05
1.2	.3631	44.	4.35	0.45	0.31E+01	0.76E-03	0.41E+04
1.7	.3567	52.	5.06	0.28	0.38E+01	0.12E-02	0.31E+04
2.5	.3501	57.	5.54	0.20	0.28E+01	0.15E-02	0.19E+04
3.5	.3426	61.	6.00	0.15	0.20E+01	0.17E-02	0.12E+04
4.5	.3300	67.	6.54	0.20	0.28E+01	0.28E-02	0.10E+04
5.5	.3179	71.	6.93	0.30	0.13E+01	0.49E-02	0.26E+03
11.2	.2908	78.	7.68	0.43	0.52E+00	0.64E-02	0.82E+02
17.5	.2586	84.	8.23	0.55	0.14E+00	0.52E-02	0.28E+02
22.5	.2463	87.	8.53	0.55	0.12E+00	0.29E-02	0.42E+02
32.5	.2370	90.	8.84	0.50	0.75E-01	0.31E-02	0.25E+02
45.0	.2282	93.	9.12	0.47	0.67E-01	0.34E-02	0.20E+02
60.0	.2203	96.	9.43	0.48	0.44E-01	0.21E-02	0.21E+02
80.0	.2127	100.	9.78	0.55	0.23E-01	0.22E-02	0.10E+02
100.0	.2075	102.	10.02	0.67	0.14E-01	0.21E-02	0.64E+01
120.0	.2044	104.	10.20	0.77	0.70E-02	0.13E-02	0.56E+01

DEPTH	76. CM		SITE E-2				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3724	4.	0.35	0.89	0.57E+01	0.38E-03	0.15E+05
0.2	.3711	7.	0.69	0.82	0.58E+01	0.38E-03	0.15E+05
0.2	.3701	11.	1.07	0.77	0.39E+01	0.14E-03	0.29E+05
0.4	.3695	14.	1.40	0.72	0.48E+01	0.32E-03	0.15E+05
0.4	.3685	17.	1.65	0.69	0.48E+01	0.43E-03	0.11E+05
0.6	.3666	20.	1.93	0.75	0.33E+01	0.10E-02	0.31E+04
0.9	.3646	24.	2.39	0.65	0.32E+01	0.15E-03	0.22E+05
1.2	.3623	31.	3.04	0.45	0.35E+01	0.53E-03	0.67E+04
1.7	.3592	36.	3.57	0.41	0.30E+01	0.75E-03	0.41E+04
2.5	.3560	40.	3.92	0.37	0.18E+01	0.10E-02	0.18E+04
3.5	.3503	44.	4.28	0.33	0.15E+01	0.21E-02	0.72E+03
4.5	.3405	49.	4.76	0.27	0.33E+01	0.20E-02	0.17E+04
5.5	.3336	52.	5.13	0.22	0.22E+01	0.15E-02	0.14E+04
6.7	.3296	54.	5.32	0.18	0.15E+01	0.23E-02	0.64E+03
11.2	.3157	59.	5.80	0.12	0.27E+01	0.30E-02	0.92E+03
17.5	.2974	65.	6.34	0.06	0.25E+01	0.44E-02	0.58E+03
22.5	.2870	68.	6.62	0.04	0.23E+01	0.30E-02	0.78E+03
32.5	.2782	70.	6.86	0.02	0.32E+01	0.43E-02	0.74E+03
175.0	.2434	91.	8.92	0.05	0.56E-02	0.24E-03	0.23E+02
195.0	.2427	93.	9.11	0.07	0.55E-01	0.14E-02	0.39E+02
210.0	.2417	94.	9.20	0.09	0.20E-01	0.96E-03	0.21E+02
230.0	.2405	95.	9.32	0.12	0.20E-01	0.12E-02	0.17E+02
245.0	.2393	96.	9.39	0.12	0.37E-01	0.24E-02	0.15E+02
*400.0	.2322	103.	10.08	0.24	0.87E-02	0.13E-02	0.68E+01
550.0	.2268	107.	10.49	0.22	0.14E-01	0.13E-02	0.11E+02
750.0	.2215	113.	11.03	0.18	0.47E-02	0.68E-03	0.68E+01

DEPTH	104. CM		SITE E-2				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.3331	7.	0.67	1.70	0.31E+01	0.46E-06	0.67E+07
0.2	.3328	10.	0.98	1.62	0.31E+01	0.31E-03	0.10E+05
0.2	.3321	13.	1.28	1.51	0.21E+01	0.61E-03	0.35E+04
0.4	.3298	17.	1.63	1.36	0.29E+01	0.32E-02	0.93E+03
0.6	.3259	19.	1.87	1.24	0.22E+01	0.13E-02	0.17E+04
0.9	.3230	22.	2.12	1.14	0.20E+01	0.12E-02	0.17E+04
1.2	.3208	25.	2.44	1.08	0.16E+01	0.56E-03	0.29E+04
1.7	.3184	29.	2.88	1.07	0.13E+01	0.52E-03	0.25E+04
2.5	.3160	33.	3.23	1.11	0.68E+00	0.90E-03	0.76E+03
3.5	.3134	36.	3.50	1.08	0.59E+00	0.11E-02	0.56E+03
4.5	.3111	39.	3.80	1.00	0.11E+01	0.66E-03	0.16E+04
5.5	.3092	41.	4.07	0.97	0.53E+00	0.98E-03	0.54E+03
6.7	.3073	43.	4.21	0.97	0.36E+00	0.14E-02	0.25E+03
11.2	.3008	46.	4.55	0.92	0.41E+00	0.21E-02	0.19E+03
17.5	.2936	50.	4.91	0.85	0.23E+00	0.16E-02	0.14E+03
22.5	.2896	52.	5.12	0.82	0.16E+00	0.22E-02	0.72E+02
32.5	.2825	54.	5.34	0.83	0.88E-01	0.44E-02	0.20E+02
45.0	.2747	57.	5.55	0.84	0.76E-01	0.28E-02	0.27E+02
60.0	.2679	59.	5.81	0.79	0.55E-01	0.25E-02	0.22E+02
80.0	.2610	62.	6.12	0.72	0.38E-01	0.18E-02	0.21E+02
100.0	.2566	65.	6.39	0.68	0.27E-01	0.13E-02	0.20E+02
120.0	.2535	68.	6.63	0.67	0.18E-01	0.13E-02	0.14E+02
195.0	.2522	73.	7.19	0.51	0.11E-01	0.68E-03	0.15E+02
210.0	.2514	74.	7.30	0.50	0.71E-02	0.80E-03	0.88E+01
230.0	.2502	76.	7.42	0.48	0.84E-02	0.12E-02	0.70E+01
245.0	.2491	77.	7.51	0.49	0.15E-01	0.13E-02	0.12E+02

DEPTH	104.	CM	(CONT)				
275.0	.1767	79.	7.75	0.43	0.29E+00	0.34E-01	0.87E+01
400.0	.2423	83.	8.12	0.31	0.94E-02	0.12E-02	0.77E+01
550.0	.2387	86.	8.38	0.23	0.17E-01	0.13E-02	0.12E+02
750.0	.2342	89.	8.73	0.14	0.96E-02	0.12E-02	0.83E+01

DOERING 1-STEP DATA

0.0	.1613	111.	10.85	83.33	0.72E-02	0.10E-02	0.69E+01
0.0	.1583	114.	11.15	83.33	0.67E-02	0.96E-03	0.69E+01
0.1	.1553	117.	11.47	83.33	0.62E-02	0.90E-03	0.69E+01
0.1	.1523	120.	11.80	83.33	0.58E-02	0.84E-03	0.69E+01
0.2	.1493	124.	12.17	83.33	0.53E-02	0.78E-03	0.69E+01
0.2	.1463	128.	12.56	83.33	0.49E-02	0.72E-03	0.69E+01
0.3	.1433	132.	12.99	83.33	0.46E-02	0.66E-03	0.69E+01
0.3	.1403	137.	13.45	83.33	0.42E-02	0.61E-03	0.69E+01
0.4	.1373	142.	13.96	83.33	0.38E-02	0.56E-03	0.69E+01
0.4	.1343	148.	14.51	83.33	0.35E-02	0.50E-03	0.69E+01
0.5	.1313	154.	15.12	83.33	0.32E-02	0.46E-03	0.70E+01
0.5	.1283	161.	15.80	83.33	0.29E-02	0.41E-03	0.70E+01
0.6	.1253	169.	16.57	83.33	0.26E-02	0.36E-03	0.71E+01
0.6	.1223	178.	17.42	83.33	0.23E-02	0.32E-03	0.71E+01
0.7	.1193	188.	18.40	83.33	0.20E-02	0.28E-03	0.72E+01
0.8	.1163	199.	19.52	83.33	0.18E-02	0.24E-03	0.73E+01
0.8	.1133	212.	20.83	83.33	0.15E-02	0.21E-03	0.73E+01
0.9	.1103	228.	22.37	83.33	0.13E-02	0.17E-03	0.74E+01
0.9	.1073	247.	24.23	83.33	0.11E-02	0.14E-03	0.75E+01
1.0	.1043	271.	26.53	83.33	0.88E-03	0.11E-03	0.77E+01
1.1	.1013	300.	29.44	83.33	0.69E-03	0.89E-04	0.78E+01
1.1	.0983	340.	33.29	83.33	0.52E-03	0.66E-04	0.79E+01
1.2	.0953	394.	38.66	83.33	0.37E-03	0.45E-04	0.81E+01
1.3	.0923	478.	46.83	83.33	0.23E-03	0.28E-04	0.83E+01

DEPTH	135.	CM	WITE E-2				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.2	.2814	24.	2.39	1.19	0.31E+01	0.54E-02	0.58E+03
0.4	.2799	25.	2.42	1.20	0.31E+01	0.27E-02	0.11E+04
0.4	.2770	25.	2.46	1.20	0.44E+01	0.97E-02	0.46E+03
0.6	.2709	26.	2.54	1.20	0.28E+01	0.72E-02	0.38E+03
0.9	.2655	27.	2.64	1.20	0.22E+01	0.36E-02	0.62E+03
1.2	.2600	29.	2.84	1.17	0.18E+01	0.25E-02	0.73E+03
1.7	.2535	32.	3.16	1.11	0.15E+01	0.18E-02	0.84E+03
2.5	.2463	35.	3.47	1.05	0.90E+00	0.31E-02	0.29E+03
3.5	.2396	37.	3.65	1.02	0.73E+00	0.65E-02	0.11E+03
4.5	.2363	39.	3.79	0.99	0.12E+01	0.89E-03	0.13E+04
5.5	.2332	40.	3.94	0.95	0.65E+00	0.45E-02	0.14E+03
6.7	.2284	41.	4.03	0.91	0.47E+00	0.57E-02	0.82E+02
11.2	.2177	43.	4.21	0.86	0.51E+00	0.57E-02	0.89E+02
17.5	.2071	45.	4.43	0.83	0.27E+00	0.32E-02	0.86E+02
22.5	.2025	47.	4.58	0.82	0.19E+00	0.30E-02	0.64E+02
32.5	.1953	49.	4.76	0.80	0.12E+00	0.44E-02	0.27E+02
45.0	.1880	50.	4.93	0.77	0.10E+00	0.36E-02	0.29E+02
60.0	.1831	52.	5.09	0.74	0.72E-01	0.26E-02	0.28E+02
80.0	.1785	54.	5.28	0.72	0.48E-01	0.23E-02	0.21E+02
100.0	.1752	55.	5.43	0.69	0.33E-01	0.17E-02	0.19E+02
120.0	.1726	57.	5.59	0.65	0.25E-01	0.15E-02	0.17E+02
195.0	.1713	60.	5.92	0.62	0.12E-01	0.14E-02	0.89E+01
210.0	.1702	61.	6.00	0.62	0.87E-02	0.12E-02	0.73E+01

DEPTH	135.	CM	(CONT)				
230.0	.1693	62.	6.09	0.61	0.86E-02	0.63E-03	0.13E+02
245.0	.1689	63.	6.15	0.59	0.16E-01	0.76E-03	0.21E+02
275.0	.1677	64.	6.29	0.57	0.29E+00	0.90E-03	0.32E+03
400.0	.1648	66.	6.50	0.56	0.62E-02	0.10E-02	0.59E+01
550.0	.1626	69.	6.72	0.59	0.75E-02	0.10E-02	0.73E+01
750.0	.1599	71.	6.97	0.59	0.31E-02	0.11E-02	0.29E+01

DOERING 1-STEP DATA

0.6	.1579	126.	12.37	83.33	0.40E-02	0.37E-03	0.11E+02
0.6	.1539	138.	13.54	83.33	0.31E-02	0.31E-03	0.99E+01
0.7	.1502	151.	14.78	83.33	0.25E-02	0.27E-03	0.92E+01
0.7	.1469	164.	16.09	83.33	0.20E-02	0.23E-03	0.86E+01
0.8	.1439	178.	17.47	83.33	0.16E-02	0.20E-03	0.81E+01
0.8	.1412	193.	18.94	83.33	0.13E-02	0.17E-03	0.76E+01
0.9	.1387	209.	20.50	83.33	0.11E-02	0.15E-03	0.72E+01
0.9	.1364	226.	22.17	83.33	0.87E-03	0.13E-03	0.68E+01
1.0	.1342	244.	23.96	83.33	0.72E-03	0.11E-03	0.65E+01
1.0	.1322	264.	25.88	83.33	0.59E-03	0.96E-04	0.62E+01
1.1	.1303	285.	27.94	83.33	0.49E-03	0.83E-04	0.59E+01
1.1	.1286	308.	30.17	83.33	0.41E-03	0.72E-04	0.57E+01
1.2	.1269	332.	32.58	83.33	0.34E-03	0.63E-04	0.54E+01
1.2	.1254	359.	35.20	83.33	0.28E-03	0.54E-04	0.52E+01
1.3	.1239	388.	38.05	83.33	0.24E-03	0.47E-04	0.50E+01
1.3	.1225	420.	41.16	83.33	0.20E-03	0.41E-04	0.49E+01
1.4	.1212	455.	44.58	83.33	0.17E-03	0.35E-04	0.47E+01
1.4	.1199	493.	48.35	83.33	0.14E-03	0.30E-04	0.45E+01

DEPTH	168.	CM	SITE E-2				
TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.6	.2569	30.	2.91	1.00	0.40E+01	0.13E-01	0.32E+03
0.9	.2533	30.	2.95	0.95	0.34E+01	0.63E-02	0.53E+03
1.2	.2489	31.	3.01	0.90	0.29E+01	0.68E-02	0.42E+03
1.7	.2416	32.	3.11	0.83	0.25E+01	0.76E-02	0.33E+03
2.5	.2306	33.	3.28	0.82	0.16E+01	0.55E-02	0.29E+03
3.5	.2189	36.	3.55	0.91	0.11E+01	0.36E-02	0.30E+03
4.5	.2112	39.	3.86	1.07	0.12E+01	0.16E-02	0.76E+03
5.5	.2058	42.	4.10	1.17	0.66E+00	0.43E-02	0.15E+03
6.7	.1996	43.	4.20	1.22	0.46E+00	0.78E-02	0.58E+02
11.2	.1894	45.	4.39	1.29	0.39E+00	0.43E-02	0.91E+02
17.5	.1721	47.	4.60	1.32	0.23E+00	0.17E-01	0.14E+02
22.5	.1586	48.	4.74	1.33	0.14E+00	0.38E-02	0.38E+02
32.5	.1500	50.	4.91	1.35	0.87E-01	0.58E-02	0.15E+02
45.0	.1419	52.	5.05	1.36	0.69E-01	0.60E-02	0.11E+02
60.0	.1382	53.	5.17	1.35	0.45E-01	0.19E-02	0.24E+02
80.0	.1351	54.	5.29	1.33	0.31E-01	0.33E-02	0.92E+01
100.0	.1321	55.	5.38	1.32	0.20E-01	0.35E-02	0.58E+01
120.0	.1294	56.	5.46	1.31	0.16E-01	0.38E-02	0.42E+01
195.0	.1245	56.	5.47	1.12	0.43E-02	0.95E-03	0.45E+01
230.0	.1244	52.	5.12	0.79	0.71E-02	0.12E-05	0.60E+04
245.0	.1241	53.	5.19	0.81	0.14E-01	0.77E-03	0.18E+02
275.0	.1220	55.	5.34	0.85	0.20E+00	0.16E-02	0.12E+03
400.0	.1173	57.	5.63	0.90	0.44E-02	0.64E-03	0.69E+01
550.0	.1150	61.	6.01	0.98	0.50E-02	0.58E-03	0.87E+01
750.0	.1125	65.	6.40	1.07	0.20E-02	0.79E-03	0.25E+01

DEPTH	198.	CM	SITE E-2				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.6	.2675	26.	2.53	0.76	0.58E+01	0.21E-01	0.27E+03
0.9	.2656	26.	2.56	0.79	0.44E+01	0.32E-02	0.14E+04
1.2	.2630	27.	2.61	0.83	0.35E+01	0.90E-02	0.38E+03
1.7	.2576	27.	2.67	0.87	0.29E+01	0.11E-01	0.26E+03
2.5	.2479	29.	2.82	0.87	0.20E+01	0.52E-02	0.38E+03
3.5	.2360	32.	3.13	0.82	0.16E+01	0.28E-02	0.57E+03
4.5	.2271	36.	3.49	0.70	0.21E+01	0.19E-02	0.11E+04
5.5	.2224	38.	3.77	0.62	0.15E+01	0.13E-02	0.12E+04
6.7	.2182	40.	3.95	0.62	0.11E+01	0.45E-02	0.24E+03
11.2	.2066	42.	4.12	0.54	0.10E+01	0.70E-02	0.15E+03
17.5	.1856	44.	4.31	0.49	0.91E+00	0.16E-01	0.55E+02
22.5	.1694	45.	4.45	0.48	0.48E+00	0.62E-02	0.76E+02
32.5	.1578	47.	4.57	0.44	0.33E+00	0.10E-01	0.32E+02
45.0	.1473	48.	4.70	0.43	0.26E+00	0.55E-02	0.47E+02
60.0	.1424	49.	4.80	0.43	0.16E+00	0.45E-02	0.34E+02
80.0	.1381	50.	4.88	0.42	0.11E+00	0.54E-02	0.21E+02
100.0	.1345	51.	4.98	0.43	0.74E-01	0.31E-02	0.24E+02
120.0	.1313	52.	5.06	0.44	0.58E-01	0.67E-02	0.87E+01
230.0	.1308	47.	4.63	0.88	0.69E-02	0.64E-03	0.11E+02
245.0	.1302	48.	4.70	0.86	0.15E-01	0.95E-03	0.16E+02
275.0	.1276	49.	4.84	0.82	0.21E+00	0.23E-02	0.91E+02
400.0	.1224	52.	5.11	0.75	0.60E-02	0.77E-03	0.79E+01
550.0	.1197	55.	5.43	0.64	0.85E-02	0.85E-03	0.10E+02
750.0	.1163	59.	5.79	0.54	0.48E-02	0.96E-03	0.50E+01

SITE F (ARVESON SERIES)

Site F was located in a nonirrigated wheat field. The location and description are summarized on Table 1. According to the La Moure County (ND) Soil Survey Report (USDA, 1971) the Arveson soil series consists of "poorly drained and very poorly drained, calcareous soils on sandy uplands". They were "formed in moderately coarse-textured and coarse-textured deposits left by glacial melt water ". Arveson soils are associated with Hamar, Maddock, and Ulen soils. The specific site measured (location Fig. 2) was located in a depression at the base of a lengthy toposequence, which included a Hecla soil (site D) at crest and a Ulen soil (site E) at the toeslope.

In-situ measurements and site descriptions were made during late June and July, 1985. The measurment period was concurrent with sites D and E which were located nearby, and also site G which was located approximately 3.25 miles (7 km) northeast of the field location. Soil samples and soil profile descriptions were collected approximately 4 weeks after hydraulic measurements were completed. Although measurements were made for more than two weeks, drainage was approximately complete at 7 days.

Infiltration and soil-water suction profiles during wetting were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

Measurements were possible, despite the poorly drained classification, because of recently-installed tile drains within a few feet of the measurement site, which maintained reasonably deep water table conditions. Water was at approximately 5.5 to 6 feet below land surface.

The topsoil contained much organic matter from erosion and long-term development under waterlogged conditions, and also contained a highly compacted plow pan, which resulted in small hydraulic gradients near the surface. Surface $K(\theta,\psi)$ measurements were considered to be unreliable and were discarded. Underlying layers are considered to be most accurate in slightly drier water content ranges, where the overlying plow pan would not be saturated.

SITE F, REPLICATION 1

Table F-1.1. Soil morphologic data for Site F, replication 1.

Site and Location: F-1 Arveson, Oakes Aquifer 520 feet south and 470 feet west of the east quarter corner of Section 9, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 08/02/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Arveson sandy loam; coarse-loamy, frigid Typic Calciaquoll

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: F-l north side of pit.

Ap 0-7 inches (0-18 cm) black (lOYR 2/1) sandy loam (fine sandy loam), dark gray (lOYR 4/1, dry); moderate coarse and medium granular struc- ture; soft, very friable, slightly sticky and slightly plastic; many very fine roots, strong to violent effervescence; abrupt smooth boundary.

Ak 7-12 inches (18-30 cm) black (lOYR 2/1) sandy loam (fine sandy loam), dark gray (lOYR 4/1, dry); moderate coarse prismatic parting to moderate medium and fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; violent effervescence; clear smooth boundary.

Bk 12-23 inches (30-58 cm) gray (2.5Y 5/0) sandy loam (fine sandy loam), light gray (2.5Y 7/0, dry); moderate coarse prismatic parting to moderate medium and fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; violent effervescence; clear smooth boundary.

Cl 23-40 inches (58-102 cm) pale olive (5Y 6/3) sand (fine sand), light gray (5Y 7/2, dry) with common manganese pellets at 34 inches and discontinuous organic staining on prism faces; very weak very coarse prismatic structure; soft, very friable to loose, nonsticky and nonplastic; few very fine roots; very slight effervescence; clear wavy boundary.

C2g 40-55 inches (102-140 cm) pale olive (5Y 6/3) sand (fine sand), white (5Y 8/2, dry) with many medium prominent brown and strong brown (7.5YR 4/4 and 5/6) and common medium prominent very dark brown (lOYR 2/2) mottles and discontinuous organic staining on prism faces; very weak very coarse prismatic structure; very friable to loose, nonsticky and nonplastic; clear smooth boundary.

C3 55-64 inches (140-163 cm) dark gray and very dark gray (lOYR 4/1 and 3/1) sandy loam (fine sand), gray (lOYR 6/1 and 5/1, dry); massive; soft, soft very friable, slightly sticky and slightly plastic.

Table F-1.2 ARVESON SERIES SITE F-1 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.	11.5	9.3	10.3	17.2	34.0	15.2	2.4	0.1
23.	12.9	9.6	8.4	15.7	33.3	16.5	3.4	0.1
38.	20.0	10.5	5.9	14.5	35.7	11.5	1.8	0.0
53.	14.2	2.2	5.8	16.6	47.2	12.2	1.8	0.0
76.	6.4	1.8	2.8	20.2	50.2	15.4	2.9	0.1
107.	2.8	2.2	3.0	2.6	60.7	28.1	0.4	0.1
137.	3.9	4.7	4.0	2.5	51.6	32.8	0.5	0.0
167.	1.7	2.6	2.4	3.0	51.3	37.7	1.3	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON		
8.	68.9	19.6	11.5	A	6	6=p
23.	69.1	18.0	12.9	A	10	8=g
38.	63.6	16.4	20.0	B	10	10=k
53.	77.8	8.0	14.2	B	10	
76.	89.0	4.6	6.4	C 1		
107.	92.0	5.2	2.8	C 2	8	
137.	87.4	8.7	3.9	C 2	8	
167.	93.3	5.0	1.7	C 3		

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	3.515	0.0637	6.1	0.0104	0.468	1.36	2.49
23.	3.833	0.0630	6.7	0.0094	0.446	1.44	2.03
38.	3.872	0.0421	8.3	0.0051	0.412	1.52	0.75
53.	9.725	0.0705	6.5	0.0108	0.685	1.62	0.23
76.	19.304	0.1137	4.2	0.0273	0.942	1.72	0.04
107.	17.673	0.1661	3.0	0.0559	1.472	1.55	0.04
137.	10.046	0.1492	3.7	0.0405	1.108	1.41	0.04
167.	18.660	0.1900	2.7	0.0708	1.353	1.43	0.04

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	2.303	1.881	-0.8411	1.9981	-8.41	0.62
23.	2.216	1.903	-0.8526	2.0010	-8.53	0.62
38.	2.145	2.049	-0.7857	1.8415	-7.86	0.46
53.	1.506	3.038	-1.0388	2.2562	-10.39	0.88
76.	1.207	5.075	-1.2142	2.5752	-12.14	1.19
107.	1.276	8.397	-1.2538	2.6651	-12.54	1.28
137.	1.571	6.036	-1.1688	2.5346	-11.69	1.15
167.	1.257	7.584	-1.2747	2.7057	-12.75	1.33

Table F-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site F, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
			Saturation Extract Soluble Ions meq/l					
0 - 15	3.01	5.35	1.11	0.30	-	5.12	0.30	4.36
15 - 30	2.71	5.12	1.16	0.32	-	5.48	0.25	3.58
30 - 46	1.16	2.31	2.33	0.03	-	3.68	0.25	1.90
46 - 61	0.60	0.87	5.48	0.01	-	4.30	0.25	2.21
61 - 91	0.43	0.59	4.73	0.02	-	3.58	0.20	1.75
..91 - 122	0.56	0.34	3.57	0.05	-	3.02	0.25	1.25
122 - 152	0.99	0.24	2.77	0.06	-	2.44	0.15	1.47
152 - 182	1.08	0.64	1.60	0.09	-	1.88	0.15	1.37

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.78	0.54	47	8.1	-	fsl	10.93
15 - 30	0.79	0.58	42	8.1	3.0	fsl	10.07
30 - 46	0.46	1.77	36	8.2	14.3	fsl	9.33
46 - 61	0.55	6.40	29	8.5	7.0	fsl	5.35
61 - 91	0.48	6.62	25	8.6	-	fs	3.70
..91 - 122	0.36	5.33	22	8.2	-	fs	2.86
122 - 152	0.33	3.54	25	8.0	-	fs	5.80
152 - 182	0.30	1.72	25	7.8	-	fs	3.42

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
24.	0.5381	0.0541	24.	0.4101	0.0653	10.	0.4352	0.0384	10.	0.3327	0.0006
40.	0.4970	0.0228	40.	0.3870	0.0518	20.	0.4293	0.0394	20.	0.3259	0.0004
50.	0.4666	0.0088	50.	0.3732	0.0466	30.	0.4025	0.0330	30.	0.2981	0.0019
62.	0.4376	0.0001	62.	0.3573	0.0429	40.	0.3458	0.0053	40.	0.2818	0.0037
70.	0.4140	0.0051	70.	0.3507	0.0419	50.	0.3205	0.0022	50.	0.2696	0.0046
82.	0.3926	0.0085	82.	0.3396	0.0405	60.	0.2997	0.0023	60.	0.2458	0.0050
98.	0.3697	0.0078	98.	0.3291	0.0387	70.	0.2952	0.0023	70.	0.2357	0.0045
150.	0.3231	0.0058	150.	0.3038	0.0347	80.	0.2826	0.0029	80.	0.2200	0.0030
340.	0.2706	0.0058	340.	0.2679	0.0325	100.	0.2730	0.0035	100.	0.2024	0.0029
503.	0.2529	0.0056	503.	0.2532	0.0314	120.	0.2633	0.0031	120.	0.1854	0.0004
835.	0.2411	0.0097	835.	0.2426	0.0332	180.	0.2411	0.0032	180.	0.1623	0.0026
334.	0.2196	0.0028	334.	0.1446	0.0036						
554.	0.2070	0.0024	554.	0.1378	0.0037						
834.	0.1951	0.0035	834.	0.1235	0.0033						
BD =	1.36			1.44			1.52			1.62	
N =	2			2			2			2	

DEPTH (CM)

	76.			107.			137.			168.	
10.	0.4211	0.0012	10.	0.3799	0.0052	10.	0.4204	0.0011	24.	0.3709	0.0024
20.	0.4141	0.0005	20.	0.3749	0.0046	20.	0.4100	0.0001	40.	0.2439	0.0002
30.	0.4009	0.0011	30.	0.3416	0.0046	30.	0.3842	0.0020	50.	0.1548	0.0148
40.	0.3782	0.0028	40.	0.2516	0.0039	40.	0.2695	0.0006	62.	0.1320	0.0158
50.	0.3525	0.0034	50.	0.2089	0.0027	50.	0.2363	0.0007	70.	0.1206	0.0157
60.	0.2573	0.0059	60.	0.1594	0.0003	60.	0.2061	0.0003	82.	0.1106	0.0157
70.	0.2246	0.0049	70.	0.1495	0.0005	70.	0.2002	0.0004	98.	0.1063	0.0157
80.	0.1809	0.0017	80.	0.1381	0.0006	80.	0.1929	0.0005	150.	0.0935	0.0147
100.	0.1450	0.0029	100.	0.1296	0.0007	100.	0.1848	0.0011	340.	0.0828	0.0132
120.	0.1256	0.0013	120.	0.1225	0.0008	120.	0.1774	0.0012	503.	0.0785	0.0122
180.	0.1045	0.0008	180.	0.1112	0.0010	180.	0.1671	0.0013	835.	0.0756	0.0112
334.	0.0905	0.0008	334.	0.1020	0.0006	334.	0.1545	0.0020			
554.	0.0827	0.0009	554.	0.0971	0.0002	554.	0.1457	0.0022			
834.	0.0796	0.0013	834.	0.0879	0.0002	834.	0.1413	0.0001			
BD =	1.72			1.55			1.41			1.43	
N =	2			2			2			2	

Table F-1.5 ARVESON SERIES SITE F-1 (NDSWC 1985)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETER

DEPTH 38. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3761	1.	0.14	1.21	0.12E+00	0.38E-03	0.31E+03
0.7	.3752	4.	0.40	1.23	0.13E+00	0.14E-03	0.94E+03
1.5	.3738	17.	1.63	1.23	0.16E+00	0.96E-04	0.16E+04
2.5	.3711	34.	3.31	1.15	0.22E+00	0.34E-03	0.65E+03
3.5	.3675	42.	4.13	0.99	0.27E+00	0.71E-03	0.37E+03
4.5	.3637	47.	4.56	0.78	0.46E+00	0.11E-02	0.42E+03
7.5	.3541	51.	5.03	0.62	0.22E+00	0.26E-02	0.83E+02
15.0	.3440	58.	5.71	0.57	0.74E-01	0.62E-03	0.12E+03
30.0	.3369	68.	6.67	0.54	0.35E-01	0.80E-03	0.43E+02
50.0	.3294	77.	7.55	0.40	0.27E-01	0.99E-03	0.27E+02
70.0	.3247	82.	8.03	0.26	0.29E-01	0.93E-03	0.31E+02
90.0	.3214	85.	8.37	0.21	0.26E-01	0.11E-02	0.24E+02
110.0	.3189	88.	8.62	0.18	0.16E-01	0.87E-03	0.19E+02
130.0	.3177	90.	8.82	0.18	0.54E-02	0.28E-03	0.19E+02
150.0	.3172	92.	8.97	0.18	0.54E-02	0.39E-03	0.14E+02
175.0	.3155	94.	9.17	0.18	0.22E-01	0.11E-02	0.21E+02
245.0	.3129	97.	9.55	0.10	0.13E-01	0.44E-03	0.30E+02
400.0	.3090	103.	10.06	0.05	0.21E-01	0.11E-02	0.19E+02
575.0	.3044	108.	10.59	0.14	0.74E-02	0.70E-03	0.11E+02
775.0	.3003	114.	11.16	0.16	0.38E-02	0.73E-03	0.52E+01

DEPTH 53. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3407	6.	0.64	1.77	0.95E-01	0.38E-03	0.25E+03
0.7	.3400	11.	1.12	1.75	0.11E+00	0.69E-04	0.16E+04
1.5	.3390	23.	2.28	1.55	0.14E+00	0.95E-04	0.15E+04
2.5	.3370	37.	3.65	1.27	0.24E+00	0.30E-03	0.78E+03
3.5	.3347	43.	4.22	1.14	0.27E+00	0.82E-03	0.33E+03
4.5	.3312	46.	4.49	1.12	0.38E+00	0.19E-02	0.20E+03
7.5	.3245	50.	4.88	1.19	0.15E+00	0.16E-02	0.92E+02
15.0	.3133	56.	5.50	1.16	0.49E-01	0.20E-02	0.25E+02
30.0	.3000	64.	6.32	0.99	0.28E-01	0.14E-02	0.20E+02
50.0	.2897	71.	6.96	0.82	0.19E-01	0.26E-02	0.75E+01
70.0	.2833	74.	7.23	0.68	0.16E-01	0.20E-02	0.78E+01
90.0	.2787	76.	7.46	0.58	0.14E-01	0.20E-02	0.68E+01
110.0	.2752	78.	7.65	0.54	0.87E-02	0.14E-02	0.60E+01
130.0	.2730	80.	7.83	0.51	0.33E-02	0.96E-03	0.35E+01
150.0	.2718	81.	7.98	0.51	0.30E-02	0.64E-03	0.46E+01
245.0	.2690	87.	8.49	0.49	0.36E-02	0.14E-02	0.26E+01
400.0	.2621	91.	8.96	0.49	0.31E-02	0.15E-02	0.21E+01

DEPTH 76. CM SITE F-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.2948	23.	2.30	1.77	0.16E+00	0.31E-02	0.52E+02
0.7	.2904	27.	2.63	1.64	0.22E+00	0.14E-02	0.16E+03
1.5	.2849	33.	3.28	1.33	0.23E+00	0.79E-03	0.30E+03
2.5	.2797	40.	3.91	1.03	0.38E+00	0.11E-02	0.34E+03

DEPTH 76. CM (CONT)

3.5	.2759	43.	4.23	0.94	0.39E+00	0.14E-02	0.27E+03
4.5	.2718	45.	4.45	0.92	0.59E+00	0.21E-02	0.28E+03
7.5	.2640	49.	4.77	0.83	0.26E+00	0.26E-02	0.10E+03
15.0	.2518	53.	5.17	0.71	0.12E+00	0.33E-02	0.38E+02
30.0	.2382	58.	5.67	0.58	0.73E-01	0.22E-02	0.33E+02
50.0	.2275	62.	6.08	0.52	0.48E-01	0.36E-02	0.13E+02
70.0	.2208	64.	6.28	0.54	0.31E-01	0.31E-02	0.10E+02
90.0	.2160	66.	6.46	0.55	0.23E-01	0.23E-02	0.99E+01
110.0	.2124	68.	6.65	0.56	0.14E-01	0.15E-02	0.94E+01
130.0	.2097	70.	6.82	0.57	0.70E-02	0.18E-02	0.38E+01
150.0	.2077	71.	6.99	0.59	0.53E-02	0.75E-03	0.70E+01
175.0	.2073	71.	6.92	0.42	0.97E-02	0.32E-03	0.31E+02
245.0	.2047	71.	7.00	0.29	0.10E-01	0.12E-02	0.83E+01
400.0	.1979	77.	7.58	0.35	0.69E-02	0.12E-02	0.57E+01
575.0	.1915	82.	8.04	0.32	0.73E-02	0.17E-02	0.42E+01

DEPTH 106. CM SITE F-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.2734	36.	3.48	0.86	0.58E+00	0.11E-01	0.53E+02
0.7	.2685	36.	3.53	0.86	0.83E+00	0.92E-02	0.90E+02
1.5	.2623	37.	3.61	0.86	0.58E+00	0.64E-02	0.89E+02
2.5	.2557	38.	3.72	0.85	0.67E+00	0.53E-02	0.13E+03
3.5	.2494	40.	3.88	0.84	0.60E+00	0.30E-02	0.20E+03
4.5	.2423	42.	4.08	0.84	0.89E+00	0.40E-02	0.22E+03
7.5	.2305	44.	4.31	0.86	0.35E+00	0.63E-02	0.55E+02
15.0	.2147	47.	4.62	0.91	0.15E+00	0.42E-02	0.35E+02
30.0	.2011	51.	5.03	0.96	0.63E-01	0.27E-02	0.24E+02
50.0	.1917	55.	5.37	0.97	0.38E-01	0.30E-02	0.13E+02
70.0	.1851	57.	5.59	0.97	0.26E-01	0.28E-02	0.92E+01
90.0	.1804	59.	5.80	0.98	0.19E-01	0.17E-02	0.11E+02
110.0	.1768	61.	6.02	0.99	0.13E-01	0.17E-02	0.80E+01
130.0	.1740	63.	6.21	0.99	0.77E-02	0.13E-02	0.58E+01
150.0	.1720	65.	6.42	1.00	0.56E-02	0.68E-03	0.83E+01
175.0	.1714	65.	6.38	1.17	0.29E-02	0.16E-03	0.19E+02
245.0	.1700	65.	6.40	1.25	0.34E-02	0.95E-03	0.36E+01
400.0	.1659	70.	6.88	1.14	0.29E-02	0.79E-03	0.37E+01
575.0	.1618	77.	7.51	1.28	0.25E-02	0.53E-03	0.48E+01
775.0	.1584	83.	8.10	1.50	0.28E-02	0.60E-03	0.46E+01

DOERING 1-STEP DATA

4.2	.1809	65.	6.34	83.33	0.21E-02	0.19E-02	0.11E+01
8.2	.1611	77.	7.60	83.33	0.78E-03	0.13E-02	0.62E+00
12.2	.1503	87.	8.56	83.33	0.43E-03	0.96E-03	0.45E+00
16.2	.1431	96.	9.37	83.33	0.28E-03	0.78E-03	0.36E+00
20.2	.1377	103.	10.11	83.33	0.20E-03	0.66E-03	0.30E+00
24.2	.1335	110.	10.80	83.33	0.15E-03	0.56E-03	0.27E+00
28.2	.1300	117.	11.45	83.33	0.12E-03	0.49E-03	0.24E+00
32.2	.1270	123.	12.07	83.33	0.95E-04	0.44E-03	0.22E+00
36.2	.1245	129.	12.67	83.33	0.78E-04	0.39E-03	0.20E+00
40.2	.1222	135.	13.26	83.33	0.66E-04	0.35E-03	0.19E+00
44.2	.1202	141.	13.85	83.33	0.56E-04	0.32E-03	0.18E+00
48.2	.1185	147.	14.42	83.33	0.48E-04	0.29E-03	0.17E+00
52.2	.1168	153.	14.99	83.33	0.42E-04	0.27E-03	0.16E+00
122.0	.1008	264.	25.84	83.33	0.81E-05	0.77E-04	0.11E+00
194.0	.0931	447.	43.81	83.33	0.23E-05	0.23E-04	0.10E+00

DEPTH 137. CM SITE F-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3210	36.	3.51	1.16	0.56E+00	0.16E-02	0.34E+03
0.7	.3198	37.	3.58	1.18	0.79E+00	0.16E-02	0.48E+03
1.5	.3176	38.	3.71	1.22	0.52E+00	0.16E-02	0.33E+03
2.5	.3134	40.	3.90	1.29	0.58E+00	0.26E-02	0.23E+03
3.5	.3074	42.	4.12	1.34	0.52E+00	0.27E-02	0.19E+03
4.5	.2984	45.	4.37	1.38	0.75E+00	0.44E-02	0.17E+03
7.5	.2843	48.	4.66	1.41	0.28E+00	0.49E-02	0.57E+02
*15.0	.2662	52.	5.06	1.41	0.13E+00	0.42E-02	0.31E+02
30.0	.2504	57.	5.55	1.42	0.56E-01	0.24E-02	0.23E+02
50.0	.2397	60.	5.88	1.40	0.35E-01	0.68E-02	0.51E+01
70.0	.2321	61.	6.01	1.33	0.26E-01	0.66E-02	0.39E+01
90.0	.2266	63.	6.13	1.25	0.20E-01	0.34E-02	0.58E+01
110.0	.2227	64.	6.25	1.17	0.16E-01	0.36E-02	0.43E+01
130.0	.2193	65.	6.35	1.11	0.11E-01	0.31E-02	0.34E+01
150.0	.2171	66.	6.46	1.03	0.78E-02	0.11E-02	0.68E+01
245.0	.2147	67.	6.57	0.85	0.59E-02	0.95E-03	0.62E+01
400.0	.2111	70.	6.87	0.85	0.48E-02	0.13E-02	0.37E+01
575.0	.2064	75.	7.40	0.65	0.62E-02	0.61E-03	0.10E+02
775.0	.2024	82.	8.00	0.42	0.11E-01	0.69E-03	0.16E+02

DOERING 1-STEP DATA

0.4	.2484	55.	5.39	83.33	0.62E-01	0.26E-02	0.23E+02
0.4	.2364	60.	5.88	83.33	0.45E-01	0.22E-02	0.21E+02
0.5	.2265	65.	6.38	83.33	0.33E-01	0.18E-02	0.19E+02
0.5	.2180	70.	6.89	83.33	0.25E-01	0.15E-02	0.17E+02
0.6	.2108	76.	7.40	83.33	0.20E-01	0.13E-02	0.16E+02
0.6	.2044	81.	7.94	83.33	0.15E-01	0.11E-02	0.14E+02
0.7	.1988	87.	8.49	83.33	0.12E-01	0.92E-03	0.13E+02
0.7	.1939	92.	9.06	83.33	0.98E-02	0.79E-03	0.12E+02
0.8	.1894	98.	9.65	83.33	0.79E-02	0.68E-03	0.12E+02
0.8	.1854	105.	10.28	83.33	0.65E-02	0.59E-03	0.11E+02
0.9	.1817	112.	10.93	83.33	0.53E-02	0.51E-03	0.10E+02
0.9	.1784	119.	11.62	83.33	0.43E-02	0.44E-03	0.98E+01
1.0	.1753	126.	12.35	83.33	0.36E-02	0.38E-03	0.93E+01
1.0	.1725	134.	13.13	83.33	0.30E-02	0.33E-03	0.89E+01
1.1	.1698	142.	13.96	83.33	0.25E-02	0.29E-03	0.85E+01
1.1	.1674	151.	14.85	83.33	0.20E-02	0.25E-03	0.81E+01
1.2	.1651	161.	15.81	83.33	0.17E-02	0.22E-03	0.78E+01
1.2	.1630	172.	16.84	83.33	0.14E-02	0.19E-03	0.75E+01
1.3	.1610	183.	17.97	83.33	0.12E-02	0.16E-03	0.72E+01
1.3	.1592	196.	19.21	83.33	0.95E-03	0.14E-03	0.70E+01
1.4	.1574	210.	20.57	83.33	0.79E-03	0.12E-03	0.67E+01
1.4	.1558	225.	22.08	83.33	0.64E-03	0.99E-04	0.65E+01
1.5	.1542	242.	23.77	83.33	0.52E-03	0.83E-04	0.63E+01
1.5	.1527	262.	25.69	83.33	0.42E-03	0.70E-04	0.61E+01
1.6	.1513	284.	27.87	83.33	0.34E-03	0.58E-04	0.59E+01
1.6	.1499	310.	30.40	83.33	0.27E-03	0.47E-04	0.57E+01
1.7	.1487	340.	33.37	83.33	0.21E-03	0.38E-04	0.56E+01
1.7	.1474	377.	36.92	83.33	0.16E-03	0.30E-04	0.54E+01
1.8	.1463	421.	41.27	83.33	0.12E-03	0.23E-04	0.53E+01
1.8	.1452	477.	46.74	83.33	0.88E-04	0.17E-04	0.51E+01

DEPTH	167. CM		SITE F-1				
TIME	WATER	MAT-POT	MAT-POT	HYD-GRAD	HYD-CON	SP-MOIS	DIFF
(HR)	(CM3/CM3)	(CM)	(KPA)	(CM/CM)	(CM/HR)	(1/CM)	(CM2/HR)
0.2	.3272	45.	4.36	1.43	0.50E+00	0.11E-02	0.44E+03
0.7	.3265	45.	4.42	1.40	0.71E+00	0.16E-02	0.45E+03
1.5	.3250	46.	4.55	1.34	0.54E+00	0.13E-02	0.43E+03
2.5	.3217	48.	4.73	1.26	0.71E+00	0.25E-02	0.28E+03
3.5	.3161	50.	4.91	1.17	0.77E+00	0.43E-02	0.18E+03
4.5	.3075	52.	5.07	1.08	0.13E+01	0.62E-02	0.20E+03
7.5	.2936	54.	5.27	0.98	0.51E+00	0.77E-02	0.67E+02
15.0	.2739	56.	5.48	0.86	0.29E+00	0.11E-01	0.27E+02
30.0	.2558	58.	5.72	0.70	0.14E+00	0.46E-02	0.31E+02
50.0	.2441	60.	5.87	0.60	0.10E+00	0.17E+00	0.62E+00
70.0	.2360	60.	5.88	0.60	0.74E-01	0.66E-01	0.11E+01
90.0	.2301	60.	5.90	0.62	0.51E-01	0.19E-01	0.28E+01
110.0	.2259	60.	5.92	0.63	0.38E-01	0.16E-01	0.24E+01
130.0	.2224	61.	5.95	0.65	0.25E-01	0.13E-01	0.20E+01
150.0	.2202	61.	5.97	0.66	0.15E-01	0.32E-01	0.49E+00
245.0	.2165	61.	5.99	0.76	0.75E-02	0.28E-02	0.27E+01
400.0	.2113	62.	6.10	0.65	0.77E-02	0.55E-02	0.14E+01
775.0	.1996	66.	6.46	0.54	0.95E-02	0.73E-03	0.13E+

SITE F, REPLICATION 2

Table F-2.1. Soil morphologic data for Site F, replication 2.

Site and location: F-2 Arveson, Oakes Aquifer 525 feet south and 470 feet west of the east quarter corner of Section 9, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 08/02/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classifiation: Arveson sandy loam; coarse-loamy, frigid Typic Calciaquoll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Poor.

NOTES; Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: F-2 south side of pit.

Ap 0-7 inches (0-18 cm) black (10YR 2/1) sandy loam (fine sandy loam), dark gray (10YR 4/1, dry); moderate coarse and medium granular struc- ture; soft, very friable, slightly sticky and slightly plastic; many very fine roots; strong to violent effervescence; abrupt smooth boundary.

Ak 7-12 inches (18-30 cm) black (2.5Y 2/0) sandy loam (fine sandy loam), gray (2.5Y 5/0, dry); moderate coarse prismatic parting to moderate medium and fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; violent effervescence; clear smooth boundary.

Bk 12-24 inches (30-76 cm) gray (5Y 5/1) sandy loam (sandy clay loam), light gray (2.5Y 7/0, dry); moderate coarse prismatic parting to moderate medium and fine subangular block structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; violent effervescence; clear smooth boundary.

C1 24-40 inches (76-102 cm) pale olive (5Y 6/3) sand (loamy fine sand), pale yellow (5Y 7/3, dry) with discontinuous organic staining on prism faces; very weak very coarse prismatic structure; soft, very friable, nonsticky and nonplastic; few very fine roots; very slight effervescence, gradual wavy boundary.

C2 40-56 inches (102-142 cm) light olive gray (5Y 6/2) sand (fine sand), white (5Y 8/2, dry) with few medium prominent strong brown (7.5YR 5/6) mottles; single grained; loose, nonsticky and nonplastic; clear smooth boundary.

C3 56-64 inches (142-163 cm) dark gray and very dark gray (10YR 4/1 and 3/1) sandy loam (fine sand), gray (10YR 6/1 and 5/1, dry); massive; soft, very friable, slightly sticky and slightly plastic.

Table F-2.2 ARVESON SERIES SITE F-2 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.	13.0	10.8	7.7	16.9	34.2	14.7	2.6	0.2
23.	14.5	8.1	8.1	16.9	35.2	14.3	2.5	0.3
38.	22.8	5.5	7.8	14.5	36.5	10.9	1.7	0.2
53.	9.0	6.2	6.2	17.8	48.3	10.7	1.8	0.0
76.	6.4	6.2	2.5	18.8	47.1	14.8	3.7	0.5
107.	2.8	3.3	4.0	3.1	61.0	25.6	0.3	0.0
137.	3.5	3.3	4.6	2.5	55.1	30.5	0.5	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZONS		
8.	68.5	18.5	13.0	A	6	6=p
23.	69.3	16.2	14.5	A	10	10=k
38.	63.9	13.3	22.8	B	10	
53.	78.6	12.4	9.0	B	10	
76.	84.9	8.7	6.4	B	10	
107.	89.9	7.3	2.8	C 1		
137.	88.6	7.9	3.5	C 2		

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	3.708	0.0591	6.6	0.0089	0.450	1.28	2.55
23.	4.272	0.0587	7.0	0.0084	0.464	1.54	2.49
38.	4.797	0.0405	8.9	0.0045	0.430	1.63	0.75
53.	6.339	0.0803	5.1	0.0157	0.697	1.70	0.20
76.	9.759	0.1036	4.5	0.0228	0.778	1.72	0.08
107.	12.329	0.1538	3.1	0.0501	1.340	1.57	0.08
137.	11.215	0.1540	3.4	0.0454	1.210	1.46	0.08

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER CM/DAY-KPA		K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	2.245	1.860	-0.8439	1.9894	-8.44	0.61
23.	2.110	1.877	-0.8667	2.0068	-8.67	0.63
38.	1.924	2.081	-0.8094	1.8502	-8.09	0.47
53.	1.842	3.132	-1.0223	2.2794	-10.22	0.90
76.	1.574	3.860	-1.1338	2.4621	-11.34	1.08
107.	1.460	6.671	-1.2140	2.6100	-12.14	1.23
137.	1.510	5.952	-1.1906	2.5694	-11.91	1.19

Table F-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site F, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
	Saturation Extract Soluble Ions meq/l							
0 - 15	3.66	6.75	1.11	1.74	-	5.36	0.45	7.45
15 - 30	2.58	3.74	1.26	0.26	-	5.92	0.30	1.62
30 - 46	0.86	2.40	2.54	0.06	-	3.92	0.20	1.75
46 - 61	0.56	0.67	4.96	0.01	0.16	4.00	0.20	1.83
61 - 91	0.43	0.47	4.58	0.01	0.16	3.28	0.18	1.87
..91 - 122	0.86	0.36	3.19	0.07	-	3.28	0.18	1.03
122 - 152	0.86	0.36	2.35	0.09	-	2.36	0.15	1.16

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	1.17	0.49	44	7.9	3.5	fsl	10.92
15 - 30	0.66	0.71	43	8.2	3.5	fsl	11.10
30 - 46	0.51	1.99	37	8.2	15.0	scl	9.05
46 - 61	0.53	6.34	30	8.5	5.0	lfs	5.28
61 - 91	0.46	6.83	27	8.5	3.3	lfs	4.14
..91 - 122	0.39	4.08	22	8.2	-	fs	4.21
122 - 152	0.30	3.01	30	8.0	-	fs	4.74

Table F-2.4 ARVESON SERIES SITE F-2 NDSWC:1985

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

8.			23.			38.			53.		
CM	CC/CC	SE									
24.	0.4017	0.0079	10.	0.3587	******	10.	0.3716	0.0030	10.	0.4508	0.0126
40.	0.4052	0.0065	20.	0.3587	******	20.	0.3672	0.0021	20.	0.4391	0.0100
50.	0.4007	0.0053	31.	0.3491	******	31.	0.3313	0.0022	31.	0.4243	0.0097
62.	0.3942	0.0044	40.	0.3477	******	40.	0.3086	0.0011	40.	0.3888	0.0107
70.	0.3847	0.0034	50.	0.3395	******	50.	0.2932	0.0008	50.	0.3598	0.0095
82.	0.3739	0.0033	60.	0.3258	******	60.	0.2712	0.0002	60.	0.2886	0.0056
98.	0.3630	0.0022	70.	0.3217	******	70.	0.2632	0.0002	70.	0.2620	0.0027
150.	0.3268	0.0003	80.	0.3121	******	80.	0.2500	0.0001	80.	0.2281	0.0014
340.	0.2780	0.0017	100.	0.3053	******	100.	0.2368	0.0003	100.	0.1875	0.0012
503.	0.2636	0.0020	120.	0.2957	******	120.	0.2243	0.0000	120.	0.1643	0.0017
834.	0.2487	0.0037	180.	0.2697	******	180.	0.2045	0.0009	180.	0.1379	0.0023
334.	0.2396	******	334.	0.1876	0.0007	334.	0.1180	0.0027			
534.	0.2231	******	534.	0.1774	0.0009	534.	0.1081	0.0029			
834.	0.2012	******	834.	0.1656	0.0011	834.	0.1015	0.0031			
BD =	1.28			1.54			1.63			1.70	
N =	2			1			2			2	

DEPTH (CM)

76.			107.			137.		
24.	0.3345	0.0045	24.	0.3728	0.0059	24.	0.4139	0.0672
40.	0.3129	0.0044	40.	0.3190	0.0006	40.	0.2987	0.0869
50.	0.2868	0.0065	50.	0.1956	0.0199	50.	0.1833	0.0918
62.	0.2552	0.0091	62.	0.1638	0.0224	62.	0.1555	0.0929
70.	0.2398	0.0101	70.	0.1488	0.0226	70.	0.1416	0.0928
82.	0.2159	0.0117	82.	0.1367	0.0228	82.	0.1303	0.0921
98.	0.1959	0.0127	98.	0.1299	0.0223	98.	0.1225	0.0915
150.	0.1658	0.0131	150.	0.1164	0.0214	150.	0.1077	0.0908
340.	0.1419	0.0103	340.	0.1029	0.0184	340.	0.0903	0.0895
503.	0.1319	0.0097	503.	0.0991	0.0179	503.	0.0825	0.0888
834.	0.1265	0.0081	834.	0.0946	0.0158	834.	0.1626	0.0248
BD =	1.72			1.57			1.57	
N =	2			2			2	

Table F-2.5 ARVESON SERIES SITE F-2 (NDSWC 1985)
In-situ K(θ,ψ) and θ(ψ), and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 7. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.7	.4664	3.	0.29	2.14	0.78E-02	0.16E-03	0.49E+02
1.5	.4630	14.	1.39	2.41	0.17E-01	0.37E-03	0.47E+02
2.5	.4575	27.	2.64	2.45	0.17E-01	0.55E-03	0.31E+02
3.5	.4492	36.	3.54	2.18	0.38E-01	0.14E-02	0.28E+02
4.5	.4355	45.	4.39	1.84	0.67E-01	0.18E-02	0.37E+02
7.5	.4181	56.	5.49	1.53	0.18E-01	0.14E-02	0.13E+02
15.0	.3995	71.	6.94	1.09	0.13E-01	0.11E-02	0.11E+02
25.0	.3826	84.	8.19	0.65	0.18E-01	0.17E-02	0.10E+02
40.0	.3702	95.	9.29	0.34	0.10E-01	0.71E-03	0.14E+02
60.0	.3628	105.	10.31	0.12	0.18E-01	0.75E-03	0.24E+02

DOERING 1-STEP DATA

0.1	.2868	332.	32.53	83.33	0.45E-02	0.17E-03	0.27E+02
0.2	.2795	380.	37.24	83.33	0.28E-02	0.14E-03	0.20E+02
0.2	.2743	419.	41.07	83.33	0.19E-02	0.13E-03	0.15E+02
0.3	.2703	452.	44.34	83.33	0.15E-02	0.11E-03	0.13E+02
0.3	.2670	482.	47.22	83.33	0.12E-02	0.11E-03	0.11E+02

DEPTH 38. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3710	15.	1.42	1.21	0.74E-01	0.32E-03	0.23E+03
0.7	.3704	20.	1.96	1.07	0.60E-01	0.65E-04	0.93E+03
1.5	.3693	33.	3.23	0.83	0.18E+00	0.93E-04	0.19E+04
2.5	.3674	46.	4.52	0.72	0.22E+00	0.30E-03	0.73E+03
3.5	.3645	52.	5.05	0.73	0.41E+00	0.14E-02	0.29E+03
4.5	.3598	55.	5.37	0.70	0.65E+00	0.15E-02	0.45E+03
7.5	.3527	60.	5.90	0.56	0.20E+00	0.12E-02	0.16E+03
15.0	.3435	68.	6.63	0.48	0.12E+00	0.13E-02	0.95E+02
25.0	.3343	74.	7.26	0.49	0.95E-01	0.20E-02	0.48E+02
40.0	.3273	80.	7.81	0.38	0.38E-01	0.78E-03	0.48E+02
60.0	.3226	86.	8.39	0.24	0.38E-01	0.83E-03	0.46E+02
80.0	.3193	90.	8.79	0.18	0.38E-01	0.83E-03	0.45E+02
100.0	.3167	93.	9.09	0.14	0.29E-01	0.90E-03	0.33E+02
120.0	.3149	95.	9.33	0.13	0.16E-01	0.61E-03	0.26E+02
140.0	.3135	97.	9.53	0.10	0.24E-01	0.74E-03	0.32E+02
170.0	.3112	100.	9.83	0.13	0.13E-01	0.80E-03	0.16E+02
*245.0	.3085	105.	10.28	0.10	0.13E-01	0.44E-03	0.31E+02
375.0	.3061	109.	10.69	0.02	0.73E-01	0.83E-03	0.89E+02

DEPTH 53. CM SITE F-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3407	20.	1.95	1.53	0.71E-01	0.42E-03	0.17E+03
0.7	.3401	24.	2.33	1.41	0.60E-01	0.10E-03	0.59E+03
1.5	.3386	33.	3.25	1.16	0.15E+00	0.18E-03	0.84E+03
2.5	.3361	44.	4.29	0.97	0.20E+00	0.38E-03	0.53E+03

DEPTH 53. CM SITE F-2

3.5	.3326	49.	4.79	0.92	0.39E+00	0.17E-02	0.23E+03
4.5	.3277	52.	5.05	0.87	0.63E+00	0.21E-02	0.30E+03
7.5	.3204	56.	5.44	0.83	0.16E+00	0.17E-02	0.97E+02
15.0	.3100	62.	6.04	0.73	0.10E+00	0.18E-02	0.57E+02
25.0	.2983	67.	6.58	0.61	0.10E+00	0.29E-02	0.36E+02
40.0	.2882	71.	7.00	0.54	0.36E-01	0.19E-02	0.19E+02
60.0	.2804	76.	7.43	0.48	0.28E-01	0.17E-02	0.16E+02
*80.0	.2744	79.	7.75	0.44	0.22E-01	0.20E-02	0.11E+02
100.0	.2703	82.	8.00	0.41	0.16E-01	0.12E-02	0.12E+02
120.0	.2677	84.	8.20	0.37	0.88E-02	0.14E-02	0.61E+01
140.0	.2656	85.	8.36	0.36	0.10E-01	0.11E-02	0.92E+01
245.0	.2609	93.	9.07	0.31	0.68E-02	0.21E-02	0.33E+01
375.0	.2542	97.	9.47	0.37	0.41E-02	0.12E-02	0.33E+01
525.0	.2495	101.	9.92	0.38	0.39E-02	0.92E-03	0.42E+01

DOERING 1-STEP DATA

0.9	.1752	106.	10.38	83.33	0.71E-02	0.78E-03	0.91E+01
1.0	.1723	110.	10.76	83.33	0.63E-02	0.73E-03	0.86E+01
1.0	.1696	114.	11.13	83.33	0.56E-02	0.68E-03	0.82E+01
1.1	.1671	117.	11.51	83.33	0.50E-02	0.64E-03	0.79E+01
1.1	.1648	121.	11.88	83.33	0.45E-02	0.60E-03	0.75E+01
1.2	.1626	125.	12.24	83.33	0.41E-02	0.56E-03	0.72E+01
1.2	.1606	129.	12.61	83.33	0.37E-02	0.53E-03	0.70E+01
1.3	.1586	132.	12.97	83.33	0.34E-02	0.50E-03	0.67E+01
1.3	.1568	136.	13.33	83.33	0.31E-02	0.48E-03	0.65E+01
1.4	.1551	140.	13.69	83.33	0.28E-02	0.45E-03	0.62E+01
1.4	.1535	143.	14.05	83.33	0.26E-02	0.43E-03	0.60E+01
1.5	.1520	147.	14.41	83.33	0.24E-02	0.41E-03	0.58E+01
1.5	.1506	151.	14.76	83.33	0.22E-02	0.39E-03	0.57E+01
1.6	.1492	154.	15.12	83.33	0.20E-02	0.37E-03	0.55E+01
1.6	.1479	158.	15.47	83.33	0.19E-02	0.36E-03	0.53E+01
1.7	.1466	161.	15.82	83.33	0.18E-02	0.34E-03	0.52E+01

DEPTH 53. CM SITE F-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.7	.1454	165.	16.17	83.33	0.16E-02	0.33E-03	0.50E+01
1.8	.1443	169.	16.53	83.33	0.15E-02	0.31E-03	0.49E+01
1.8	.1432	172.	16.88	83.33	0.14E-02	0.30E-03	0.48E+01
1.9	.1422	176.	17.23	83.33	0.13E-02	0.29E-03	0.47E+01
1.9	.1411	179.	17.58	83.33	0.13E-02	0.28E-03	0.45E+01
2.0	.1402	183.	17.93	83.33	0.12E-02	0.27E-03	0.44E+01
2.0	.1392	186.	18.28	83.33	0.11E-02	0.26E-03	0.43E+01
2.1	.1384	190.	18.63	83.33	0.10E-02	0.25E-03	0.42E+01
2.1	.1375	194.	18.98	83.33	0.98E-03	0.24E-03	0.41E+01
2.2	.1367	197.	19.33	83.33	0.93E-03	0.23E-03	0.41E+01
2.2	.1359	201.	19.68	83.33	0.88E-03	0.22E-03	0.40E+01
2.3	.1351	204.	20.03	83.33	0.83E-03	0.21E-03	0.39E+01
2.3	.1343	208.	20.38	83.33	0.79E-03	0.21E-03	0.38E+01
2.4	.1336	211.	20.73	83.33	0.75E-03	0.20E-03	0.37E+01
2.4	.1329	215.	21.08	83.33	0.71E-03	0.19E-03	0.37E+01
2.5	.1322	219.	21.43	83.33	0.67E-03	0.19E-03	0.36E+01
2.5	.1315	222.	21.78	83.33	0.64E-03	0.18E-03	0.35E+01
2.6	.1309	226.	22.14	83.33	0.61E-03	0.18E-03	0.35E+01
2.6	.1303	229.	22.49	83.33	0.58E-03	0.17E-03	0.34E+01
2.7	.1297	233.	22.84	83.33	0.55E-03	0.16E-03	0.34E+01
2.7	.1291	237.	23.20	83.33	0.53E-03	0.16E-03	0.33E+01

DEPTH 53. CM (CONT)

2.8	.1285	240.	23.55	83.33	0.50E-03	0.16E-03	0.32E+01
2.8	.1280	244.	23.91	83.33	0.48E-03	0.15E-03	0.32E+01
2.9	.1274	248.	24.26	83.33	0.46E-03	0.15E-03	0.31E+01
4.9	.1131	408.	39.97	83.33	0.11E-03	0.55E-04	0.19E+01

DEPTH 76. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3029	25.	2.47	1.06	0.12E+00	0.33E-03	0.36E+03
0.7	.3027	27.	2.65	0.99	0.10E+00	0.81E-04	0.13E+04
1.5	.3010	31.	3.07	0.78	0.31E+00	0.53E-03	0.58E+03
2.5	.2971	36.	3.57	0.56	0.50E+00	0.10E-02	0.49E+03
3.5	.2913	40.	3.91	0.49	0.10E+01	0.28E-02	0.36E+03
4.5	.2837	43.	4.18	0.52	0.14E+01	0.30E-02	0.46E+03
7.5	.2739	46.	4.53	0.50	0.37E+00	0.27E-02	0.14E+03
15.0	.2615	51.	5.00	0.47	0.22E+00	0.26E-02	0.85E+02
40.0	.2468	59.	5.74	0.41	0.12E+00	0.87E-02	0.14E+02
60.0	.2256	62.	6.12	0.41	0.53E-01	0.22E-02	0.24E+02
80.0	.2188	66.	6.44	0.42	0.38E-01	0.22E-02	0.18E+02
100.0	.2143	68.	6.69	0.43	0.23E-01	0.14E-02	0.17E+02
120.0	.2117	71.	6.91	0.46	0.12E-01	0.11E-02	0.12E+02
140.0	.2099	72.	7.10	0.48	0.11E-01	0.81E-03	0.14E+02
245.0	.2048	79.	7.75	0.47	0.86E-02	0.19E-02	0.47E+01
375.0	.1976	84.	8.22	0.48	0.47E-02	0.12E-02	0.39E+01
525.0	.1925	88.	8.64	0.46	0.50E-02	0.12E-02	0.41E+01
750.0	.1879	93.	9.11	0.41	0.62E-03	0.76E-03	0.81E+00

DEPTH 106. CM SITE F-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.2784	29.	2.85	1.20	0.12E+00	0.48E-03	0.24E+03
0.7	.2780	30.	2.92	1.19	0.11E+00	0.80E-03	0.13E+03
1.5	.2754	31.	3.04	1.18	0.30E+00	0.26E-02	0.12E+03
2.5	.2691	33.	3.24	1.18	0.41E+00	0.36E-02	0.11E+03
3.5	.2595	36.	3.49	1.18	0.66E+00	0.40E-02	0.16E+03
4.5	.2478	39.	3.79	1.18	0.87E+00	0.38E-02	0.23E+03
7.5	.2317	42.	4.14	1.19	0.23E+00	0.53E-02	0.44E+02
15.0	.2178	46.	4.55	1.18	0.11E+00	0.17E-02	0.66E+02
40.0	.2067	53.	5.15	1.14	0.89E-01	0.90E-02	0.98E+01
60.0	.1870	56.	5.50	1.13	0.28E-01	0.17E-02	0.16E+02
80.0	.1820	59.	5.79	1.10	0.21E-01	0.17E-02	0.13E+02
100.0	.1786	62.	6.03	1.08	0.13E-01	0.12E-02	0.11E+02
120.0	.1765	64.	6.25	1.06	0.81E-02	0.74E-03	0.11E+02
140.0	.1752	66.	6.44	1.04	0.69E-02	0.63E-03	0.11E+02
170.0	.1730	67.	6.58	0.98	0.29E-02	0.25E-02	0.12E+01
245.0	.1685	70.	6.90	0.93	0.66E-02	0.11E-02	0.61E+01
375.0	.1635	75.	7.39	0.94	0.34E-02	0.10E-02	0.34E+01
525.0	.1596	80.	7.87	1.00	0.32E-02	0.63E-03	0.50E+01
750.0	.1564	86.	8.40	1.08	0.56E-03	0.59E-03	0.95E+00

DOERING 1-STEP DATA

4.5	.1506	90.	8.87	83.33	0.15E-02	0.10E-02	0.15E+01
8.5	.1309	117.	11.49	83.33	0.43E-03	0.52E-03	0.83E+00
12.5	.1212	141.	13.82	83.33	0.19E-03	0.32E-03	0.58E+00
16.5	.1150	164.	16.10	83.33	0.99E-04	0.22E-03	0.46E+00
20.5	.1106	188.	18.47	83.33	0.57E-04	0.15E-03	0.38E+00

DOERING 1-STEP DATA (CONT)

24.5	.1073	214.	21.02	83.33	0.35E-04	0.11E-03	0.33E+00
28.5	.1047	243.	23.86	83.33	0.22E-04	0.77E-04	0.29E+00
32.5	.1025	277.	27.11	83.33	0.14E-04	0.55E-04	0.26E+00
36.5	.1007	316.	30.96	83.33	0.92E-05	0.39E-04	0.23E+00
40.5	.0991	364.	35.69	83.33	0.58E-05	0.27E-04	0.22E+00
44.5	.0977	426.	41.78	83.33	0.36E-05	0.18E-04	0.20E+00

DEPTH 136. CM SITE F-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3442	30.	2.97	0.86	0.19E+00	0.13E-02	0.15E+03
0.7	.3432	31.	3.02	0.86	0.21E+00	0.26E-02	0.83E+02
1.5	.3403	32.	3.11	0.85	0.58E+00	0.36E-02	0.16E+03
2.5	.3344	33.	3.27	0.83	0.86E+00	0.37E-02	0.23E+03
3.5	.3289	35.	3.48	0.80	0.12E+01	0.16E-02	0.78E+03
4.5	.3179	38.	3.76	0.79	0.19E+01	0.53E-02	0.36E+03
7.5	.2982	42.	4.12	0.78	0.51E+00	0.56E-02	0.92E+02
15.0	.2828	47.	4.57	0.82	0.20E+00	0.19E-02	0.11E+03
25.0	.2715	50.	4.93	0.87	0.35E-01	0.74E-02	0.47E+01
40.0	.2605	53.	5.20	0.88	0.15E+00	0.26E-02	0.58E+02
80.0	.2875	59.	5.80	0.90	0.97E-01	0.33E-01	0.29E+01
100.0	.2444	61.	6.02	0.91	0.20E-01	0.16E-02	0.13E+02
120.0	.2417	63.	6.21	0.91	0.13E-01	0.12E-02	0.10E+02
140.0	.2398	65.	6.36	0.91	0.10E-01	0.14E-02	0.75E+01
170.0	.2383	66.	6.43	0.91	0.50E-02	0.12E-01	0.42E+00
245.0	.2347	68.	6.65	0.90	0.86E-02	0.14E-02	0.64E+01
375.0	.2292	72.	7.09	0.86	0.48E-02	0.11E-02	0.42E+01
525.0	.2248	77.	7.57	0.79	0.49E-02	0.77E-03	0.64E+01
750.0	.2212	82.	8.05	0.68	0.14E-02	0.71E-03	0.19E+01

DEPTH 167. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.3487	28.	2.77	0.99	0.27E+00	0.12E-01	0.22E+02
0.7	.3468	28.	2.79	0.98	0.27E+00	0.64E-02	0.42E+02
1.5	.3468	29.	2.83	0.95	0.56E+00	-.21E-02	-.26E+03
2.5	.3451	30.	2.91	0.92	0.97E+00	0.48E-02	0.20E+03
3.5	.3419	31.	3.03	0.89	0.12E+01	0.98E-03	0.12E+04
4.5	.3327	33.	3.25	0.86	0.24E+01	0.57E-02	0.41E+03
7.5	.3162	37.	3.59	0.85	0.60E+00	0.43E-02	0.14E+03
15.0	.2992	42.	4.08	0.85	0.24E+00	0.29E-02	0.84E+02
25.0	.2826	46.	4.50	0.84	0.87E-01	0.76E-02	0.11E+02
40.0	.2695	49.	4.76	0.84	0.18E+00	0.33E-02	0.54E+02
60.0	.3002	52.	5.06	0.82	-.26E+10	-.26E-01	0.10E+12
80.0	.2946	54.	5.31	0.79	0.27E+00	0.37E-01	0.73E+01
100.0	.2516	56.	5.51	0.76	0.30E-01	0.17E-02	0.18E+02
120.0	.2493	58.	5.66	0.74	0.19E-01	0.14E-02	0.14E+02
140.0	.2477	59.	5.77	0.72	0.16E-01	0.15E-02	0.11E+02
170.0	.2451	58.	5.69	0.63	0.10E-01	-.17E-02	-.60E+01
245.0	.2414	59.	5.77	0.56	0.16E-01	0.92E-03	0.18E+02
375.0	.2363	63.	6.16	0.55	0.96E-02	0.17E-02	0.56E+01
525.0	.2322	67.	6.56	0.57	0.78E-02	0.41E-03	0.19E+02
750.0	.2285	72.	7.06	0.67	0.21E-02	0.10E-02	0.20E+01

SITE G (HEIMDAL SERIES)

Site G was located on an elevated knob in a nonirrigated corn field. The location and description are summarized on Table 1 and illustrated on Fig. 2. In-situ measurements and site descriptions were made during late June and July, 1985. The measurment period was concurrent with sites D, E and F which were approximately 3.25 miles (7 km) southwest of the field location. Soil samples and soil profile descriptions were collected approximately 4 weeks after hydraulic measurements were completed.

The Heimdal series "consists of deep, nearly level to steep, well-drained soils that formed in medium-textured glacial till. " Soils of the Heimdal series are found on "glacial till plains and sand-mantled till plains" (USDA 1977). The field in which this site was situated was mapped as Barnes-Svea series. The Barnes soil is similar to the Heimdal, except that it is of overall finer texture.

Infiltration and soil-water and suction profiles during wetting were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

SITE G, REPLICATION 1

Table G-1.1. Soil morphologic data for Site G, replication 1.

Site and location: G-1 Heimdal, Oakes Aquifer 300 feet south and 100 feet east of the west quarter corner of Section 25, Township 131 north, Range 59 west, Dickey County, North Dakota.

Sampled: 08/01/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Heimdal loam; coarse-loamy, mixed Udic Haploboroll.

Physiography and parent material: Glacial till ground moraine.

Drainage: Well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: G-1 north side of pit.

Alp 0-6 inches (0-15 cm) black (lOYR 2/1) loam, dark gray (lOYR 4/1, dry); mdoerate coarse and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 30 mm diameter; common very fine roots; abrupt smooth boundary.

A12 6-11 inches (15-28 cm) black (lOYR 2/1) loam, dark gray (lOYR 4/1, dry); moderate medium prismatic parting to moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 10 mm diameter; common very fine roots; clear smooth boundary.

Bw 11-16 inches (28-41 cm) dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2, dry); moderate coarse prismatic parting to moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 40 mm diameter; common very fine roots; clear wavy boundary.

BCk 16-32 inches (41-81 cm) light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 8/4, dry); moderate coarse prismatic parting to moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 25 mm diameter; common very fine roots; black (lOYR 2/1) crotovina at 8 inches [79 cm]; violent effervescence; abrupt to gradual wavy boundary with a discontinuous pebble line up to 3 inches thick.

Cl 32-46 inches (81-117 cm) light yellowish brown 2.5Y 6/4) loam, pale yellow (2.5Y 8/4, dry); weak coarse prismatic parting to weak to moderate fine platy structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 20 mm diameter; few very fine roots; strong effervescence; gradual wavy boundary.

C2 46-60 inches (117-152 cm) light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 8/4, dry) with few medium prominent yellowish red (5YR 5/6) mottles; weak coarse prismatic parting to moderate to strong fine platy structure; slightly hard, friable; slightly sticky and slightly plastic; very few coarse fragments to 20 mm diameter; strong effervescence.

Table G-1.2 HEIMDAL SERIES SITE G-1 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	PARTICLE SIZE CLASSES (MICRON/PERCENT) 2.	20.	50.	100.	250.	500.	1000.	2000.
8.	16.5	19.3	16.3	14.3	18.7	11.2	3.6	0.1
23.	16.2	19.7	16.4	14.3	18.2	11.4	3.6	0.1
38.	16.3	21.0	18.5	13.0	17.2	10.8	2.9	0.3
53.	14.2	29.8	18.8	11.8	13.3	8.2	4.0	0.0
76.	13.1	26.1	15.2	14.3	17.9	9.7	3.6	0.1
107.	8.7	26.6	19.0	15.2	17.1	9.0	4.4	0.0
138.	7.9	25.0	22.2	13.9	17.3	9.7	4.0	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	47.9	35.6	16.5	A 1 6	6=p
23.	47.7	36.1	16.2	A 1 2	7=w
38.	44.2	39.5	16.3	B 7	10=k
53.	37.2	48.6	14.2	BC 10	
76.	45.6	41.3	13.1	BC 10	
107.	45.7	45.6	8.7	C 1 0	
138.	44.9	47.2	7.9	C 2 0	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	1.346	0.0343	7.2	0.0048	0.304	1.41	1.74
23.	1.319	0.0345	7.2	0.0048	0.306	1.40	1.68
38.	1.119	0.0320	7.0	0.0046	0.308	1.44	0.75
53.	0.767	0.0278	6.3	0.0044	0.332	1.32	0.58
76.	1.104	0.0341	6.4	0.0053	0.332	1.39	0.12
107.	1.002	0.0395	5.5	0.0072	0.396	1.50	0.12
138.	0.951	0.0414	5.3	0.0079	0.417	1.47	0.04

DEPTH cm	MOISTURE/SUCTION SLOPE GHOSH	BLOEMEN	GARDNER K-PARAMETERS CM/DAY-KPA K-SLOPE	K-INT	(JAYNE & TYLER) CM/HR-BAR K-SLOPE	K-INT
8.	3.325	1.772	-0.4463	1.3891	-4.46	0.01
23.	3.353	1.777	-0.4390	1.3804	-4.39	0.00
38.	3.577	1.872	-0.3700	1.2818	-3.70	-0.10
53.	4.160	1.945	-0.2160	1.0817	-2.16	-0.30
76.	3.612	2.148	-0.3782	1.3224	-3.78	-0.06
107.	3.764	2.335	-0.3525	1.3253	-3.53	-0.05
137.	3.842	2.602	-0.3312	1.3021	-3.31	-0.08

Table G-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site G, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	5.03	1.78	0.67	0.38	-	3.48	0.25	4.14
15 - 30	3.87	1.64	0.44	0.20	-	3.12	0.15	2.88
30 - 46	3.57	1.41	0.27	0.10	-	3.16	0.15	2.04
46 - 61	3.23	1.88	0.21	0.07	-	3.00	0.15	2.23
61 - 91	2.37	2.53	0.19	0.05	-	3.04	0.20	1.89
..91 - 122	0.86	4.24	0.90	0.03	-	3.20	0.20	2.63
122 - 152	0.64	3.84	1.64	0.03	-	3.28	0.30	2.58

D4.24epth (cm3.00)	ECE mmhos/cm	SAR	H2O at Sat. %	pH	CO3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.67	0.36	43	7.7	-	1	10.41
15 - 30	0.53	0.27	42	7.8	-	1	8.94
30 - 46	0.45	0.17	42	7.8	-	1	10.05
46 - 61	0.44	0.13	41	7.9	3.3	1	8.32
61 - 91	0.39	0.12	37	8.0	2.5	1	7.67
..91 - 122	0.48	0.57	35	8.2	-	1	7.34
122 - 152	0.50	1.09	35	8.2	-	1	7.54

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

8.			23.			38.			53.		
CM	CC/CC	SE									
10.	0.5531	0.0399	10.	0.5280	0.0006	10.	0.4900	0.0013	24.	0.4271	0.0045
20.	0.5402	0.0359	20.	0.5161	0.0022	20.	0.4726	0.0009	40.	0.3989	0.0010
40.	0.4832	0.0096	40.	0.4582	0.0051	40.	0.4370	0.0047	50.	0.3834	0.0003
60.	0.4538	0.0004	60.	0.4241	0.0034	60.	0.4163	0.0058	62.	0.3760	0.0002
80.	0.4191	0.0001	80.	0.3924	0.0035	80.	0.3948	0.0063	70.	0.3693	0.0004
100.	0.4036	0.0007	100.	0.3791	0.0028	100.	0.3849	0.0065	82.	0.3612	0.0010
120.	0.3844	0.0015	120.	0.3615	0.0029	120.	0.3726	0.0051	98.	0.3553	0.0011
180.	0.3497	0.0017	180.	0.3290	0.0024	180.	0.3420	0.0064	150.	0.3272	0.0015
334.	0.3104	0.0027	334.	0.2932	0.0009	334.	0.3065	0.0078	334.	0.2851	0.0025
534.	0.2894	0.0035	534.	0.2740	0.0001	534.	0.3189	0.0069	534.	0.2666	0.0023
834.	0.2702	0.0030	834.	0.2593	0.0043	834.	0.2652	0.0088	834.	0.2459	0.0025
BD =	1.41			1.40			1.63			1.32	
N =	2			2			2			2	

DEPTH (CM)

76.			107.			137.		
10.	0.4046	0.0143	10.	0.4362	0.0111	10.	0.3253	0.0032
20.	0.3902	0.0127	20.	0.4179	0.0067	20.	0.3154	0.0005
40.	0.3621	0.0101	40.	0.3859	0.0056	40.	0.2919	0.0030
60.	0.3429	0.0100	60.	0.3691	0.0055	60.	0.2771	0.0031
80.	0.3333	0.0089	80.	0.3515	0.0049	80.	0.2703	0.0035
100.	0.3190	0.0083	100.	0.3470	0.0049	100.	0.2604	0.0036
120.	0.3094	0.0082	120.	0.3409	0.0092	120.	0.2549	0.0040
180.	0.2902	0.0081	180.	0.3203	0.0086	180.	0.2431	0.0036
334.	0.2601	0.0069	334.	0.2852	0.0052	334.	0.2265	0.0032
534.	0.2423	0.0087	534.	0.2616	0.0025	534.	0.2098	0.0037
834.	0.2232	0.0085	834.	0.2410	0.0019	834.	0.1888	0.0012
BD =	1.36			1.57			1.28	
N =	2			2			2	

Table G-1.5 HEIMDAL SERIES SITE G-1 (NDSWC 1985)
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4785	1.	0.10	0.07	0.14E+01	0.96E-03	0.15E+04
1.7	.4726	8.	0.75	0.05	0.17E+01	0.87E-03	0.20E+04
2.2	.4650	13.	1.27	0.05	0.29E+01	0.24E-02	0.12E+04
2.7	.4558	17.	1.69	0.08	0.16E+01	0.20E-02	0.82E+03
3.2	.4478	21.	2.07	0.15	0.72E+00	0.24E-02	0.30E+03
3.7	.4426	24.	2.37	0.22	0.23E+00	0.11E-02	0.21E+03
4.2	.4388	28.	2.72	0.22	0.31E+00	0.11E-02	0.28E+03
4.7	.4361	32.	3.14	0.17	0.99E-01	0.24E-03	0.41E+03
6.2	.4290	38.	3.77	0.12	0.34E+00	0.16E-02	0.21E+03
8.7	.4180	47.	4.59	0.15	0.18E+00	0.11E-02	0.17E+03
12.5	.4085	56.	5.47	0.20	0.76E-01	0.11E-02	0.68E+02
17.5	.3969	64.	6.32	0.23	0.85E-01	0.16E-02	0.52E+02
25.0	.3852	77.	7.52	0.33	0.24E-01	0.65E-03	0.36E+02
35.0	.3736	88.	8.67	0.43	0.22E-01	0.18E-02	0.12E+02
45.0	.3634	96.	9.42	0.53	0.11E-01	0.95E-03	0.11E+02
55.0	.3557	104.	10.19	0.62	0.93E-02	0.10E-02	0.92E+01
70.0	.3464	115.	11.24	0.68	0.61E-02	0.82E-03	0.75E+01
90.0	.3367	127.	12.47	0.80	0.40E-02	0.77E-03	0.52E+01
110.0	.3287	137.	13.44	0.88	0.32E-02	0.87E-03	0.37E+01
130.0	.3223	144.	14.14	0.95	0.22E-02	0.99E-03	0.22E+01
165.0	.3103	154.	15.11	1.20	0.24E-02	0.13E-02	0.18E+01
195.0	.2988	166.	16.24	1.38	0.24E-02	0.52E-03	0.47E+01
225.0	.2946	175.	17.14	1.38	0.43E-03	0.41E-03	0.10E+01
275.0	.2922	186.	18.26	1.42	0.10E-03	0.75E-04	0.14E+01
325.0	.2888	199.	19.46	1.55	0.57E-03	0.53E-03	0.11E+01
375.0	.2840	210.	20.56	1.70	0.35E-03	0.35E-03	0.98E+00
450.0	.2794	225.	22.06	1.77	0.23E-03	0.28E-03	0.82E+00
550.0	.2753	243.	23.86	1.83	0.12E-03	0.17E-03	0.70E+00
650.0	.2724	260.	25.51	1.93	0.11E-03	0.18E-03	0.63E+00
750.0	.2645	276.	27.01	2.07	0.48E-03	0.92E-03	0.51E+00

DEPTH 23. CM SITE G-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.7	.4444	0.	0.03	0.05	0.45E+01	0.54E-03	0.83E+04
2.2	.4398	6.	0.56	0.05	0.76E+01	0.14E-02	0.55E+04
2.7	.4321	6.	0.58	0.08	0.50E+01	0.20E-02	0.25E+04
3.2	.4250	13.	1.25	0.15	0.19E+01	0.13E-02	0.15E+04
3.7	.4213	17.	1.67	0.22	0.63E+00	0.75E-03	0.85E+03
4.2	.4186	21.	2.04	0.22	0.82E+00	0.79E-03	0.10E+04
4.7	.4166	25.	2.43	0.17	0.30E+00	0.27E-03	0.11E+04
6.2	.4126	31.	3.01	0.12	0.86E+00	0.90E-03	0.95E+03
8.7	.4067	40.	3.87	0.15	0.46E+00	0.50E-03	0.92E+03
12.5	.4013	49.	4.81	0.20	0.20E+00	0.69E-03	0.29E+03
17.5	.3941	58.	5.70	0.23	0.22E+00	0.95E-03	0.23E+03
25.0	.3866	71.	6.95	0.33	0.63E-01	0.41E-03	0.15E+03
35.0	.3785	84.	8.22	0.43	0.61E-01	0.12E-02	0.50E+02
45.0	.3704	92.	9.05	0.53	0.32E-01	0.77E-03	0.41E+02

DEPTH 23. CM (CONT)

55.0	.3636	101.	9.89	0.62	0.27E-01	0.85E-03	0.32E+02
70.0	.3554	112.	10.98	0.68	0.18E-01	0.69E-03	0.26E+02
90.0	.3468	126.	12.30	0.80	0.12E-01	0.61E-03	0.19E+02
110.0	.3396	136.	13.35	0.88	0.95E-02	0.83E-03	0.12E+02
130.0	.3342	144.	14.10	0.95	0.57E-02	0.55E-03	0.10E+02
165.0	.3245	156.	15.24	1.20	0.68E-02	0.94E-03	0.72E+01
195.0	.3147	169.	16.52	1.38	0.67E-02	0.42E-03	0.16E+02
225.0	.3115	178.	17.42	1.38	0.12E-02	0.30E-03	0.39E+01
275.0	.3092	189.	18.56	1.42	0.39E-03	0.13E-03	0.30E+01
325.0	.3064	203.	19.86	1.55	0.15E-02	0.31E-03	0.50E+01
375.0	.3031	215.	21.07	1.70	0.93E-03	0.23E-03	0.40E+01
450.0	.2995	231.	22.61	1.77	0.66E-03	0.24E-03	0.28E+01
550.0	.2955	250.	24.46	1.83	0.38E-03	0.19E-03	0.20E+01
650.0	.2923	267.	26.19	1.93	0.34E-03	0.17E-03	0.20E+01
750.0	.2870	284.	27.79	2.07	0.12E-02	0.51E-03	0.24E+01

DEPTH 38. CM SITE G-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.2	.4146	1.	0.06	0.02	0.24E+02	0.50E-03	0.48E+05
3.7	.4125	5.	0.46	0.02	0.12E+02	0.57E-03	0.22E+05
4.2	.4105	9.	0.86	0.08	0.30E+01	0.44E-03	0.69E+04
4.7	.4085	11.	1.12	0.22	0.45E+00	0.45E-03	0.10E+04
6.2	.4064	19.	1.82	0.32	0.40E+00	0.27E-03	0.15E+04
8.7	.4042	28.	2.73	0.34	0.27E+00	0.23E-03	0.12E+04
12.5	.4013	40.	3.96	0.70	0.78E-01	0.25E-03	0.32E+03
17.5	.3974	51.	4.99	0.77	0.92E-01	0.93E-03	0.99E+02
25.0	.3927	59.	5.83	0.17	0.18E+00	0.39E-03	0.47E+03
35.0	.3865	73.	7.18	0.23	0.17E+00	0.54E-03	0.31E+03
45.0	.3794	86.	8.39	0.59	0.47E-01	0.71E-03	0.65E+02
55.0	.3732	95.	9.29	0.59	0.44E-01	0.65E-03	0.67E+02
70.0	.3659	106.	10.42	0.57	0.34E-01	0.63E-03	0.54E+02
90.0	.3581	121.	11.87	0.64	0.23E-01	0.44E-03	0.52E+02
110.0	.3518	133.	13.06	0.74	0.18E-01	0.70E-03	0.26E+02
130.0	.3474	141.	13.85	0.72	0.11E-01	0.37E-03	0.29E+02
165.0	.3414	155.	15.23	0.81	0.15E-01	0.44E-03	0.34E+02
195.0	.3362	171.	16.74	0.91	0.14E-01	0.12E-03	0.11E+03
225.0	.3353	180.	17.67	0.96	0.23E-02	0.69E-04	0.33E+02
275.0	.3346	193.	18.92	1.06	0.88E-03	0.52E-04	0.17E+02
325.0	.3325	207.	20.32	1.06	0.33E-02	0.25E-03	0.13E+02
375.0	.3266	221.	21.62	1.02	0.32E-02	0.67E-03	0.47E+01
450.0	.3203	237.	23.26	1.09	0.17E-02	0.21E-03	0.79E+01
550.0	.3161	257.	25.22	1.17	0.11E-02	0.21E-03	0.50E+01
650.0	.3132	276.	27.05	1.21	0.86E-03	0.11E-03	0.78E+01
750.0	.3115	294.	28.80	1.27	0.26E-02	0.86E-04	0.30E+02

DEPTH 53. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
4.7	.4383	2.	0.17	0.25	0.70E+00	0.48E-03	0.15E+04
6.2	.4345	9.	0.88	0.27	0.56E+00	0.58E-03	0.96E+03
8.7	.4290	17.	1.62	0.30	0.39E+00	0.59E-03	0.65E+03
12.5	.4224	30.	2.93	0.03	0.21E+01	0.45E-03	0.47E+04
17.5	.4148	41.	4.05	0.07	0.14E+01	0.17E-02	0.82E+03
25.0	.4063	51.	5.04	0.77	0.54E-01	0.60E-03	0.89E+02
35.0	.3973	66.	6.48	0.80	0.65E-01	0.65E-03	0.99E+02
45.0	.3890	78.	7.69	0.48	0.80E-01	0.77E-03	0.10E+03
55.0	.3826	88.	8.60	0.48	0.70E-01	0.63E-03	0.11E+03

DEPTH 53. CM (CONT)

70.0	.3755	99.	9.72	0.50	0.53E-01	0.62E-03	0.85E+02
90.0	.3682	114.	11.17	0.43	0.44E-01	0.39E-03	0.11E+03
110.0	.3635	127.	12.41	0.40	0.44E-01	0.38E-03	0.11E+03
130.0	.3605	136.	13.33	0.58	0.16E-01	0.28E-03	0.59E+02
165.0	.3548	151.	14.76	0.57	0.26E-01	0.43E-03	0.60E+02
195.0	.3502	166.	16.29	0.50	0.27E-01	0.36E-06	0.74E+05
225.0	.3501	177.	17.32	0.58	0.40E-02	0.22E-04	0.18E+03
275.0	.3486	190.	18.63	0.57	0.26E-02	0.19E-03	0.14E+02
325.0	.3445	205.	20.05	0.58	0.83E-02	0.38E-03	0.22E+02
375.0	.3374	218.	21.36	0.63	0.92E-02	0.72E-03	0.13E+02
450.0	.3302	235.	23.03	0.62	0.42E-02	0.26E-03	0.16E+02
550.0	.3255	256.	25.05	0.60	0.31E-02	0.21E-03	0.15E+02
650.0	.3227	275.	26.90	0.60	0.22E-02	0.96E-04	0.23E+02

DEPTH 76. CM SITE G-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
8.7	.4267	1.	0.10	0.21	0.12E+01	0.17E-02	0.73E+03
12.5	.4202	13.	1.26	0.25	0.25E+00	********	********
17.5	.4187	21.	2.01	0.29	0.45E+00	0.87E-03	0.51E+03
25.0	.4095	38.	3.68	0.36	0.17E+00	0.42E-03	0.40E+03
35.0	.4006	55.	5.44	0.43	0.17E+00	0.92E-03	0.18E+03
45.0	.3928	66.	6.43	0.44	0.12E+00	0.67E-03	0.18E+03
55.0	.3869	75.	7.35	0.45	0.10E+00	0.64E-03	0.16E+03
70.0	.3801	87.	8.54	0.49	0.74E-01	0.52E-03	0.14E+03
90.0	.3734	102.	9.96	0.49	0.52E-01	0.43E-03	0.12E+03
110.0	.3691	113.	11.12	0.45	0.47E-01	0.32E-03	0.15E+03
130.0	.3662	123.	12.07	0.39	0.32E-01	0.30E-03	0.11E+03
165.0	.3598	138.	13.49	0.39	0.50E-01	0.50E-03	0.10E+03
195.0	.3544	154.	15.05	0.44	0.33E-01	0.76E-04	0.44E+03
225.0	.3535	165.	16.18	0.45	0.59E-02	0.81E-04	0.74E+02
275.0	.3497	179.	17.53	0.49	0.80E-02	0.45E-03	0.18E+02
325.0	.3432	194.	18.97	0.49	0.15E-01	0.46E-03	0.34E+02
375.0	.3378	207.	20.30	0.48	0.18E-01	0.35E-03	0.51E+02
450.0	.3325	224.	21.95	0.48	0.84E-02	0.30E-03	0.28E+02
550.0	.3274	245.	23.99	0.49	0.55E-02	0.19E-03	0.29E+02
650.0	.3244	264.	25.85	0.50	0.35E-02	0.12E-03	0.29E+02
750.0	.3220	282.	27.61	0.50	0.77E-02	0.14E-03	0.53E+02

DEPTH 107. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
17.5	.4009	6.	0.57	0.49	0.35E+00	0.33E-03	0.10E+04
25.0	.3970	17.	1.64	0.48	0.17E+00	0.18E-03	0.97E+03
35.0	.3913	38.	3.74	0.46	0.21E+00	0.74E-03	0.29E+03
45.0	.3854	48.	4.74	0.44	0.16E+00	0.45E-03	0.35E+03
55.0	.3813	58.	5.64	0.42	0.14E+00	0.49E-03	0.30E+03
70.0	.3763	70.	6.85	0.40	0.12E+00	0.37E-03	0.31E+03
90.0	.3705	85.	8.33	0.43	0.77E-01	0.43E-03	0.18E+03
110.0	.3650	100.	9.75	0.64	0.44E-01	0.36E-03	0.12E+03
130.0	.3599	111.	10.89	0.80	0.22E-01	0.69E-03	0.33E+02
165.0	.3560	123.	12.08	0.65	0.36E-01	0.17E-03	0.21E+03
195.0	.3555	137.	13.47	0.50	0.25E-01	********	********
225.0	.3559	149.	14.63	0.51	0.66E-02	0.96E-04	0.69E+02
275.0	.3461	164.	16.08	0.54	0.21E-01	0.12E-02	0.18E+02
325.0	.3336	179.	17.57	0.57	0.20E-01	0.48E-03	0.43E+02
375.0	.3278	193.	18.88	0.57	0.20E-01	0.39E-03	0.50E+02

DEPTH 107. CM (CONT)

450.0	.3224	209.	20.50	0.54	0.11E-01	0.30E-03	0.37E+02
550.0	.3116	229.	22.49	0.50	0.11E-01	0.81E-03	0.14E+02
650.0	.3028	248.	24.33	0.48	0.52E-02	0.12E-03	0.42E+02
750.0	.3004	266	26.04	0.45	0.10E-01	0.16E-03	0.64E+0

DEPTH 137. CM SITE G-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
25.0	.3881	3.	0.31	0.23	0.36E+00	********	********
35.0	.3861	17.	1.70	0.34	0.34E+00	0.58E-03	0.59E+03
45.0	.3815	29.	2.84	0.35	0.23E+00	0.34E-03	0.67E+03
55.0	.3796	38.	3.76	0.36	0.19E+00	0.94E-04	0.20E+04
70.0	.3788	51.	4.99	0.39	0.13E+00	0.46E-04	0.29E+04
90.0	.3765	67.	6.60	0.43	0.96E-01	0.27E-03	0.35E+03
110.0	.3717	83.	8.09	0.29	0.13E+00	0.37E-03	0.33E+03
130.0	.3664	94.	9.26	0.16	0.16E+00	0.63E-03	0.25E+03
165.0	.3626	107.	10.52	0.33	0.75E-01	0.17E-03	0.44E+03
195.0	.3627	122.	11.95	0.48	0.92E-02	********	********
225.0	.3639	133.	13.06	0.44	0.92E-02	0.80E-04	0.12E+03
275.0	.3556	148.	14.47	0.39	0.55E-01	0.99E-03	0.56E+02
325.0	.3455	162.	15.91	0.33	0.45E-01	0.35E-03	0.13E+03
375.0	.3414	176.	17.22	0.33	0.41E-01	0.29E-03	0.14E+03
450.0	.3368	192.	18.83	0.35	0.22E-01	0.28E-03	0.78E+02
550.0	.3266	211.	20.72	0.33	0.31E-01	0.82E-03	0.38E+02
650.0	.3179	229.	22.48	0.29	0.11E-01	0.15E-03	0.74E+02
750.0	.3158	246.	24.09	0.25	0.21E-01	0.11E-03	0.19E+03

DEPTH 168. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
45.0	.3821	12.	1.16	0.57	0.16E+00	0.55E-03	0.30E+03
55.0	.3801	21.	2.08	0.53	0.13E+00	********	********
70.0	.3827	33.	3.22	0.45	0.11E+00	********	********
90.0	.3834	49.	4.76	0.37	0.13E+00	0.23E-03	0.55E+03
110.0	.3800	61.	6.02	0.33	0.13E+00	0.32E-03	0.42E+03
130.0	.3770	71.	7.00	0.33	0.93E-01	0.30E-03	0.31E+03
165.0	.3758	87.	8.56	0.38	0.68E-01	0.84E-05	0.82E+04
225.0	.3759	119.	11.65	0.61	0.74E-02	0.42E-04	0.18E+03
275.0	.3752	132.	12.92	0.56	0.48E-01	0.78E-04	0.62E+03
325.0	.3731	144.	14.14	0.47	0.37E-01	0.28E-03	0.13E+03
375.0	.3703	156.	15.28	0.37	0.43E-01	0.21E-03	0.20E+03
450.0	.3661	169.	16.55	0.13	0.71E-01	0.42E-03	0.17E+03

DEPTH 198. CM SITE G-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
55.0	.3856	5.	0.46	0.28	0.24E+00	0.33E-04	0.72E+04
70.0	.3848	17.	1.63	0.35	0.13E+00	0.84E-04	0.16E+04
90.0	.3828	29.	2.84	0.41	0.12E+00	0.20E-03	0.63E+03
110.0	.3815	43.	4.21	0.47	0.99E-01	0.88E-07	0.11E+07
130.0	.3823	54.	5.28	0.51	0.61E-01	********	********
165.0	.3854	70.	6.82	0.46	0.54E-01	********	********
195.0	.3875	89.	8.73	0.35	********	0.42E-04	********
225.0	.3868	101.	9.94	0.28	0.18E-01	0.66E-04	0.27E+03
275.0	.3861	113.	11.07	0.23	0.12E+00	0.72E-04	0.17E+04
325.0	.3846	123.	12.08	0.18	0.10E+00	0.22E-03	0.47E+03
375.0	.3827	133.	13.06	0.17	0.10E+00	0.18E-03	0.56E+03
450.0	.3783	142.	13.88	0.08	0.14E+00	0.11E-02	0.13E+03

DEPTH 229. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
55.0	.3854	4.	0.41	1.69	0.41E-01	0.67E-04	0.60E+03
70.0	.3845	16.	1.52	1.58	0.31E-01	0.90E-04	0.34E+03
90.0	.3843	28.	2.70	1.46	0.36E-01	********	********
110.0	.3852	41.	3.99	1.36	0.34E-01	********	********
130.0	.3869	51.	5.00	1.28	0.22E-01	********	********
165.0	.3891	66.	6.49	1.30	0.18E-01	********	********
195.0	.3907	76.	7.49	0.81	********	********	********
225.0	.3915	86.	8.40	0.74	0.69E-02	********	********
275.0	.3908	105.	10.25	1.19	0.24E-01	0.19E-03	0.12E+03
325.0	.3892	114.	11.16	1.16	0.17E-01	0.15E-03	0.11E+03
375.0	.3879	123.	12.02	1.10	0.16E-01	0.15E-03	0.11E+03
450.0	.3849	132.	12.92	1.23	0.11E-01	0.50E-03	0.21E+02
550.0	.3829	145.	14.16	1.31	0.11E-01	********	********
650.0	.3830	160.	15.69	1.15	0.38E-02	0.18E-04	0.21E+03
750.0	.3808	173.	16.99	0.98	0.83E-02	0.35E-03	0.24E+02

SITE G, REPLICATION 2

Table G-2.1. Soil morphologic data for Site G, replication 2.

Site and location: G-2 Heimdal, Oakes Aquifer 305 feet south and 100 feet east of the west quarter corner of Section 25, Township 131 north, Range 59 west, Dickey County, North Dakota.

Sampled: 08/01/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Heimdal loam; coarse-loamy, mixed Udic Haploboroll.

Physiography and parent material: Glacial till ground moraine.

Drainage: Well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: G-2 south side of pit.

Alp 0-6 inches (0-15 cm) black (l0YR 2/1) loam, dark gray (l0YR 4/1, dry); moderate coarse and medium granular structure; slightly hard to hard, friable, slightly sticky and slightly plastic; few coarse fragments to 30 mm diameter; common very fine roots; abrupt smooth boundary.

A12 6-11 inches(15-28 cm) black (l0YR 2/1) loam, dark gray (l0YR 4/1, dry); moderate coarse prismatic parting to moderte medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 10 mm diameter; common very fine roots; clear smooth boundary.

Bw 11-16 inches (28-41 cm) dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2, dry); moderate coarse prismatic parting to moderate medium and fine subangular block structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 10 mm diameter; common very fine roots; clear wavy boun dary.

BCk 16-34 inches (41-86 cm) light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 8/4, dry); moderate coarse prismatic parting to moderate medium and fine subangular block structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 10 mm diameter; common very fine roots; violent effervescence; gradual wavy boundary.

Cl 34-41 inches (86-104 cm) light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 8/4 and 7/4, dry); weak coarse prismatic parting to moderate fine platy structure; slightly hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 20 mm diameter; few very fine roots; strong effervescence; gradual wavy boundary.

C2 41-60 inches (104-152 cm) light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 8/4, dry) with few medium prominent yellowish red (5YR 5/6) mottles; weak coarse prismatic parting to moderate to strong fine platy structure; slighty hard, friable, slightly sticky and slightly plastic; very few coarse fragments to 15 mm diameter; strong effervescence.

Table G-2.2 HEIMDAL SERIES SITE G-2 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
cm	2.	20.	50.	100.	250.	500.	1000.	2000.
8.	14.1	19.3	20.0	15.2	18.2	10.4	2.7	0.1
23.	17.1	19.1	18.8	14.2	17.5	10.2	3.0	0.1
38.	19.2	19.8	19.3	12.8	16.5	9.2	3.2	0.0
53.	12.0	31.3	19.5	12.3	13.7	7.9	3.2	0.1
76.	9.8	31.3	16.0	12.2	18.7	9.3	2.7	0.0
107.	8.7	25.0	21.0	14.1	17.4	9.6	4.3	0.0
137.	10.5	24.3	21.4	14.9	16.8	8.5	3.6	0.0

DEPTH	SAND	SILT	CLAY	HORIZON	
cm	%	%	%		
8.	46.6	39.3	14.1	A 1 6	6=p
23.	45.0	37.9	17.1	A 1 2	7=w
38.	41.7	39.1	19.2	B 7	10=k
53.	37.2	50.8	12.0	BC 10	
76.	43.9	47.3	9.8	BC 10	
107.	45.3	46.0	8.7	C 1 0	
137.	43.8	45.7	10.5	C 2 0	

DEPTH	SA/SI	GMEAN	GDEV	Z	F-INDEX	BD	OC
cm		mm	mm			g/cc	%
8.	1.186	0.0356	6.4	0.0056	0.343	1.37	1.86
23.	1.187	0.0316	7.0	0.0045	0.309	1.39	1.74
38.	1.066	0.0277	7.3	0.0038	0.290	1.46	0.87
53.	0.732	0.0291	5.8	0.0050	0.365	1.38	0.55
76.	0.738	0.0397	6.8	0.0059	0.388	1.36	0.27
107.	0.987	0.0405	5.5	0.0074	0.399	1.51	0.12
137.	0.958	0.0365	5.6	0.0065	0.381	1.28	0.08

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	3.508	1.807	-0.4048	1.3514	-4.05	-0.03
23.	3.490	1.777	-0.3912	1.3050	-3.91	-0.08
38.	3.628	1.827	-0.3375	1.2093	-3.37	-0.17
53.	4.245	2.015	-0.2008	1.0788	-2.01	-0.30
76.	4.236	2.176	-0.1906	1.0121	-1.91	-0.37
107.	3.787	2.343	-0.3458	1.3166	-3.46	-0.06
137.	3.826	2.354	-0.3253	1.2702	-3.25	-0.11

Table G-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site G, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
			Saturation Extract Soluble Ions meq/l					
0 - 15	6.02	2.14	0.78	0.38	-	3.56	0.20	5.56
15 - 30	3.66	2.87	0.57	0.24	-	4.24	0.15	2.95
30 - 46	3.44	1.46	0.32	0.07	-	3.00	0.12	2.16
46 - 61	3.23	1.67	0.25	0.07	-	2.64	0.23	2.35
61 - 91	1.72	3.38	0.57	0.02	-	3.28	0.20	2.21
..91 - 122	0.86	3.83	1.22	0.03	-	3.28	0.20	2.46
122 - 152	0.64	4.25	1.91	0.03	-	3.20	0.30	3.34

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.79	0.38	43	7.8	-	l	10.34
15 - 30	0.60	0.31	45	7.8	-	l	10.69
30 - 46	0.44	0.20	46	7.8	-	l	10.26
46 - 61	0.44	0.16	41	7.9	-	sil	8.33
61 - 91	0.46	0.36	39	8.1	2.0	l	8.15
..91 - 122	0.49	0.80	36	8.2	-	l	7.67
122 - 152	0.61	1.22	36	8.2	-	l	8.10

Table G-2.4 HEIMDAL LOAM SITE G-2 NDSWC:1985
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			76.	
CM	CC/CC	SE									
10.	0.5073	0.0061	10.	0.5116	0.0009	10.	0.4697	0.0124	10.	0.4359	0.0154
20.	0.4840	0.0076	20.	0.5062	0.0017	20.	0.4542	0.0088	20.	0.4167	0.0109
40.	0.4350	0.0145	40.	0.4707	0.0128	40.	0.4135	0.0020	40.	0.3832	0.0094
60.	0.4125	0.0154	60.	0.4353	0.0145	60.	0.3905	0.0007	60.	0.3640	0.0089
80.	0.3835	0.0140	80.	0.4038	0.0146	80.	0.3698	0.0039	80.	0.3540	0.0090
100.	0.3698	0.0121	100.	0.3911	0.0142	100.	0.3613	0.0046	100.	0.3391	0.0085
120.	0.3545	0.0103	120.	0.3722	0.0136	120.	0.3483	0.0065	120.	0.3298	0.0090
180.	0.3246	0.0071	180.	0.3389	0.0103	180.	0.3207	0.0083	180.	0.3099	0.0090
334.	0.2907	0.0034	334.	0.3064	0.0087	334.	0.2894	0.0106	334.	0.2842	0.0091
534.	0.2746	0.0021	534.	0.2796	0.0078	534.	0.2733	0.0126	534.	0.2685	0.0101
834.	0.2569	0.0008	834.	0.2583	0.0077	834.	0.2551	0.0087	834.	0.2472	0.0101
BD =	1.37			1.40			1.46			1.36	
N =	2			2			2			2	

DEPTH (CM)

	107.			130.		
24.	0.3734	0.0001	24.	0.3156	0.0021	
40.	0.3602	0.0005	40.	0.3044	0.0006	
50.	0.3504	0.0015	50.	0.2970	0.0007	
62.	0.3449	0.0015	62.	0.2920	0.0016	
70.	0.3400	0.0020	70.	0.2878	0.0004	
82.	0.3337	0.0024	82.	0.2866	0.0031	
98.	0.3282	0.0024	98.	0.2785	0.0001	
150.	0.3094	0.0038	150.	0.2625	0.0006	
334.	0.2738	0.0042	334.	0.2373	0.0016	
503.	0.2550	0.0037	503.	0.2231	0.0019	
834.	0.2376	0.0002	834.	0.2034	0.0025	
BD =	1.51			1.28		
N =	2			2		0

Table G-2.5 HEIMDAL SERIES SITE G-2 (NDSWC 1985)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.2	.4914	1.	0.07	0.10	********	********	********
0.7	.4914	5.	0.50	0.15	0.12E+00	0.21E-03	0.56E+03
1.2	.4839	12.	1.20	0.15	0.14E+01	0.16E-02	0.86E+03
1.7	.4729	21.	2.07	0.07	0.19E+01	0.94E-03	0.21E+04
2.2	.4667	28.	2.77	0.00	********	0.78E-03	********
2.7	.4628	33.	3.22	0.04	0.14E+01	0.98E-03	0.14E+04
3.5	.4528	39.	3.82	0.09	0.13E+01	0.20E-02	0.65E+03
4.2	.4423	46.	4.47	0.13	0.56E+00	0.98E-03	0.57E+03
4.7	.4377	51.	5.02	0.18	0.36E+00	0.73E-03	0.50E+03
6.2	.4320	58.	5.67	0.23	0.92E-01	0.10E-02	0.91E+02
8.7	.4218	67.	6.52	0.28	0.14E+00	0.13E-02	0.11E+03
12.5	.4082	76.	7.42	0.40	0.52E-01	0.17E-02	0.30E+02
17.5	.3958	84.	8.27	0.50	0.33E-01	0.12E-02	0.27E+02
25.0	.3865	98.	9.57	0.58	0.10E-01	0.46E-03	0.22E+02
35.0	.3759	110.	10.82	0.70	0.15E-01	0.17E-02	0.87E+01
45.0	.3596	119.	11.62	0.77	0.19E-01	0.24E-02	0.79E+01
55.0	.3437	126.	12.37	0.87	0.11E-01	0.18E-02	0.61E+01
70.0	.3339	137.	13.42	1.00	0.26E-02	0.50E-03	0.53E+01
90.0	.3282	150.	14.71	1.10	0.15E-02	0.37E-03	0.41E+01
110.0	.3247	160.	15.71	1.18	0.79E-03	0.31E-03	0.26E+01
130.0	.3196	166.	16.31	1.28	0.23E-02	0.20E-02	0.12E+01
165.0	.3144	177.	17.31	1.50	0.25E-03	0.15E-03	0.16E+01
195.0	.3102	189.	18.54	1.70	0.26E-02	0.69E-03	0.38E+01
225.0	.3024	199.	19.46	1.78	0.83E-03	0.98E-03	0.85E+00
275.0	.2927	209.	20.49	1.88	0.78E-03	0.92E-03	0.85E+00
325.0	.2869	221.	21.61	2.00	0.15E-03	0.16E-03	0.91E+00
375.0	.2854	233.	22.81	2.07	0.71E-04	0.81E-04	0.88E+00
450.0	.2835	250.	24.49	2.08	0.11E-03	0.13E-03	0.78E+00
550.0	.2816	270.	26.48	2.12	0.35E-04	0.52E-04	0.66E+00
650.0	.2787	289.	28.31	2.13	0.17E-03	0.27E-03	0.64E+00
750.0	.2686	307.	30.06	2.13	0.55E-03	0.90E-03	0.61E+00

DEPTH 23. CM SITE G-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.7	.4526	-1.	-0.14	0.15	********	********	0.22E+04
1.2	.4488	6.	0.56	0.15	0.34E+01	0.80E-03	0.43E+04
1.7	.4435	11.	1.07	0.07	0.48E+01	0.53E-03	0.92E+04
2.2	.4404	19.	1.85	0.00	********	********	********
2.7	.4384	24.	2.38	0.04	0.34E+01	0.43E-03	0.81E+04
3.5	.4334	31.	3.03	0.09	0.33E+01	0.99E-03	0.33E+04
4.2	.4266	38.	3.75	0.13	0.18E+01	0.10E-02	0.17E+04
4.7	.4216	44.	4.35	0.18	0.11E+01	0.69E-03	0.16E+04
6.2	.4169	51.	5.05	0.23	0.25E+00	0.68E-03	0.37E+03
8.7	.4106	61.	5.93	0.28	0.37E+00	0.73E-03	0.50E+03
12.5	.4029	71.	6.94	0.40	0.13E+00	0.83E-03	0.16E+03
17.5	.3947	80.	7.87	0.50	0.93E-01	0.96E-03	0.97E+02
25.0	.3865	94.	9.20	0.58	0.30E-01	0.43E-03	0.71E+02
35.0	.3751	108.	10.58	0.70	0.45E-01	0.18E-02	0.26E+02

DEPTH 23. CM (CONT)

45.0	.3621	117.	11.43	0.77	0.49E-01	0.13E-02	0.38E+02
55.0	.3529	125.	12.26	0.87	0.28E-01	0.91E-03	0.31E+02
70.0	.3465	137.	13.39	1.00	0.74E-02	0.37E-03	0.20E+02
90.0	.3415	151.	14.78	1.10	0.46E-02	0.36E-03	0.13E+02
110.0	.3377	162.	15.85	1.18	0.26E-02	0.34E-03	0.75E+01
130.0	.3335	169.	16.52	1.28	0.63E-02	0.11E-02	0.55E+01
165.0	.3284	180.	17.66	1.50	0.98E-03	0.26E-03	0.38E+01
195.0	.3244	194.	19.05	1.70	0.67E-02	0.35E-03	0.19E+02
225.0	.3193	204.	20.03	1.78	0.23E-02	0.66E-03	0.34E+01
275.0	.3239	216.	21.13	1.88	0.24E-03	********	********
325.0	.3306	228.	22.34	2.00	0.53E-03	0.23E-03	0.23E+01
375.0	.3282	241.	23.59	2.07	0.27E-03	0.15E-03	0.19E+01
450.0	.3261	258.	25.26	2.08	0.30E-03	0.11E-03	0.27E+01
550.0	.3244	279.	27.29	2.12	0.11E-03	0.53E-04	0.20E+01
650.0	.3220	297.	29.13	2.13	0.48E-03	0.20E-03	0.23E+01
750.0	.3150	315.	30.88	2.13	0.15E-02	0.62E-03	0.24E+01

DEPTH 38. CM SITE G-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.7	.4370	2.	0.23	0.40	0.19E+01	0.37E-02	0.53E+03
2.2	.4240	6.	0.62	0.44	0.43E+00	0.94E-04	0.46E+04
2.7	.4236	13.	1.29	0.46	0.40E+00	0.58E-04	0.69E+04
3.5	.4226	20.	1.97	0.46	0.82E+00	0.19E-03	0.42E+04
4.2	.4197	28.	2.70	0.44	0.89E+00	0.78E-03	0.11E+04
4.7	.4154	34.	3.29	0.39	0.85E+00	0.68E-03	0.12E+04
6.2	.4115	41.	4.01	0.39	0.22E+00	0.42E-03	0.52E+03
8.7	.4081	51.	4.96	0.42	0.33E+00	0.32E-03	0.10E+04
12.5	.4039	62.	6.05	0.42	0.18E+00	0.47E-03	0.38E+03
17.5	.3979	72.	7.08	0.45	0.15E+00	0.70E-03	0.22E+03
25.0	.3905	87.	8.52	0.52	0.57E-01	0.41E-03	0.14E+03
35.0	.3804	102.	10.01	0.54	0.97E-01	0.13E-02	0.72E+02
45.0	.3719	111.	10.91	0.54	0.93E-01	0.54E-03	0.17E+03
55.0	.3677	121.	11.82	0.55	0.59E-01	0.39E-03	0.15E+03
70.0	.3628	133.	13.05	0.55	0.21E-01	0.39E-03	0.55E+02
90.0	.3573	148.	14.53	0.57	0.15E-01	0.38E-03	0.41E+02
110.0	.3527	160.	15.70	0.62	0.92E-02	0.41E-03	0.22E+02
130.0	.3492	168.	16.45	0.62	0.18E-01	0.57E-03	0.32E+02
165.0	.3440	181.	17.73	0.60	0.55E-02	0.35E-03	0.16E+02
325.0	.3540	233.	22.87	0.69	0.34E-02	0.38E-03	0.88E+01
375.0	.3500	247.	24.18	0.70	0.18E-02	0.22E-03	0.80E+01
450.0	.3471	264.	25.89	0.74	0.14E-02	0.14E-03	0.10E+02
550.0	.3442	285.	27.95	0.74	0.69E-03	0.14E-03	0.48E+01
650.0	.3410	304.	29.80	0.74	0.21E-02	0.21E-03	0.10E+02
750.0	.3365	322.	31.55	0.74	0.59E-02	0.31E-03	0.19E+02

DOERING 1-STEP DATA

1.3	.3395	*	13.38	83.33	0.16E-02	0.48E-03	0.34E+01
1.4	.3386	*	13.58	83.33	0.16E-02	0.47E-03	0.33E+01
1.4	.3377	*	13.77	83.33	0.15E-02	0.46E-03	0.32E+01
1.5	.3368	*	13.96	83.33	0.14E-02	0.45E-03	0.31E+01
1.5	.3360	*	14.14	83.33	0.13E-02	0.44E-03	0.30E+01
1.6	.3352	*	14.32	83.33	0.13E-02	0.44E-03	0.29E+01
1.6	.3344	*	14.49	83.33	0.12E-02	0.43E-03	0.29E+01
1.7	.3336	*	14.67	83.33	0.12E-02	0.42E-03	0.28E+01
1.7	.3329	*	14.84	83.33	0.11E-02	0.42E-03	0.27E+01
1.8	.3322	*	15.00	83.33	0.11E-02	0.41E-03	0.27E+01

DOERING 1-STEP DATA (CONT)

1.8	.3315	*	15.17	83.33	0.10E-02	0.40E-03	0.26E+01
1.9	.3309	*	15.33	83.33	0.10E-02	0.40E-03	0.25E+01
1.9	.3302	*	15.48	83.33	0.97E-03	0.39E-03	0.25E+01

DEPTH 38. CM (DOERING 1-STEP CONTINUED) SITE G-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.0	.3296	*	15.64	83.33	0.94E-03	0.39E-03	0.24E+01
2.0	.3290	*	15.79	83.33	0.90E-03	0.38E-03	0.24E+01
2.1	.3285	*	15.94	83.33	0.87E-03	0.38E-03	0.23E+01
2.1	.3279	*	16.09	83.33	0.85E-03	0.37E-03	0.23E+01
2.2	.3273	*	16.24	83.33	0.82E-03	0.37E-03	0.22E+01
2.2	.3268	*	16.38	83.33	0.79E-03	0.36E-03	0.22E+01
2.3	.3263	*	16.52	83.33	0.77E-03	0.36E-03	0.22E+01
4.3	.3121	*	21.18	83.33	0.32E-03	0.25E-03	0.13E+01
8.3	.2992	*	27.21	83.33	0.14E-03	0.18E-03	0.77E+00
12.3	.2921	*	31.60	83.33	0.84E-04	0.14E-03	0.59E+00
16.3	.2873	*	35.15	83.33	0.60E-04	0.12E-03	0.49E+00
20.3	.2837	*	38.19	83.33	0.47E-04	0.11E-03	0.43E+00
24.3	.2808	*	40.86	83.33	0.39E-04	0.99E-04	0.39E+00
28.3	.2785	*	43.27	83.33	0.33E-04	0.92E-04	0.36E+00
32.3	.2765	*	45.48	83.33	0.29E-04	0.86E-04	0.34E+00
36.3	.2748	*	47.51	83.33	0.26E-04	0.80E-04	0.33E+00

DEPTH 53. CM SITE G-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.5	.4418	6.	0.57	*****	********	********	********
4.2	.4405	13.	1.25	*****	********	0.30E-03	********
4.7	.4380	15.	1.51	*****	********	0.45E-03	********
6.2	.4348	26.	2.51	*****	********	0.35E-03	********
8.7	.4307	38.	3.71	0.03	0.49E+01	0.36E-03	0.14E+05
12.5	.4254	52.	5.07	0.32	0.29E+00	0.48E-03	0.59E+03
17.5	.4180	64.	6.25	0.45	0.21E+00	0.82E-03	0.25E+03
25.0	.4098	79.	7.75	0.47	0.90E-01	0.38E-03	0.23E+03
35.0	.4022	95.	9.28	0.50	0.13E+00	0.77E-03	0.17E+03
45.0	.3954	104.	10.20	0.52	0.11E+00	0.72E-03	0.16E+03
55.0	.3898	113.	11.08	0.47	0.84E-01	0.55E-03	0.15E+03
70.0	.3833	126.	12.31	0.45	0.38E-01	0.51E-03	0.75E+02
90.0	.3769	140.	13.76	0.42	0.30E-01	0.37E-03	0.82E+02
110.0	.3724	152.	14.91	0.33	0.26E-01	0.43E-03	0.61E+02
130.0	.3692	160.	15.68	0.35	0.38E-01	0.40E-03	0.96E+02
165.0	.3644	174.	17.01	0.43	0.13E-01	0.34E-03	0.37E+02
195.0	.2730	190.	18.64	0.43	0.96E+00	0.17E-01	0.57E+02
325.0	.3495	227.	22.23	0.47	0.82E-02	0.33E-03	0.24E+02
375.0	.3459	241.	23.58	0.50	0.42E-02	0.20E-03	0.21E+02
450.0	.3428	259.	25.34	0.53	0.29E-02	0.16E-03	0.18E+02
550.0	.3390	280.	27.43	0.57	0.18E-02	0.20E-03	0.88E+01
650.0	.3349	299.	29.33	0.63	0.35E-02	0.23E-03	0.15E+02

DEPTH 76. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
6.2	.4220	8.	0.76	0.29	0.44E+00	0.20E-03	0.22E+04
8.7	.4195	12.	1.21	0.23	0.83E+00	0.20E-03	0.42E+04
12.5	.4166	32.	3.10	0.18	0.59E+00	0.22E-03	0.27E+04
17.5	.4117	45.	4.46	0.18	0.69E+00	0.58E-03	0.12E+04

DEPTH 76. CM (CONT)

25.0	.4051	63.	6.16	0.29	0.20E+00	0.29E-03	0.69E+03
35.0	.3991	81.	7.94	0.39	0.21E+00	0.50E-03	0.42E+03
45.0	.3931	91.	8.89	0.39	0.19E+00	0.82E-03	0.23E+03
55.0	.3878	99.	9.72	0.38	0.13E+00	0.47E-03	0.27E+03
70.0	.3825	111.	10.89	0.35	0.72E-01	0.43E-03	0.17E+03
90.0	.3773	126.	12.34	0.36	0.48E-01	0.27E-03	0.17E+03
110.0	.3741	138.	13.52	0.42	0.30E-01	0.28E-03	0.11E+03
130.0	.3721	147.	14.37	0.46	0.32E-01	0.15E-03	0.21E+03
165.0	.3688	161.	15.80	0.49	0.17E-01	0.25E-03	0.69E+02
195.0	.3656	178.	17.49	0.52	0.11E+01	0.73E-04	0.14E+05
325.0	.3523	215.	21.10	0.51	0.11E-01	0.34E-03	0.34E+02
375.0	.3484	229.	22.41	0.47	0.75E-02	0.25E-03	0.30E+02
450.0	.3449	246.	24.14	0.44	0.55E-02	0.17E-03	0.32E+02
550.0	.3409	268.	26.25	0.44	0.45E-02	0.21E-03	0.21E+02

DEPTH 107. CM SITE G-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
8.7	.3999	7.	0.67	0.88	0.25E+00	********	********
12.5	.3983	13.	1.28	0.38	0.32E+00	0.14E-03	0.24E+04
17.5	.3961	24.	2.32	0.42	0.37E+00	0.21E-03	0.18E+04
25.0	.3926	43.	4.17	0.43	0.17E+00	0.18E-03	0.97E+03
35.0	.3886	62.	6.12	0.40	0.24E+00	0.36E-03	0.65E+03
45.0	.3834	72.	7.05	0.38	0.24E+00	0.79E-03	0.31E+03
55.0	.3778	81.	7.89	0.40	0.15E+00	0.55E-03	0.28E+03
70.0	.3715	92.	9.05	0.42	0.88E-01	0.53E-03	0.17E+03
90.0	.3663	107.	10.52	0.42	0.52E-01	0.17E-03	0.31E+03
110.0	.3639	120.	11.73	0.38	0.43E-01	0.24E-03	0.18E+03
130.0	.3620	129.	12.64	0.38	0.44E-01	0.17E-03	0.26E+03
165.0	.3593	144.	14.12	0.40	0.28E-01	0.18E-03	0.16E+03
195.0	.3570	162.	15.84	0.38	0.14E+01	0.48E-04	0.30E+05
325.0	.3473	199.	19.52	0.43	0.20E-01	0.34E-03	0.59E+02
375.0	.3431	212.	20.82	0.47	0.12E-01	0.31E-03	0.39E+02
450.0	.3392	229.	22.46	0.43	0.82E-02	0.19E-03	0.43E+02
550.0	.3351	250.	24.46	0.37	0.89E-02	0.22E-03	0.40E+02

DEPTH 137. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
17.5	.4175	4.	0.44	0.15	0.11E+01	0.13E-03	0.88E+04
25.0	.4149	25.	2.43	0.21	0.41E+00	0.13E-03	0.33E+04
35.0	.4121	41.	3.98	0.24	0.43E+00	0.24E-03	0.18E+04
45.0	.4095	51.	5.00	0.28	0.38E+00	0.30E-03	0.13E+04
55.0	.4069	63.	6.18	0.48	0.15E+00	0.17E-03	0.86E+03
70.0	.4032	76.	7.41	0.48	0.99E-01	0.48E-03	0.21E+03
90.0	.3990	88.	8.60	0.32	0.81E-01	0.24E-03	0.34E+03
110.0	.3961	100.	9.84	0.36	0.57E-01	0.24E-03	0.24E+03
130.0	.3938	110.	10.81	0.40	0.48E-01	0.25E-03	0.20E+03
165.0	.3904	126.	12.36	0.43	0.33E-01	0.20E-03	0.16E+03
195.0	.3878	144.	14.13	0.47	0.12E+01	0.47E-04	0.25E+05
275.0	.3861	169.	16.53	0.50	0.19E-02	0.18E-03	0.11E+02
325.0	.3838	182.	17.88	0.47	0.23E-01	0.17E-03	0.14E+03
375.0	.3813	196.	19.18	0.43	0.18E-01	0.24E-03	0.75E+02
450.0	.3783	212.	20.77	0.43	0.11E-01	0.15E-03	0.69E+02
550.0	.3751	231.	22.65	0.42	0.11E-01	0.19E-03	0.55E+02
650.0	.3716	248.	24.34	0.39	0.15E-01	0.22E-03	0.66E+02
750.0	.3674	264.	25.91	0.38	0.24E-01	0.32E-03	0.75E+02

SITE H (STIRUM SERIES)

Site H was located in a broad, nearly depressional area in a fallow field. The location and description are summarized on Table 1 and on Fig. 2. In-situ measurements and site descriptions were made during August and October, 1985. Because of slow infiltration rate, several days were required to fully wet the soil profile.

The Stirum series consists of "poorly drained to very poorly drained alkali soils on lake plains. These soils occur as nearly level areas or as slight depressions. They are formed in moderately coarse textured and coarse textured deposits left by glacial melt water." (USDA, 1971).

Infiltration and soil-water content and suction profiles during wetting were made on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

As with site F, drainage measurements were possible on Site H because the field had recently been tiled in connection with a 5,000-acre test plot for the Oakes Irrigation Tract of the Garrison Irrigation Project.

SITE H, REPLICATION 1

Table H-1.1. Soil morphologic data for Site H, replication 1.

Site and location: H-l Stirum, Oakes Aquifer 950 feet south and 360 feet west of the east quarter corner of Section 29, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Stirum sandy loam; coarse-loamy, mixed, frigid, Typic Natraquoll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Poor (drain for 5,000 acre Oakes test area 200 feet to the north).

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parentheis if different from field texture.

Soil profile: H-l north side of pit.

Ap 0-6 inches (0-15 cm) very dark gray (lOYR 3/1) sandy loam (fine sandy loam), gray (lOYR 5/1, dry); moderate medium granular structure; slightly hard, very friable, slighty sticky and slightly plastic; common very fine roots; strong effervescence; abrupt smooth boundary.

Bt 6-8 inches (15-20 cm) very dark gray (lOYR 3/1) sandy loam (fine sandy loam), dark gray (lOYR 4/1, dry); strong coarse and medium angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; abrupt smooth boundary.

Btkl 8-15 inches (20-38 cm) gray (lOYR 5/1) sandy loam (sandy clay loam), light gray (lOYR 6/1, dry) with continuous thin clay films, dark gray (lOYR 4/1) organic stains and bleached sand grains on prism faces; moderate coarse prismatic parting to moderate coarse subangular blocky and moderate coarse platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; violent effervescence; clear wavy boundary.

Btk2 15-20 inches (38-51 cm) gray (5Y 5/1) sandy loam (sandy clay loam), light gray (2.5Y 7/0, dry) with continuous thin clay films, dark gray (lOYR 4/1) organic stains and bleached sand grains on prism faces; moderate coarse prismatic parting to moderate coarse and medium subangular blocky and weak coarse platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; violent effervescence; clear wavy boundary.

BC 20-29 inches (51-74 cm) olive (5Y 5/3) loamy sand (fine sandy loam), pale olive (5Y 6/3, dry) with many thin clay films and gray (5Y 5/1) organic stains on prism faces; weak coarse prismatic parting to weak subangular blocky and weak platy structure; soft, very friable, slightly sticky and nonplastic; few very fine roots; strong effervescence; abrupt discontinuous boundary.

2Ab 29-33 (74-84 cm) dark gray (lOYR 4/1) sandy loam (fine sandy loam), gray (lOYR 5/1, dry); weak coarse prismatic parting to weak coarse and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; strong effervescence; abrupt discontinuous boundary.

C2 33-60 inches (84-152 cm) light gray to gray (5Y 6/1) and strong brown (7.5YR 5/6) sand, with few medium distinct dark reddish brown (5YR 2/2) mottles; single grained; loose, nonsticky and nonplastic; slight effervescence.

Table H-1.2 STIRUM SERIES SITE H-1 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.	15.3	7.9	11.6	28.2	29.8	5.9	1.0	0.2
23.	15.1	5.6	11.4	29.9	29.9	6.4	1.4	0.2
38.	22.7	5.9	8.9	30.0	26.4	4.9	1.2	0.1
53.	10.5	3.3	9.9	32.8	35.6	6.3	1.5	0.1
69.	8.3	7.7	8.6	17.2	33.3	19.7	4.5	0.7
84.	8.2	4.7	10.8	11.7	30.6	26.5	5.9	1.6
99.	3.9	1.8	4.9	3.9	27.9	43.4	13.5	0.7
114.	0.6	0.4	3.6	1.2	18.7	43.3	32.0	0.3
137.	1.7	2.2	2.1	0.7	11.3	52.9	28.8	0.4

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	65.2	19.5	15.3	A 6	6=p
23.	67.9	17.0	15.1	B 11	9=b
38.	62.5	14.8	22.7	B 1 10 11	10=k
53.	76.3	13.2	10.5	BC	11=t
69.	75.4	16.3	8.3	BC	
84.	76.3	15.5	8.2	2A 9	
99.	89.4	6.7	3.9	2C 9	
114.	95.4	4.0	0.6	2C	
137.	94.0	4.3	1.7	2C	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	3.338	0.0445	6.3	0.0071	0.518	1.27	2.30
23.	3.988	0.0479	6.3	0.0076	0.567	1.74	0.94
38.	4.230	0.0327	7.7	0.0042	0.498	1.70	0.27
53.	5.780	0.0645	5.0	0.0128	0.748	1.70	0.27
69.	4.626	0.0873	5.5	0.0159	0.519	1.67	0.07
84.	4.923	0.1057	5.7	0.0186	0.535	1.62	0.13
99.	13.343	0.2093	3.9	0.0533	0.885	1.69	0.13
114.	23.875	0.3490	2.4	0.1463	1.179	1.59	0.07
137.	21.884	0.3321	3.0	0.1109	1.350	1.53	0.07

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	2.323	1.945	-0.7886	1.8879	-7.89	0.51
23.	2.164	2.260	-0.8421	1.9662	-8.42	0.59
38.	2.035	2.453	-0.7832	1.8154	-7.83	0.44
53.	1.900	3.159	-0.9850	2.2127	-9.85	0.83
69.	2.087	2.863	-0.9529	2.1866	-9.53	0.81
84.	2.038	2.753	-0.9706	2.2127	-9.71	0.83
99.	1.411	4.037	-1.2094	2.5926	-12.09	1.21
114.	1.153	5.921	-1.3118	2.7695	-13.12	1.39
137.	1.185	6.890	-1.2903	2.7289	-12.90	1.35

Table H-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site H, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	3.68	4.04	1.09	0.76	-	4.84	0.23	4.50
15 - 30	0.76	1.64	5.21	0.12	0.24	4.20	0.32	2.97
30 - 46	0.55	0.93	4.56	0.07	0.24	3.76	0.10	2.01
46 - 61	0.42	0.98	6.22	0.06	0.32	4.84	0.20	2.32
61 - 76	0.42	0.58	5.84	0.07	-	4.08	0.20	2.63
76 - 91	0.63	0.37	5.31	0.08	0.08	3.80	0.10	2.41
91- 107	0.76	0.44	4.79	0.09	-	3.28	0.20	2.60
107 - 122	0.63	0.25	4.18	0.08	-	3.32	0.12	1.70
122 - 152	0.51	0.49	4.20	0.11		3.30	0.14	1.87

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.70	0.6	42	8.2	-	fsl	7.49
15 - 30	0.66	4.8	40	8.6	3.4	fsl	6.97
30 - 46	0.48	5.3	38	8.6	-	scl;	7.48
46 - 61	0.67	7.4	36	8.6	3.8	fsl	4.86
61 - 76	0.51	8.3	33	8.1	-	fsl;	4.97
76 - 91	0.57	7.5	31	8.5	-	fsl	4.94
91- 107	0.51	6.2	26	8.2	-	s	4.13
107 - 122	0.40	6.3	19	8.2	-	s	2.04
122 - 152	0.43	5.9	24	8.2	-	s	2.49

Table H-1.4 STIRUM SERIES SITE H-1 NDSWC:1985

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

CM	8. CC/CC	SE	CM	23. CC/CC	SE	CM	38. CC/CC	SE	CM	53. CC/CC	SE
14.	0.5288	0.0156	14.	0.3757	0.0044	14.	0.3615	0.0062	14.	0.3412	0.0015
20.	0.5187	0.0181	20.	0.3606	0.0027	20.	0.3608	0.0057	20.	0.3412	0.0015
30.	0.4875	0.0089	30.	0.3593	0.0002	30.	0.3540	0.0086	30.	0.3426	0.0015
40.	0.4605	0.0060	40.	0.3606	0.0018	40.	0.3464	0.0081	40.	0.3382	0.0006
60.	0.3793	0.0054	60.	0.3425	0.0050	60.	0.3293	0.0027	60.	0.3251	0.0004
80.	0.3225	0.0027	80.	0.3252	0.0049	80.	0.3053	0.0050	80.	0.2944	0.0011
100.	0.2971	0.0002	100.	0.3135	0.0046	100.	0.2848	0.0069	100.	0.2652	0.0029
120.	0.2757	0.0013	120.	0.3032	0.0043	120.	0.2711	0.0068	120.	0.2455	0.0032
160.	0.2505	0.0020	160.	0.2859	0.0042	160.	0.2520	0.0068	160.	0.2148	0.0030
238.	0.2268	0.0027	238.	0.2645	0.0041	238.	0.2308	0.0081	238.	0.1922	0.0043
340.	0.2142	0.0019	340.	0.2555	0.0038	340.	0.2225	0.0081	340.	0.1878	0.0063
544.	0.2016	0.0023	544.	0.2396	0.0036	544.	0.2157	0.0061	544.	0.1784	0.0068
850.	0.1868	0.0012	850.	0.2266	0.0005	850.	0.1958	0.0065	850.	0.1579	0.0056
BD =	1.27			1.74			1.70			1.70	
N =	2			2			2			2	

DEPTH (CM)

CM	69. CC/CC	SE	CM	84. CC/CC	SE	CM	99. CC/CC	SE	CM	114. CC/CC	SE
14.	0.3281	0.0085	10.	0.2935	0.0021	10.	0.3239	0.0135	14.	0.4707	0.0198
20.	0.3159	0.0089	20.	0.2855	0.0011	20.	0.3203	0.0161	20.	0.4661	0.0211
30.	0.3123	0.0114	40.	0.2734	0.0008	40.	0.2888	0.0082	30.	0.4581	0.0218
40.	0.3095	0.0134	60.	0.2478	0.0047	60.	0.2450	0.0090	40.	0.3660	0.0114
60.	0.2809	0.0183	80.	0.2129	0.0076	80.	0.2143	0.0088	60.	0.2199	0.0224
80.	0.2528	0.0124	100.	0.2122	0.0081	100.	0.2135	0.0083	80.	0.2000	0.0146
100.	0.2348	0.0097	120.	0.2122	0.0081	120.	0.2135	0.0083	100.	0.1946	0.0144
120.	0.2226	0.0091	180.	0.1867	0.0072	180.	0.1953	0.0129	120.	0.1940	0.0148
160.	0.2046	0.0074	334.	0.1565	0.0068	334.	0.1719	0.0148	160.	0.1866	0.0141
238.	0.1881	0.0078	530.	0.1504	0.0082	530.	0.1580	0.0153	238.	0.1831	0.0126
340.	0.1788	0.0062	834.	0.1336	0.0030	834.	0.1434	0.0131	340.	0.1825	0.0130
544.	0.1716	0.0061	544.	0.1785	0.0138						
850.	0.1551	0.0055	850.	0.1740	0.0151						
BD =	1.67			1.62			1.69			1.59	
N =	2			2			2			2	

DEPTH (CM)

CM	137. CC/CC	SE
14.	0.6463	0.1439
20.	0.4491	0.0608
30.	0.3840	0.0575
40.	0.2290	0.0702
60.	0.1749	0.0687
80.	0.1659	0.0671
100.	0.1594	0.0638
120.	0.1543	0.0626
160.	0.1469	0.0599
238.	0.1384	0.0563
340.	0.1339	0.0531
544.	0.1255	0.0496
850.	0.1159	0.0452
BD =	1.53	
N =	2	

Table H-1.5 HAMAR SERIES SITE H -1 (NDSWC 1984)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

STIRUM SERIES SITE H-1 (NDSWC 1985)

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.5	.4027	0.	0.00	2.15	0.24E-01	0.72E-03	0.34E+02
4.5	.3961	9.	0.85	2.38	0.20E-01	0.84E-03	0.24E+02
6.2	.3914	18.	1.72	2.55	0.37E-02	0.31E-03	0.12E+02
8.7	.3878	27.	2.62	2.48	0.51E-02	0.52E-03	0.98E+01
12.5	.3841	34.	3.37	2.42	0.20E-02	0.44E-03	0.44E+01
17.5	.3803	41.	4.02	2.32	0.30E-02	0.77E-03	0.39E+01
22.5	.3761	47.	4.62	2.20	0.25E-02	0.60E-03	0.41E+01
27.5	.3720	53.	5.17	2.08	0.34E-02	0.92E-03	0.36E+01
35.0	.3649	57.	5.62	2.00	0.37E-02	0.24E-02	0.15E+01
45.0	.3565	61.	6.02	1.92	0.28E-02	0.18E-02	0.16E+01
80.0	.3427	72.	7.09	1.73	0.12E-02	0.10E-02	0.12E+01
100.0	.3374	77.	7.59	1.62	0.12E-02	0.11E-02	0.11E+01
120.0	.3334	82.	8.02	1.53	0.74E-03	0.75E-03	0.99E+00
140.0	.3302	86.	8.42	1.45	0.91E-03	0.87E-03	0.10E+01
160.0	.3275	89.	8.77	1.37	0.55E-03	0.66E-03	0.83E+00
210.0	.3196	96.	9.39	1.22	0.11E-02	0.15E-02	0.74E+00
300.0	.3117	105.	10.29	0.93	0.16E-03	0.23E-03	0.69E+00
400.0	.3097	112.	11.02	0.68	0.22E-03	0.33E-03	0.67E+00
500.0	.3080	117.	11.47	0.63	0.18E-03	0.49E-03	0.36E+00
625.0	.3034	121.	11.82	0.65	0.61E-03	0.20E-02	0.31E+00
800.0	.2983	127.	12.42	0.48	0.19E-03	0.30E-03	0.63E+00
1000.0	.2961	133.	13.02	0.33	0.22E-03	0.49E-03	0.46E+00

DEPTH 23. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.5	.3918	0.	0.02	2.13	0.49E-01	0.45E-03	0.11E+03
3.5	.3879	9.	0.86	2.15	0.65E-01	0.48E-03	0.13E+03
4.5	.3834	15.	1.47	2.38	0.53E-01	0.39E-03	0.14E+03
6.2	.3799	26.	2.57	2.55	0.11E-01	0.31E-03	0.35E+02
8.7	.3770	36.	3.54	2.48	0.14E-01	0.40E-03	0.35E+02
12.5	.3740	44.	4.29	2.42	0.57E-02	0.45E-03	0.13E+02
17.5	.3707	50.	4.90	2.32	0.86E-02	0.73E-03	0.12E+02
22.5	.3676	55.	5.44	2.20	0.66E-02	0.46E-03	0.14E+02
27.5	.3649	60.	5.92	2.08	0.90E-02	0.72E-03	0.12E+02
35.0	.3607	65.	6.32	2.00	0.94E-02	0.15E-02	0.62E+01
45.0	.3559	68.	6.67	1.92	0.73E-02	0.13E-02	0.55E+01
80.0	.3477	78.	7.62	1.73	0.32E-02	0.78E-03	0.41E+01
100.0	.3446	82.	8.04	1.62	0.30E-02	0.73E-03	0.41E+01
120.0	.3423	86.	8.41	1.53	0.19E-02	0.50E-03	0.38E+01
140.0	.3405	89.	8.75	1.45	0.23E-02	0.57E-03	0.40E+01
160.0	.3390	92.	9.04	1.37	0.14E-02	0.45E-03	0.32E+01
210.0	.3335	97.	9.54	1.22	0.29E-02	0.13E-02	0.23E+01
300.0	.3291	104.	10.24	0.93	0.24E-03	********	********
400.0	.3293	110.	10.77	0.68	0.49E-03	0.10E-03	0.49E+01
500.0	.3266	114.	11.19	0.63	0.96E-03	0.14E-02	0.67E+00
625.0	.3209	118.	11.55	0.65	0.17E-02	0.17E-02	0.10E+01

DEPTH 23. CM (CONT)

800.0	.3172	123.	12.02	0.48	0.46E-03	0.17E-03	0.27E+01
1000.0	.3161	128.	12.50	0.33	0.58E-03	0.31E-03	0.19E+01

DEPTH 38. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3602	5.	0.48	3.24	0.33E-01	0.23E-03	0.14E+03
1.5	.3594	11.	1.12	3.25	0.43E-01	0.34E-03	0.13E+03
2.5	.3585	18.	1.79	3.12	0.43E-01	0.15E-03	0.28E+03
3.5	.3574	28.	2.70	2.82	0.67E-01	0.20E-03	0.33E+03
4.5	.3556	39.	3.78	2.43	0.72E-01	0.19E-03	0.38E+03
6.2	.3538	48.	4.75	2.05	0.20E-01	0.25E-03	0.79E+02
8.7	.3523	55.	5.36	1.74	0.28E-01	0.28E-03	0.10E+03
12.5	.3506	60.	5.85	1.49	0.14E-01	0.47E-03	0.29E+02
17.5	.3487	64.	6.23	1.33	0.22E-01	0.54E-03	0.41E+02
22.5	.3471	67.	6.57	1.21	0.16E-01	0.42E-03	0.39E+02
27.5	.3455	70.	6.85	1.07	0.25E-01	0.80E-03	0.31E+02
35.0	.3437	72.	7.02	0.87	0.28E-01	0.15E-02	0.18E+02
45.0	.3417	74.	7.24	0.81	0.24E-01	0.71E-03	0.34E+02
80.0	.3353	81.	7.98	0.72	0.11E-01	0.76E-03	0.14E+02
100.0	.3332	84.	8.28	0.69	0.95E-02	0.63E-03	0.15E+02
120.0	.3317	87.	8.57	0.67	0.61E-02	0.41E-03	0.15E+02
140.0	.3308	90.	8.83	0.65	0.66E-02	0.27E-03	0.24E+02
160.0	.3303	92.	9.04	0.64	0.39E-02	0.19E-03	0.21E+02
210.0	.3271	96.	9.39	0.57	0.89E-02	0.12E-02	0.75E+01
400.0	.3245	103.	10.07	0.39	0.11E-02	0.35E-03	0.33E+01
500.0	.3211	106.	10.37	0.29	0.50E-02	0.18E-02	0.28E+01
625.0	.3158	109.	10.68	0.20	0.84E-02	0.16E-02	0.51E+01

DOERING 1-STEP DATA

0.9	.2933	60.	5.90	83.33	0.31E-02	0.70E-03	0.45E+01
1.0	.2925	61.	6.01	83.33	0.29E-02	0.68E-03	0.43E+01
1.0	.2918	62.	6.11	83.33	0.28E-02	0.67E-03	0.41E+01
1.1	.2911	63.	6.21	83.33	0.26E-02	0.66E-03	0.40E+01
1.1	.2905	64.	6.31	83.33	0.25E-02	0.65E-03	0.38E+01
1.2	.2898	65.	6.41	83.33	0.24E-02	0.64E-03	0.37E+01
1.2	.2892	66.	6.50	83.33	0.23E-02	0.63E-03	0.36E+01
1.3	.2887	67.	6.59	83.33	0.22E-02	0.62E-03	0.35E+01
1.3	.2881	68.	6.68	83.33	0.21E-02	0.61E-03	0.34E+01
1.4	.2876	69.	6.77	83.33	0.20E-02	0.60E-03	0.33E+01
1.4	.2871	70.	6.85	83.33	0.19E-02	0.59E-03	0.32E+01
1.5	.2866	71.	6.93	83.33	0.18E-02	0.58E-03	0.31E+01
1.5	.2861	72.	7.01	83.33	0.18E-02	0.57E-03	0.31E+01
1.6	.2856	72.	7.09	83.33	0.17E-02	0.57E-03	0.30E+01
1.6	.2852	73.	7.17	83.33	0.16E-02	0.56E-03	0.29E+01
1.7	.2848	74.	7.24	83.33	0.16E-02	0.55E-03	0.29E+01
1.7	.2844	75.	7.32	83.33	0.15E-02	0.55E-03	0.28E+01
1.8	.2840	75.	7.39	83.33	0.15E-02	0.54E-03	0.27E+01
1.8	.2836	76.	7.46	83.33	0.14E-02	0.53E-03	0.27E+01
1.9	.2832	77.	7.53	83.33	0.14E-02	0.53E-03	0.26E+01
1.9	.2828	78.	7.60	83.33	0.14E-02	0.52E-03	0.26E+01
2.0	.2825	78.	7.67	83.33	0.13E-02	0.52E-03	0.25E+01
2.0	.2821	79.	7.73	83.33	0.13E-02	0.51E-03	0.25E+01
2.1	.2818	80.	7.80	83.33	0.12E-02	0.51E-03	0.24E+01

DEPTH 38. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.1	.2815	80.	7.86	83.33	0.12E-02	0.50E-03	0.24E+01
2.2	.2811	81.	7.93	83.33	0.12E-02	0.50E-03	0.24E+01
2.2	.2808	81.	7.99	83.33	0.12E-02	0.49E-03	0.23E+01
2.3	.2805	82.	8.05	83.33	0.11E-02	0.49E-03	0.23E+01
2.3	.2802	83.	8.11	83.33	0.11E-02	0.49E-03	0.23E+01
2.4	.2799	83.	8.17	83.33	0.11E-02	0.48E-03	0.22E+01
2.4	.2796	84.	8.23	83.33	0.10E-02	0.48E-03	0.22E+01
2.5	.2793	85.	8.29	83.33	0.10E-02	0.47E-03	0.22E+01
2.5	.2791	85.	8.34	83.33	0.10E-02	0.47E-03	0.21E+01
2.6	.2788	86.	8.40	83.33	0.98E-03	0.47E-03	0.21E+01
2.6	.2785	86.	8.46	83.33	0.96E-03	0.46E-03	0.21E+01
2.7	.2783	87.	8.51	83.33	0.94E-03	0.46E-03	0.21E+01
2.7	.2780	87.	8.56	83.33	0.92E-03	0.46E-03	0.20E+01
2.8	.2778	88.	8.62	83.33	0.91E-03	0.45E-03	0.20E+01
2.8	.2775	88.	8.67	83.33	0.89E-03	0.45E-03	0.20E+01
2.9	.2773	89.	8.72	83.33	0.87E-03	0.45E-03	0.20E+01
4.9	.2700	107.	10.49	83.33	0.50E-03	0.36E-03	0.14E+01
8.9	.2623	131.	12.86	83.33	0.29E-03	0.29E-03	0.10E+01
12.9	.2576	149.	14.60	83.33	0.22E-03	0.25E-03	0.90E+00
16.9	.2542	163.	16.01	83.33	0.19E-03	0.22E-03	0.87E+00
20.9	.2515	176.	17.21	83.33	0.18E-03	0.21E-03	0.88E+00
24.9	.2494	186.	18.27	83.33	0.18E-03	0.19E-03	0.94E+00
28.9	.2476	196.	19.22	83.33	0.19E-03	0.18E-03	0.11E+01
32.9	.2460	205.	20.09	83.33	0.22E-03	0.17E-03	0.13E+01
36.9	.2446	213.	20.89	83.33	0.27E-03	0.16E-03	0.17E+01
40.9	.2434	221.	21.64	83.33	0.42E-03	0.16E-03	0.26E+01
44.9	.2423	228.	22.34	83.33	0.12E-02	0.15E-03	0.76E+01

DEPTH 53. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3432	33.	3.26	0.75	0.15E+00	0.29E-03	0.53E+03
1.5	.3427	35.	3.44	0.63	0.24E+00	0.25E-03	0.96E+03
2.5	.3422	37.	3.67	0.55	0.26E+00	0.18E-03	0.14E+04
3.5	.3417	41.	4.03	0.50	0.41E+00	0.11E-03	0.37E+04
4.5	.3404	47.	4.57	0.40	0.51E+00	0.31E-03	0.17E+04
6.2	.3392	52.	5.09	0.35	0.13E+00	0.13E-03	0.10E+04
8.7	.3384	55.	5.41	0.32	0.18E+00	0.36E-03	0.49E+03
12.5	.3374	58.	5.66	0.28	0.88E-01	0.44E-03	0.20E+03
17.5	.3364	60.	5.89	0.25	0.13E+00	0.44E-03	0.30E+03
22.5	.3352	62.	6.10	0.20	0.12E+00	0.75E-03	0.16E+03
27.5	.3332	64.	6.29	0.22	0.15E+00	0.14E-02	0.11E+03
45.0	.3285	67.	6.54	0.28	0.83E-01	0.92E-03	0.90E+02
80.0	.3197	73.	7.12	0.17	0.61E-01	0.12E-02	0.50E+02
100.0	.3166	76.	7.40	0.17	0.49E-01	0.98E-03	0.50E+02
120.0	.3145	78.	7.65	0.13	0.39E-01	0.69E-03	0.57E+02
140.0	.3132	80.	7.87	0.10	0.49E-01	0.49E-03	0.10E+03
160.0	.3118	82.	8.07	0.10	0.33E-01	0.86E-03	0.38E+02
210.0	.3062	85.	8.35	0.07	0.98E-01	0.26E-02	0.37E+02
500.0	.2965	93.	9.14	0.08	0.27E-01	0.20E-02	0.13E+02
625.0	.2910	96.	9.39	0.08	0.27E-01	0.24E-02	0.11E+02
800.0	.2874	98.	9.63	0.10	0.39E-02	0.77E-03	0.50E+01
1000.0	.2853	101.	9.89	0.12	0.37E-02	0.79E-03	0.47E+01

53-CM (CONT. NEXT PAGE)

DOERING 1-STEP DATA (53 CM)

6.2	.2816	84.	8.28	83.33	0.73E-03	0.13E-02	0.55E+00
6.3	.2814	85.	8.29	83.33	0.73E-03	0.13E-02	0.55E+00
6.3	.2812	85.	8.31	83.33	0.72E-03	0.13E-02	0.55E+00
6.4	.2809	85.	8.33	83.33	0.71E-03	0.13E-02	0.54E+00
6.4	.2807	85.	8.34	83.33	0.70E-03	0.13E-02	0.54E+00
6.5	.2805	85.	8.36	83.33	0.70E-03	0.13E-02	0.54E+00
6.5	.2803	85.	8.38	83.33	0.69E-03	0.13E-02	0.53E+00
6.6	.2801	86.	8.39	83.33	0.68E-03	0.13E-02	0.53E+00
6.6	.2798	86.	8.41	83.33	0.68E-03	0.13E-02	0.53E+00
6.7	.2796	86.	8.43	83.33	0.67E-03	0.13E-02	0.52E+00
6.7	.2794	86.	8.44	83.33	0.66E-03	0.13E-02	0.52E+00
6.8	.2792	86.	8.46	83.33	0.66E-03	0.13E-02	0.52E+00
6.8	.2790	86.	8.48	83.33	0.65E-03	0.13E-02	0.51E+00
6.9	.2788	87.	8.49	83.33	0.64E-03	0.13E-02	0.51E+00
6.9	.2786	87.	8.51	83.33	0.64E-03	0.13E-02	0.51E+00

DEPTH 53. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
7.0	.2784	87.	8.52	83.33	0.63E-03	0.13E-02	0.50E+00
7.0	.2782	87.	8.54	83.33	0.63E-03	0.13E-02	0.50E+00
7.1	.2780	87.	8.56	83.33	0.62E-03	0.12E-02	0.50E+00
7.1	.2778	87.	8.57	83.33	0.61E-03	0.12E-02	0.49E+00
7.2	.2776	88.	8.59	83.33	0.61E-03	0.12E-02	0.49E+00
7.2	.2774	88.	8.60	83.33	0.60E-03	0.12E-02	0.49E+00
7.3	.2772	88.	8.62	83.33	0.60E-03	0.12E-02	0.48E+00
7.3	.2770	88.	8.63	83.33	0.59E-03	0.12E-02	0.48E+00
7.4	.2768	88.	8.65	83.33	0.59E-03	0.12E-02	0.48E+00
7.4	.2766	88.	8.66	83.33	0.58E-03	0.12E-02	0.48E+00
7.5	.2764	89.	8.68	83.33	0.58E-03	0.12E-02	0.47E+00
7.5	.2762	89.	8.70	83.33	0.57E-03	0.12E-02	0.47E+00
7.6	.2760	89.	8.71	83.33	0.57E-03	0.12E-02	0.47E+00
7.6	.2758	89.	8.73	83.33	0.56E-03	0.12E-02	0.47E+00
7.7	.2757	89.	8.74	83.33	0.56E-03	0.12E-02	0.46E+00
7.7	.2755	89.	8.76	83.33	0.55E-03	0.12E-02	0.46E+00
7.8	.2753	89.	8.77	83.33	0.55E-03	0.12E-02	0.46E+00
7.8	.2751	90.	8.79	83.33	0.54E-03	0.12E-02	0.45E+00
7.9	.2749	90.	8.80	83.33	0.54E-03	0.12E-02	0.45E+00
7.9	.2748	90.	8.81	83.33	0.53E-03	0.12E-02	0.45E+00
8.0	.2746	90.	8.83	83.33	0.53E-03	0.12E-02	0.45E+00
8.0	.2744	90.	8.84	83.33	0.52E-03	0.12E-02	0.45E+00
8.1	.2742	90.	8.86	83.33	0.52E-03	0.12E-02	0.44E+00
10.1	.2680	96.	9.41	83.33	0.39E-03	0.11E-02	0.36E+00
14.1	.2590	105.	10.31	83.33	0.25E-03	0.90E-03	0.28E+00
18.1	.2525	113.	11.07	83.33	0.18E-03	0.79E-03	0.22E+00
22.1	.2474	120.	11.73	83.33	0.14E-03	0.72E-03	0.19E+00
26.1	.2432	126.	12.32	83.33	0.11E-03	0.66E-03	0.17E+00
30.1	.2397	131.	12.87	83.33	0.91E-04	0.61E-03	0.15E+00
34.1	.2366	136.	13.37	83.33	0.77E-04	0.57E-03	0.13E+00
38.1	.2340	141.	13.84	83.33	0.66E-04	0.54E-03	0.12E+00
42.1	.2316	146.	14.29	83.33	0.58E-04	0.51E-03	0.11E+00
46.1	.2295	150.	14.71	83.33	0.51E-04	0.48E-03	0.11E+00
50.1	.2275	154.	15.11	83.33	0.46E-04	0.46E-03	0.10E+00
54.1	.2258	158.	15.50	83.33	0.41E-04	0.44E-03	0.94E-01
58.1	.2241	162.	15.87	83.33	0.38E-04	0.42E-03	0.89E-01
122.0	.2078	211.	20.65	83.33	0.14E-04	0.27E-03	0.53E-01
194.0	.1981	253.	24.81	83.33	0.76E-05	0.19E-03	0.40E-01

DEPTH	53.	CM	(CONT)				
266.0	.1919	290.	28.39	83.33	0.51E-05	0.15E-03	0.33E-01
338.0	.1872	323.	31.67	83.33	0.38E-05	0.13E-03	0.30E-01
410.0	.1836	354.	34.75	83.33	0.30E-05	0.11E-03	0.28E-01
482.0	.1806	385.	37.71	83.33	0.25E-05	0.93E-04	0.27E-01
554.0	.1780	414.	40.58	83.33	0.21E-05	0.82E-04	0.26E-01
626.0	.1758	443.	43.39	83.33	0.19E-05	0.73E-04	0.26E-01

DEPTH 69. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3612	28.	2.75	0.59	0.21E+00	0.68E-03	0.30E+03
1.5	.3607	29.	2.83	0.55	0.29E+00	0.68E-03	0.43E+03
2.5	.3600	30.	2.96	0.50	0.31E+00	0.38E-03	0.80E+03
3.5	.3590	33.	3.21	0.42	0.52E+00	0.39E-03	0.13E+04
4.5	.3572	37.	3.60	0.32	0.75E+00	0.48E-03	0.16E+04
6.2	.3552	41.	4.04	0.27	0.20E+00	0.45E-03	0.45E+03
8.7	.3501	45.	4.36	0.29	0.30E+00	0.37E-02	0.80E+02
12.5	.3482	47.	4.58	0.27	0.73E-01	********	********
17.5	.3498	48.	4.72	0.20	0.19E+00	0.15E-02	0.12E+03
22.5	.3482	50.	4.85	0.15	0.19E+00	0.86E-03	0.22E+03
27.5	.3465	51.	5.03	0.12	0.34E+00	0.11E-02	0.30E+03
35.0	.3446	53.	5.19	0.13	0.22E+00	0.12E-02	0.19E+03
45.0	.3427	55.	5.39	0.18	0.15E+00	0.89E-03	0.17E+03
80.0	.3375	60.	5.93	0.23	0.54E-01	0.99E-03	0.54E+02
100.0	.3353	63.	6.19	0.22	0.44E-01	0.66E-03	0.67E+02
120.0	.3338	65.	6.38	0.17	0.38E-01	0.10E-02	0.38E+02
* 140.0	.3325	67.	6.52	0.10	0.56E-01	0.66E-03	0.85E+02
160.0	.3310	68.	6.70	0.07	0.70E-01	0.99E-03	0.71E+02
210.0	.3255	71.	6.92	0.03	0.25E+00	0.35E-02	0.71E+02

DOERING 1-STEP DATA

6.7	.2799	61.	5.94	83.33	0.95E-03	0.16E-02	0.59E+00
10.7	.2652	71.	6.96	83.33	0.50E-03	0.12E-02	0.40E+00
14.7	.2557	79.	7.78	83.33	0.32E-03	0.10E-02	0.31E+00
18.7	.2488	87.	8.49	83.33	0.23E-03	0.89E-03	0.26E+00
22.7	.2433	93.	9.13	83.33	0.17E-03	0.79E-03	0.22E+00
26.7	.2388	99.	9.71	83.33	0.14E-03	0.72E-03	0.19E+00
30.7	.2350	105.	10.26	83.33	0.11E-03	0.66E-03	0.18E+00
34.7	.2317	110.	10.77	83.33	0.97E-04	0.61E-03	0.16E+00
38.7	.2288	115.	11.25	83.33	0.83E-04	0.56E-03	0.15E+00
42.7	.2263	119.	11.71	83.33	0.73E-04	0.53E-03	0.14E+00
46.7	.2240	124.	12.16	83.33	0.64E-04	0.50E-03	0.13E+00
50.7	.2218	128.	12.59	83.33	0.57E-04	0.47E-03	0.12E+00
122.0	.2006	192.	18.81	83.33	0.17E-04	0.24E-03	0.71E-01
194.0	.1902	245.	23.97	83.33	0.94E-05	0.16E-03	0.58E-01
266.0	.1834	293.	28.73	83.33	0.64E-05	0.12E-03	0.53E-01
338.0	.1785	340.	33.31	83.33	0.50E-05	0.94E-04	0.53E-01

DEPTH 84. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3245	20.	1.93	0.36	0.36E+00	0.17E-02	0.22E+03
1.5	.3240	20.	1.96	0.34	0.50E+00	0.11E-02	0.45E+03
2.5	.3231	21.	2.04	0.32	0.53E+00	0.99E-03	0.54E+03
3.5	.3210	23.	2.22	0.29	0.87E+00	0.13E-02	0.67E+03
4.5	.3173	25.	2.50	0.23	0.12E+01	0.13E-02	0.93E+03

DEPTH 84. CM (CONT)

6.2	.3131	29.	2.82	0.13	0.53E+00	0.12E-02	0.43E+03
8.7	.3064	32.	3.10	0.08	0.17E+01	0.36E-02	0.47E+03
17.5	.3037	36.	3.50	0.18	0.24E+00	0.20E-02	0.12E+03
22.5	.3013	37.	3.66	0.25	0.14E+00	0.12E-02	0.11E+03
27.5	.2994	39.	3.83	0.27	0.17E+00	0.11E-02	0.15E+03
35.0	.2977	41.	3.99	0.25	0.13E+00	0.98E-03	0.13E+03
45.0	.2959	42.	4.16	0.18	0.16E+00	0.11E-02	0.15E+03
80.0	.2761	48.	4.70	0.13	0.11E+00	0.77E-03	0.14E+03
100.0	.2737	51.	4.95	0.13	0.83E-01	0.13E-02	0.66E+02
120.0	.2721	52.	5.10	0.13	0.54E-01	0.64E-03	0.85E+02
140.0	.2711	53.	5.20	0.13	0.49E-01	0.13E-02	0.37E+02
160.0	.2698	54.	5.33	0.10	0.59E-01	0.89E-03	0.67E+02
210.0	.2658	56.	5.53	0.10	0.10E+00	0.26E-02	0.39E+02
*300.0	.2622	58.	5.72	0.18	0.29E-02	0.58E-03	0.50E+01
500.0	.2622	64.	6.27	0.08	0.46E-01	0.10E-02	0.44E+02
625.0	.2567	67.	6.53	0.09	0.42E-01	0.34E-02	0.12E+02

DEPTH 99. CM SITE H-1

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.2420	16.	1.55	1.06	0.13E+00	0.87E-03	0.15E+03
1.5	.2414	16.	1.60	1.10	0.16E+00	0.16E-02	0.10E+03
2.5	.2403	17.	1.66	1.08	0.17E+00	0.19E-02	0.92E+02
3.5	.2378	18.	1.76	1.02	0.29E+00	0.29E-02	0.10E+03
4.5	.2334	19.	1.91	0.88	0.41E+00	0.30E-02	0.14E+03
6.2	.2280	21.	2.09	0.80	0.12E+00	0.27E-02	0.45E+02
8.7	.2228	24.	2.31	0.77	0.24E+00	0.20E-02	0.12E+03
12.5	.2183	26.	2.54	0.73	0.12E-01	0.20E-02	0.57E+01
17.5	.2147	28.	2.74	0.73	0.71E-01	0.17E-02	0.43E+02
22.5	.2115	30.	2.91	0.69	0.61E-01	0.22E-02	0.28E+02
27.5	.2087	31.	3.02	0.61	0.85E-01	0.26E-02	0.32E+02
35.0	.2066	32.	3.11	0.54	0.65E-01	0.20E-02	0.33E+02
45.0	.2045	32.	3.18	0.48	0.70E-01	0.34E-02	0.21E+02
80.0	.1782	37.	3.65	0.72	0.24E-01	0.17E-02	0.14E+02
100.0	.1749	38.	3.77	0.64	0.24E-01	0.40E-02	0.60E+01
140.0	.1726	40.	3.88	0.56	0.14E-01	0.25E-02	0.58E+01
160.0	.1712	40.	3.92	0.52	0.15E-01	0.29E-02	0.50E+01
210.0	.1665	42.	4.13	0.53	0.22E-01	0.21E-02	0.11E+02
300.0	.1619	45.	4.40	0.54	0.15E-02	0.11E-02	0.14E+01
500.0	.1586	48.	4.67	0.42	0.10E-01	0.13E-02	0.82E+01
625.0	.1568	49.	4.83	0.35	0.13E-01	0.87E-03	0.15E+02

DEPTH 114. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.2004	23.	2.25	2.05	0.69E-01	0.64E-03	0.11E+03
1.5	.1998	24.	2.30	2.01	0.94E-01	0.24E-02	0.40E+02
2.5	.1990	24.	2.34	1.97	0.11E+00	0.47E-02	0.22E+02
3.5	.1975	24.	2.37	1.94	0.18E+00	0.71E-02	0.25E+02
4.5	.1946	25.	2.41	1.92	0.23E+00	0.10E-01	0.22E+02
6.2	.1903	25.	2.49	1.84	0.71E-01	0.55E-02	0.13E+02
8.7	.1852	27.	2.62	1.70	0.13E+00	0.47E-02	0.27E+02
12.5	.1799	28.	2.74	1.57	0.15E-01	0.54E-02	0.27E+01
17.5	.1750	29.	2.86	1.45	0.44E-01	0.38E-02	0.11E+02
22.5	.1714	30.	2.94	1.36	0.38E-01	0.74E-02	0.52E+01
27.5	.1684	30.	2.98	1.33	0.45E-01	0.13E-01	0.34E+01
35.0	.1659	31.	3.00	1.31	0.29E-01	0.95E-02	0.31E+01
45.0	.1637	31.	3.03	1.29	0.29E-01	0.84E-02	0.34E+01

SITE H, REPLICATION 2

Table H-2.1. Soil morphologic data for Site H, replication 2

Site and location: H-2 Stirum, Oakes Aquifer 955 feet south and 360 feet west of the east quarter corner of Section 29, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/23/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North nakota.

Soil type and classification: Stirum sandy loam; coarse-loamy, mixed, frigid Typic Natraquoll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin which have been reworked by wind to some extent.

Drainage: Poor (drain for 5,000 acres Oakes test are 200 feet to the north).

NOTES; Moist colors otherwise specified. piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: H-2 south side of pit.

Ap 0-6 inches (0-15 cm) very dark gray (l0YR 3/1) sandy loam (fine sandy loam), gray (l0YR 5/1, dry); moderate medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; strong effervescence; abrupt smooth boundary.

Bt 6-9 inches (15-23 cm) very dark gray (l0YR 3/1) sandy loam (fine sandy loam), dark gray (l0YR 4/1, dry); strong coarse and medium angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; abrupt smooth boundary.

Btkl 9-12 inches (23-30 cm) gray (l0YR 5/1) sandy loam (fine sandy loam), light gray (l0YR 6/1, dry) with continuous thin clay films, dark gray (l0YR 4/1) organic stains and bleached and grains on prism faces; moderate coarse prismatic parting to moderate coarse subangular blocky and moderate coarse platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots, violent effervescence; clear wavy boundary.

Btk2 12-17 inches (30-43 cm) light brownish gray (2.5Y 6/2) sandy loam (sandy clay loam), light gray (2.5Y 7/2, dry) with continuous thin clay films, gray (l0YR 5/1) organic stains and bleached sand grains on prism faces; moderate coarse prismatic parting to moderate coarse and medium subangular blocky and weak coarse platy structure; slightly hard, very friable; slightly sticky and slightly plastic; few very fine roots; violent effervescence; clear wavy boundary.

B17-23 inches (43-58 cm) light olive gray (5Y 6/2) loamy sand (fine sandy loam), light gray (5Y 7/2, dry) with many thin clay films and gray (5Y 5/1) organic stains on prism faces; weak coarse prismatic parting to weak medium subangular blocky and weak platy structure; soft, very friable, slightly sticky and nonplastic; few very fine roots; strong effervescence; clear wavy boundary.

BC 23-32 inches (58-81 cm) light brownish gray (2.5Y 6/2) and brownish yellow (l0YR 6/6) loamy sand (fine sandy loam), light gray (2.5Y 7/2, dry) and yellow (l0YR 7/6, dry) with few medium prominent dark red- dish brown (5YR 2/2) mottles and many thin clay films and gray (5Y 5/1) organic stains on prism faces; moderate coarse prismatic parting to moderate coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; slight effervescence with few white lime masses; clear wavy boundary.

C32-60 inches (81-152 cm) light gray to gray (SY 6/1) and strong brown (7.5YR 5/6) sand, with few medium distinct dark reddish brown (5YR 2/2) mottles; single grained; loose, nonsticky and nonplastic; slight effervescence.

Table H-2.2 STIRUM SERIES SITE H-2 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	PARTICLE SIZE CLASSES (MICRON/PERCENT) 2.	20.	50.	100.	250.	500.	1000.	2000.
8.	13.1	8.7	11.5	29.0	30.8	5.8	0.9	0.1
23.	18.7	9.6	10.2	27.7	27.8	5.1	0.8	0.1
38.	21.3	7.8	7.4	29.6	28.1	4.7	1.0	0.1
54.	15.3	0.4	5.7	35.0	39.5	3.5	0.6	0.1
68.	12.7	9.2	6.4	30.1	36.4	3.8	1.1	0.4
84.	6.8	4.4	8.0	12.4	37.4	27.6	2.6	0.7
99.	10.6	17.8	16.8	9.8	17.3	20.6	5.6	1.4
107.	0.6	1.5	2.7	1.5	16.7	38.1	37.8	1.0
137.	0.2	1.4	2.7	0.6	8.5	44.7	40.6	1.3

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	66.7	20.2	13.1	A 6	6=p
23.	61.5	19.8	18.7	B 11	10=k
38.	63.5	15.2	21.3	B 2 10 11	11=t
54.	78.6	6.1	15.3	BC1	
68.	71.7	15.6	12.7	BC2	
84.	80.8	12.4	6.8	C	
99.	54.8	34.6	10.6	C	
107.	95.2	4.2	0.6	C	
137.	95.7	4.1	0.2	C	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	3.297	0.0483	5.8	0.0084	0.547	1.29	2.10
23.	3.106	0.0361	6.9	0.0052	0.466	1.72	1.10
38.	4.178	0.0342	7.5	0.0045	0.501	1.66	0.60
54.	12.902	0.0552	6.0	0.0092	0.872	1.66	0.07
68.	4.603	0.0518	5.7	0.0090	0.628	1.70	0.27
84.	6.508	0.1125	4.9	0.0231	0.644	1.74	0.13
99.	1.581	0.0569	6.9	0.0082	0.359	1.53	0.40
107.	22.643	0.3650	2.6	0.1424	1.082	1.61	0.07
137.	23.341	0.4143	2.3	0.1826	1.396	1.57	0.00

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	2.351	1.997	-0.8051	1.9314	-8.05	0.55
23.	2.363	2.059	-0.7363	1.7835	-7.36	0.40
38.	2.063	2.263	-0.7932	1.8415	-7.93	0.46
54.	1.319	4.358	-1.0634	2.2823	-10.63	0.90
68.	2.062	2.808	-0.9069	2.0822	-9.07	0.70
84.	1.837	3.123	-1.0517	2.3403	-10.52	0.96
99.	3.150	2.049	-0.5478	1.5863	-5.48	0.21
107.	1.176	5.401	-1.3049	2.7579	-13.05	1.38
137.	1.165	3.759	-1.3140	2.7753	-13.14	1.40

Table H-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site H, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	2.75	2.45	1.18	0.37	-	3.52	0.15	3.08
15 - 30	0.93	1.47	5.19	0.21	0.16	5.44	0.10	2.10
30 - 46	0.97	1.15	3.70	0.21	-	4.20	0.12	1.71
46 - 61	0.63	1.25	2.84	0.08	-	2.96	0.09	1.75
61 - 76	0.38	0.54	4.62	0.07	-	3.56	0.14	1.91
76 - 91	0.38	0.38	4.37	0.59	0.08	3.40	0.75	1.49
91- 107	0.34	0.94	5.04	0.09	0.16	3.52	0.15	2.58
107 - 122	0.76	0.44	3.78	0.10	0.16	3.84	0.08	1.00
122 - 152	0.68	0.72	3.44	0.09	-	2.96	0.17	1.80

D4.24epth (cm3.00)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.57	0.7	40	8.1	-	fsl	7.73
15 - 30	0.62	4.7	42	8.4	-	fsl	8.49
30 - 46	0.46	3.6	38	8.0	-	cl	7.20
46 - 61	0.36	2.9	34	8.2	-	fsl	4.14
61 - 76	0.44	6.8	35	8.2	-	fsl	5.76
76 - 91	0.44	7.1	34	8.5	-	ls	4.13
91- 107	0.57	6.3	38	8.4	-	fsl	8.24
107 - 122	0.43	4.9	23	8.5	-	cs	2.25
122 - 152	0.40	4.1	25	8.2	-	cs	2.56

Table H-2.4 STIRUM SERIES SITE H-2 NDSWC:1985

Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

23.			38.			53.			69.		
CM	CC/CC	SE									
14.	0.4070	0.0276	10.	0.3641	0.0014	14.	0.3859	0.0114	14.	0.4028	0.0126
20.	0.3858	0.0262	20.	0.3569	0.0015	20.	0.3660	0.0123	20.	0.4021	0.0131
30.	0.3879	0.0267	40.	0.3497	0.0015	30.	0.3612	0.0127	30.	0.3978	0.0121
40.	0.3828	0.0272	60.	0.3367	0.0026	40.	0.3604	0.0112	40.	0.3891	0.0080
60.	0.3631	0.0248	80.	0.3222	0.0006	60.	0.3242	0.0053	60.	0.3725	0.0085
80.	0.3522	0.0233	100.	0.3215	0.0001	80.	0.2861	0.0018	80.	0.3249	0.0146
100.	0.3441	0.0229	120.	0.3237	0.0016	100.	0.2439	0.0019	100.	0.2816	0.0217
120.	0.3368	0.0229	180.	0.3006	0.0024	120.	0.2114	0.0033	120.	0.2563	0.0212
160.	0.3259	0.0214	334.	0.2659	0.0032	160.	0.1715	0.0015	160.	0.2209	0.0227
238.	0.3098	0.0216	534.	0.2500	0.0032	238.	0.1453	0.0022	238.	0.1913	0.0221
340.	0.3010	0.0206	834.	0.2356	0.0031	340.	0.1370	0.0034	340.	0.1848	0.0196
544.	0.2886	0.0191	544.	0.1301	0.0036	544.	0.1747	0.0165			
850.	0.2703	0.0177	850.	0.1212	0.0024	850.	0.1545	0.0144			
BD =	1.72			1.66			1.66			1.70	
N =	2			2			2			2	

DEPTH (CM)

84.			99.			114.			137.		
10.	0.3904	0.0449	10.	0.4082	0.0151	14.	0.4123	0.0138	10.	0.6029	0.0070
20.	0.3738	0.0424	20.	0.3915	0.0174	20.	0.3497	0.0109	20.	0.5910	0.0058
40.	0.3496	0.0345	40.	0.3605	0.0117	30.	0.2928	0.0219	40.	0.5613	0.0016
60.	0.3261	0.0333	60.	0.3348	0.0076	40.	0.1811	0.0102	60.	0.5443	0.0005
80.	0.3009	0.0381	80.	0.3165	0.0078	60.	0.1031	0.0033	80.	0.5375	0.0005
100.	0.2993	0.0380	100.	0.3158	0.0083	80.	0.0938	0.0023	100.	0.5282	0.0013
120.	0.2981	0.0412	120.	0.3194	0.0078	100.	0.0898	0.0029	120.	0.5222	0.0019
180.	0.2784	0.0397	180.	0.2997	0.0080	120.	0.0867	0.0029	180.	0.5087	0.0030
334.	0.2489	0.0404	334.	0.2755	0.0070	160.	0.0812	0.0024	334.	0.4883	0.0030
534.	0.2361	0.0375	534.	0.2615	0.0052	238.	0.0774	0.0019	534.	0.4653	0.0011
834.	0.2198	0.0383	834.	0.2475	0.0034	340.	0.0774	0.0019	834.	0.4382	0.0011
544.	0.0742	0.0031									
850.	0.0672	0.0015									
BD =	1.74			1.53			1.61			1.57	
N =	2			2			2			2	

DEPTH (CM)

137.		
10.	0.3857	0.0051
20.	0.3148	0.0029
40.	0.2040	0.0005
60.	0.0889	0.0014
80.	0.0821	0.0018
100.	0.0723	0.0012
120.	0.0701	0.0017
180.	0.0671	0.0016
334.	0.0648	0.0010
534.	0.0618	0.0010
834.	0.0573	0.0009
BD =	1.57	
N =	2	

Table H-2.5 HAMAR SERIES SITE H - 2 (NDSWC 1984)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
4.5	.4119	5.	0.52	2.85	0.17E-01	0.11E-02	0.16E+02
6.2	.4061	12.	1.22	3.15	0.51E-02	0.66E-03	0.77E+01
8.7	.4000	20.	1.97	3.13	0.66E-02	0.97E-03	0.68E+01
12.5	.3924	27.	2.62	3.13	0.40E-02	0.14E-02	0.29E+01
17.5	.3841	32.	3.17	3.10	0.41E-02	0.17E-02	0.25E+01
22.5	.3769	37.	3.67	3.03	0.31E-02	0.12E-02	0.25E+01
27.5	.3710	42.	4.14	2.95	0.29E-02	0.13E-02	0.23E+01
40.0	.3636	48.	4.74	2.83	0.12E-02	0.12E-02	0.10E+01
60.0	.3555	56.	5.47	2.68	0.10E-02	0.10E-02	0.99E+00
80.0	.3487	62.	6.07	2.55	0.97E-03	0.13E-02	0.75E+00
100.0	.3427	67.	6.57	2.43	0.86E-03	0.11E-02	0.78E+00
120.0	.3374	72.	7.02	2.32	0.82E-03	0.12E-02	0.66E+00
140.0	.3327	76.	7.42	2.22	0.77E-03	0.11E-02	0.69E+00
160.0	.3282	79.	7.77	2.15	0.79E-03	0.15E-02	0.53E+00
210.0	.3191	85.	8.34	2.05	0.64E-03	0.16E-02	0.39E+00
300.0	.3063	93.	9.07	1.95	0.46E-03	0.20E-02	0.23E+00
400.0	.2983	99.	9.67	1.85	0.18E-03	0.73E-03	0.25E+00
525.0	.2949	107.	10.44	1.55	0.79E-04	0.26E-03	0.31E+00
750.0	.2924	116.	11.37	1.15	0.53E-04	0.27E-03	0.20E+00
1050.0	.2900	125.	12.27	0.78	0.78E-04	0.27E-03	0.29E+00

DEPTH 23. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.5	.3907	8.	0.78	2.55	0.30E-01	0.22E-03	0.13E+03
4.5	.3869	12.	1.17	2.85	0.47E-01	0.46E-03	0.10E+03
6.2	.3827	23.	2.26	3.15	0.13E-01	0.44E-03	0.31E+02
8.7	.3788	32.	3.16	3.13	0.18E-01	0.63E-03	0.28E+02
12.5	.3738	40.	3.89	3.13	0.11E-01	0.91E-03	0.12E+02
17.5	.3685	46.	4.47	3.10	0.11E-01	0.11E-02	0.93E+01
22.5	.3639	51.	4.96	3.03	0.83E-02	0.91E-03	0.91E+01
27.5	.3602	55.	5.41	2.95	0.75E-02	0.88E-03	0.85E+01
40.0	.3556	61.	5.95	2.83	0.32E-02	0.90E-03	0.36E+01
60.0	.3505	67.	6.60	2.68	0.27E-02	0.79E-03	0.34E+01
80.0	.3462	73.	7.13	2.55	0.26E-02	0.95E-03	0.27E+01
100.0	.3424	77.	7.56	2.43	0.23E-02	0.88E-03	0.26E+01
120.0	.3390	81.	7.94	2.32	0.22E-02	0.10E-02	0.22E+01
140.0	.3362	84.	8.28	2.22	0.20E-02	0.77E-03	0.26E+01
160.0	.3337	88.	8.59	2.15	0.20E-02	0.90E-03	0.22E+01
210.0	.3276	93.	9.09	2.05	0.17E-02	0.13E-02	0.13E+01
300.0	.3193	99.	9.75	1.95	0.12E-02	0.12E-02	0.97E+00
400.0	.3139	105.	10.28	1.85	0.51E-03	0.77E-03	0.66E+00
525.0	.3107	111.	10.84	1.55	0.25E-03	0.43E-03	0.57E+00
750.0	.3077	117.	11.47	1.15	0.18E-03	0.51E-03	0.35E+00
1050.0	.3047	123.	12.10	0.78	0.25E-03	0.47E-03	0.54E+00

DEPTH 38. CM SITE H-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.5	.3551	12.	1.16	2.30	0.83E-02	0.72E-04	0.11E+03
2.5	.3547	15.	1.46	2.16	0.26E-01	0.52E-04	0.49E+03
3.5	.3538	25.	2.46	1.90	0.57E-01	0.16E-03	0.35E+03
4.5	.3516	37.	3.62	1.56	0.12E+00	0.22E-03	0.57E+03
6.2	.3495	48.	4.69	1.36	0.42E-01	0.21E-03	0.20E+03
8.7	.3476	54.	5.34	1.24	0.61E-01	0.41E-03	0.15E+03
12.5	.3451	60.	5.84	1.04	0.44E-01	0.61E-03	0.72E+02
17.5	.3423	64.	6.25	0.91	0.50E-01	0.79E-03	0.63E+02
22.5	.3393	67.	6.58	0.82	0.44E-01	0.10E-02	0.44E+02
27.5	.3362	70.	6.87	0.74	0.43E-01	0.12E-02	0.36E+02
40.0	.3321	74.	7.21	0.64	0.21E-01	0.12E-02	0.18E+02
60.0	.3277	78.	7.61	0.50	0.20E-01	0.11E-02	0.19E+02
80.0	.3246	81.	7.97	0.45	0.20E-01	0.66E-03	0.30E+02
100.0	.3224	85.	8.31	0.47	0.16E-01	0.66E-03	0.25E+02
120.0	.3207	88.	8.60	0.49	0.14E-01	0.54E-03	0.26E+02
140.0	.3196	90.	8.86	0.50	0.11E-01	0.29E-03	0.38E+02
160.0	.3182	93.	9.10	0.49	0.12E-01	0.87E-03	0.14E+02
210.0	.3142	96.	9.45	0.39	0.13E-01	0.13E-02	0.10E+02
300.0	.3087	101.	9.92	0.25	0.13E-01	0.10E-02	0.13E+02
400.0	.3043	105.	10.31	0.18	0.83E-02	0.12E-02	0.69E+01
525.0	.3008	108.	10.60	0.13	0.51E-02	0.13E-02	0.40E+01
750.0	.2974	111.	10.90	0.10	0.38E-02	0.10E-02	0.36E+01
1050.0	.2942	115.	11.30	0.17	0.20E-02	0.60E-03	0.34E+01

DOERING 1-STEP DATA

0.9	.2763	265.	26.03	83.33	0.54E-03	0.14E-03	0.39E+01
1.0	.2753	273.	26.72	83.33	0.50E-03	0.13E-03	0.38E+01
1.0	.2744	279.	27.40	83.33	0.47E-03	0.13E-03	0.36E+01
1.1	.2736	286.	28.06	83.33	0.44E-03	0.13E-03	0.35E+01
1.1	.2727	293.	28.70	83.33	0.41E-03	0.12E-03	0.33E+01
1.2	.2719	299.	29.33	83.33	0.39E-03	0.12E-03	0.32E+01
1.2	.2712	306.	29.95	83.33	0.37E-03	0.12E-03	0.31E+01
1.3	.2705	312.	30.56	83.33	0.35E-03	0.12E-03	0.30E+01
1.3	.2698	318.	31.15	83.33	0.33E-03	0.11E-03	0.29E+01
1.4	.2691	324.	31.74	83.33	0.32E-03	0.11E-03	0.29E+01
1.4	.2685	330.	32.31	83.33	0.30E-03	0.11E-03	0.28E+01
1.5	.2679	335.	32.87	83.33	0.29E-03	0.11E-03	0.27E+01
1.5	.2673	341.	33.43	83.33	0.27E-03	0.10E-03	0.26E+01
1.6	.2667	347.	33.97	83.33	0.26E-03	0.10E-03	0.26E+01
1.6	.2661	352.	34.51	83.33	0.25E-03	0.10E-03	0.25E+01
1.7	.2656	357.	35.04	83.33	0.24E-03	0.99E-04	0.24E+01
1.7	.2651	363.	35.56	83.33	0.23E-03	0.97E-04	0.24E+01
1.8	.2646	368.	36.08	83.33	0.22E-03	0.96E-04	0.23E+01
1.9	.2636	378.	37.08	83.33	0.21E-03	0.93E-04	0.22E+01
2.1	.2614	403.	39.49	83.33	0.18E-03	0.86E-04	0.20E+01
2.2	.2606	412.	40.42	83.33	0.17E-03	0.84E-04	0.20E+01
2.3	.2598	421.	41.32	83.33	0.16E-03	0.82E-04	0.19E+01
2.4	.2591	431.	42.21	83.33	0.15E-03	0.80E-04	0.18E+01
2.5	.2584	439.	43.07	83.33	0.14E-03	0.78E-04	0.18E+01
2.6	.2577	448.	43.92	83.33	0.13E-03	0.76E-04	0.17E+01
2.7	.2571	457.	44.76	83.33	0.13E-03	0.75E-04	0.17E+01
2.8	.2565	465.	45.58	83.33	0.12E-03	0.73E-04	0.16E+01
2.9	.2562	469.	45.98	83.33	0.12E-03	0.73E-04	0.16E+01

DEPTH 53. CM SITE H-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.5	.3469	17.	1.65	0.45	0.53E-01	0.53E-04	0.10E+04
2.5	.3466	22.	2.16	0.42	0.15E+00	0.72E-04	0.21E+04
3.5	.3457	28.	2.76	0.38	0.34E+00	0.22E-03	0.15E+04
4.5	.3438	36.	3.55	0.32	0.73E+00	0.24E-03	0.30E+04
6.2	.3419	44.	4.33	0.20	0.33E+00	0.25E-03	0.13E+04
8.7	.3400	49.	4.83	0.13	0.67E+00	0.56E-03	0.12E+04
12.5	.3374	53.	5.19	0.13	0.41E+00	0.10E-02	0.41E+03
17.5	.3343	56.	5.49	0.13	0.41E+00	0.11E-02	0.38E+03
22.5	.3313	59.	5.78	0.15	0.30E+00	0.99E-03	0.30E+03
27.5	.3283	61.	6.02	0.17	0.25E+00	0.16E-02	0.15E+03
40.0	.3242	64.	6.31	0.18	0.95E-01	0.14E-02	0.69E+02
60.0	.3196	68.	6.64	0.22	0.61E-01	0.14E-02	0.42E+02
80.0	.3159	71.	6.95	0.20	0.56E-01	0.98E-03	0.57E+02
100.0	.3130	74.	7.26	0.15	0.62E-01	0.89E-03	0.69E+02

DEPTH 69. CM SITE H-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3424	9.	0.87	1.01	********	********	********
1.5	.3425	12.	1.14	0.81	********	********	********
2.5	.3438	15.	1.46	0.62	********	********	********
3.5	.3448	19.	1.89	0.45	0.34E+00	0.24E-03	0.14E+04
4.5	.3424	26.	2.50	0.30	0.91E+00	0.47E-03	0.20E+04
6.2	.3394	32.	3.13	0.22	0.36E+00	0.53E-03	0.69E+03
8.7	.3370	36.	3.57	0.18	0.56E+00	0.60E-03	0.93E+03
12.5	.3348	40.	3.91	0.17	0.38E+00	0.75E-03	0.50E+03
17.5	.3328	43.	4.21	0.17	0.37E+00	0.58E-03	0.63E+03
22.5	.3313	46.	4.50	0.15	0.34E+00	0.45E-03	0.75E+03
27.5	.3302	48.	4.74	0.13	0.36E+00	0.50E-03	0.71E+03
40.0	.3286	51.	5.02	0.12	0.17E+00	0.59E-03	0.29E+03
60.0	.3262	55.	5.38	0.12	0.13E+00	0.76E-03	0.17E+03
80.0	.3236	58.	5.68	0.12	0.12E+00	0.99E-03	0.12E+03
100.0	.3214	61.	5.94	0.10	0.11E+00	0.69E-03	0.16E+03
120.0	.3193	63.	6.16	0.12	0.84E-01	0.14E-02	0.59E+02
140.0	.3171	65.	6.32	0.10	0.79E-01	0.13E-02	0.60E+02
160.0	.3148	66.	6.49	0.07	0.15E+00	0.14E-02	0.11E+03
210.0	.3122	69.	6.81	0.12	0.57E-01	0.58E-03	0.10E+03
300.0	.3068	74.	7.21	0.15	0.38E-01	0.22E-02	0.17E+02
400.0	.3007	77.	7.53	0.10	0.27E-01	0.16E-02	0.17E+02
525.0	.2963	79.	7.78	0.10	0.17E-01	0.19E-02	0.86E+01
750.0	.2931	82.	8.05	0.10	0.62E-02	0.57E-03	0.11E+02
1050.0	.2917	86.	8.45	0.03	0.15E-01	0.19E-03	0.76E+02

DOERING 1-STEP DATA

1.7	.2797	103.	10.06	83.33	0.32E-02	0.13E-02	0.25E+01
1.8	.2790	103.	10.11	83.33	0.31E-02	0.13E-02	0.24E+01
1.8	.2783	104.	10.17	83.33	0.30E-02	0.13E-02	0.24E+01
1.9	.2777	104.	10.22	83.33	0.29E-02	0.13E-02	0.23E+01
1.9	.2771	105.	10.26	83.33	0.29E-02	0.13E-02	0.23E+01
2.0	.2764	105.	10.31	83.33	0.28E-02	0.12E-02	0.22E+01
2.0	.2758	106.	10.36	83.33	0.27E-02	0.12E-02	0.22E+01
2.1	.2753	106.	10.41	83.33	0.26E-02	0.12E-02	0.22E+01
2.1	.2747	107.	10.45	83.33	0.26E-02	0.12E-02	0.21E+01
2.2	.2741	107.	10.50	83.33	0.25E-02	0.12E-02	0.21E+01
2.2	.2736	108.	10.54	83.33	0.24E-02	0.12E-02	0.20E+01

DOERING 1-STEP DATA (CONT)

2.3	.2731	108.	10.59	83.33	0.24E-02	0.12E-02	0.20E+01
2.3	.2726	108.	10.63	83.33	0.23E-02	0.12E-02	0.20E+01
2.4	.2721	109.	10.67	83.33	0.23E-02	0.12E-02	0.19E+01
2.4	.2716	109.	10.71	83.33	0.22E-02	0.12E-02	0.19E+01
2.5	.2711	110.	10.75	83.33	0.22E-02	0.11E-02	0.19E+01
2.9	.2676	113.	11.06	83.33	0.18E-02	0.11E-02	0.17E+01
3.0	.2668	114.	11.13	83.33	0.18E-02	0.11E-02	0.16E+01
3.1	.2660	114.	11.20	83.33	0.17E-02	0.11E-02	0.16E+01
49.2	.2090	212.	20.80	83.33	0.15E-03	0.32E-03	0.46E+00
53.2	.2076	217.	21.24	83.33	0.15E-03	0.31E-03	0.48E+00

DEPTH 84. CM SITE H-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.3348	7.	0.65	0.72	********	********	********
1.5	.3347	8.	0.76	0.70	********	********	********
2.5	.3355	10.	0.95	0.69	********	********	********
3.5	.3362	13.	1.23	0.64	0.27E+00	0.43E-03	0.64E+03
4.5	.3336	17.	1.68	0.55	0.60E+00	0.65E-03	0.92E+03
6.2	.3305	22.	2.17	0.47	0.20E+00	0.62E-03	0.32E+03
8.7	.3281	26.	2.53	0.40	0.29E+00	0.74E-03	0.39E+03
12.5	.3259	29.	2.83	0.37	0.19E+00	0.74E-03	0.25E+03
17.5	.3239	32.	3.12	0.35	0.19E+00	0.63E-03	0.30E+03
22.5	.3216	34.	3.37	0.32	0.18E+00	0.13E-02	0.14E+03
27.5	.3190	37.	3.59	0.31	0.17E+00	0.10E-02	0.16E+03
40.0	.3160	39.	3.86	0.31	0.72E-01	0.11E-02	0.65E+02
60.0	.3127	43.	4.19	0.29	0.62E-01	0.91E-03	0.68E+02
80.0	.3101	46.	4.50	0.29	0.54E-01	0.80E-03	0.68E+02
100.0	.3084	48.	4.75	0.29	0.42E-01	0.54E-03	0.78E+02
120.0	.3071	51.	4.96	0.27	0.42E-01	0.74E-03	0.57E+02
140.0	.3058	52.	5.14	0.30	0.30E-01	0.73E-03	0.41E+02
160.0	.3045	54.	5.29	0.30	0.39E-01	0.10E-02	0.39E+02
210.0	.3021	57.	5.57	0.22	0.33E-01	0.77E-03	0.44E+02
300.0	.2976	60.	5.92	0.12	0.58E-01	0.21E-02	0.27E+02
400.0	.2939	63.	6.15	0.07	0.47E-01	0.73E-03	0.64E+02
525.0	.2935	65.	6.42	0.08	0.23E-01	-.22E-03	-.10E+03
750.0	.2938	69.	6.72	0.12	0.57E-02	0.90E-04	0.64E+02
1050.0	.2928	72.	7.03	0.07	0.84E-02	0.48E-03	0.17E+02

DEPTH 99. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.5	.2852	10.	0.96	1.98	********	********	********
1.5	.2850	11.	1.05	1.91	********	********	********
2.5	.2844	12.	1.20	1.80	********	********	********
3.5	.2821	14.	1.41	1.67	0.13E+00	0.19E-02	0.67E+02
4.5	.2784	18.	1.72	1.50	0.26E+00	0.10E-02	0.25E+03
6.2	.2756	21.	2.06	1.35	0.80E-01	0.70E-03	0.11E+03
8.7	.2733	24.	2.32	1.28	0.10E+00	0.12E-02	0.87E+02
12.5	.2708	26.	2.58	1.26	0.61E-01	0.82E-03	0.74E+02
17.5	.2671	29.	2.85	1.25	0.62E-01	0.22E-02	0.28E+02
22.5	.2626	31.	3.06	1.23	0.55E-01	0.20E-02	0.28E+02
27.5	.2590	33.	3.25	1.19	0.51E-01	0.20E-02	0.26E+02
40.0	.2546	36.	3.49	1.14	0.23E-01	0.18E-02	0.13E+02
60.0	.2501	38.	3.77	1.09	0.18E-01	0.13E-02	0.14E+02
80.0	.2471	41.	3.99	1.00	0.17E-01	0.13E-02	0.14E+02
100.0	.2449	43.	4.17	0.90	0.15E-01	0.13E-02	0.12E+02

DEPTH 99. CM (CONT)

120.0	.2433	44.	4.32	0.83	0.15E-01	0.79E-03	0.19E+02
140.0	.2422	45.	4.46	0.75	0.13E-01	0.86E-03	0.15E+02
160.0	.2413	46.	4.55	0.67	0.19E-01	0.12E-02	0.15E+02
210.0	.2382	48.	4.73	0.62	0.13E-01	0.17E-02	0.75E+01
300.0	.2335	50.	4.95	0.55	0.14E-01	0.30E-02	0.46E+01
400.0	.2318	52.	5.08	0.47	0.70E-02	********	********
525.0	.2322	54.	5.29	0.38	0.48E-02	********	********
750.0	.2327	57.	5.55	0.30	0.22E-02	********	********
1050.0	.2320	59.	5.78	0.25	0.26E-02	0.85E-03	0.31E+01

DEPTH 114. CM SITE H-2

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.5	.2148	19.	1.83	0.79	0.34E+00	0.50E-02	0.69E+02
4.5	.2110	20.	1.94	0.74	0.60E+00	0.27E-02	0.23E+03
6.2	.2076	21.	2.07	0.65	0.19E+00	0.21E-02	0.89E+02
8.7	.2046	23.	2.25	0.62	0.24E+00	0.16E-02	0.15E+03
12.5	.2011	25.	2.48	0.61	0.14E+00	0.13E-02	0.10E+03
17.5	.1964	27.	2.69	0.56	0.17E+00	0.34E-02	0.50E+02
22.5	.1915	29.	2.87	0.52	0.15E+00	0.22E-02	0.69E+02
27.5	.1882	31.	3.02	0.52	0.13E+00	0.22E-02	0.62E+02
40.0	.1839	33.	3.20	0.51	0.60E-01	0.23E-02	0.26E+02
60.0	.1794	35.	3.42	0.48	0.47E-01	0.17E-02	0.29E+02
80.0	.1766	37.	3.59	0.49	0.39E-01	0.18E-02	0.22E+02
100.0	.1744	38.	3.71	0.50	0.29E-01	0.19E-02	0.15E+02
120.0	.1729	39.	3.80	0.49	0.27E-01	0.16E-02	0.17E+02
140.0	.1719	40.	3.89	0.50	0.21E-01	0.83E-03	0.26E+02
160.0	.1711	40.	3.93	0.51	0.25E-01	********	********
210.0	.1679	41.	3.98	0.40	0.23E-01	0.39E-02	0.60E+01
300.0	.1645	42.	4.09	0.32	0.24E-01	0.15E-02	0.17E+02
400.0	.1634	43.	4.17	0.34	0.99E-02	0.12E-02	0.83E+01
525.0	.1678	44.	4.31	0.32	0.41E-02	********	********
750.0	.1661	46.	4.48	0.29	0.35E-02	0.77E-02	0.45E+00
1050.0	.1582	48.	4.67	0.27	0.28E-02	0.11E-02	0.26E+01

DEPTH 130. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
4.5	.2002	20.	1.95	1.27	0.39E+00	0.52E-02	0.76E+02
6.2	.1976	20.	1.99	1.22	0.11E+00	0.12E-01	0.95E+01
8.7	.1949	21.	2.07	1.12	0.15E+00	0.24E-02	0.64E+02
12.5	.1911	22.	2.19	0.97	0.10E+00	0.47E-02	0.21E+02
17.5	.1873	23.	2.27	0.86	0.13E+00	0.36E-02	0.35E+02
22.5	.1845	24.	2.36	0.77	0.12E+00	0.29E-02	0.40E+02
27.5	.1822	25.	2.44	0.69	0.11E+00	0.22E-02	0.51E+02
40.0	.1795	26.	2.53	0.59	0.57E-01	0.31E-02	0.19E+02
60.0	.1766	27.	2.64	0.48	0.51E-01	0.19E-02	0.27E+02
80.0	.1747	28.	2.74	0.39	0.52E-01	0.16E-02	0.33E+02
100.0	.1735	29.	2.81	0.33	0.48E-01	0.16E-02	0.31E+02
120.0	.1728	29.	2.85	0.29	0.48E-01	0.16E-02	0.31E+02
140.0	.1724	29.	2.89	0.22	0.50E-01	0.34E-03	0.15E+03
160.0	.1722	30.	2.91	0.19	0.72E-01	********	********
210.0	.1700	30.	2.96	0.27	0.38E-01	0.43E-02	0.89E+01
300.0	.1669	31.	3.06	0.31	0.26E-01	0.27E-02	0.95E+01
400.0	.1650	32.	3.12	0.28	0.13E-01	0.25E-02	0.50E+01
525.0	.1684	33.	3.21	0.23	0.15E-02	********	********
750.0	.1653	34.	3.31	0.18	0.94E-02	0.12E-01	0.79E+00
1050.0	.1569	35.	3.43	0.12	0.74E-02	0.15E-02	0.48E+

SITE I (ECKMAN SERIES)

Site I was located in the nonirrigated corner of a center-pivot irrigated cornfield The location and description are summarized on Table 1 and on Fig. 2. In-situ measurements and site descriptions were made during late August through October, 1985.

The Eckman series consists of "deep, well-drained soils on uplands " and on "alluvial fans and foot slopes in the James River Valley and on lake plains. These soils are nearly level, undulating, and sloping. They formed in medium-textured deposits left by glacial melt water. " (USDA, 1971)

Infiltration and soil-water and suction profiles during wetting were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

This soil profile was irrigated for about 2 days. Although the initial infiltration rate was substantial (at about 28 cm/h), it declined quickly, and was almost immeasurably small at 38 hours. This soil seemed to reach a state in which further infiltration ceased. Reasons for the final slow infiltration in this soil are unclear, but may have been due to dispersion of silts caused by the high SAR of the Eckman subsoil.

SITE I, REPLICATION 1

Table I-1.1. Soil morphologic data for Site I, replication 1

Site and location: I-l Eckman, Oakes Aquifer 125 feet south and 175 feet east of the northwest corner of Section 25, Township 129 north, Range 60 west, Dickey County, North Dakota.

Sampled: 10/23/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Eckman silt loam; coarse-silty, mixed Udic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin.

Drainage: Well

Notes: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches, laboratory texture in parenthesis if different from field texture.

Soil profile: I-l east side of pit.

Ap 0-6 inches (0-15 cm) black (lOYR 2/1) silt loam, dark gray (lOYR 4/1, dry); moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; abrupt smooth boundary.

Bw 6-12 inches (15-30 cm) very dar kgrayish brown (lOYR 3/2) silt loam (loam), grayish brown (lOYR 5/2, dry); moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; common very fine roots; clear smooth boundary.

BCk 12-21 inches (30-53 cm) light yellowish brown to pale yellow (2.5Y 6.5/4) silt loam (silty clay loam), white (2.5Y 8/2, dry); weak coarse prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; very dark gray (lOYR 3/1) crotovina; violent effervescence; few salt crystals; clear smooth boundary.

BCsa 21-32 inches (53-81 cm) light yellowish brown (2.5 6/4) silt loam, pale yellow (2.5Y 8/4, dry); weak coarse prismatic parting to weak coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence with few large irregularly shaped lime concretions; common salt crystals; clear wavy boundary.

C132-52 inches (81-132 cm) light olive brown (2.5Y 5/4) very fine sandy loam (silt), pale yellow (2.5Y 8/4, dry) with common medium distinct light gray to gray (5Y 6/1) and common large distinct strong brown (7.5YR 5/8) mottles and dark reddish brown (5YR 3/3) root channels; moderate medium and fine platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; strong to slight effervescence.

Table I-1.2 ECKMAN SERIES SITE I-1 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	PARTICLE SIZE CLASSES (MICRON/PERCENT) 2.	20.	50.	100.	250.	500.	1000.	2000.
8.	16.3	23.7	27.0	20.9	8.8	2.6	0.5	0.1
23.	14.6	19.3	29.7	26.2	8.0	1.8	0.3	0.0
38.	32.1	36.0	22.0	6.6	2.5	0.7	0.1	0.0
53.	23.0	47.2	22.9	4.3	1.7	0.6	0.2	0.1
68.	13.6	45.8	24.8	9.0	4.6	1.5	0.3	0.2
84.	14.8	60.9	22.5	0.8	0.6	0.3	0.1	0.0
99.	12.5	67.8	18.0	0.4	0.3	0.3	0.4	0.3
114.	6.5	48.7	43.3	0.8	0.3	0.1	0.1	0.1
137.	5.1	61.6	30.6	0.7	0.9	0.3	0.2	0.5

DEPTH cm	SAND %	SILT %	CLAY %	HORIZONS		
8.	33.0	50.7	16.3	A	6	6=p
23.	36.4	49.0	14.6	B	7	7=w
38.	9.9	58.0	32.1	BC	10	10=k
53.	6.9	70.1	23.0	BC	12	12=sa
68.	15.8	70.6	13.6	BC	12	
84.	1.8	83.4	14.8	C		
99.	1.7	85.8	12.5	C		
114.	1.5	92.0	6.5	C		
137.	2.7	92.2	5.1	C		

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	0.649	0.0219	5.2	0.0042	0.402	1.66	3.00
23.	0.741	0.0244	4.8	0.0051	0.484	1.48	1.50
38.	0.171	0.0082	5.0	0.0016	0.283	1.35	0.94
53.	0.098	0.0097	4.2	0.0023	0.393	1.44	0.60
68.	0.221	0.0155	4.1	0.0038	0.468	1.40	0.40
84.	0.022	0.0105	3.1	0.0034	0.582	1.37	0.13
99.	0.020	0.0106	3.0	0.0036	0.671	1.37	0.34
114.	0.015	0.0162	2.6	0.0062	0.778	1.35	0.13
137.	0.028	0.0151	2.6	0.0058	0.859	1.33	0.20

DEPTH cm	MOISTURE/SUCTION SLOPE GHOSH	BLOEMEN	GARDNER CM/DAY-KPA K-SLOPE	K-INT	K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR K-SLOPE	K-INT
8.	4.435	1.790	-0.1412	0.9541	-1.41	-0.43
23.	4.217	2.014	-0.1995	1.0527	-2.00	-0.33
38.	7.495	1.808	0.2268	0.2871	2.27	-1.09
53.	9.379	2.053	0.3450	0.2001	3.45	-1.18
68.	6.800	2.288	0.2264	0.4524	2.26	-0.93
84.	17.096	2.908	0.5002	0.0522	5.00	-1.33
107.	17.668	2.840	0.5167	0.0493	5.17	-1.33
114.	19.528	3.615	0.5600	0.0406	5.60	-1.34
137.	15.295	3.679	0.5445	0.0754	5.44	-1.30

Table I-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site I, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
	Saturation Extract Soluble Ions meq/l							
0 - 15	17.77	8.07	3.42	0.91	-	3.72	0.64	25.81
15 - 30	22.63	13.53	7.20	0.29	-	1.00	0.76	41.89
30 - 46	25.17	30.03	16.30	0.20	-	1.76	1.00	68.94
46 - 61	23.27	43.54	27.10	0.22	-	1.60	1.10	91.42
61 - 76	22.21	62.35	34.00	0.43	-	1.20	2.90	114.89
76 - 91	13.11	56.09	49.98	0.40	-	1.44	3.70	114.44
91- 107	10.36	63.64	24.15	0.43	-	1.44	4.80	92.34
107 - 122	14.81	82.55	71.19	0.40	-	1.12	3.30	164.53
122 - 152	20.09	95.11	71.61	0.59	-	1.12	6.50	179.78

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	2.15	1.0	48	7.9	-	sil	10.42
15 - 30	2.94	1.7	45	7.8	-	l	8.37
30 - 46	4.41	3.1	46	7.8	-	sicl	9.35
46 - 61	5.99	4.7	50	7.9	-	sil	10.43
61 - 76	8.37	5.2	45	7.9	-	sil	9.88
76 - 91	7.58	8.5	57	7.9	-	sil	10.92
91- 107	8.71	4.0	54	7.9	-	sil	10.27
107 - 122	9.05	10.2	47	7.9	-	si	7.50
122 - 152	9.95	9.4	51	7.9	-	si	9.70

* There should be some CO3 clay in this profile. Records indicate none, however. Reasons for nondetection are not clear. There is no sample left for a second determination. (M. D. Sweeney)

Table I-1.4 SITE I-1 ECKMAN SOIL 1985 NDSWC
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			58.	
CM	CC/CC	SE									
14.	0.4650	0.0202	14.	0.4457	0.0241	14.	0.4382	0.0077	10.	0.5081	0.0121
20.	0.4685	0.0216	20.	0.4458	0.0251	20.	0.4313	0.0048	20.	0.5152	0.0139
30.	0.4676	0.0210	30.	0.4391	0.0231	30.	0.4184	0.0019	30.	0.4960	0.0046
40.	0.4692	0.0211	40.	0.4317	0.0217	40.	0.4062	0.0005	40.	0.4944	0.0034
60.	0.4655	0.0185	60.	0.4127	0.0184	60.	0.3904	0.0004	60.	0.4857	0.0004
80.	0.4567	0.0143	80.	0.3982	0.0175	80.	0.3700	0.0014	80.	0.4614	0.0042
100.	0.4506	0.0120	100.	0.3860	0.0172	100.	0.3579	0.0017	100.	0.4590	0.0048
120.	0.4428	0.0096	120.	0.3752	0.0170	120.	0.3474	0.0009	120.	0.4496	0.0062
160.	0.4292	0.0061	160.	0.3541	0.0151	160.	0.3315	0.0018	180.	0.4240	0.0075
238.	0.4083	0.0025	238.	0.3246	0.0138	238.	0.3120	0.0012	334.	0.4023	0.0082
340.	0.3925	0.0006	340.	0.3030	0.0134	340.	0.2984	0.0015	534.	0.3767	0.0085
544.	0.3753	0.0004	544.	0.2868	0.0159	544.	0.2848	0.0018	834.	0.3257	0.0057
850.	0.3517	0.0007	850.	0.2584	0.0125	850.	0.2712	0.0032			
BD =	1.66			1.48			1.35			1.44	
N =	2			2			2			2	

DEPTH (CM)

	69.			84.			99.			114.	
14.	0.5270	0.0030	14.	0.6026	0.0406	14.	0.6148	0.0073	10.	0.5558	0.0058
20.	0.5233	0.0023	20.	0.5982	0.0396	20.	0.6091	0.0089	20.	0.5630	0.0014
30.	0.5124	0.0023	30.	0.5955	0.0388	30.	0.6007	0.0075	30.	0.5465	0.0027
40.	0.5065	0.0010	40.	0.5718	0.0340	40.	0.5702	0.0094	40.	0.5434	0.0027
60.	0.4948	0.0006	60.	0.5547	0.0338	60.	0.5401	0.0050	60.	0.5387	0.0017
80.	0.4782	0.0001	80.	0.5384	0.0332	80.	0.5185	0.0032	80.	0.5240	0.0002
100.	0.4695	0.0008	100.	0.5279	0.0312	100.	0.5035	0.0015	100.	0.5224	0.0003
120.	0.4580	0.0012	120.	0.5200	0.0300	120.	0.4943	0.0007	120.	0.5170	0.0002
160.	0.4406	0.0014	160.	0.5062	0.0289	160.	0.4735	0.0006	180.	0.5013	0.0011
238.	0.4161	0.0023	238.	0.4863	0.0267	238.	0.4494	0.0031	334.	0.4850	0.0008
340.	0.3958	0.0024	340.	0.4708	0.0255	340.	0.4328	0.0036	534.	0.4481	0.0085
544.	0.3738	0.0007	544.	0.4445	0.0265	544.	0.4141	0.0112	834.	0.3272	0.0108
850.	0.3612	0.0039	850.	0.4171	0.0256	850.	0.3739	0.0048			
BD =	1.40			1.37			1.37			1.35	
N =	2			2			2			2	

DEPTH (CM)

	137.	
14.	0.5159	0.0122
20.	0.5107	0.0106
30.	0.5047	0.0096
40.	0.5032	0.0085
60.	0.4965	0.0080
80.	0.4920	0.0070
100.	0.4882	0.0065
120.	0.4838	0.0054
160.	0.4778	0.0055
238.	0.4688	0.0055
340.	0.4590	0.0040
544.	0.4418	0.0046
850.	0.4147	0.0058
BD =	1.33	
N =	2	

Table I-1.5 ECKMAN LOAM SITE I-1 NDSWC:1985
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.1	.3883	15.	1.44	-1.54	0.17E-01	-.21E-02	0.80E+01
2.4	.3875	15.	1.50	-1.52	0.13E-01	-.10E-02	0.13E+02
2.7	.3869	16.	1.59	-1.49	0.97E-02	-.48E-03	0.20E+02
3.0	.3863	17.	1.70	-1.45	0.13E-01	-.59E-03	0.22E+02
4.0	.3835	22.	2.20	-1.30	0.14E-01	-.41E-03	0.35E+02
4.6	.3818	26.	2.56	-1.17	0.22E-01	-.50E-03	0.44E+02
7.0	.3798	34.	3.38	-0.89	0.30E-02	-.13E-03	0.23E+02
11.1	.3782	45.	4.41	-0.69	0.48E-02	-.19E-03	0.26E+02
31.3	.3757	68.	6.70	-0.43	0.23E-02	-.17E-03	0.14E+02
35.4	.3753	71.	6.94	-0.40	0.17E-02	-.21E-03	0.80E+01
43.5	.3744	74.	7.24	-0.43	0.27E-02	-.41E-03	0.66E+01
47.5	.3737	76.	7.41	-0.45	0.28E-02	-.37E-03	0.75E+01
55.6	.3725	80.	7.79	-0.50	0.21E-02	-.27E-03	0.79E+01
59.6	.3719	82.	8.00	-0.51	0.19E-02	-.24E-03	0.77E+01
67.7	.3710	86.	8.41	-0.53	0.16E-02	-.23E-03	0.70E+01
71.8	.3705	88.	8.60	-0.54	0.14E-02	-.23E-03	0.62E+01
79.9	.3698	91.	8.93	-0.57	0.14E-02	-.27E-03	0.50E+01
132.9	.3633	112.	10.98	-0.67	0.14E-02	-.32E-03	0.43E+01
150.0	.3609	118.	11.61	-0.67	0.18E-02	-.44E-03	0.41E+01
167.1	.3581	125.	12.21	-0.67	0.18E-02	-.49E-03	0.38E+01
287.2	.3576	153.	15.00	-0.36	0.15E-02	-.42E-03	0.36E+01
304.3	.3558	156.	15.27	-0.34	0.32E-02	-.93E-03	0.34E+01
321.5	.3530	158.	15.52	-0.33	0.42E-02	-.13E-02	0.31E+01
338.5	.3501	161.	15.75	-0.33	0.36E-02	-.11E-02	0.32E+01
372.8	.3469	166.	16.28	-0.33	0.75E-03	-.19E-03	0.39E+01
407.2	.3462	172.	16.81	-0.36	0.44E-03	-.15E-03	0.30E+01
424.3	.3458	174.	17.04	-0.41	0.55E-03	-.23E-03	0.24E+01

DEPTH 23. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.4	.4075	19.	1.84	-1.51	0.36E-01	-.91E-03	0.40E+02
3.0	.4066	20.	2.00	-1.44	0.37E-01	-.72E-03	0.51E+02
3.5	.4053	22.	2.16	-1.34	0.44E-01	-.73E-03	0.61E+02
4.0	.4040	25.	2.41	-1.29	0.45E-01	-.52E-03	0.86E+02
4.6	.4023	27.	2.67	-1.16	0.68E-01	-.78E-03	0.87E+02
7.0	.3994	33.	3.26	-0.89	0.13E-01	-.35E-03	0.37E+02
11.1	.3963	42.	4.14	-0.68	0.19E-01	-.38E-03	0.49E+02
27.3	.3927	60.	5.92	-0.48	0.12E-01	-.35E-03	0.34E+02
31.3	.3914	64.	6.25	-0.42	0.96E-02	-.41E-03	0.23E+02
39.4	.3895	68.	6.63	-0.40	0.79E-02	-.58E-03	0.14E+02
47.5	.3877	71.	6.98	-0.45	0.96E-02	-.49E-03	0.19E+02
51.5	.3867	73.	7.19	-0.47	0.91E-02	-.46E-03	0.20E+02
59.6	.3849	78.	7.62	-0.51	0.70E-02	-.39E-03	0.18E+02
67.7	.3833	82.	8.05	-0.53	0.60E-02	-.38E-03	0.16E+02
75.8	.3819	86.	8.43	-0.55	0.47E-02	-.37E-03	0.13E+02
83.9	.3806	89.	8.77	-0.58	0.48E-02	-.40E-03	0.12E+02
115.7	.3745	103.	10.05	-0.64	0.53E-02	-.50E-03	0.11E+02
132.9	.3713	109.	10.72	-0.66	0.48E-02	-.47E-03	0.10E+02
150.0	.3681	116.	11.35	-0.67	0.59E-02	-.54E-03	0.11E+02

167.1	.3648	122.	11.95	-0.67	0.58E-02	-.55E-03	0.11E+02

DEPTH 23. CM (CONT)

287.2	.3607	148.	14.51	-0.36	0.49E-02	-.58E-03	0.84E+01
304.3	.3592	151.	14.77	-0.33	0.85E-02	-.61E-03	0.14E+02
321.5	.3575	153.	15.01	-0.33	0.11E-01	-.78E-03	0.14E+02
355.7	.3522	158.	15.50	-0.33	0.91E-02	-.14E-02	0.63E+01
390.0	.3452	164.	16.05	-0.33	0.41E-02	-.89E-03	0.46E+01
424.3	.3453	169.	16.59	-0.40	-.53E+10	0.85E-03	0.63E+13

DEPTH 38. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
11.1	.4152	33.	3.19	-0.14	0.27E+00	-.12E-02	0.22E+03
27.3	.4070	50.	4.91	-0.20	0.69E-01	-.77E-03	0.89E+02
31.3	.4041	53.	5.24	-0.24	0.49E-01	-.11E-02	0.43E+02
35.4	.4013	56.	5.46	-0.26	0.37E-01	-.15E-02	0.24E+02
39.4	.3988	57.	5.63	-0.27	0.34E-01	-.14E-02	0.24E+02
43.5	.3967	59.	5.81	-0.27	0.35E-01	-.97E-03	0.37E+02
47.5	.3949	61.	6.02	-0.27	0.35E-01	-.82E-03	0.42E+02
51.5	.3931	64.	6.23	-0.26	0.36E-01	-.81E-03	0.44E+02
55.6	.3915	66.	6.44	-0.23	0.36E-01	-.77E-03	0.47E+02
59.6	.3899	68.	6.64	-0.20	0.40E-01	-.78E-03	0.52E+02
63.7	.3884	70.	6.84	-0.17	0.44E-01	-.71E-03	0.62E+02
67.7	.3870	72.	7.04	-0.14	0.50E-01	-.70E-03	0.71E+02
71.8	.3857	74.	7.23	-0.13	0.50E-01	-.64E-03	0.78E+02
75.8	.3845	76.	7.43	-0.14	0.43E-01	-.60E-03	0.73E+02
79.9	.3834	78.	7.62	-0.16	0.39E-01	-.56E-03	0.70E+02
83.9	.3823	80.	7.82	-0.17	0.34E-01	-.54E-03	0.63E+02
115.7	.3750	94.	9.18	-0.21	0.31E-01	-.51E-03	0.62E+02
132.9	.3715	101.	9.90	-0.26	0.23E-01	-.48E-03	0.49E+02
150.0	.3683	108.	10.59	-0.32	0.21E-01	-.44E-03	0.48E+02
167.1	.3658	114.	11.20	-0.34	0.18E-01	-.38E-03	0.49E+02
184.3	.3639	120.	11.73	-0.36	0.81E-02	-.34E-03	0.24E+02
270.0	.3562	138.	13.48	-0.57	0.34E-02	-.83E-03	0.41E+01
287.2	.3544	140.	13.69	-0.54	0.59E-02	-.82E-03	0.71E+01
304.3	.3530	142.	13.89	-0.49	0.81E-02	-.55E-03	0.15E+02
321.5	.3519	144.	14.09	-0.45	0.11E-01	-.51E-03	0.21E+02
338.5	.3504	146.	14.31	-0.42	0.13E-01	-.86E-03	0.16E+02
355.7	.3477	149.	14.55	-0.41	0.15E-01	-.13E-02	0.12E+02
372.8	.3439	151.	14.83	-0.42	0.14E-01	-.14E-02	0.97E+01
390.0	.3404	154.	15.13	-0.45	0.82E-02	-.90E-03	0.90E+01

DEPTH 53. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.8	.4455	3.	0.28	-0.37	0.31E+00	-.16E-02	0.20E+03
4.0	.4440	4.	0.40	-0.33	0.48E+00	-.18E-02	0.26E+03
4.3	.4423	5.	0.52	-0.32	0.61E+00	-.21E-02	0.29E+03
4.6	.4407	6.	0.63	-0.33	0.63E+00	-.22E-02	0.29E+03
4.9	.4392	7.	0.73	-0.36	0.53E+00	-.22E-02	0.25E+03
7.0	.4345	11.	1.08	-0.28	0.23E+00	-.11E-02	0.21E+03
11.1	.4261	19.	1.87	-0.17	0.43E+00	-.11E-02	0.39E+03
27.3	.4202	38.	3.71	-0.21	0.11E+00	-.55E-03	0.21E+03
31.3	.4179	41.	4.06	-0.20	0.11E+00	-.85E-03	0.13E+03
35.4	.4157	44.	4.30	-0.20	0.93E-01	-.12E-02	0.79E+02
39.4	.4137	46.	4.47	-0.20	0.84E-01	-.11E-02	0.75E+02
43.5	.4121	47.	4.65	-0.20	0.79E-01	-.69E-03	0.11E+03
47.5	.4108	50.	4.86	-0.20	0.77E-01	-.58E-03	0.13E+03

51.5	.4096	52.	5.07	-0.20	0.73E-01	-.61E-03	0.12E+03
DEPTH	53.	CM	(CONT)				
55.6	.4083	54.	5.27	-0.22	0.63E-01	-.61E-03	0.10E+03
63.7	.4059	58.	5.66	-0.25	0.49E-01	-.63E-03	0.77E+02
71.8	.4036	62.	6.04	-0.27	0.41E-01	-.58E-03	0.71E+02
79.9	.4014	66.	6.42	-0.24	0.42E-01	-.51E-03	0.83E+02
83.9	.4005	68.	6.62	-0.22	0.44E-01	-.50E-03	0.89E+02
115.7	.3941	82.	8.01	-0.22	0.42E-01	-.37E-03	0.11E+03
150.0	.3894	96.	9.43	-0.14	0.63E-01	-.27E-03	0.23E+03
167.1	.3880	103.	10.05	-0.13	0.57E-01	-.17E-03	0.34E+03
201.4	.3853	113.	11.10	-0.14	0.13E-01	-.36E-03	0.37E+02
235.7	.3817	122.	11.92	-0.12	0.67E-02	-.55E-03	0.12E+02
252.9	.3799	125.	12.21	-0.09	0.24E-01	-.69E-03	0.34E+02
270.0	.3782	127.	12.43	-0.05	0.65E-01	-.90E-03	0.73E+02

DEPTH 69. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
7.0	.4497	2.	0.20	-0.30	0.29E+00	-.49E-03	0.59E+03
11.1	.4474	7.	0.65	-0.40	0.23E+00	-.13E-03	0.17E+04
27.3	.4456	26.	2.57	-0.28	0.10E+00	-.98E-04	0.11E+04
31.3	.4452	30.	2.91	-0.27	0.10E+00	-.14E-03	0.69E+03
35.4	.4448	32.	3.17	-0.29	0.80E-01	-.21E-03	0.37E+03
43.5	.4440	37.	3.58	-0.36	0.52E-01	-.15E-03	0.35E+03
51.5	.4436	41.	4.05	-0.42	0.41E-01	0.13E-04	-.31E+04
59.6	.4440	46.	4.52	-0.47	0.33E-01	0.65E-04	-.51E+03
67.7	.4439	51.	4.96	-0.53	0.28E-01	-.16E-03	0.18E+03
75.8	.4422	55.	5.35	-0.54	0.27E-01	-.67E-03	0.40E+02
83.9	.4395	58.	5.70	-0.53	0.27E-01	-.84E-03	0.32E+02
115.7	.4330	71.	6.99	-0.41	0.28E-01	-.35E-03	0.82E+02
132.9	.4306	78.	7.67	-0.39	0.28E-01	-.37E-03	0.75E+02
167.1	.4260	90.	8.87	-0.28	0.32E-01	-.37E-03	0.87E+02
201.4	.4234	100.	9.82	-0.15	0.19E-01	-.17E-03	0.11E+03
235.7	.4220	108.	10.56	-0.07	0.28E-01	-.25E-03	0.11E+03
270.0	.4195	113.	11.07	-0.13	0.39E-01	-.84E-03	0.46E+02
304.3	.4163	117.	11.44	-0.24	0.26E-01	-.80E-03	0.33E+02
338.5	.4142	121.	11.82	-0.27	0.29E-01	-.35E-03	0.83E+02
355.7	.4135	123.	12.06	-0.27	0.33E-01	-.25E-03	0.13E+03
372.8	.4129	126.	12.35	-0.27	0.31E-01	-.18E-03	0.17E+03
390.0	.4123	129.	12.67	-0.27	0.21E-01	-.15E-03	0.14E+03
407.2	.4119	133.	13.01	-0.27	0.39E-02	-.12E-03	0.33E+02
424.3	.4115	136.	13.35	-0.27	-.80E+10	-.99E-04	-.81E+14
441.5	.4112	140.	13.70	-0.27	-.80E+10	-.10E-03	-.79E+14

DEPTH 91. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
27.3	.4651	7.	0.66	-0.04	0.75E+00	-.15E-03	0.50E+04
31.3	.4646	10.	0.98	-0.04	0.80E+00	-.14E-03	0.57E+04
35.4	.4641	13.	1.26	-0.05	0.54E+00	-.20E-03	0.27E+04
39.4	.4636	15.	1.51	-0.06	0.38E+00	-.27E-03	0.14E+04
43.5	.4629	11.	1.04	-0.07	0.31E+00	-.27E-03	0.11E+04
47.5	.4623	14.	1.42	-0.07	0.29E+00	-.23E-03	0.12E+04
51.5	.4619	18.	1.73	-0.06	0.29E+00	-.10E-03	0.28E+04
55.6	.4618	21.	2.03	-0.05	0.28E+00	0.90E-05	-.31E+05
59.6	.4618	24.	2.31	-0.05	0.33E+00	0.21E-04	-.15E+05
63.7	.4618	26.	2.57	-0.04	0.41E+00	-.26E-04	0.16E+05
67.7	.4616	29.	2.82	-0.03	0.50E+00	-.15E-03	0.33E+04

71.8	.4610	31.	3.06	-0.04	0.55E+00	-.41E-03	0.14E+04

DEPTH 91. CM (CONT)

75.8	.4600	33.	3.28	-0.04	0.52E+00	-.58E-03	0.89E+03
79.9	.4588	36.	3.49	-0.05	0.46E+00	-.72E-03	0.64E+03
83.9	.4575	38.	3.69	-0.06	0.36E+00	-.74E-03	0.49E+03
115.7	.4523	52.	5.08	-0.12	0.12E+00	-.30E-03	0.40E+03
150.0	.4480	64.	6.31	-0.09	0.16E+00	-.43E-03	0.38E+03
167.1	.4457	70.	6.87	-0.10	0.12E+00	-.43E-03	0.28E+03
184.3	.4441	75.	7.37	-0.12	0.59E-01	-.24E-03	0.25E+03
201.4	.4433	80.	7.81	-0.13	0.28E-01	-.95E-04	0.30E+03
218.6	.4431	84.	8.19	-0.14	0.16E-01	-.39E-04	0.41E+03
235.7	.4428	87.	8.51	-0.14	0.19E-01	-.13E-03	0.15E+03
252.9	.4421	90.	8.78	-0.13	0.39E-01	-.43E-03	0.91E+02
270.0	.4408	92.	9.00	-0.10	0.69E-01	-.77E-03	0.90E+02
287.2	.4391	94.	9.20	-0.08	0.10E+00	-.90E-03	0.11E+03
304.3	.4376	96.	9.39	-0.07	0.12E+00	-.70E-03	0.17E+03
321.5	.4365	98.	9.59	-0.07	0.11E+00	-.44E-03	0.26E+03
338.5	.4356	100.	9.83	-0.09	0.99E-01	-.30E-03	0.33E+03
355.7	.4349	103.	10.10	-0.11	0.93E-01	-.24E-03	0.39E+03
372.8	.4342	106.	10.42	-0.12	0.78E-01	-.22E-03	0.36E+03
390.0	.4335	110.	10.76	-0.13	0.50E-01	-.19E-03	0.26E+03

DEPTH 114. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
51.5	.4757	2.	0.20	-0.14	0.14E+00	-.22E-03	0.64E+03
59.6	.4748	7.	0.65	-0.14	0.11E+00	-.18E-03	0.59E+03
63.7	.4745	5.	0.54	-0.13	0.12E+00	-.18E-03	0.68E+03
67.7	.4741	8.	0.82	-0.11	0.17E+00	-.15E-03	0.11E+04
71.8	.4738	11.	1.07	-0.09	0.25E+00	-.17E-03	0.15E+04
75.8	.4735	13.	1.30	-0.09	0.29E+00	-.14E-03	0.21E+04
79.9	.4732	15.	1.52	-0.08	0.33E+00	-.14E-03	0.23E+04
83.9	.4729	18.	1.73	-0.08	0.34E+00	-.15E-03	0.22E+04
115.7	.4711	32.	3.10	-0.01	0.12E+01	-.13E-03	0.91E+04
132.9	.4702	38.	3.74	-0.04	0.40E+00	-.14E-03	0.28E+04
150.0	.4692	44.	4.34	-0.07	0.25E+00	-.23E-03	0.11E+04
167.1	.4680	50.	4.90	-0.07	0.21E+00	-.19E-03	0.11E+04
184.3	.4676	55.	5.41	-0.05	0.15E+00	0.20E-04	-.76E+04
201.4	.4678	60.	5.85	-0.03	0.13E+00	0.70E-04	-.18E+04
218.6	.4676	64.	6.22	-0.01	0.27E+00	-.19E-03	0.14E+04
235.7	.4659	67.	6.54	0.00	0.17E+05	-.95E-03	0.18E+08
252.9	.4618	69.	6.79	-0.01	0.84E+00	-.25E-02	0.34E+03
270.0	.4554	71.	7.00	-0.03	0.35E+00	-.38E-02	0.92E+02
304.3	.4437	75.	7.37	-0.06	0.17E+00	-.19E-02	0.88E+02
321.5	.4417	77.	7.56	-0.04	0.21E+00	-.33E-03	0.65E+03

DEPTH 137. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
115.7	.5082	12.	1.19	-0.14	0.19E-01	0.24E-02	-.82E+01
132.9	.5120	12.	1.22	-0.16	0.15E+00	-.13E-02	0.12E+03
150.0	.5033	22.	2.12	-0.18	0.14E+00	-.15E-02	0.93E+02
167.1	.5002	29.	2.80	-0.20	0.60E-01	0.57E-03	-.11E+03
184.3	.5025	34.	3.33	-0.19	0.32E-01	0.38E-03	-.86E+02
201.4	.5032	38.	3.74	-0.17	0.23E-01	-.81E-04	0.29E+03
218.6	.5014	41.	4.06	-0.15	0.41E-01	-.12E-02	0.35E+02
235.7	.4966	44.	4.32	-0.12	0.92E-01	-.25E-02	0.36E+02
252.9	.4888	46.	4.55	-0.10	0.20E+00	-.42E-02	0.46E+02

270.0	.4789	49.	4.77	-0.09	0.26E+00	-.50E-02	0.52E+02
DEPTH	137.	CM					
287.2	.4693	51.	4.99	-0.09	0.25E+00	-.44E-02	0.57E+02
304.3	.4627	53.	5.19	-0.10	0.16E+00	-.24E-02	0.66E+02
321.5	.4600	55.	5.38	-0.11	0.98E-01	-.46E-03	0.21E+03
338.5	.4599	57.	5.60	-0.11	0.82E-01	0.26E-03	-.31E+03
355.7	.4603	60.	5.85	-0.10	0.11E+00	0.75E-04	-.14E+04
372.8	.4602	63.	6.16	-0.08	0.13E+00	-.12E-03	0.11E+04
390.0	.4597	66.	6.50	-0.07	0.11E+00	-.15E-03	0.76E+03

SITE I, REPLICATION 2

Table I-2.1. Soil morphologic data for Site I, replication 2

Site and location: 1-2 Eckman, Oakes Aquifer 125 feet south and 170 feet east of the northwest corner of Section 25, Township 129 north, Range 60 west, Dickey County, North Dakota.

Sampled: 10/23/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Eckman silt loam; coarse-silty, mixed Udic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin.

Drainage: Well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: I-2 west side of pit.

Ap 0-6 inches (0-15 cm) black (10YR 2/1) silt loam (loam), dark gray (10YR 4/1, dry); moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; abrupt smooth boundary.

Bw 6-12 inches (15-30 cm) very dark grayish brown (10YR 3/2) silt loam (loam), grayish brown (10YR 5/2, dry); moderate coarse and medium prismatic parting to moderate coarse and medium subangular blocky structure; common very fine roots; clear smooth boundary.

BCk 12-20 inches (30-51 cm) light yellowish brown to pale yellow (2.5Y 6.5/4) silt loam (silty clay loam), white (2.5Y 8/2, dry); weak coarse prismatic parting to moderate coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; violent effervescence; few salt crystals; clear smooth boundary.

BCsa 20-31 inches (51-79 cm) light yellowish brown (2.5Y 6/4) silt loam, pale yellow (2.5Y 8/4, dry); weak coarse prismatic parting to weak coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence with few large irregularly shaped lime concretions; common salt crystals; clear wavy boundary.

C1 31-52 inches (79-132 cm) light yellowish brown (2.5Y 6/4) very fine sandy loam (silt loam), pale yellow (2.5Y 8/4, dry) with common medium distinct light gray to gray (5Y 6/1) and common large distinct strong brown (7.5YR 5/8) mottles and dark reddish brown (5YR 3/3) root channels; moderate medium and fine platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; strong to slight effervescence

Table I-2.2 ECKMAN SERIES SITE I-2 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.	17.8	22.6	26.0	21.9	8.7	2.4	0.4	0.1
23.	15.4	20.1	26.6	28.2	7.7	1.8	0.3	0.0
38.	32.6	36.8	21.1	6.2	2.4	0.7	0.1	0.1
54.	22.0	48.8	22.3	4.1	1.9	0.7	0.2	0.0
68.	13.1	52.8	30.2	2.1	1.2	0.4	0.1	0.1
84.	17.8	58.6	22.0	0.7	0.5	0.2	0.1	0.0
99.	16.3	67.4	14.4	0.3	0.3	0.3	0.4	0.5
114.	6.1	47.4	44.6	1.2	0.4	0.1	0.1	0.0
137.	14.9	64.1	20.2	0.3	0.2	0.1	0.1	0.1

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	33.6	48.6	17.8	A 0 6	6=p
23.	37.9	46.7	15.4	B 0 7	7=w
38.	9.5	57.9	32.6	BCO 10	10=k
54.	6.9	71.1	22.0	BCO 12	12=sa
68.	3.9	83.0	13.1	BCO 12	
84.	1.6	80.6	17.8	C 0 0	
99.	1.9	81.8	16.3	C 0 0	
114.	1.9	92.0	6.1	C 0 0	
137.	0.8	84.3	14.9	C 0 0	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	0.689	0.0210	5.4	0.0039	0.391	1.58	2.80
23.	0.814	0.0236	4.9	0.0048	0.466	1.46	1.60
38.	0.164	0.0080	5.0	0.0016	0.280	1.25	1.10
54.	0.097	0.0099	4.1	0.0024	0.407	1.42	0.67
68.	0.047	0.0126	3.3	0.0038	0.570	1.35	0.40
84.	0.019	0.0097	3.3	0.0029	0.526	1.35	0.34
99.	0.022	0.0094	3.3	0.0029	0.603	1.35	0.27
114.	0.020	0.0167	2.6	0.0065	0.791	1.31	0.13
137.	0.009	0.0100	3.0	0.0033	0.605	1.38	0.34

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER CM/DAY-KPA		K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	4.323	1.793	-0.1628	0.9715	-1.63	-0.41
23.	4.061	1.977	-0.2378	1.1020	-2.38	-0.28
38.	7.616	1.788	0.2318	0.2755	2.32	-1.10
54.	9.433	2.060	0.3513	0.2001	3.51	-1.18
68.	12.579	2.526	0.4683	0.1131	4.68	-1.27
84.	18.125	2.464	0.4868	0.0435	4.87	-1.34
99.	16.972	2.736	0.4901	0.0522	4.90	-1.33
114.	17.690	3.668	0.5544	0.0522	5.54	-1.33
137.	23.531	2.664	0.5199	0.0232	5.20	-1.36

Table I-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site I, replication 2

Depth (cm)	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4
	Saturation Extract Soluble Ions meq/l							
0 - 15	6.77	2.83	1.64	0.72	-	2.72	0.30	8.94
15 - 30	6.13	2.87	1.39	0.21	-	1.16	0.20	9.24
30 - 46	7.83	3.97	1.58	0.08	-	1.32	0.18	11.96
46 - 61	27.71	15.09	3.53	0.11	-	1.00	0.12	45.32
61 - 76	20.52	27.88	15.30	0.25	-	1.60	0.30	62.05
76 - 91	4.86	22.98	30.10	0.28	-	1.92	0.70	55.60
91- 107	6.35	34.86	31.10	0.31	-	1.76	2.46	68.39
107 - 122	10.15	65.45	65.73	0.32	-	1.32	4.94	135.39
122 - 152	18.40	78.00	64.68	0.46	-	1.28	5.30	154.96

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.94	0.7	47	8.2	-	l	9.37
15 - 30	0.85	0.7	43	7.8	-	l	8.68
30 - 46	1.13	0.6	45	7.9	15.9	sicl	8.94
46 - 61	2.83	0.8	48	7.7	7.4	sil	9.86
61 - 76	4.07	3.1	53	7.9	-	sil	10.39
76 - 91	4.41	8.1	55	8.0	-	sil	11.17
91- 107	5.77	6.9	64	8.0	-	sil	12.52
107 - 122	9.05	10.7	49	7.9	-	si	7.85
122 - 152	9.72	9.3	57	7.9	-	sil	11.85

Table I-2.4 SITE I-2 ECKMAN SERIES 1985 NDSWC
Laboratory soil-water retention data

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

8.			23.			38.			53.		
CM	CC/CC	SE									
14.	0.4370	0.0067	10.	0.4148	0.0003	10.	0.4341	0.0008	10.	0.5193	0.0344
20.	0.4370	0.0067	20.	0.4191	0.0003	20.	0.4398	0.0017	20.	0.5180	0.0379
30.	0.4354	0.0067	30.	0.4061	0.0006	30.	0.3912	0.0034	30.	0.4676	0.0256
40.	0.4346	0.0062	40.	0.4046	0.0006	40.	0.3876	0.0029	40.	0.4641	0.0243
60.	0.4289	0.0057	60.	0.3974	0.0005	60.	0.3726	0.0026	60.	0.4489	0.0225
80.	0.4200	0.0042	80.	0.3734	0.0003	80.	0.3425	0.0030	80.	0.4142	0.0168
100.	0.4135	0.0032	100.	0.3720	0.0003	100.	0.3397	0.0031	100.	0.4116	0.0161
120.	0.4070	0.0022	120.	0.3647	0.0004	120.	0.3304	0.0037	120.	0.4023	0.0151
160.	0.3939	0.0014	180.	2.4811	1.5146	180.	0.3054	0.0015	180.	0.3778	0.0111
238.	0.3775	0.0006	334.	0.3168	0.0020	334.	0.2889	0.0022	334.	0.3575	0.0090
340.	0.3669	0.0003	534.	0.2922	0.0023	534.	0.2725	0.0019	534.	0.3364	0.0063
544.	0.3522	0.0007	834.	0.2371	0.0019	834.	0.2388	0.0019	834.	0.2942	0.0010
850.	0.3358	0.0011									

BD = 1.58 1.46 1.25 1.42
N = 2 2 2 2

DEPTH (CM)

68.			83.			99.			114.		
10.	0.4994	0.0142	10.	0.5487	0.0160	10.	0.5733	0.0176	10.	0.5204	0.0063
20.	0.5063	0.0127	20.	0.5611	0.0159	20.	0.5814	0.0188	20.	0.5204	0.0063
30.	0.4832	0.0121	30.	0.5277	0.0166	30.	0.5558	0.0186	30.	0.5107	0.0079
40.	******	******	40.	0.5269	0.0161	40.	0.5550	0.0192	40.	0.5107	0.0079
60.	0.4671	0.0121	60.	0.5106	0.0167	60.	0.5438	0.0213	60.	0.5055	0.0085
80.	0.4417	0.0119	80.	0.4912	0.0173	80.	0.5255	0.0229	80.	0.4959	0.0101
100.	0.4393	0.0113	100.	0.4897	0.0173	100.	0.5247	0.0235	100.	0.4951	0.0096
120.	0.4309	0.0116	120.	0.4850	0.0173	120.	0.5191	0.0240	120.	0.4921	0.0106
180.	0.4110	0.0132	180.	0.4648	0.0163	180.	0.5023	0.0233	180.	0.4788	0.0107
334.	0.3879	0.0114	334.	0.4447	0.0153	334.	0.4807	0.0214	334.	0.4624	0.0139
534.	0.3640	0.0102	534.	0.4229	0.0143	534.	0.4591	0.0184	534.	0.4319	0.0199
834.	0.3007	0.0051	834.	0.3740	0.0161	834.	0.4062	0.0123	834.	0.3458	0.0203

BD = 1.35 1.35 1.35 1.31
N = 2 2 2 2

DEPTH (CM)

137.		
14.	0.6904	0.0381
20.	0.6865	0.0373
30.	0.6842	0.0367
40.	0.6713	0.0388
60.	0.6643	0.0297
80.	0.6507	0.0312
100.	0.6397	0.0285
120.	0.6329	0.0298
160.	0.6267	0.0295
238.	0.6091	0.0292
340.	0.6001	0.0309
544.	0.5791	0.0364
850.	0.5418	0.0232

BD = 1.38
N = 2

Table I-2.5 ECKMAN LOAM SITE I-2 (SCHUH AND CLINE)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.5	.3883	2.	0.24	-1.49	0.58E-02	-.77E-03	0.76E+01
1.9	.3879	3.	0.30	-1.48	0.59E-02	-.62E-03	0.95E+01
2.3	.3874	4.	0.38	-1.47	0.81E-02	-.69E-03	0.12E+02
2.6	.3868	5.	0.47	-1.46	0.82E-02	-.59E-03	0.14E+02
3.0	.3862	6.	0.57	-1.44	0.90E-02	-.58E-03	0.15E+02
3.4	.3856	7.	0.69	-1.42	0.76E-02	-.41E-03	0.19E+02
3.7	.3851	9.	0.84	-1.40	0.85E-02	-.34E-03	0.25E+02
4.1	.3845	11.	1.03	-1.36	0.95E-02	-.27E-03	0.35E+02
4.5	.3839	13.	1.28	-1.32	0.90E-02	-.22E-03	0.42E+02
4.8	.3833	16.	1.54	-1.27	0.85E-02	-.20E-03	0.43E+02
7.0	.3820	25.	2.48	-1.10	0.38E-02	-.14E-03	0.28E+02
11.1	.3805	39.	3.81	-0.89	0.16E-02	-.74E-04	0.22E+02
15.1	.3798	47.	4.64	-0.74	0.13E-02	-.82E-04	0.16E+02
19.2	.3792	54.	5.28	-0.63	0.23E-02	-.12E-03	0.19E+02
23.2	.3786	60.	5.87	-0.56	0.14E-02	-.75E-04	0.18E+02
27.3	.3780	65.	6.40	-0.41	0.37E-02	-.17E-03	0.22E+02
31.3	.3772	70.	6.82	-0.26	0.48E-02	-.19E-03	0.25E+02
39.4	.3764	74.	7.29	-0.38	0.13E-02	-.15E-03	0.85E+01
47.5	.3760	78.	7.65	-0.45	0.87E-03	-.11E-03	0.80E+01
55.6	.3756	82.	8.02	-0.42	0.93E-03	-.11E-03	0.81E+01
63.7	.3750	86.	8.40	-0.38	0.20E-02	-.20E-03	0.10E+02
71.8	.3742	90.	8.80	-0.33	0.21E-02	-.20E-03	0.10E+02
132.9	.3690	113.	11.12	-0.34	0.17E-02	-.22E-03	0.78E+01
150.0	.3677	120.	11.72	-0.34	0.17E-02	-.22E-03	0.79E+01
167.1	.3663	126.	12.31	-0.34	0.18E-02	-.23E-03	0.78E+01
201.4	.3632	137.	13.42	-0.29	0.25E-02	-.32E-03	0.79E+01
235.7	.3606	146.	14.27	-0.21	0.17E-02	-.25E-03	0.69E+01
355.7	.3615	160.	15.67	-0.26	0.69E-03	-.14E-03	0.51E+01
372.8	.3610	163.	15.98	-0.24	0.10E-02	-.17E-03	0.60E+01
390.0	.3604	166.	16.31	-0.21	0.13E-02	-.18E-03	0.70E+01
407.2	.3598	170.	16.65	-0.19	0.13E-02	-.16E-03	0.79E+01
424.3	.3593	173.	17.00	-0.17	0.13E-02	-.14E-03	0.92E+01

DEPTH 23. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4058	4.	0.42	-1.49	0.98E-02	-.20E-03	0.49E+02
1.9	.4054	6.	0.55	-1.47	0.17E-01	-.58E-03	0.29E+02
2.6	.4044	7.	0.73	-1.45	0.25E-01	-.63E-03	0.39E+02
3.4	.4034	10.	0.95	-1.42	0.22E-01	-.40E-03	0.55E+02
4.5	.4001	15.	1.49	-1.31	0.47E-01	-.79E-03	0.59E+02
7.0	.3961	25.	2.44	-1.09	0.13E-01	-.20E-03	0.62E+02
15.1	.3931	45.	4.44	-0.74	0.40E-02	-.11E-03	0.37E+02
19.2	.3923	51.	4.98	-0.62	0.82E-02	-.20E-03	0.41E+02
23.2	.3911	56.	5.53	-0.56	0.64E-02	-.21E-03	0.30E+02
27.3	.3899	61.	5.94	-0.41	0.14E-01	-.45E-03	0.31E+02
31.3	.3884	64.	6.24	-0.26	0.21E-01	-.52E-03	0.40E+02
39.4	.3856	69.	6.81	-0.37	0.87E-02	-.48E-03	0.18E+02
43.5	.3845	72.	7.03	-0.44	0.61E-02	-.51E-03	0.12E+02

DEPTH 23. CM (CONT)

47.5	.3836	74.	7.22	-0.44	0.57E-02	-.53E-03	0.11E+02
55.6	.3818	77.	7.56	-0.41	0.54E-02	-.46E-03	0.12E+02
63.7	.3805	81.	7.92	-0.38	0.68E-02	-.29E-03	0.23E+02
67.7	.3799	83.	8.10	-0.35	0.82E-02	-.33E-03	0.25E+02
75.8	.3785	86.	8.44	-0.32	0.89E-02	-.53E-03	0.17E+02
83.9	.3766	89.	8.76	-0.32	0.91E-02	-.58E-03	0.16E+02
115.7	.3712	102.	10.00	-0.33	0.73E-02	-.43E-03	0.17E+02
132.9	.3689	108.	10.61	-0.33	0.63E-02	-.36E-03	0.17E+02
150.0	.3671	114.	11.20	-0.33	0.55E-02	-.25E-03	0.22E+02
167.1	.3657	120.	11.80	-0.33	0.53E-02	-.20E-03	0.26E+02
184.3	.3647	126.	12.36	-0.32	0.58E-02	-.17E-03	0.34E+02
201.4	.3639	131.	12.87	-0.28	0.62E-02	-.14E-03	0.44E+02
218.6	.3633	136.	13.31	-0.24	0.61E-02	-.11E-03	0.54E+02
235.7	.3630	139.	13.66	-0.21	0.39E-02	-.72E-04	0.54E+02
338.5	.3615	151.	14.83	-0.27	0.20E-02	-.27E-03	0.73E+01
355.7	.3608	154.	15.11	-0.26	0.26E-02	-.24E-03	0.11E+02
372.8	.3602	157.	15.40	-0.24	0.32E-02	-.20E-03	0.16E+02
390.0	.3597	160.	15.71	-0.21	0.35E-02	-.14E-03	0.24E+02
407.2	.3593	164.	16.03	-0.19	0.30E-02	-.55E-04	0.55E+02
424.3	.3593	167.	16.36	-0.17	0.26E-02	0.77E-05	-.34E+03
441.5	.3593	170.	16.69	-0.14	0.27E-02	0.39E-04	-.70E+02

DEPTH 46. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
3.4	.4117	0.	0.02	-0.14	0.47E+00	-.56E-03	0.85E+03
3.7	.4109	1.	0.14	-0.14	0.69E+00	-.78E-03	0.89E+03
4.1	.4094	3.	0.30	-0.15	0.11E+01	-.11E-02	0.99E+03
4.5	.4073	5.	0.49	-0.16	0.12E+01	-.12E-02	0.11E+04
15.1	.4106	25.	2.46	-0.06	0.72E-01	-.18E-04	0.40E+04
19.2	.4094	31.	3.00	-0.07	0.24E+00	-.46E-03	0.52E+03
23.2	.4074	36.	3.54	-0.07	0.19E+00	-.37E-03	0.51E+03
27.3	.4056	40.	3.97	-0.11	0.14E+00	-.68E-03	0.20E+03
31.3	.4036	44.	4.29	-0.17	0.95E-01	-.75E-03	0.13E+03
35.4	.4014	47.	4.60	-0.17	0.87E-01	-.68E-03	0.13E+03
39.4	.3993	50.	4.91	-0.14	0.93E-01	-.70E-03	0.13E+03
43.5	.3973	53.	5.20	-0.15	0.81E-01	-.75E-03	0.11E+03
47.5	.3954	56.	5.45	-0.18	0.61E-01	-.80E-03	0.75E+02
51.5	.3939	58.	5.67	-0.21	0.45E-01	-.76E-03	0.59E+02
55.6	.3927	60.	5.85	-0.22	0.35E-01	-.63E-03	0.56E+02
59.6	.3918	61.	6.02	-0.22	0.30E-01	-.44E-03	0.67E+02
63.7	.3911	63.	6.19	-0.22	0.27E-01	-.35E-03	0.75E+02
67.7	.3904	65.	6.37	-0.23	0.30E-01	-.43E-03	0.69E+02
71.8	.3895	67.	6.55	-0.24	0.36E-01	-.67E-03	0.53E+02
75.8	.3881	69.	6.72	-0.24	0.41E-01	-.87E-03	0.47E+02
79.9	.3866	70.	6.89	-0.25	0.44E-01	-.10E-02	0.43E+02
83.9	.3849	72.	7.06	-0.25	0.44E-01	-.99E-03	0.44E+02
115.7	.3764	85.	8.32	-0.25	0.29E-01	-.67E-03	0.43E+02
132.9	.3726	91.	8.96	-0.27	0.23E-01	-.55E-03	0.41E+02
150.0	.3694	98.	9.60	-0.30	0.17E-01	-.43E-03	0.38E+02
167.1	.3670	104.	10.21	-0.30	0.14E-01	-.36E-03	0.38E+02
184.3	.3657	110.	10.76	-0.30	0.92E-02	-.11E-03	0.86E+02
201.4	.3657	115.	11.26	-0.30	0.52E-02	0.11E-03	-.46E+02
218.6	.3664	119.	11.67	-0.31	0.26E-02	0.26E-03	-.10E+02
304.3	.3658	129.	12.66	-0.23	0.39E-02	-.73E-03	0.54E+01
321.5	.3646	131.	12.85	-0.22	0.71E-02	-.59E-03	0.12E+02
338.5	.3634	133.	13.08	-0.22	0.87E-02	-.46E-03	0.19E+02
355.7	.3623	136.	13.35	-0.23	0.82E-02	-.35E-03	0.24E+02

DEPTH 46. CM (CONT)

372.8	.3615	139.	13.65	-0.24	0.70E-02	-.23E-03	0.31E+02
390.0	.3610	143.	13.98	-0.26	0.48E-02	-.10E-03	0.48E+02
407.2	.3609	146.	14.32	-0.28	0.19E-02	0.45E-04	-.42E+02

DEPTH 69. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
15.1	.4351	10.	0.96	-0.50	0.95E-02	-.13E-04	0.72E+03
19.2	.4341	15.	1.50	-0.51	0.56E-01	-.36E-03	0.16E+03
23.2	.4325	20.	2.00	-0.50	0.42E-01	-.31E-03	0.14E+03
27.3	.4312	25.	2.42	-0.46	0.55E-01	-.31E-03	0.17E+03
31.3	.4299	29.	2.80	-0.46	0.57E-01	-.41E-03	0.14E+03
35.4	.4286	31.	3.08	-0.45	0.56E-01	-.51E-03	0.11E+03
39.4	.4273	34.	3.32	-0.41	0.58E-01	-.57E-03	0.10E+03
43.5	.4261	36.	3.56	-0.35	0.62E-01	-.50E-03	0.12E+03
47.5	.4249	39.	3.80	-0.30	0.66E-01	-.46E-03	0.14E+03
51.5	.4239	41.	4.03	-0.28	0.58E-01	-.39E-03	0.15E+03
55.6	.4232	43.	4.23	-0.29	0.44E-01	-.32E-03	0.14E+03
59.6	.4227	45.	4.41	-0.30	0.34E-01	-.28E-03	0.12E+03
63.7	.4222	47.	4.58	-0.30	0.31E-01	-.28E-03	0.11E+03
67.7	.4216	49.	4.75	-0.28	0.39E-01	-.35E-03	0.11E+03
71.8	.4209	50.	4.93	-0.27	0.54E-01	-.50E-03	0.11E+03
75.8	.4199	52.	5.11	-0.26	0.68E-01	-.62E-03	0.11E+03
79.9	.4187	54.	5.29	-0.27	0.73E-01	-.68E-03	0.11E+03
83.9	.4175	56.	5.47	-0.29	0.68E-01	-.68E-03	0.10E+03
115.7	.4101	69.	6.75	-0.32	0.42E-01	-.73E-03	0.57E+02
132.9	.4060	76.	7.42	-0.32	0.34E-01	-.50E-03	0.67E+02
150.0	.4029	82.	8.05	-0.28	0.31E-01	-.49E-03	0.63E+02
167.1	.3997	88.	8.65	-0.27	0.28E-01	-.58E-03	0.49E+02
184.3	.3977	94.	9.20	-0.26	0.14E-01	-.14E-03	0.99E+02
287.2	.3993	110.	10.83	-0.18	0.12E-01	-.22E-02	0.56E+01
304.3	.3972	112.	10.96	-0.20	0.14E-01	-.13E-02	0.11E+02
321.5	.3953	114.	11.14	-0.21	0.16E-01	-.88E-03	0.18E+02
338.5	.3937	116.	11.36	-0.21	0.17E-01	-.56E-03	0.30E+02
355.7	.3923	119.	11.64	-0.21	0.15E-01	-.42E-03	0.37E+02
372.8	.3912	122.	11.96	-0.20	0.14E-01	-.31E-03	0.43E+02
390.0	.3902	126.	12.30	-0.20	0.95E-02	-.23E-03	0.40E+02

DEPTH 84. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
23.2	.4625	9.	0.92	0.00	0.89E+06	-.16E-03	0.55E+10
27.3	.4623	11.	1.05	0.00	0.12E+07	0.50E-04	-.23E+11
132.9	.4563	63.	6.13	0.00	0.55E+05	-.59E-03	0.94E+08
270.0	.4446	96.	9.39	-0.07	0.34E-01	-.10E-02	0.33E+02
287.2	.4433	97.	9.52	-0.07	0.55E-01	-.10E-02	0.54E+02
304.3	.4422	99.	9.66	-0.07	0.63E-01	-.64E-03	0.98E+02
321.5	.4411	100.	9.85	-0.07	0.67E-01	-.51E-03	0.13E+03
338.5	.4401	103.	10.08	-0.07	0.63E-01	-.39E-03	0.16E+03
355.7	.4391	106.	10.36	-0.07	0.57E-01	-.34E-03	0.17E+03
372.8	.4381	109.	10.67	-0.07	0.50E-01	-.30E-03	0.16E+03
390.0	.4371	112.	11.01	-0.07	0.38E-01	-.27E-03	0.14E+03
407.2	.4361	116.	11.38	-0.06	0.24E-01	-.26E-03	0.91E+02
424.3	.4351	120.	11.77	-0.04	0.16E-01	-.25E-03	0.63E+02
441.5	.4341	124.	12.17	-0.01	0.11E-01	-.26E-03	0.44E+02

DEPTH 99. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
31.3	.4838	2.	0.19	0.00	0.72E+01	0.53E-03	-.14E+05
35.4	.4848	5.	0.47	-0.01	0.38E+01	0.17E-03	-.23E+05
55.6	.4840	15.	1.45	-0.15	0.91E-01	-.79E-04	0.11E+04
59.6	.4840	18.	1.78	-0.25	0.41E-01	0.82E-04	-.50E+03
63.7	.4844	20.	2.00	-0.30	0.30E-01	0.40E-03	-.75E+02
67.7	.4850	22.	2.15	-0.28	0.41E-01	0.43E-03	-.97E+02
71.8	.4854	23.	2.29	-0.25	0.70E-01	0.10E-03	-.70E+03
75.8	.4853	25.	2.45	-0.22	0.10E+00	-.19E-03	0.54E+03
79.9	.4849	27.	2.61	-0.20	0.12E+00	-.30E-03	0.41E+03
83.9	.4844	28.	2.79	-0.18	0.14E+00	-.32E-03	0.43E+03
115.7	.4811	42.	4.10	-0.17	0.12E+00	-.70E-03	0.18E+03
132.9	.4756	48.	4.75	-0.15	0.13E+00	-.10E-02	0.12E+03
150.0	.4719	55.	5.37	-0.15	0.71E-01	-.14E-03	0.49E+03
184.3	.4748	66.	6.48	-0.11	0.45E-01	0.11E-03	-.41E+03
218.6	.4722	75.	7.33	-0.08	0.11E-01	-.74E-03	0.15E+02
252.9	.4677	80.	7.87	-0.10	0.18E-01	-.76E-03	0.24E+02
270.0	.4668	82.	8.03	-0.12	0.26E-01	-.33E-03	0.79E+02
287.2	.4666	83.	8.17	-0.13	0.33E-01	0.81E-04	-.40E+03
321.5	.4668	87.	8.51	-0.13	0.39E-01	-.45E-06	0.87E+05
355.7	.4664	92.	9.01	-0.13	0.38E-01	-.13E-03	0.31E+03
390.0	.4652	99.	9.66	-0.13	0.27E-01	-.22E-03	0.12E+03
407.2	.4643	102.	10.03	-0.14	0.17E-01	-.27E-03	0.61E+02
424.3	.4632	106.	10.42	-0.16	0.10E-01	-.29E-03	0.34E+02

DEPTH 114. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
51.5	.4935	1.	0.06	-0.29	0.82E-01	-.10E-02	0.81E+02
55.6	.4915	3.	0.33	-0.15	0.11E+00	-.44E-03	0.25E+03
59.6	.4932	6.	0.58	-0.02	0.78E-01	0.20E-02	-.40E+02
75.8	.5149	11.	1.11	-0.13	0.22E+00	-.22E-02	0.10E+03
79.9	.5094	13.	1.31	-0.16	0.25E+00	-.44E-02	0.57E+02
83.9	.5016	15.	1.50	-0.17	0.25E+00	-.49E-02	0.50E+02
115.7	.4839	29.	2.82	-0.15	0.17E+00	-.55E-03	0.31E+03
132.9	.4805	35.	3.47	-0.16	0.14E+00	-.54E-03	0.27E+03
150.0	.4773	42.	4.09	-0.14	0.88E-01	-.50E-03	0.18E+03
167.1	.4735	48.	4.66	-0.13	0.68E-01	-.89E-03	0.76E+02
184.3	.4706	53.	5.16	-0.13	0.37E-01	-.20E-03	0.19E+03
201.4	.4711	57.	5.61	-0.13	0.15E-01	0.47E-03	-.32E+02
218.6	.4737	61.	5.98	-0.13	0.54E-02	0.93E-03	-.58E+01
235.7	.4767	64.	6.29	-0.11	0.42E-02	0.11E-02	-.38E+01
252.9	.4787	66.	6.51	-0.10	0.20E-01	0.63E-03	-.32E+02
270.0	.4791	68.	6.68	-0.08	0.42E-01	-.40E-03	0.10E+03
287.2	.4782	70.	6.81	-0.07	0.63E-01	-.90E-03	0.70E+02
304.3	.4772	71.	6.96	-0.07	0.75E-01	-.55E-03	0.14E+03
321.5	.4765	73.	7.16	-0.07	0.73E-01	-.22E-03	0.33E+03
338.5	.4761	76.	7.40	-0.09	0.63E-01	-.98E-04	0.64E+03
355.7	.4759	78.	7.68	-0.10	0.51E-01	-.66E-04	0.77E+03
372.8	.4756	82.	8.00	-0.11	0.42E-01	-.83E-04	0.50E+03
390.0	.4752	85.	8.36	-0.13	0.32E-01	-.16E-03	0.20E+03
407.2	.4744	89.	8.74	-0.14	0.24E-01	-.27E-03	0.88E+02
424.3	.4731	93.	9.15	-0.14	0.19E-01	-.34E-03	0.57E+02

DEPTH 137. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
115.7	.4925	11.	1.08	-0.20	0.14E+00	-.38E-03	0.37E+03
132.9	.4906	12.	1.18	-0.23	0.11E+00	-.20E-03	0.55E+03
150.0	.4877	22.	2.14	-0.28	0.64E-01	-.66E-03	0.96E+02
167.1	.4807	29.	2.86	-0.32	0.61E-01	-.17E-02	0.36E+02
287.2	.4860	48.	4.69	-0.14	0.51E-01	-.17E-02	0.30E+02
304.3	.4841	49.	4.83	-0.13	0.53E-01	-.11E-02	0.46E+02
321.5	.4827	51.	5.01	-0.12	0.56E-01	-.57E-03	0.98E+02
338.5	.4817	53.	5.24	-0.10	0.61E-01	-.31E-03	0.20E+03
355.7	.4810	56.	5.50	-0.08	0.68E-01	-.19E-03	0.35E+03
372.8	.4805	59.	5.80	-0.06	0.84E-01	-.14E-03	0.59E+03
390.0	.4800	63.	6.14	-0.04	0.11E+00	-.16E-03	0.69E+03
407.2	.4793	66.	6.51	-0.03	0.17E+00	-.23E-03	0.73E+03
424.3	.4783	70.	6.90	-0.02	0.28E+00	-.28E-03	0.10E+04
441.5	.4771	75.	7.31	-0.01	0.84E+00	-.30E-03	0.28E+04

SITE J (GARDENA SERIES)

Site J was located in a nonirrigated wheat field. The location and description are summarized on Table 1 and on Fig. 2. In-situ measurements and site descriptions were made during late August through October, 1985.

The Gardena series consists of "deep, moderately well drained, nearly level to gently sloping soils on uplands and on terraces and lower foot slopes in the James River Valley. These soils are medium textured. They formed in deposits left by glacial melt water" (USDA 1971).

Infiltration and soil-water and suction profiles during wetting were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

SITE J, REPLICATION 1

Table J-1.1. Soil morphologic data for Site J, replication 1

Site and location: J-1 Gardena, Oakes Aquifer 185 feet north and 90 feet east of the southwest corner of Section 18, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/21/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Gardena silt loam; coarse-silty, mixed Pachic Udic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial ake Dakota Basin.

Drainage: Moderately well.

Notes: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture. Aberdeen series pedon about 25 feet to north.

Soil profile: J-1 north side of pit.

Ap 0-8 inches (0-20 cm) black (10YR 2/1) silt loam, dark gray (10YR 4/1, dry); moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; abrupt smooth boundary.

Bw 8-28 inches (20-71 cm) very dark grayish brown (10YR 3/2) silty clay loam (loam), grayish brown (10YR 5/2, dry); moderate medium prismatic parting to moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; abrupt wavy boundary.

BCk1 28-37 inches (71-94 cm) light gray (2.5Y 7/2) silty clay loam, white (2.5Y 8/2, dry); weak medium prismatic parting to weak medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; violent effervescence; clear wavy boundary.

BCk2 37-50 inches (94-127cm) light olive brown (2.5Y 5/4) silty clay loam (silt loam), pale yellow (2.5Y 7/4, dry); weak medium prismatic parting to weak medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; strong effervescence; clear wavy boundary.

C1 50-55 inches (127-140 cm) gray (5Y 5/1) silty clay loam (silt loam), light gray (5Y 7/1, dry) with many fine distinct reddish brown (5YR 4/4) mottles; weak coarse prismatic parting to moderate coarse and medium platy structure; slightly hard, friable, sticky and plastic; few very fine roots; slight effervescence; clear wavy boundary.

C2 55-70 inches (140-178 cm) gray (5Y 5/1) silty clay loam (silt loam), light gray (5Y 7/1, dry) with dark red (2.5YR 3/6) root channels; weak medium prismatic parting to weak medium subangular blocky and weak medium platy structure; slightly hard, friable, sticky and plastic; few very fine roots; slight effervescence.

Table J-1.2 OVERLY SERIES SITE J-1 NDSWC:1985

Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.	18.4	25.3	25.4	11.6	15.1	3.1	1.1	0.0
23.	16.4	30.0	20.2	12.4	16.4	3.4	1.2	0.1
38.	16.1	21.1	20.3	13.3	22.9	4.5	1.6	0.2
54.	15.2	18.0	18.6	11.7	28.0	6.1	2.3	0.1
68.	31.3	37.8	18.7	5.1	5.7	0.7	0.4	0.2
84.	25.5	40.5	18.6	7.0	7.5	0.6	0.2	0.0
99.	19.2	50.1	22.6	3.2	4.0	0.5	0.3	0.1
107.	19.0	55.8	19.3	2.0	3.0	0.7	0.2	0.0
137.	15.2	60.4	18.6	1.1	1.1	0.9	1.5	1.0
145.	17.0	63.6	15.6	1.1	1.7	0.6	0.3	0.1

DEPTH cm	SAND %	SILT %	CLAY %	HORZON	
8.	30.9	50.7	18.4	A 6	6=p
23.	33.4	50.2	16.4	B 7	7=w
38.	42.5	41.4	16.1	B 7	10=k
54.	48.2	36.6	15.2	B 7	
68.	12.2	56.5	31.3	B 7	
84.	15.4	59.1	25.5	BC1 10	
99.	8.1	72.7	19.2	BC2 10	
107.	5.9	75.1	19.0	BC2 10	
137.	5.8	79.0	15.2	C 1 0	
145.	3.8	79.2	17.0	C 2 0	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	0.609	0.0211	5.9	0.0036	0.341	1.33	5.20
23.	0.667	0.0222	5.8	0.0039	0.336	1.24	2.40
38.	1.027	0.0291	6.3	0.0046	0.342	1.41	1.10
54.	1.317	0.0354	6.5	0.0054	0.358	1.51	1.00
68.	0.214	0.0088	5.4	0.0016	0.272	1.20	1.40
84.	0.259	0.0108	5.1	0.0021	0.312	1.46	0.74
99.	0.111	0.0111	4.1	0.0027	0.436	1.42	0.60
107.	0.079	0.0102	3.8	0.0027	0.472	1.40	0.74
137.	0.071	0.0116	4.0	0.0029	0.551	1.35	0.47
145.	0.048	0.0098	3.4	0.0029	0.555	1.27	0.74

DEPTH cm	MOISTURE/SUCTION SLOPE GHOSH	BLOEMEN	GARDNER K-PARAMETERS CM/DAY-KPA K-SLOPE	K-INT	(JAYNE & TYLER) CM/HR-BAR K-SLOPE	K-INT
8.	4.536	1.667	-0.1132	0.8961	-1.13	-0.48
23.	4.386	1.767	-0.1527	0.9715	-1.53	-0.41
38.	3.702	1.877	-0.3342	1.2325	-3.34	-0.15
54.	3.361	1.915	-0.4442	1.3978	-4.44	0.02
68.	6.835	1.755	0.1866	0.3509	1.87	-1.03
84.	6.348	1.880	0.1581	0.4437	1.58	-0.94
99.	8.927	2.135	0.3446	0.2349	3.45	-1.15
107.	10.265	2.158	0.3905	0.1711	3.91	-1.21
137.	10.690	2.434	0.4193	0.1624	4.19	-1.22
145.	12.487	2.310	0.4458	0.1102	4.46	-1.27

Table J-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site J, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
	Saturation Extract Soluble Ions meq/l							
0 - 15	6.35	3.05	0.65	0.91	-	3.16	0.25	7.55
15 - 30	3.17	2.03	0.32	0.31	-	3.04	0.10	2.69
30 - 46	2.41	1.59	0.42	0.11	-	2.08	0.25	2.20
46 - 61	2.12	1.57	0.25	0.15	-	2.20	0.10	1.78
61 - 76	1.90	2.90	0.44	0.07	-	3.88	0.15	1.28
76 - 91	1.61	2.87	0.46	0.09	-	3.20	0.05	1.78
91- 107	2.12	3.48	0.74	0.22	-	2.32	0.13	4.10
107 - 122	2.03	2.69	0.95	0.18	-	2.68	0.15	3.01
122 - 137	3.17	3.83	0.92	0.29	-	2.24	0.20	5.77
137 - 152	4.02	3.58	1.07	0.35	-	2.08	0.40	6.54

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.88	0.3	52	8.0	-	sil	12.09
15 - 30	0.45	0.2	47	7.8	-	sil	10.38
30 - 46	0.40	0.3	41	7.7	-	l	9.43
46 - 61	0.40	0.2	38	8.0	-	l	8.25
61 - 76	0.46	0.3	52	8.2	11.8	sicl	16.18
76 - 91	0.46	0.3	50	8.1	5.9	sicl	13.24
91- 107	0.58	0.4	53	8.2	5.0	sil	10.66
107 - 122	0.49	0.6	56	8.2	0.8	sil	11.97
122 - 137	0.70	0.5	56	8.2	-	sil	11.25
137 - 152	0.76	0.5	56	7.9	-	sil	14.69

Table J-1.4 OVERLY SERIES SITE J-1 NDSWC:1985
In-situ $K(\theta,\psi)$ and $\theta(\psi)$, and laboratory $K(\theta,\psi)$ data.

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.*			23.			38.			53.	
CM	CC/CC	SE									
14.	0.8217	0.1532	14.	0.4044	0.0103	14.	0.4573	0.0024	14.	0.4241	0.0126
20.	0.6019	0.0165	20.	0.4014	0.0101	20.	0.4048	0.0084	20.	0.4172	0.0174
30.	0.5468	0.0067	30.	0.3917	0.0080	30.	0.3720	0.0037	30.	0.4120	0.0137
40.	0.5148	0.0080	40.	0.3801	0.0064	40.	0.3479	0.0022	40.	0.3677	0.0105
60.	0.4813	0.0082	60.	0.3641	0.0056	60.	0.3217	0.0021	60.	0.3252	0.0107
80.	0.4619	0.0064	80.	0.3542	0.0053	80.	0.3129	0.0010	80.	0.3005	0.0105
100.	0.4400	0.0082	100.	0.3395	0.0043	100.	0.2910	0.0005	100.	0.2862	0.0112
120.	0.4279	0.0090	120.	0.3315	0.0035	120.	0.2845	0.0005	120.	0.2777	0.0116
160.	0.4057	0.0092	160.	0.3161	0.0030	160.	0.2702	0.0003	160.	0.2608	0.0105
238.	0.3829	0.0077	238.	0.2982	0.0027	238.	0.2494	0.0004	238.	0.2438	0.0104
340.	0.3686	0.0042	340.	0.2921	0.0070	340.	0.2451	0.0004	340.	0.2311	0.0101
544.	0.3515	0.0012	544.	0.2774	0.0060	544.	0.2330	0.0050	544.	0.2180	0.0072
850.	0.3301	0.0017	850.	0.2664	0.0008	850.	0.2243	0.0050	850.	0.2016	0.0086
BD =	1.33			1.24			1.41			1.51	
N =	2			2			2			2	

DEPTH (CM)

	69.			84.			99.			114.	
14.	0.4294	0.0282	14.	0.4404	0.0228	14.	0.4881	0.0228	14.	0.5183	0.0181
20.	0.4039	0.0159	20.	0.4313	0.0191	20.	0.4818	0.0195	20.	0.5073	0.0126
30.	0.3783	0.0047	30.	0.4138	0.0121	30.	0.4680	0.0148	30.	0.4939	0.0099
40.	0.3627	0.0006	40.	0.4002	0.0070	40.	0.4572	0.0113	40.	0.4844	0.0089
60.	0.3431	0.0040	60.	0.3833	0.0032	60.	0.4420	0.0087	60.	0.4694	0.0073
80.	0.3345	0.0055	80.	0.3746	0.0025	80.	0.4366	0.0070	80.	0.4638	0.0091
100.	0.3219	0.0075	100.	0.3622	0.0000	100.	0.4237	0.0050	100.	0.4496	0.0070
120.	0.3195	0.0069	120.	0.3534	0.0017	120.	0.4169	0.0042	120.	0.4441	0.0065
160.	0.3093	0.0083	160.	0.3433	0.0026	160.	0.4070	0.0024	160.	0.4346	0.0066
238.	0.2967	0.0092	238.	0.3273	0.0048	238.	0.3926	0.0014	238.	0.4172	0.0045
340.	0.2936	0.0102	340.	0.3227	0.0027	340.	0.3836	0.0011	340.	0.4077	0.0034
544.	0.2841	0.0100	544.	0.3166	0.0007	544.	0.3744	0.0002	544.	0.3991	0.0007
850.	0.2723	0.0103	850.	0.3027	0.0033	850.	0.3599	0.0044	850.	0.3873	0.0042
BD =	1.20			1.46			1.46			1.40	
N =	2			2			2			2	

DEPTH (CM)

	130.			145.	
14.	0.5302	0.0097	14.	0.5181	0.0133
20.	0.5154	0.0101	20.	0.5112	0.0133
30.	0.5014	0.0110	30.	0.4995	0.0127
40.	0.4907	0.0118	40.	0.4642	0.0051
60.	0.4742	0.0122	60.	0.4455	0.0025
80.	0.4702	0.0105	80.	0.4345	0.0034
100.	0.4570	0.0109	100.	0.4256	0.0038
120.	0.4497	0.0104	120.	0.4200	0.0038
160.	0.4415	0.0095	160.	0.4097	0.0042
238.	0.4243	0.0081	238.	0.3959	0.0051
340.	0.4096	0.0061	340.	0.3877	0.0060
544.	0.3843	0.0027	544.	0.3704	0.0073
850.	0.3493	0.0041	850.	0.3504	0.0066
BD =	1.35			1.27	
N =	2			2	

* error likely for 8 cm depth.

Table J-1.5 OVERLY SERIES SITE J-1 (SCHUH AND CLINE)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4410	4.	0.37	1.90	0.17E-01	0.31E-03	0.56E+02
1.7	.4388	10.	1.02	1.80	0.18E-01	0.36E-03	0.51E+02
2.2	.4366	16.	1.57	1.65	0.20E-01	0.43E-03	0.46E+02
2.7	.4344	20.	1.97	1.55	0.21E-01	0.72E-03	0.29E+02
3.2	.4320	24.	2.32	1.47	0.28E-01	0.68E-03	0.41E+02
3.7	.4293	27.	2.62	1.40	0.29E-01	0.13E-02	0.22E+02
4.5	.4253	33.	3.22	1.23	0.33E-01	0.54E-03	0.62E+02
6.2	.4212	42.	4.07	1.00	0.81E-02	0.38E-03	0.21E+02
8.7	.4159	50.	4.92	0.85	0.29E-01	0.80E-03	0.36E+02
15.0	.4066	56.	5.52	1.08	0.74E-02	0.53E-02	0.14E+01
25.0	.3982	67.	6.52	1.02	0.47E-02	0.35E-03	0.13E+02
40.0	.3898	82.	8.07	0.48	0.82E-02	0.80E-03	0.10E+02
60.0	.3815	93.	9.07	0.33	0.71E-02	0.89E-03	0.80E+01
80.0	.3764	99.	9.72	0.33	0.47E-02	0.69E-03	0.68E+01
100.0	.3725	105.	10.32	0.33	0.41E-02	0.60E-03	0.68E+01
120.0	.3700	111.	10.89	0.32	0.18E-02	0.28E-03	0.66E+01
140.0	.3684	116.	11.42	0.30	0.19E-02	0.31E-03	0.63E+01
160.0	.3672	121.	11.89	0.28	0.14E-02	0.23E-03	0.60E+01
210.0	.3649	131.	12.82	0.23	0.15E-02	0.25E-03	0.57E+01
275.0	.3621	141.	13.82	0.20	0.15E-02	0.34E-03	0.46E+01
350.0	.3590	150.	14.71	0.20	0.15E-02	0.34E-03	0.46E+01
450.0	.3537	162.	15.91	0.20	0.25E-02	0.55E-03	0.46E+01
600.0	.3474	175.	17.11	0.18	0.12E-02	0.50E-03	0.25E+01
800.0	.3422	187.	18.31	0.17	0.10E-02	0.38E-03	0.27E+01
1000.0	.3387	199.	19.46	0.18	0.52E-03	0.23E-03	0.23E+01
1200.0	.3367	208.	20.41	0.10	0.57E-03	0.19E-03	0.30E+01

DEPTH 23. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4310	5.	0.45	1.90	0.52E-01	0.33E-03	0.16E+03
1.7	.4287	15.	1.47	1.80	0.57E-01	0.48E-03	0.12E+03
2.2	.4262	20.	1.98	1.65	0.62E-01	0.65E-03	0.97E+02
2.7	.4238	24.	2.34	1.55	0.66E-01	0.88E-03	0.76E+02
3.2	.4226	27.	2.64	1.47	0.56E-01	0.80E-05	0.70E+04
3.7	.4199	30.	2.90	1.40	0.12E+00	0.27E-02	0.44E+02
4.5	.4143	34.	3.36	1.23	0.10E+00	0.78E-03	0.13E+03
6.2	.4098	41.	4.06	1.00	0.26E-01	0.53E-03	0.49E+02
8.7	.4040	49.	4.78	0.85	0.87E-01	0.96E-03	0.91E+02
15.0	.3947	57.	5.57	1.08	0.22E-01	0.15E-02	0.15E+02
25.0	.3850	66.	6.50	1.02	0.16E-01	0.76E-03	0.22E+02
40.0	.3758	78.	7.65	0.48	0.23E-01	0.84E-03	0.28E+02
60.0	.3690	87.	8.55	0.33	0.19E-01	0.66E-03	0.29E+02
80.0	.3649	94.	9.20	0.33	0.13E-01	0.60E-03	0.23E+02
100.0	.3612	100.	9.80	0.33	0.13E-01	0.63E-03	0.20E+02
120.0	.3577	106.	10.36	0.32	0.76E-02	0.62E-03	0.12E+02
140.0	.3544	111.	10.88	0.30	0.80E-02	0.65E-03	0.12E+02
160.0	.3512	116.	11.34	0.28	0.71E-02	0.76E-03	0.93E+01

DEPTH 23. CM (CONT)

210.0	.3493	125.	12.21	0.23	0.31E-02	0.40E-04	0.78E+02
275.0	.3475	135.	13.20	0.20	0.54E-02	0.50E-03	0.11E+02
450.0	.3779	156.	15.29	0.20	0.38E-01	0.71E-02	0.53E+01
600.0	.3326	168.	16.48	0.18	0.36E-02	0.45E-03	0.81E+01
800.0	.3275	180.	17.67	0.17	0.32E-02	0.41E-03	0.77E+01
1000.0	.3236	192.	18.83	0.18	0.17E-02	0.26E-03	0.63E+01
1200.0	.3209	201.	19.72	0.10	0.21E-02	0.38E-03	0.55E+01

DEPTH 38. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4042	11.	1.07	0.35	0.42E+00	0.15E-03	0.28E+04
1.7	.4032	17.	1.70	0.40	0.38E+00	0.21E-03	0.18E+04
2.2	.4027	21.	2.11	0.47	0.30E+00	0.11E-04	0.28E+05
2.7	.4026	24.	2.35	0.45	0.32E+00	0.16E-03	0.19E+04
3.7	.4003	28.	2.76	0.44	0.76E+00	0.23E-02	0.33E+03
4.5	.3930	33.	3.19	0.54	0.44E+00	0.15E-02	0.30E+03
6.2	.3859	38.	3.75	0.60	0.86E-01	0.11E-02	0.80E+02
8.7	.3792	44.	4.34	0.55	0.22E+00	0.12E-02	0.19E+03
15.0	.3709	53.	5.19	0.45	0.84E-01	0.79E-03	0.11E+03
25.0	.3620	62.	6.11	0.45	0.68E-01	0.13E-02	0.53E+02
40.0	.3527	71.	6.94	0.55	0.33E-01	0.98E-03	0.34E+02
60.0	.3455	79.	7.76	0.60	0.17E-01	0.79E-03	0.22E+02
80.0	.3407	86.	8.40	0.59	0.13E-01	0.69E-03	0.18E+02
100.0	.3367	92.	8.97	0.55	0.13E-01	0.69E-03	0.19E+02
120.0	.3329	97.	9.51	0.54	0.95E-02	0.75E-03	0.13E+02
140.0	.3291	102.	10.00	0.52	0.98E-02	0.79E-03	0.12E+02
160.0	.3254	109.	10.66	0.81	0.58E-02	0.44E-03	0.13E+02
210.0	.3242	118.	11.52	0.82	0.81E-03	-.14E-03	-.57E+01
275.0	.3237	125.	12.29	0.57	0.33E-02	0.34E-03	0.96E+01
450.0	.3546	148.	14.48	0.70	0.29E-01	0.75E-02	0.39E+01
600.0	.3079	159.	15.59	0.62	0.18E-02	0.61E-03	0.29E+01
800.0	.3026	170.	16.66	0.47	0.19E-02	0.40E-03	0.47E+01
1000.0	.2983	180.	17.65	0.23	0.25E-02	0.46E-03	0.54E+01
1200.0	.2949	189.	18.52	0.29	0.14E-02	0.31E-03	0.44E+01

DEPTH 53. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.3835	4.	0.42	0.55	0.28E+00	-.57E-04	-.49E+04
1.7	.3852	9.	0.91	0.57	0.22E+00	-.59E-03	-.37E+03
2.2	.3883	14.	1.39	0.58	0.16E+00	-.83E-03	-.19E+03
2.7	.3898	17.	1.68	0.63	0.23E+00	-.26E-05	-.92E+05
3.2	.3891	19.	1.86	0.67	0.12E+00	0.78E-03	0.16E+03
3.7	.3866	21.	2.08	0.63	0.75E+00	0.13E-02	0.55E+03
4.5	.3808	26.	2.54	0.60	0.61E+00	0.12E-02	0.52E+03
6.2	.3732	32.	3.13	0.57	0.16E+00	0.15E-02	0.10E+03
8.7	.3668	38.	3.69	0.58	0.29E+00	0.87E-03	0.33E+03
15.0	.3617	46.	4.55	0.68	0.70E-01	0.40E-03	0.17E+03
25.0	.3559	56.	5.51	0.73	0.60E-01	0.92E-03	0.65E+02
40.0	.3473	66.	6.45	0.80	0.32E-01	0.89E-03	0.36E+02
60.0	.3388	75.	7.37	0.87	0.18E-01	0.10E-02	0.17E+02
80.0	.3327	82.	8.01	0.88	0.12E-01	0.86E-03	0.14E+02
100.0	.3285	88.	8.58	0.92	0.11E-01	0.60E-03	0.18E+02
120.0	.3254	93.	9.12	0.93	0.81E-02	0.54E-03	0.15E+02
140.0	.3229	98.	9.61	0.95	0.77E-02	0.47E-03	0.17E+02
160.0	.3207	105.	10.29	0.70	0.99E-02	0.25E-03	0.40E+02

DEPTH 53. CM (CONT)

210.0	.3193	114.	11.20	0.75	0.79E-03	0.53E-04	0.15E+02
275.0	.3188	123.	12.04	1.10	0.21E-02	0.66E-04	0.32E+02
450.0	.3109	144.	14.14	0.83	0.33E-01	0.10E-02	0.33E+02
600.0	.3023	154.	15.09	0.70	0.24E-02	0.81E-03	0.30E+01
800.0	.2966	163.	15.99	0.63	0.18E-02	0.39E-03	0.47E+01
1000.0	.2934	170.	16.70	0.48	0.18E-02	0.50E-03	0.36E+01
1200.0	.2913	178.	17.43	0.27	0.19E-02	0.11E-03	0.18E+02

DEPTH 69. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.7	.4261	9.	0.90	0.44	0.39E+00	0.53E-03	0.73E+03
3.2	.4246	12.	1.18	0.49	0.27E+00	0.71E-03	0.38E+03
3.7	.4229	14.	1.39	0.49	0.11E+01	0.10E-02	0.11E+04
4.5	.4204	18.	1.73	0.37	0.12E+01	0.57E-03	0.22E+04
6.2	.4171	23.	2.26	0.34	0.36E+00	0.72E-03	0.50E+03
8.7	.4126	29.	2.89	0.39	0.52E+00	0.74E-03	0.71E+03
15.0	.4068	39.	3.81	0.37	0.15E+00	0.54E-03	0.28E+03
25.0	.3978	49.	4.81	0.35	0.17E+00	0.15E-02	0.11E+03
40.0	.3869	59.	5.76	0.30	0.11E+00	0.88E-03	0.12E+03
60.0	.3781	69.	6.73	0.30	0.69E-01	0.10E-02	0.69E+02
80.0	.3716	76.	7.41	0.34	0.44E-01	0.90E-03	0.49E+02
100.0	.3670	82.	8.04	0.37	0.35E-01	0.59E-03	0.58E+02
120.0	.3635	88.	8.64	0.44	0.22E-01	0.56E-03	0.40E+02
140.0	.3609	94.	9.19	0.50	0.18E-01	0.42E-03	0.43E+02
160.0	.3587	99.	9.75	0.57	0.15E-01	0.37E-03	0.41E+02
210.0	.3560	110.	10.75	0.67	0.14E-02	0.22E-03	0.64E+01
275.0	.3541	121.	11.87	0.67	0.36E-02	0.54E-04	0.67E+02
450.0	.3484	141.	13.80	0.70	0.41E-01	0.73E-03	0.56E+02
600.0	.3417	149.	14.58	0.62	0.37E-02	0.94E-03	0.40E+01
800.0	.3353	156.	15.26	0.39	0.38E-02	0.96E-03	0.39E+01
1000.0	.3314	161.	15.77	0.27	0.41E-02	0.55E-03	0.75E+01

DEPTH 84. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.7	.4570	3.	0.29	0.60	0.32E+00	0.57E-04	0.56E+04
3.2	.4567	4.	0.38	0.55	0.29E+00	0.19E-03	0.16E+04
3.7	.4563	6.	0.62	0.54	0.11E+01	0.28E-03	0.39E+04
4.5	.4558	9.	0.93	0.57	0.85E+00	0.15E-03	0.55E+04
6.2	.4552	16.	1.55	0.70	0.19E+00	0.55E-04	0.34E+04
8.7	.4532	22.	2.19	0.64	0.36E+00	0.80E-03	0.45E+03
15.0	.4475	29.	2.88	0.39	0.17E+00	0.75E-03	0.23E+03
25.0	.4385	39.	3.83	0.35	0.21E+00	0.13E-02	0.17E+03
40.0	.4262	49.	4.81	0.44	0.97E-01	0.12E-02	0.78E+02
60.0	.4154	59.	5.79	0.44	0.61E-01	0.99E-03	0.61E+02
80.0	.4109	66.	6.48	0.42	0.41E-01	0.25E-03	0.17E+03
100.0	.4090	73.	7.13	0.42	0.36E-01	0.31E-03	0.12E+03
120.0	.4048	79.	7.77	0.40	0.33E-01	0.11E-02	0.31E+02
140.0	.3995	85.	8.37	0.40	0.29E-01	0.70E-03	0.41E+02
160.0	.3968	91.	8.96	0.39	0.25E-01	0.23E-03	0.11E+03
210.0	.3936	102.	10.01	0.35	0.50E-02	0.31E-03	0.16E+02
600.0	.3830	140.	13.71	0.22	0.13E-01	0.10E-02	0.12E+

DEPTH 99. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
4.5	.4410	1.	0.14	0.25	0.20E+01	0.44E-04	0.45E+05
6.2	.4404	8.	0.80	0.20	0.69E+00	0.14E-03	0.51E+04
8.7	.4391	12.	1.18	0.23	0.10E+01	0.36E-03	0.29E+04
15.0	.4364	20.	1.94	0.40	0.19E+00	0.42E-03	0.44E+03
25.0	.4323	30.	2.90	0.43	0.20E+00	0.46E-03	0.43E+03
40.0	.4246	40.	3.91	0.37	0.14E+00	0.11E-02	0.13E+03
60.0	.4168	49.	4.83	0.30	0.10E+00	0.60E-03	0.17E+03
100.0	.4143	64.	6.23	0.38	0.42E-01	0.78E-04	0.53E+03
120.0	.4111	70.	6.88	0.40	0.45E-01	0.97E-03	0.46E+02
140.0	.4065	76.	7.48	0.40	0.36E-01	0.57E-03	0.63E+02
160.0	.4042	82.	8.04	0.38	0.28E-01	0.20E-03	0.14E+03
210.0	.4027	92.	9.00	0.30	0.81E-02	0.14E-03	0.56E+02
275.0	.4003	102.	10.02	0.20	0.16E-01	0.48E-03	0.33E+02

DEPTH 114. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
8.7	.4435	5.	0.48	0.57	0.43E+00	-.21E-03	-.21E+04
15.0	.4429	9.	0.90	0.30	0.27E+00	0.38E-03	0.70E+03

DEPTH 130. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
15.0	.4695	6.	0.55	1.07	0.80E-01	0.79E-03	0.10E+03
25.0	.4624	11.	1.12	1.02	0.99E-01	0.17E-02	0.60E+02
40.0	.4561	19.	1.85	0.85	0.70E-01	0.27E-03	0.26E+03
80.0	.4544	34.	3.32	0.65	0.33E-01	0.17E-03	0.19E+03
100.0	.4531	40.	3.94	0.55	0.35E-01	0.26E-03	0.13E+03
120.0	.4509	46.	4.52	0.45	0.51E-01	0.53E-03	0.98E+02
140.0	.4486	52.	5.05	0.37	0.47E-01	0.35E-03	0.13E+03
275.0	.4524	74.	7.25	0.10	0.47E-01	0.47E-03	0.10E+03

DEPTH 145. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
15.0	.4836	6.	0.57	0.94	0.95E-01	0.50E-03	0.19E+03
25.0	.4780	10.	1.00	0.80	0.15E+00	0.24E-02	0.61E+02
60.0	.4738	21.	2.11	0.57	0.62E-01	0.12E-04	0.52E+04
140.0	.4770	42.	4.08	0.36	0.52E-01	0.34E-03	0.15E+03
160.0	.4743	46.	4.49	0.31	0.46E-01	0.10E-02	0.44E+02
275.0	.4764	61.	6.01	0.26	0.20E-01	0.42E-03	0.46E+02

SITE J, REPLICATION 2

Table J-2.1. Soil morphologic data for Site J, replication 2

Site and location: J-2 Gardena, Oakes Aquifer 180 feet north and 90 feet east of the southwest corner of Section 18, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/21/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Gardena loam; coarse-silty, mixed Pachic Udic Haploboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin.

Drainage: Moderately well.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory textue in parenthesis if different from field texture. Aberdeen series pedon within 25 feet to north.

Soil profile: J-2 south side of pit.

Ap 0-8 inches (0-20 cm) black (10YR 2/1) silt loam (loam), dark gray (10YR 4/1, dry); moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; abrupt smooth boundary.

Bw 8-24 inches (20-61 cm) very dark grayish brown (10YR 3/2) silty clay loam (loam), grayish brown (10YR 5/2, dry); moderate medium prismatic parting to moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; clear broken boundary.

2Ab 24-30 inches (61-76 cm) black (10YR 2/1) silty clay loam, dark gray (10YR 4/1, dry); weak coarse prismatic parting to weak medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; abrupt broken boundary. This horizon seems to occur in pockets.

BCk 30-39 inches (76-99 cm) light yellowish brown to pale yellow (2.5Y 6.5/2) silty clay loam, white (2.5Y 8/2, dry); weak coarse prismatic parting to weak medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; violent effervescence; clear wavy boundary.

C1 39-55 inches (99-140 cm) gray (5Y 5/1) silty clay loam (silt loam), light gray (5Y 7/1, dry) with many fine distinct reddish brown (5YR 4/4) mottles; weak coarse prismatic parting to moderate coarse and medium platy structure; slightly hard, friable, sticky and plastic; few very fine roots; slight effervescence; clear wavy boundary.

C2 55-70 inches (140-178 cm) gray (5Y 5/1) silty clay loam, light gray (5Y 7/1, dry) with dark red (2.5YR 3/2) root channels; weak medium platy structure; slightly hard, friable, sticky and plastic; few very fine roots; slight effervescence.

Table J-2.2 OVERLY SERIES SITE J-2 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES (MICRON/PERCENT)							
8.	18.3	27.0	22.2	12.2	15.7	3.4	1.1	0.2
23.	20.0	25.2	22.0	11.9	16.4	3.2	1.1	0.2
38.	16.7	22.4	21.7	13.0	20.5	4.0	1.5	0.2
54.	15.5	17.5	15.1	12.3	29.4	7.0	3.0	0.2
68.	24.0	37.2	18.5	6.5	11.1	2.0	0.6	0.1
68.	26.6	39.9	18.2	5.6	8.0	1.3	0.4	0.0
84.	24.9	48.3	17.4	4.1	4.5	0.5	0.2	0.1
99.	18.1	59.4	20.0	1.1	1.0	0.2	0.1	0.0
114.	14.7	45.3	33.3	2.9	3.0	0.5	0.2	0.1
130.	15.4	66.8	12.9	1.0	1.2	0.9	1.1	0.5
145.	15.5	73.3	9.1	0.4	0.7	0.3	0.3	0.3

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	32.5	49.2	18.3	A 6	6=p
23.	32.8	47.2	20.0	B 7	7=w
38.	39.2	44.1	16.7	B 7	9=b
54.	51.9	32.6	15.5	B 7	10=k
68.	20.3	55.7	24.0	2A 9	
68.	15.3	58.1	26.6	2A 9	
84.	9.4	65.7	24.9	BC 10	
99.	2.5	79.4	18.1	BC 10	
114.	6.7	78.6	14.7	C 1	
130.	4.9	79.7	15.4	C 1	
145.	2.1	82.4	15.5	C 2	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	0.663	0.0213	6.0	0.0035	0.324	1.13	4.50
23.	0.695	0.0206	6.3	0.0033	0.310	1.25	2.90
38.	0.889	0.0266	6.2	0.0043	0.338	1.38	1.30
54.	1.592	0.0379	6.9	0.0055	0.350	1.42	1.10
68.	0.364	0.0131	5.8	0.0023	0.299	1.40	2.30
68.	0.263	0.0106	5.4	0.0020	0.299	1.40	2.40
84.	0.143	0.0094	4.5	0.0021	0.362	1.29	0.94
99.	0.028	0.0096	3.4	0.0028	0.521	1.39	0.60
114.	0.085	0.0135	3.7	0.0036	0.515	1.44	0.60
130.	0.059	0.0104	3.6	0.0029	0.601	1.38	0.54
145.	0.024	0.0090	3.0	0.0030	0.670	1.36	0.34

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER K-PARAMETERS CM/DAY-KPA		(JAYNE & TYLER) CM/HR-BAR	
cm	GOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	4.388	1.677	-0.1464	0.9454	-1.46	-0.43
23.	4.297	1.719	-0.1618	0.9512	-1.62	-0.43
38.	3.915	1.849	-0.2710	1.1368	-2.71	-0.24
54.	3.117	1.889	-0.5212	1.5051	-5.21	0.12
68.	5.537	1.735	0.0667	0.5887	0.67	-0.79
68.	6.300	1.731	0.1518	0.4437	1.52	-0.94
84.	8.067	1.929	0.2823	0.2726	2.82	-1.11
99.	15.456	2.303	0.4691	0.0644	4.69	-1.32
114.	9.933	2.291	0.4014	0.1943	4.01	-1.19
130.	11.502	2.500	0.4363	0.1363	4.36	-1.24
145.	16.330	2.836	0.4911	0.0580	4.91	-1.32

Table J-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site J, replication 2

Depth (cm)	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	5.08	2.64	0.50	1.03	-	3.96	0.20	5.09
15 - 30	3.09	1.27	0.17	0.19	-	2.32	0.10	2.30
30 - 46	2.33	1.15	0.06	0.14	-	1.88	0.11	1.69
46 - 61	1.90	1.42	0.06	0.15	-	1.92	0.11	1.50
61 - 76	1.78	1.42	0.04	0.11	-	1.68	0.08	1.59
61 - 76	1.78	1.74	0.13	0.14	-	1.80	0.08	1.91
76 - 91	1.99	2.45	0.88	0.10	-	1.80	0.16	3.46
91- 107	1.90	2.30	0.76	0.15	-	2.00	0.17	2.94
107 - 122	5.20	5.08	1.43	0.26	-	1.96	0.25	9.76
122 - 137	3.60	3.00	1.16	0.20	-	2.12	0.30	5.54
137 - 152	3.17	2.83	1.30	0.21	-	1.80	0.30	5.41

D4.24epth (cm3.00)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	0.92	0.3	53	8.0	-	l	12.84
15 - 30	0.45	0.1	50	7.9	-	l	9.71
30 - 46	0.35	-	43	7.8	-	l	9.38
46 - 61	0.32	-	37	7.5	-	l	7.91
61 - 76	0.32	-	56	7.8	-	sil	14.28
61 - 76	0.34	0.1	59	7.5	-	sicl	16.23
76 - 91	0.49	0.6	56	7.9	8.8	sicl	15.10
91- 107	0.46	0.5	55	7.9	2.4	sil	11.53
107 - 122	1.02	0.6	51	7.9	-	sil	9.76
122 - 137	0.69	0.6	57	7.9	-	sil	11.32
137 - 152	0.67	0.8	59	8.0	-	sil	12.41

Table J-2.4 OVERLY SERIES SITE J-2 NDSWC:1985
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	3.			9.			15.			21.	
CM	CC/CC	SE									
14.	0.3944	0.0179	10.	0.4612	0.0126	10.	0.4472	0.0087	14.	0.3895	0.0220
20.	0.3948	0.0165	20.	0.4502	0.0118	20.	0.4251	0.0048	20.	0.3857	0.0220
30.	0.3870	0.0110	40.	0.4244	0.0056	40.	0.3765	0.0002	30.	0.3639	0.0201
40.	0.3796	0.0074	60.	0.3996	0.0040	60.	0.3484	0.0005	40.	0.3396	0.0200
60.	0.3646	0.0060	80.	0.3871	0.0032	80.	0.3347	0.0006	60.	0.3107	0.0195
80.	0.3546	0.0064	100.	0.3696	0.0028	100.	0.3180	0.0007	80.	0.2960	0.0199
100.	0.3418	0.0056	120.	0.3594	0.0015	120.	0.3074	0.0008	100.	0.2768	0.0189
120.	0.3357	0.0055	180.	0.3368	0.0015	180.	0.2877	0.0002	120.	0.2697	0.0166
160.	0.3230	0.0057	334.	0.3084	0.0024	334.	0.2634	0.0000	160.	0.2512	0.0179
238.	0.3080	0.0042	534.	0.2909	0.0030	534.	0.2474	0.0006	238.	0.2339	0.0147
340.	0.3020	0.0074	834.	0.2712	0.0011	834.	0.2292	0.0007	340.	0.2268	0.0170
544.	0.2926	0.0041	544.	0.2204	0.0178						
850.	0.2698	0.0005	850.	0.2083	0.0201						
BD =	1.13			1.25			1.38			1.42	
N =	2			2			2			2	

DEPTH (CM)

	27.			33.			39.			45.	
14.	0.5361	0.0492	14.	0.4216	0.0484	14.	0.5356	0.0281	14.	0.4983	0.0038
20.	0.4850	0.0186	20.	0.4022	0.0379	20.	0.5271	0.0284	20.	0.4925	0.0029
30.	0.4556	0.0044	30.	0.3861	0.0304	30.	0.5222	0.0270	30.	0.4854	0.0000
40.	0.4387	0.0020	40.	0.3734	0.0247	40.	0.4955	0.0144	40.	0.4790	0.0024
60.	0.4180	0.0073	60.	0.3595	0.0188	60.	0.4781	0.0094	60.	0.4690	0.0043
80.	0.4075	0.0082	80.	0.3537	0.0155	80.	0.4655	0.0078	80.	0.4653	0.0037
100.	0.3941	0.0121	100.	0.3405	0.0133	100.	0.4585	0.0060	100.	0.4531	0.0049
120.	0.3886	0.0132	120.	0.3394	0.0141	120.	0.4529	0.0052	120.	0.4502	0.0049
160.	0.3769	0.0149	160.	0.3291	0.0109	160.	0.4410	0.0031	160.	0.4401	0.0057
238.	0.3614	0.0156	238.	0.3151	0.0081	238.	0.4277	0.0010	238.	0.4177	0.0067
340.	0.3569	0.0141	340.	0.3114	0.0087	340.	0.4158	0.0001	340.	0.3967	0.0057
544.	0.3513	0.0135	544.	0.3058	0.0095	544.	0.4024	0.0012	544.	0.3714	0.0057
850.	0.3387	0.0112	850.	0.2935	0.0056	850.	0.3784	0.0025	850.	0.3181	0.0211
BD =	1.40			1.29			1.39			1.44	
N =	2			2			2			2	

DEPTH (CM)

	57.	
14.	0.6014	0.0171
20.	0.5956	0.0154
30.	0.5780	0.0208
40.	0.5412	0.0223
60.	0.5212	0.0248
80.	0.5078	0.0249
100.	0.4995	0.0250
120.	0.4928	0.0250
160.	0.4820	0.0245
238.	0.4686	0.0246
340.	0.4578	0.0241
544.	0.4394	0.0231
850.	0.4227	0.0280
BD =	1.36	
N =	2	

Table J-2.5 OVERLY SERIES SITE J-2 (SCHUH AND CLINE)
In-situ K(θ,ψ) and θ(ψ) , and laboratory K(θ,ψ) data.

RICHARDS PARAMETERS

DEPTH 8. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4363	5.	0.47	1.07	0.54E-01	0.35E-03	0.16E+03
2.7	.4328	23.	2.24	0.88	0.19E-01	0.43E-03	0.43E+02
3.5	.4306	28.	2.74	0.82	0.30E-01	0.43E-03	0.70E+02
4.5	.4261	37.	3.62	0.60	0.75E-01	0.59E-03	0.13E+03
6.2	.4207	45.	4.37	0.48	0.30E-01	0.96E-03	0.31E+02
8.7	.4146	51.	4.97	0.48	0.47E-01	0.11E-02	0.44E+02
15.0	.4074	59.	5.82	0.43	0.12E-01	0.69E-03	0.18E+02
25.0	.4016	69.	6.72	0.40	0.90E-02	0.59E-03	0.15E+02
35.0	.3974	76.	7.42	0.30	0.93E-02	0.61E-03	0.15E+02
45.0	.3937	81.	7.97	0.28	0.98E-02	0.73E-03	0.13E+02
60.0	.3898	88.	8.64	0.33	0.47E-02	0.49E-03	0.97E+01
80.0	.3865	96.	9.39	0.32	0.31E-02	0.40E-03	0.78E+01
100.0	.3841	103.	10.07	0.32	0.25E-02	0.30E-03	0.84E+01
120.0	.3823	110.	10.77	0.25	0.24E-02	0.22E-03	0.11E+02
140.0	.3813	116.	11.37	0.23	0.84E-03	0.10E-03	0.81E+01
160.0	.3808	121.	11.82	0.30	0.65E-03	0.13E-03	0.51E+01

DEPTH 23. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
1.2	.4256	5.	0.52	1.07	0.13E+00	0.18E-03	0.73E+03
1.7	.4245	13.	1.23	0.93	0.26E-01	0.90E-04	0.30E+03
2.2	.4240	18.	1.78	0.90	0.27E-01	0.12E-03	0.23E+03
2.7	.4231	22.	2.15	0.88	0.56E-01	0.39E-03	0.14E+03
3.5	.4218	26.	2.58	0.82	0.76E-01	0.26E-03	0.29E+03
4.5	.4171	33.	3.28	0.60	0.25E+00	0.96E-03	0.26E+03
6.2	.4108	40.	3.95	0.48	0.92E-01	0.96E-03	0.96E+02
8.7	.4064	46.	4.55	0.48	0.12E+00	0.55E-03	0.21E+03
15.0	.3994	55.	5.36	0.43	0.42E-01	0.11E-02	0.39E+02
25.0	.3916	64.	6.24	0.40	0.28E-01	0.68E-03	0.42E+02
35.0	.3868	70.	6.87	0.30	0.29E-01	0.92E-03	0.32E+02
45.0	.3828	76.	7.40	0.28	0.30E-01	0.62E-03	0.48E+02
60.0	.3785	83.	8.12	0.33	0.15E-01	0.58E-03	0.26E+02
80.0	.3745	90.	8.86	0.32	0.10E-01	0.49E-03	0.21E+02
100.0	.3717	97.	9.53	0.32	0.78E-02	0.34E-03	0.23E+02
120.0	.3695	104.	10.18	0.25	0.78E-02	0.33E-03	0.24E+02
140.0	.3674	110.	10.77	0.23	0.54E-02	0.41E-03	0.13E+02

DEPTH 38. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.2	.4041	5.	0.45	0.02	0.27E+01	0.19E-03	0.14E+05
2.7	.4030	11.	1.12	0.03	0.27E+01	0.52E-03	0.51E+04
3.5	.4013	16.	1.58	0.05	0.17E+01	0.35E-03	0.50E+04
4.5	.3954	22.	2.19	0.07	0.42E+01	0.17E-02	0.26E+04
6.2	.3873	28.	2.79	0.05	0.16E+01	0.12E-02	0.13E+04
8.7	.3822	35.	3.42	0.08	0.96E+00	0.56E-03	0.17E+04
15.0	.3746	43.	4.25	0.13	0.26E+00	0.12E-02	0.21E+03

DEPTH 38. CM

25.0	.3659	52.	5.09	0.10	0.20E+00	0.85E-03	0.24E+03
35.0	.3599	58.	5.70	0.15	0.11E+00	0.13E-02	0.82E+02
45.0	.3551	63.	6.22	0.15	0.96E-01	0.65E-03	0.15E+03
60.0	.3502	70.	6.90	0.07	0.13E+00	0.77E-03	0.17E+03
80.0	.3454	78.	7.62	0.05	0.12E+00	0.56E-03	0.21E+03
100.0	.3423	85.	8.37	0.15	0.28E-01	0.30E-03	0.94E+02
120.0	.3400	94.	9.20	0.44	0.80E-02	0.25E-03	0.32E+02
140.0	.3377	101.	9.91	0.60	0.51E-02	0.42E-03	0.12E+02

DEPTH 53. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
2.7	.3969	3.	0.33	0.60	0.23E+00	0.63E-03	0.37E+03
3.5	.3945	5.	0.52	0.52	0.24E+00	0.66E-03	0.37E+03
4.5	.3888	12.	1.20	0.60	0.70E+00	0.10E-02	0.68E+03
6.2	.3818	20.	1.98	0.77	0.15E+00	0.10E-02	0.15E+03
8.7	.3757	27.	2.64	0.80	0.14E+00	0.83E-03	0.17E+03
15.0	.3682	36.	3.51	0.82	0.60E-01	0.88E-03	0.68E+02
25.0	.3606	45.	4.36	0.87	0.35E-01	0.95E-03	0.37E+02
35.0	.3541	51.	5.02	0.90	0.28E-01	0.11E-02	0.26E+02
45.0	.3490	57.	5.55	0.90	0.23E-01	0.91E-03	0.26E+02
60.0	.3433	63.	6.15	0.88	0.15E-01	0.93E-03	0.17E+02
80.0	.3379	70.	6.86	0.88	0.10E-01	0.59E-03	0.17E+02
100.0	.3346	79.	7.78	1.03	0.61E-02	0.23E-03	0.27E+02
120.0	.3322	90.	8.85	1.08	0.46E-02	0.22E-03	0.22E+02
140.0	.3307	98.	9.59	0.95	0.47E-02	0.19E-03	0.25E+02
160.0	.3296	103.	10.05	0.83	-.26E+10	0.31E-03	-.83E+13

DEPTH 69. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
4.5	.4194	5.	0.52	0.57	0.90E+00	0.49E-03	0.18E+04
6.2	.4161	13.	1.27	0.40	0.35E+00	0.48E-03	0.73E+03
8.7	.4129	20.	1.97	0.37	0.39E+00	0.45E-03	0.86E+03
15.0	.4090	29.	2.84	0.35	0.17E+00	0.45E-03	0.37E+03
25.0	.4035	38.	3.76	0.37	0.11E+00	0.82E-03	0.14E+03
35.0	.3975	46.	4.46	0.39	0.87E-01	0.96E-03	0.90E+02
45.0	.3923	51.	5.03	0.44	0.65E-01	0.90E-03	0.72E+02
60.0	.3863	58.	5.71	0.54	0.35E-01	0.88E-03	0.40E+02
80.0	.3806	66.	6.49	0.64	0.19E-01	0.58E-03	0.32E+02
100.0	.3770	76.	7.45	0.54	0.16E-01	0.24E-03	0.66E+02
120.0	.3747	87.	8.51	0.47	0.14E-01	0.20E-03	0.70E+02
140.0	.3734	94.	9.21	0.55	0.92E-02	0.16E-03	0.57E+02

DEPTH 84. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
6.2	.4423	4.	0.37	0.54	0.29E+00	0.33E-03	0.88E+03
8.7	.4407	11.	1.03	0.44	0.37E+00	0.25E-03	0.15E+04
15.0	.4393	19.	1.89	0.44	0.14E+00	0.10E-03	0.14E+04
25.0	.4361	29.	2.89	0.47	0.11E+00	0.68E-03	0.16E+03
35.0	.4304	37.	3.61	0.47	0.90E-01	0.99E-03	0.91E+02
45.0	.4250	43.	4.19	0.44	0.82E-01	0.88E-03	0.93E+02
60.0	.4191	50.	4.90	0.40	0.60E-01	0.77E-03	0.78E+02
80.0	.4135	59.	5.76	0.40	0.38E-01	0.53E-03	0.72E+02

DEPTH 84. CM (CONT)

100.0	.4100	68.	6.66	0.40	0.26E-01	0.26E-03	0.98E+02
120.0	.4082	78.	7.63	0.35	0.21E-01	0.11E-03	0.19E+03
140.0	.4074	86.	8.39	0.35	0.16E-01	0.92E-04	0.17E+03

DEPTH 99. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
15.0	.4419	11.	1.06	0.28	0.23E+00	0.16E-03	0.14E+04
25.0	.4378	22.	2.19	0.60	0.98E-01	0.67E-03	0.15E+03
35.0	.4327	30.	2.96	0.65	0.77E-01	0.74E-03	0.10E+03
45.0	.4286	36.	3.53	0.67	0.63E-01	0.70E-03	0.90E+02
60.0	.4241	43.	4.17	0.60	0.48E-01	0.70E-03	0.69E+02
80.0	.4195	50.	4.94	0.50	0.37E-01	0.46E-03	0.79E+02
100.0	.4167	59.	5.76	0.40	0.31E-01	0.24E-03	0.13E+03
120.0	.4151	68.	6.63	0.32	0.26E-01	0.13E-03	0.20E+03
140.0	.4143	75.	7.38	0.32	0.19E-01	0.79E-04	0.24E+03

DEPTH 114. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
15.0	.4503	6.	0.62	1.12	0.62E-01	0.21E-03	0.30E+03
25.0	.4471	16.	1.56	0.57	0.12E+00	0.51E-03	0.23E+03
35.0	.4439	22.	2.20	0.39	0.15E+00	0.52E-03	0.28E+03
45.0	.4414	28.	2.73	0.32	0.15E+00	0.40E-03	0.36E+03
60.0	.4387	34.	3.34	0.34	0.97E-01	0.47E-03	0.21E+03
80.0	.4356	42.	4.10	0.39	0.54E-01	0.37E-03	0.14E+03
100.0	.4328	49.	4.83	0.35	0.40E-01	0.37E-03	0.11E+03
120.0	.4303	57.	5.54	0.23	0.41E-01	0.35E-03	0.12E+03
140.0	.4280	63.	6.21	0.13	0.52E-01	0.33E-03	0.16E+03

DEPTH 130. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
8.7	.4667	2.	0.21	1.07	0.18E+00	0.19E-03	0.95E+03
15.0	.4659	5.	0.54	0.85	0.85E-01	0.23E-03	0.36E+03
25.0	.4649	10.	0.99	0.65	0.11E+00	0.20E-03	0.54E+03
35.0	.4637	15.	1.43	0.57	0.11E+00	0.37E-03	0.28E+03
45.0	.4623	19.	1.85	0.48	0.10E+00	0.30E-03	0.34E+03
60.0	.4609	24.	2.39	0.40	0.86E-01	0.22E-03	0.39E+03
80.0	.4591	32.	3.15	0.37	0.61E-01	0.26E-03	0.24E+03
100.0	.4569	39.	3.84	0.33	0.48E-01	0.41E-03	0.12E+03
120.0	.4546	45.	4.44	0.30	0.38E-01	0.36E-03	0.10E+03
140.0	.4522	51.	5.02	0.27	0.33E-01	0.45E-03	0.74E+02

DEPTH 145. CM

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
6.2	.4831	1.	0.13	1.09	0.16E+00	0.24E-03	0.65E+03
8.7	.4827	3.	0.28	1.04	0.19E+00	0.28E-03	0.65E+03
15.0	.4823	5.	0.45	0.97	0.76E-01	0.21E-03	0.36E+03
25.0	.4819	7.	0.67	0.87	0.80E-01	0.17E-03	0.47E+03
35.0	.4815	10.	0.93	0.74	0.83E-01	0.10E-03	0.80E+03
45.0	.4811	12.	1.20	0.64	0.78E-01	0.16E-03	0.49E+03
60.0	.4807	16.	1.57	0.50	0.70E-01	0.77E-04	0.91E+03
80.0	.4801	22.	2.15	0.32	0.74E-01	0.14E-03	0.54E+03
100.0	.4792	29.	2.84	0.37	0.47E-01	0.11E-03	0.42E+03
120.0	.4785	36.	3.52	0.45	0.28E-01	0.11E-03	0.26E+03
140.0	.4778	41.	4.02	0.39	0.26E-01	0.18E-03	0.15E+03

SITE K (EXLINE SERIES)

Site K was located on a nearly level, low hayfield near a sunflower field. The condition of the sunflowers, for which the soil was unsuited because of high sodium, was poor. The location and description are summarized on Table 1 and on Fig. 2. In-situ measurements and site descriptions were made during late August through October, 1985.

The Exline series "consists of somewhat poorly drained to poorly drained, claypan soils on stream terraces, out-wash plains, and bottom lands, and on lake plains in Dickey County. These soils formed in medium-textured to moderately fine-textured deposits left by glacial melt water and in alluvium. They are level to gently sloping. The Exline soil generally consists of a silt-loam surface soil overlying silty-clay loam subsoil" (USDA 1971).

Infiltration and wetting phase soil-water and suction profiles were measured on this site during irrigation, but at the time of this report have not yet been analyzed and prepared for presentation.

Specific Conditions and Problems

This Site was difficult to evaluate because of very high sodium content (Tables K-1.3 and K-2.3). Infiltration rates were initially very large (> 100 cm/h) but within one hour had declined to 0.15 cm/h and after 7 hours were only 0.015 cm/h. Infiltrometers were covered with polyethylene and allowed to continue operating for 262 hours. Infiltration rates continued to decrease to 0.00019 cm/h at that time (readings were taken several days apart).

Because of extremely slow water movement, no field drainage measurements were made. However, the soil profile was sampled, and laboratory measurements were made. These are presented in this report. However, here too there were serious problems. As would be expected, the high clay content of soil samples resulted in soil expansion after adding distilled water in the lab. Interpretation of results was further complicated by the potential effects of sample constraint in sample rings during wetting.

Effect of Laboratory Ring Constraint

Selected Doering 1-step diffusivity samples were wetted without ring constraint, and were then placed placed fully wetted in a ring and trimmed. Others (all of Site K-2 samples and selected K-1 samples) were wetted in the rings. The relative expansions of these samples, compared with field ring bulk density samples (non-wetted) are shown on Tables K-1.4C and K-2.4C. Expansion percent values of non-ringed samples from same depths on replications K-1 and K-2 were combined and averaged, and corresponding replication K-1 expansion values for ringed samples were subtracted. Results indicated that at 38 cm non-ringed samples expanded about 7.1 % more than ringed samples, at 53 cm non-ringed samples expanded about 40.65 % more than ringed samples (with consistent results on both K-1 and K-2 replications) , and at 106 cm non-ringed samples expanded about 9.47% more than ringed samples. In the topsoil, there was no difference. On site K-2 (table K-2.3) the 46 to 61 cm depth has the largest SAR, with the second largest SAR at 30 to 46 cm. At the 8-cm depth, non-ringed and ringed samples expanded fairly uniformly at about 13.5 to 15% volume increase.

These results indicated that not only the SAR and ionic strength of water, but the specific laboratory constraints as well are important in influencing laboratory hydraulic and physical measurements on fine soils under expansive conditions. The constraint of a ring during wetting partially inhibited expansion. In some cases, it even prevented wetting to the top of the sample, and the top of the sample remained dry for many days (resulting in low average θ values). Some such cases can be seen in the water-contents of some of the diffusivity measurements on site replication K-1.

The significance of the relationship of either the ring constrained sample or the nonconstrained sample to actual field conditions where samples are three-dimensionally constrained by a similarly expansive material is difficult to evaluate. Moreover, the use of distilled water might result in poor predictions of soil hydraulic behavior in the deeper soil profile, while hydraulic behavior of near surface soil horizons under the influence of rainwater might be better represented. We believe that these data provide a valid general comparative tool for evaluating relative magnitudes of properties of the Exline soils with other soils, but that they cannot be considered as precision indicators of field behavior requiring hydraulic parameters of high sensitivity.

Diffusivity Data

Laboratory diffusivity data are presented without corresponding hydraulic conductivity data, because of the wide error in correspondence between $\theta(\psi)$ and $D(\theta)$ functions introduced by problems in wetting and in the expansion of samples. Precise field-representative laboratory measurements of $K(\theta,\psi)$ under these conditions was considered to be unachievable. However, the diffusivity data are presented with the following general comments and analyses. Compared with diffusivities of sandy topsoils (10^2 cm^2 /h) and sandy subsoils (10^5 cm^2 /h), Exline diffusivities near saturation are about 10^{-1} cm^2 /h, less by a factor of 10^3 and 10^6 respectively.

Hydraulic Conductivity and Specific-Water Content

The comparative magnitude of $K(\theta)$ was more difficult to obtain because of the expansion problem in measuring $\theta(\psi)$ and $D(\theta)$, which resulted in nonalignment of water content and diffusivity values on an absolute θ scale. In order to obtain an approximate evaluation of $K(\theta)$ two assumptions were made. (1) It was assumed that the $\theta(\psi)$ relationship between the air entry value and the final measured equilibrium pressure (534 cm) could be represented using a log/log curve such as that of Brooks and Corey (1964) presented in Equation 14. (2) It was assumed that the percent saturation at air entry pressure of the measured $\theta(\psi)$ sample corresponding to each $D(\theta)$ measurement was the same as that on the $D(\theta)$ sample, and that air entry-water content (θ_e) on the $D(\theta)$ sample could be scaled using the water content sample. Air-entry suctions (ψ_e) were selected graphically, and were almost always at approximately 60 cm.

Using equation (14), the exponent (b) was calculated from the final (534 cm) and initial (air entry) water content of the $D(\theta)$ sample. This was, in turn, used to calculate specific-water capacity for each percent saturation (θ/θ_s) using the derivative of equation (18)

$$sp_m = \frac{d\theta}{d\psi} = \left(\theta_e - \theta_r\right)\psi_e^{\,b}\psi^{-b-1} \qquad (18).$$

Specific-water capacity (sp_m) estimated in this way was then used to calculate $K(\theta)$ using equation 3.

sp_m and $K(\theta)$ are on Tables K-1.6 and K-2.6. Compared with sandy sites, such as the Hecla soil on Site D, water retention curves are much flatter, resulting in lower b values, and in much lower sp_m. sp_m near saturation for the surface horizon of an Exline soil was approximately 10^{-3} to 10^{-4} cm^2 compared with 10^{-1} to 10^{-2} cm^2 on the Hecla. For a deep subsoil horizon, sp_m near saturation for the Exline soil remained approximately 10^{-3} to 10^{-4} cm^2 compared with 10^{-2} to 10^{-3} cm^2 on the Hecla. soil

The combined effect of lower $D(\theta)$ and sp_m resulted in extremely low $K(\theta)$ values (10^{-4} cm/h near saturation to 10^{-6} cm/h at 0.7 to 0.8 saturation fraction) for all soil depths. This compares with approximately 10^{1} cm/h near saturation and 10^{-2} cm/h at 0.7 to 0.8 saturation fraction for the Hecla soil. Thus, $K(\theta)$ for the solonized silty-clay loam Exline soil is 10,000 times less than for a sandy Hecla soil at comparable "wet" saturation fractions. Of course, for low water contents the sandy soil $K(\theta)$ values would eventually be comparable to, or less than those of the Exline soil.

The slopes (N) of the log K vs. log ψ function (Equation 16) are also presented on Tables K-1.6 and K-2.6. ρ values for Mualem theory (Equation 17) are also presented on Tables K-1.6 and K-2.6. The range of ρ values is large, as has been discussed previously by Schuh and Cline (in press) for finer soils. The range of ρ for the solonized silty-clay loam Exline soil does not, however, exceed that documented for non-solonized soils of loamy texture. This is consistent with the previous observation (Schuh and Cline, in press) that all soils with geometric-mean particle diameters of 0.08 mm or less appear to have ρ values of a single shared log-normal random distribution. However, it is observed that the range of N values derived from these ρ values is not nearly so large as ρ. This is because soils with very flat particle-size distribution curves, as represented by the b values, will have a correspondingly low sensitivity of N to ρ. On equation 17 it can be seen that as b approaches 0, N approaches 2, and the influence of ρ on N becomes negligible.

Exline Soil Summary

In summary, for the Exline soil the expansion of soil samples during wetting with distilled water was greater for samples wetted outside of the ring than for those wetted within the constraint of a wet ring. In some cases, samples wetted within the ring failed to wet fully to the sample surface. Final dry bulk densities and water-retentions varied corresponding to these differences. The relationship of either case to field constraints is not clearly understood. Also the use of distilled water may adequately reflect near surface, rain effected hydraulic phenomena, but not that of greater depths.

$D(\theta)$, and estimated sp_m, and $K(\theta)$ were lower than corresponding values for sandy soils by several orders of magnitude. Pore-interaction factor values for Mualem (1976) theory, and resulting $K(\psi)$ curve slope values were distributed in a manner similar to that described for loamy soils by Schuh and Cline (in press).

SITE K, REPLICATION 1

Table K-1.1. Soil morphologic data for Site H, replication 1

Site and location: K-1 Exline, Oakes Aquifer 45 feet south and 90 feet east of the northwest corner of Section 20, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/21/85 by M. D. Sweeney, North Dakota gricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Exline loam; fine, montmorillonitic Leptic Natriboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial ake Dakota Basin.

Drainage: Poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: K-1, north side of pit.

E 0-2 inches (0-5 cm) black (l0YR 2/1) loam, dark gray (l0YR 4/1, dry); moderate fine platy structure; soft, very friable; slightly sticky and slightly plastic; many very fine roots; abrupt smooth boundary.

Btl 2-5 inches (5-13 cm) very dark gray (l0YR 3/1) silty clay (clay loam), dark gray to gray (l0YR 4.5/1, dry); strong to moderate coarse and medium prismatic parting to strong medium and fine angular blocky structure; hard, firm, very sticky and very plastic; common very fine roots along prism faces; clear smooth boundary.

Bt2 5-10 inches (13-25 cm) very dark grayish brown (l0YR 3/2) silty clay (clay loam), dark gray (l0YR 4/1, dry); moderate coarse and medium prismatic parting to strong medium and fine angular blocky structue; hard, firm, very sticky and very plastic; common very fine roots along prism faces; clear wavy boundary.

Bksa 10-25 inches (25-64 cm) olive gray (5Y 5/2) silty clay loam (loam), light olive gray (5Y 6/2, dry) with continuous thin clay films and dark gray (5Y 4/1) organic stains on prism faces; moderate coarse and medium prismatic parting to moderate fine angular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots along prism faces; strong effervescence; clear wavy boundary.

BCk 25-39 inches (64-99 cm) light gray (5Y 7/2) silty clay loam (clay loam), white (5Y 8/2, dry) with continuous thin clay films and gray (5Y 5/1) organic stains on prism faces; moderate coarse and medium prismatic parting to moderate fine angular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots along prism faces; violent effervescence; abrupt smooth boundary.

2BC 39-44 inches (99-112 cm) light olive gray (5Y 6/2) sandy loam (fine sandy loam), light gray (5Y 7/2, dry) with common fine and medium prominent dark reddish brown (5YR 2/2) mottles and many thin clay films and gray (5Y 5/1) organic stains on prism faces; moderate coarse prismatic parting to moderate and fine angular blocky structue; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots along prism faces; slight effervescence; abrupt smooth boundary.

2C 44-60 inches (112-152 cm) olive gray (5Y 5/2) sand (fine sand), light gray (5Y 7/2, dry) with common medium distinct strong brown (7.5YR 5/8) mottles; single grained; loose, nonsticky and nonplastic; slight effervescence.

Table K-1.2 EXLINE SERIES SITE K-1 NDSWC:1985
Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
			PARTICLE SIZE CLASSES			(MICRON/PERCENT)		
8.	21.3	16.8	26.3	24.9	9.3	1.0	0.4	0.1
23.	33.1	12.9	22.7	22.6	7.7	0.8	0.1	0.1
38.	24.9	15.9	26.5	25.3	6.5	0.5	0.1	0.1
54.	25.0	14.6	26.5	26.0	7.2	0.6	0.1	0.0
76.	33.1	22.5	14.4	14.3	15.0	0.5	0.2	0.0
107.	9.0	5.9	9.6	24.8	50.1	0.5	0.0	0.1
137.	5.3	0.0	4.3	23.5	66.1	0.4	0.1	0.2

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	35.6	43.1	21.3	B 1 11	10=k
23.	31.3	35.6	33.1	B 2 11	11=t
38.	32.6	42.4	24.9	BC 8 12	12=sa
54.	33.9	41.1	25.0	BC 8 12	
76.	30.0	36.9	33.1	BC 8	
107.	75.5	15.5	9.0	2BC	
137.	90.4	4.3	5.3	2C	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	0.828	0.0197	5.8	0.0034	0.407	1.26	5.00
23.	0.879	0.0128	6.9	0.0019	0.325	1.42	1.30
38.	0.767	0.0166	6.0	0.0028	0.401	1.52	0.60
54.	0.825	0.0169	6.0	0.0028	0.410	1.62	0.34
76.	0.813	0.0120	7.1	0.0017	0.227	1.71	0.54
107.	4.871	0.0652	4.6	0.0143	0.768	1.66	0.13
137.	21.000	0.1029	3.3	0.0311	1.310	1.46	0.07

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER CM/DAY-KPA		K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	3.998	1.703	-0.2283	1.0353	-2.28	-0.34
23.	3.811	1.832	-0.2139	0.9077	-2.14	-0.47
38.	4.099	2.068	-0.1879	0.9425	-1.88	-0.44
54.	3.979	2.189	-0.2157	0.9831	-2.16	-0.40
76.	3.938	1.763	-0.1875	0.8700	-1.88	-0.51
107.	2.042	3.577	-0.9594	2.1895	-9.59	0.81
137.	1.177	6.657	-1.2371	2.6187	-12.37	1.24

Table K-1.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site K, replication 1.

Depth (cm)	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	1.78	1.42	17.70	0.28	-	13.28	1.10	6.80
15 - 30	0.85	1.39	71.82	0.45	2.24	7.16	2.36	62.75
30 - 46	1.61	8.39	165.38	1.24	0.40	4.12	4.90	167.20
46 - 61	1.06	4.70	125.24	0.78	0.96	3.16	4.60	123.06
61 - 91	0.42	1.18	51.24	0.27	2.08	3.64	3.40	43.99
91 - 122	0.34	0.86	25.62	0.11	1.44	6.80	2.04	16.65
122 - 152	0.72	0.40	10.02	0.10	-	3.24	0.95	7.05

Depth (cm)	ECE mmhos/cm	SAR	H2O at Sat. %	pH	CO3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	2.15	14.0	68	8.2	-	l	21.52
15 - 30	6.22	67.9	122	9.2	3.4	cl	20.80
30 - 46	14.70	74.0	100	8.8	5.1	l	17.46
46 - 61	10.63	73.8	93	9.1	8.5	l	16.24
61 - 91	4.75	57.3	94	9.4	21.7	cl	14.98
91 - 122	2.77	33.1	61	9.1	-	fsl	10.85
122 - 152	1.03	13.4	36	8.1	-	fs	4.23

Table K-1.4A SITE K-1 EXLINE SOIL 1985 NDSWC
Laboratory soil-water retention data, bulk density from water-retention sample.

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
10.	0.5742	0.0090	10.	0.6814	0.0216	10.	0.3038	0.0068	10.	0.5719	0.0221
40.	0.5474	0.0132	40.	0.6710	0.0153	40.	0.2960	0.0061	40.	0.5526	0.0211
60.	0.5451	0.0116	60.	0.6673	0.0147	60.	0.2949	0.0063	60.	0.5526	0.0211
80.	0.5369	0.0111	80.	0.6598	0.0126	80.	0.2927	0.0058	80.	0.3225	0.1796
100.	0.5317	0.0116	100.	0.6583	0.0116	100.	0.2919	0.0058	100.	0.5444	0.0216
150.	0.5101	0.0132	150.	0.6442	0.0068	150.	0.2856	0.0061	150.	0.5265	0.0205
200.	0.4848	0.0132	200.	0.6270	0.0042	200.	0.2800	0.0053	200.	0.5139	0.0200
334.	0.4677	0.0137	334.	0.6203	0.0016	334.	0.2748	0.0058	334.	0.5042	0.0205
534.	0.4446	0.0121	534.	0.5928	0.0011	534.	0.2666	0.0058	534.	0.4841	0.0158
			834.	0.5585	0.0000	834.	0.2450	0.0037	834.	0.4461	0.0090
BD =	1.41			1.37			0.76			1.64	
N =	2			2			2			2	

DEPTH (CM)

	76.			106.			137.	
10.	0.2830	0.1853	10.	0.7462	0.1611	10.	0.4297	0.0047
40.	0.2725	0.1780	20.	0.7514	0.1564	20.	0.4319	0.0032
60.	0.2717	0.1775	30.	0.7522	0.1474	30.	0.4118	0.0058
80.	0.2665	0.1739	40.	0.7440	0.1522	40.	0.4059	0.0058
100.	0.2635	0.1718	50.	0.7388	0.1517	50.	0.3731	0.0047
150.	0.2544	0.1655	60.	0.7358	0.1474	60.	0.3344	0.0016
200.	0.2469	0.1603	80.	0.7283	0.1411	80.	0.2495	0.0269
334.	0.2394	0.1551	100.	0.7216	0.1395	100.	0.2219	0.0211
534.	0.2296	0.1483	120.	0.7134	0.1369	120.	0.1988	0.0184
834.	0.2049	0.1311	180.	0.6889	0.1311	180.	0.1683	0.0137
			334.	0.6583	0.1295	334.	0.1385	0.0053
			534.	0.6308	0.1269	534.	0.1355	0.0042
			834.	0.3537	0.0332	834.	0.1132	0.0042
BD =	0.77			1.62			1.40	
N =	2			2			2	

Table K-1.4B SITE K-1 EXLINE SOIL 1985 NDSWC
Laboratory soil-water retention data, bulk density from field ring sample (non-wetted).

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
10.	0.5121	0.0019	10.	0.7057	0.0267	10.	0.6121	0.0137	10.	0.5657	0.0160
40.	0.4880	0.0023	40.	0.6948	0.0200	40.	0.5965	0.0146	40.	0.5466	0.0151
60.	0.4861	0.0009	60.	0.6909	0.0195	60.	0.5942	0.0139	60.	0.5466	0.0151
80.	0.4788	0.0006	80.	0.6832	0.0173	80.	0.5897	0.0148	80.	0.3155	0.1744
100.	0.4741	0.0011	100.	0.6816	0.0162	100.	0.5882	0.0147	100.	0.5384	0.0157
150.	0.4548	0.0029	150.	0.6669	0.0112	150.	0.5754	0.0136	150.	0.5208	0.0149
200.	0.4322	0.0034	200.	0.6492	0.0083	200.	0.5643	0.0147	200.	0.5082	0.0145
334.	0.4169	0.0041	334.	0.6422	0.0056	334.	0.5537	0.0132	334.	0.4987	0.0151
534.	0.3963	0.0031	534.	0.6136	0.0027	534.	0.5371	0.0124	534.	0.4788	0.0106
			834.	0.5782	0.0035	834.	0.4939	0.0147	834.	0.4414	0.0042
BD =	1.26			1.42			1.52			1.62	
N =	2			2			2			2	

DEPTH (CM)

	76.			106.			137.	
10.	0.6131	0.0105	10.	0.7874	0.2050	10.	0.4476	0.0031
40.	0.5868	0.0081	20.	0.7923	0.2004	20.	0.4500	0.0048
60.	0.5860	0.0087	30.	0.7921	0.1912	30.	0.4289	0.0017
80.	0.5745	0.0086	40.	0.7841	0.1957	40.	0.4227	0.0016
100.	0.5679	0.0086	50.	0.7787	0.1949	50.	0.3886	0.0020
150.	0.5449	0.0062	60.	0.7752	0.1904	60.	0.3484	0.0046
200.	0.5268	0.0049	80.	0.7668	0.1834	80.	0.2610	0.0327
334.	0.5087	0.0037	100.	0.7598	0.1815	100.	0.2320	0.0261
534.	0.4857	0.0025	120.	0.7510	0.1783	120.	0.2079	0.0229
834.	0.4348	0.0046	180.	0.7250	0.1711	180.	0.1759	0.0174
			334.	0.6933	0.1679	334.	0.1445	0.0081
			534.	0.6646	0.1637	534.	0.1414	0.0069
			834.	0.3619	0.0160	834.	0.1181	0.0065
BD =	1.71			1.66			1.46	
N =	2			2			2	

Table K-1.4C. Bulk density calculated from wetted 1-step diffusivity samples following trimming, measurement, and drainage. * (Before) indicates sample was wetted in ring, then trimmed. (After) indicates sample was wetted without constraint, then placed in ring and trimmed. $BD_{(nw)}$ is the oven-dry bulk density for a field sample not wetted. % + vol. is percent increase in sample volume caused by wetting the sample with distilled water.

DEPTH (cm)	BD (g/cc)	Ring Placement*	$BD_{(nw)}$ g/cc	$BD_{(nw)}$ /BD	% + vol.
8.0	1.11	Before	1.26	1.135	13.5
8.0	1.11	After	1.26	1.135	13.5
38.0	1.07	Before	1.52	1.421	42.0
53.0	0.97	After	1.62	1.540	67.0
53.0	1.24	Before	1.62	1.496	30.6
76.0	1.11	After	1.71	1.540	54.0
106.0	1.12	After	1.66	1.496	49.6
106.0	1.14	Before	1.66	1.456	45.6
106.0	1.00	After	1.66	1.660	66.0

Table K-1.5 EXLINE SERIES SITE K-1 NDSWC 1985
laboratory D(θ) data.

1STEP OUTFLOW DETERMINATIONS

DEPTH (CM) SAMPLE WETTED IN RING
7.6

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.5015	4.770

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.1539	0.0000	-0.0567	328.261	0.639

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.5742	33.803	.5451	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.99	0.0168	0.0000	-0.0906	9618.654	0.826

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5258	89.	8.76	178.	0.54E-04	0.53E-03	0.10E+00
0.7	.5228	95.	9.34	178.	0.53E-04	0.50E-03	0.11E+00
1.3	.5198	101.	9.95	178.	0.52E-04	0.46E-03	0.11E+00
1.9	.5168	108.	10.61	178.	0.51E-04	0.43E-03	0.12E+00
2.5	.5138	115.	11.31	178.	0.50E-04	0.40E-03	0.13E+00
3.1	.5108	123.	12.07	178.	0.50E-04	0.38E-03	0.13E+00
3.7	.5078	131.	12.88	178.	0.49E-04	0.35E-03	0.14E+00
4.2	.5048	140.	13.75	178.	0.49E-04	0.33E-03	0.15E+00
4.8	.5015	151.	14.77	178.	0.48E-04	0.30E-03	0.16E+00
5.3	.4987	160.	15.72	178.	0.41E-04	0.28E-03	0.15E+00
5.8	.4961	170.	16.64	178.	0.36E-04	0.26E-03	0.14E+00
6.3	.4938	179.	17.53	178.	0.32E-04	0.25E-03	0.13E+00
6.8	.4916	188.	18.39	178.	0.28E-04	0.24E-03	0.12E+00
8.8	.4845	221.	21.63	178.	0.19E-04	0.20E-03	0.96E-01
12.8	.4743	279.	27.36	178.	0.11E-04	0.15E-03	0.71E-01
16.8	.4670	331.	32.45	178.	0.73E-05	0.13E-03	0.57E-01
20.8	.4614	378.	37.10	178.	0.53E-05	0.11E-03	0.48E-01
24.8	.4568	423.	41.43	178.	0.41E-05	0.98E-04	0.42E-01
28.8	.4529	464.	45.50	178.	0.33E-05	0.88E-04	0.37E-01
32.8	.4496	504.	49.37	178.	0.27E-05	0.81E-04	0.34E-01
44.8	.4417	****	*******	178.	********	********	0.27E-01
48.8	.4396	****	*******	178.	********	********	0.25E-01
56.8	.4358	****	*******	178.	********	********	0.23E-01
122.0	.4173	****	*******	178.	********	********	0.14E-01
194.0	.4065	****	*******	178.	********	********	0.11E-01
410.0	.3896	****	*******	178.	********	********	0.82E-02
482.0	.3860	****	*******	178.	********	********	0.81E-02

DEPTH (CM) SAMPLE WETTED WITHOUT RING
7.6

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.5535	7.960

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.95	0.1426	0.0000	-0.0447	241.069	0.149

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.5742	33.803	.5451	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.99	0.0168	0.0000	-0.0906	9618.654	0.826

DEPTH (CM)
7.6

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5770	****	*******	178.	********	********	0.97E-01
1.1	.5740	****	*******	178.	********	********	0.10E+00
2.1	.5710	****	*******	178.	********	********	0.11E+00
3.1	.5680	****	*******	178.	********	********	0.11E+00
4.2	.5650	****	*******	178.	********	********	0.11E+00
5.2	.5620	****	*******	178.	********	********	0.12E+00
6.2	.5590	****	*******	178.	********	********	0.13E+00
7.2	.5560	****	*******	178.	********	********	0.13E+00
8.0	.5535	****	*******	178.	********	********	0.14E+00
8.5	.5520	****	*******	178.	********	********	0.13E+00
9.0	.5506	****	*******	178.	********	********	0.13E+00
9.5	.5492	****	*******	178.	********	********	0.12E+00
10.0	.5480	****	*******	178.	********	********	0.12E+00
12.0	.5435	62.	6.07	178.	0.81E-04	0.79E-03	0.10E+00
16.0	.5365	71.	7.00	178.	0.57E-04	0.68E-03	0.84E-01
20.0	.5312	80.	7.82	178.	0.44E-04	0.60E-03	0.72E-01
24.0	.5269	87.	8.56	178.	0.35E-04	0.55E-03	0.64E-01
28.0	.5233	94.	9.24	178.	0.29E-04	0.50E-03	0.59E-01
32.0	.5201	101.	9.87	178.	0.25E-04	0.47E-03	0.54E-01
36.0	.5174	107.	10.46	178.	0.22E-04	0.44E-03	0.51E-01
40.0	.5150	112.	11.02	178.	0.20E-04	0.41E-03	0.48E-01
44.0	.5128	118.	11.55	178.	0.18E-04	0.39E-03	0.46E-01
48.0	.5108	123.	12.06	178.	0.17E-04	0.38E-03	0.44E-01
52.0	.5090	128.	12.55	178.	0.15E-04	0.36E-03	0.42E-01
56.0	.5073	133.	13.01	178.	0.14E-04	0.35E-03	0.41E-01
122.0	.4899	195.	19.12	178.	0.80E-05	0.23E-03	0.35E-01

DEPTH (CM) SAMPLE WETTED WITHOUT RING
53.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.2087	0.382

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.98	0.2111	0.0020	-0.0893	103.468	0.871

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.5719	55.295	.5444	100.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.98	0.0320	0.0000	-0.0834	16910.957	0.829

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.2181	****	*******	178.	********	********	0.62E+00
0.2	.2151	****	*******	178.	********	********	0.82E+00
0.3	.2121	****	*******	178.	********	********	0.12E+01
0.4	.2087	****	*******	178.	********	********	0.20E+01
0.9	.1938	****	*******	178.	********	********	0.99E+00
1.4	.1863	****	*******	178.	********	********	0.68E+00
1.9	.1813	****	*******	178.	********	********	0.53E+00
4.4	.1682	****	*******	178.	********	********	0.27E+00
8.4	.1589	****	*******	178.	********	********	0.17E+00
12.4	.1535	****	*******	178.	********	********	0.13E+00
16.4	.1498	****	*******	178.	********	********	0.11E+00
20.4	.1469	****	*******	178.	********	********	0.94E-01
24.4	.1446	****	*******	178.	********	********	0.85E-01
28.4	.1427	****	*******	178.	********	********	0.79E-01
32.4	.1410	****	*******	178.	********	********	0.74E-01
36.4	.1396	****	*******	178.	********	********	0.71E-01
40.4	.1383	****	*******	178.	********	********	0.68E-01
44.4	.1372	****	*******	178.	********	********	0.66E-01
48.4	.1361	****	*******	178.	********	********	0.65E-01
52.4	.1352	****	*******	178.	********	********	0.64E-01

DEPTH (CM) SAMPLE WETTED IN RING
53.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.0564	0.331

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.96	0.5723	0.0160	-0.5745	45.544	0.829

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.5719	55.304	.5444	100.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.98	0.0320	0.0000	-0.0834	16923.762	0.829

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.0612	****	*******	178.	********	********	0.64E+00
0.3	.0582	****	*******	178.	********	********	0.16E+01
0.3	.0564	****	*******	178.	********	********	0.64E+01
0.8	.0398	****	*******	178.	********	********	0.26E+01
1.3	.0342	****	*******	178.	********	********	0.16E+01
1.8	.0311	****	*******	178.	********	********	0.12E+01
2.3	.0292	****	*******	178.	********	********	0.95E+00
4.3	.0252	****	*******	178.	********	********	0.52E+00
8.3	.0223	****	*******	178.	********	********	0.28E+00
12.3	.0211	****	*******	178.	********	********	0.20E+00
16.3	.0203	****	*******	178.	********	********	0.15E+00
20.3	.0198	****	*******	178.	********	********	0.13E+00
24.3	.0194	****	*******	178.	********	********	0.11E+00
28.3	.0191	****	*******	178.	********	********	0.95E-01
32.3	.0189	****	*******	178.	********	********	0.85E-01
36.3	.0187	****	*******	178.	********	********	0.78E-01
40.3	.0186	****	*******	178.	********	********	0.71E-01
44.3	.0184	****	*******	178.	********	********	0.66E-01
48.3	.0183	****	*******	178.	********	********	0.62E-01
52.3	.0182	****	*******	178.	********	********	0.59E-01
122.0	.0174	****	*******	178.	********	********	0.35E-01
194.0	.0170	****	*******	178.	********	********	0.33E-01

DEPTH (CM) SAMPLE WETTED WITHOUT RING
76.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.4497	6.160

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.0756	0.0000	-0.0813	-312.762	1.007

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.2830	38.307	.2717	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.97	0.0674	0.0000	-0.0911	20289.674	0.886

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5211	****	*******	178.	********	********	0.44E+01
0.0	.5181	****	*******	178.	********	********	0.16E+01
0.1	.5151	****	*******	178.	********	********	0.10E+01
0.1	.5121	****	*******	178.	********	********	0.74E+00
0.2	.5091	****	*******	178.	********	********	0.59E+00
0.3	.5061	****	*******	178.	********	********	0.49E+00
0.4	.5031	****	*******	178.	********	********	0.42E+00
0.6	.5001	****	*******	178.	********	********	0.37E+00
0.8	.4971	****	*******	178.	********	********	0.33E+00
0.9	.4941	****	*******	178.	********	********	0.30E+00
1.2	.4911	****	*******	178.	********	********	0.28E+00
1.4	.4881	****	*******	178.	********	********	0.26E+00
1.6	.4851	****	*******	178.	********	********	0.24E+00
1.9	.4821	****	*******	178.	********	********	0.23E+00
2.2	.4791	****	*******	178.	********	********	0.22E+00
2.5	.4761	****	*******	178.	********	********	0.21E+00
2.8	.4731	****	*******	178.	********	********	0.20E+00
3.2	.4701	****	*******	178.	********	********	0.19E+00
3.6	.4671	****	*******	178.	********	********	0.18E+00
4.0	.4641	****	*******	178.	********	********	0.18E+00
4.4	.4611	****	*******	178.	********	********	0.17E+00
4.8	.4581	****	*******	178.	********	********	0.17E+00
5.3	.4551	****	*******	178.	********	********	0.16E+00
5.8	.4521	****	*******	178.	********	********	0.16E+00
6.2	.4497	****	*******	178.	********	********	0.16E+00
6.7	.4469	****	*******	178.	********	********	0.15E+00
7.2	.4442	****	*******	178.	********	********	0.14E+00
7.7	.4418	****	*******	178.	********	********	0.13E+00
8.2	.4395	****	*******	178.	********	********	0.13E+00
10.2	.4318	****	*******	178.	********	********	0.11E+00
14.2	.4203	****	*******	178.	********	********	0.81E-01
18.2	.4119	****	*******	178.	********	********	0.67E-01

DEPTH (CM) CONT.
76.0

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
22.2	.4052	****	*******	178.	********	********	0.58E-01
26.2	.3998	****	*******	178.	********	********	0.51E-01
30.2	.3952	****	*******	178.	********	********	0.47E-01
34.2	.3912	****	*******	178.	********	********	0.43E-01
38.2	.3877	****	*******	178.	********	********	0.40E-01
42.2	.3846	****	*******	178.	********	********	0.37E-01
46.2	.3818	****	*******	178.	********	********	0.35E-01
50.2	.3792	****	*******	178.	********	********	0.33E-01
54.2	.3769	****	*******	178.	********	********	0.32E-01
58.2	.3747	****	*******	178.	********	********	0.30E-01
122.0	.3528	****	*******	178.	********	********	0.21E-01
194.0	.3397	****	*******	178.	********	********	0.19E-01

DEPTH (CM) SAMPLE WETTED WITHOUT RING
106.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.3893	6.066

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.0443	0.0000	-0.0835	-298.286	0.874

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.7462	48.480	.7358	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.98	0.0148	0.0000	-0.0660	*********	0.968

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.4354	****	*******	178.	********	********	0.28E+00
0.3	.4324	****	*******	178.	********	********	0.26E+00
0.5	.4294	****	*******	178.	********	********	0.24E+00
0.8	.4264	****	*******	178.	********	********	0.23E+00
1.1	.4234	****	*******	178.	********	********	0.22E+00
1.4	.4204	****	*******	178.	********	********	0.21E+00
1.8	.4174	****	*******	178.	********	********	0.20E+00
2.1	.4144	****	*******	178.	********	********	0.19E+00
2.5	.4114	****	*******	178.	********	********	0.18E+00
2.9	.4084	****	*******	178.	********	********	0.18E+00
3.4	.4054	****	*******	178.	********	********	0.17E+00
3.8	.4024	****	*******	178.	********	********	0.17E+00
4.8	.3964	****	*******	178.	********	********	0.16E+00
5.9	.3904	****	*******	178.	********	********	0.16E+00
6.1	.3893	****	*******	178.	********	********	0.15E+00
6.6	.3867	****	*******	178.	********	********	0.14E+00
8.1	.3801	****	*******	178.	********	********	0.12E+00
10.1	.3732	****	*******	178.	********	********	0.10E+00
14.1	.3629	****	*******	178.	********	********	0.78E-01
18.1	.3554	****	*******	178.	********	********	0.65E-01
22.1	.3495	****	*******	178.	********	********	0.56E-01
30.1	.3406	****	*******	178.	********	********	0.44E-01
34.1	.3371	****	*******	178.	********	********	0.41E-01
42.1	.3312	****	*******	178.	********	********	0.35E-01
46.1	.3287	****	*******	178.	********	********	0.33E-01
50.1	.3264	****	*******	178.	********	********	0.31E-01
54.1	.3243	****	*******	178.	********	********	0.30E-01
58.1	.3224	****	*******	178.	********	********	0.28E-01
122.0	.3030	****	*******	178.	********	********	0.19E-01
194.0	.2915	****	*******	178.	********	********	0.16E-01
266.0	.2839	****	*******	178.	********	********	0.15E-01

DEPTH (CM) SAMPLE WETTED IN RING
106.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.5634	0.132

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.89	2.9799	0.0000	-0.0319	0.000	0.000

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.7462	48.480	.7358	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.98	0.0148	0.0000	-0.0660	*********	0.968

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.1	.5634	****	*******	178.	*********	*********	0.40E+01
0.6	.5359	****	*******	178.	*********	*********	0.10E+01
1.1	.5261	****	*******	178.	*********	*********	0.62E+00
1.6	.5200	****	*******	178.	*********	*********	0.46E+00
4.1	.5048	****	*******	178.	*********	*********	0.22E+00
8.1	.4940	****	*******	178.	*********	*********	0.13E+00
12.1	.4877	****	*******	178.	*********	*********	0.95E-01
16.1	.4833	****	*******	178.	*********	*********	0.78E-01
20.1	.4799	****	*******	178.	*********	*********	0.67E-01
24.1	.4771	****	*******	178.	*********	*********	0.60E-01
28.1	.4748	****	*******	178.	*********	*********	0.54E-01
32.1	.4728	****	*******	178.	*********	*********	0.50E-01
36.1	.4710	****	*******	178.	*********	*********	0.47E-01
40.1	.4695	****	*******	178.	*********	*********	0.44E-01
44.1	.4680	****	*******	178.	*********	*********	0.42E-01
48.1	.4667	****	*******	178.	*********	*********	0.40E-01
52.1	.4655	****	*******	178.	*********	*********	0.39E-01

DEPTH (CM) SAMPLE WETTED WITHOUT RING
106.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.5645	0.885

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.98	0.1694	0.0000	-0.0397	6736.024	0.977

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.7462	48.480	.7358	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.98	0.0148	0.0000	-0.0660	*********	0.968

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5702	****	*******	178.	********	********	0.11E+00
0.6	.5672	****	*******	178.	********	********	0.21E+00
0.9	.5645	****	*******	178.	********	********	0.80E+00
1.4	.5545	****	*******	178.	********	********	0.55E+00
1.9	.5478	****	*******	178.	********	********	0.42E+00
2.4	.5427	****	*******	178.	********	********	0.35E+00
2.9	.5386	****	*******	178.	********	********	0.30E+00
4.9	.5275	****	*******	178.	********	********	0.20E+00
8.9	.5151	****	*******	178.	********	********	0.13E+00
12.9	.5075	****	*******	178.	********	********	0.96E-01
16.9	.5021	****	*******	178.	********	********	0.80E-01
20.9	.4979	****	*******	178.	********	********	0.70E-01
24.9	.4944	****	*******	178.	********	********	0.62E-01
28.9	.4915	****	*******	178.	********	********	0.57E-01
32.9	.4890	****	*******	178.	********	********	0.53E-01
36.9	.4868	****	*******	178.	********	********	0.50E-01
40.9	.4848	****	*******	178.	********	********	0.47E-01
44.9	.4830	****	*******	178.	********	********	0.45E-01
48.9	.4813	****	*******	178.	********	********	0.43E-01
52.9	.4798	****	*******	178.	********	********	0.42E-01
122.0	.4642	****	*******	178.	********	********	0.35E-01

DEPTH (CM)
137.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.0592	3.456

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.0384	0.0040	-0.9129	-4.550	1.781

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.4297	27.787	.4118	30.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.99	0.0357	0.0800	-0.6856	16193.569	0.914

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.1359	403.	39.50	89.	0.41E-03	0.95E-04	0.43E+01
0.1	.1329	437.	42.81	89.	0.34E-03	0.83E-04	0.41E+01
0.2	.1299	475.	46.61	89.	0.29E-03	0.72E-04	0.40E+01
0.3	.1269	520.	51.02	89.	0.24E-03	0.62E-04	0.39E+01
0.3	.1239	****	*******	89.	********	********	0.38E+01
0.4	.1209	****	*******	89.	********	********	0.38E+01
0.6	.1179	****	*******	89.	********	********	0.37E+01
0.7	.1149	****	*******	89.	********	********	0.37E+01
0.8	.1119	****	*******	89.	********	********	0.36E+01
0.9	.1089	****	*******	89.	********	********	0.36E+01
1.0	.1059	****	*******	89.	********	********	0.35E+01
1.1	.1029	****	*******	89.	********	********	0.35E+01
1.3	.0999	****	*******	89.	********	********	0.35E+01
1.4	.0969	****	*******	89.	********	********	0.35E+01
1.5	.0939	****	*******	89.	********	********	0.35E+01
1.7	.0909	****	*******	89.	********	********	0.35E+01
1.8	.0879	****	*******	89.	********	********	0.36E+01
2.0	.0849	****	*******	89.	********	********	0.36E+01
2.1	.0819	****	*******	89.	********	********	0.36E+01

Table K-1.6. Brooks and corey b and specific moisture (sp_m) calculated from laboratory cores, and estimated hydraulic conductivity (K), and Mualem theory pore-interaction factor (ρ_m) for site K, replication 1. N is the slope of the log (K/K_i) versus lon (ψ/ψ_i) curve used to calculate ρ_m . In "ring" column (+) indicates samples wetted initially in a brass ring, and (-) indicates samples were placed in rings after wetting.

Depth (cm)	Ring	b	% sat	ψ	sp_m	K	N	ρ_m
7.6	+	0.1174	0.95	60	0.00098	1.5×10^{-4}		
			0.90	92	0.00060	4.3×10^{-5}	2.92	5.83
			0.80	275	0.00018	2.5×10^{-6}	2.68	3.79
			0.73	535	0.00008	6.9×10^{-7}	2.46	1.92
7.6	-	0.0513	0.95	60	0.00047	5.6×10^{-5}		
			0.90	173	0.00015	8.3×10^{-6}	1.80	-5.84
			0.85	535	0.00005	1.7×10^{-6}	1.59	-9.85
76	-	0.1795	0	60	0.00149	4.9×10^{-4}		
			0.90	88	0.00095	1.7×10^{-4}	2.76	2.25
			0.85	120	0.00066	8.6×10^{-5}	2.51	0.84
			0.80	177	0.00042	2.8×10^{-5}	2.64	1.60
			0.65	518	0.00012	2.2×10^{-6}	2.47	0.62
106	-	0.189	0.95	72	0.00108	2.1×10^{-4}		
			0.90	99	0.00074	1.2×10^{-4}	1.76	-3.27
			0.85	126	0.00056	5.6×10^{-5}	2.36	-.085
			0.80	178	0.00037	2.1×10^{-5}	2.54	0.88
			0.75	255	0.00024	7.5×10^{-6}	2.63	1.36
			0.65	535	0.00010	1.5×10^{-6}	2.46	0.45
106	+	0.0935	0.99	60	0.0041	9.7×10^{-4}		
			0.95	88.9	0.00026	5.8×10^{-5}	7.16	53.23
			0.9	169	0.00013	2.9×10^{-5}	3.38	12.86
			0.85	289	7.2×10^{-5}	4.8×10^{-6}	3.38	12.73
			0.80	535	3.0×10^{-5}	1.1×10^{-6}	3.14	10.22
106	-	0.0876	0.986	60	0.0004	2.9×10^{-5}		
			0.95	92	0.00025	5.6×10^{-5}	1.54	-7.25
			0.90	163	0.00014	1.8×10^{-6}	2.78	-6.92
			0.85	326	6.4×10^{-5}	3.0×10^{-6}	1.34	-9.53
			0.81	535	3.7×10^{-5}	1.3×10^{-6}	1.42	-8.63

SITE K, REPLICATION 2

Table K-2.1. Soil morphologic data for Site K, replication 2

Site and location: K-2 Exline, Oakes Aquifer 50 feet south and 90 feet east of the northwest corner of Section 20, Township 130 north, Range 59 west, Dickey County, North Dakota.

Sampled: 10/21/85 by M. D. Sweeney, North Dakota Agricultural Experiment Station, Fargo, North Dakota.

Soil type and classification: Exline loam; fine, montmorillonitic Leptic Natriboroll.

Physiography and parent material: Glacio-fluvial-lacustrine deposits in the Glacial Lake Dakota Basin.

Drainage: Poor.

NOTES: Moist colors unless otherwise specified. Piece of pipe buried at 14 inches. Laboratory texture in parenthesis if different from field texture.

Soil profile: K-2, south side of pit.

E 0-2 inches (0-5 cm) black (10YR 2/1) loam, dark gray (10YR 4/1, dry); moderate fine platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; abrupt smooth boundary.

Bt1 2-5 inches (5-13 cm) black (2.5Y 2/0) silty clay (clay loam), dark gray (2.5Y 4/0, dry); strong to moderate coarse and medium prismatic parting to strong medium and fine angular blocky structure; hard, firm, very sticky and very plastic; common very fine roots along prism faces; clear smooth boundary.

Bt2 5-9 inches (13-23 cm) very dark grayish brown (10YR 3/2) silty clay (clay loam), dark gray (10YR 4/1, dry); moderate coarse and medium prismatic parting to strong medium and fine angular blocky structure; hard, firm, very sticky and very plastic; common very fine roots along prism faces; clear wavy boundary.

Bksa 9-25 inches (23-64 cm) gray (5Y 5/1) silty clay loam (clay loam), light gray to gray (5Y 6/1, dry) with continuous thin clay films and dark gray (5Y 4/1) organic stains on prism faces; moderate coarse and medium prismatic parting to moderate fine angular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots along prism faces; strong effervescence; clear wavy boundary.

BCk 25-39 inches (64-99 cm) light gray (5Y 7/2) silty clay loam (clay loam), white (5Y 8/2, dry) with continuous thin clay films and light gray to gray (5Y 6/1) organic stains on prism faces; moderate coarse and medium prismatic parting to moderate fine angular blocky structure; slightly hard, firm, sticky and plastic; few very fine roots along prism faces; violent effervescence; abrupt wavy boundary.

2BC 39-44 inches (99-112 cm) light olive gray (5Y 6/2) sandy loam (fine sandy loam), light gray (5Y 7/2, dry) with common fine and medium prominent dark reddish brown (5YR 2/2) mottles and many thin clay films and olive gray (5Y 5/2) organic stains on prism faces; moderate coarse prismatic parting to moderate medium and fine angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots along prism faces; slight effervescence; abrupt smooth boundary.

2C 44-60 inches (112-152 cm) olive (5Y 5/3) sand (fine sand), pale yellow (5Y 7/3, dry) with common medium distinct strong brown (7.5YR 5/8) mottles; single grained; loose, nonsticky and nonplastic; slight effervescence.

Table K-2.2 EXLINE SERIES SITE K-2 NDSWC:1985

Soil particle-size, bulk density, and organic carbon data and indices.

DEPTH cm	2.	20.	50.	100.	250.	500.	1000.	2000.
	PARTICLE SIZE CLASSES				(MICRON/PERCENT)			
8.	19.6	18.2	27.3	24.4	9.4	0.8	0.2	0.2
23.	31.5	11.7	23.1	25.9	6.9	0.7	0.1	0.1
38.	30.0	10.2	24.8	28.8	5.8	0.3	0.0	0.1
54.	26.5	12.0	26.7	27.3	6.9	0.3	0.1	0.1
76.	36.7	26.2	14.9	10.9	9.9	0.9	0.4	0.0
107.	10.5	8.4	6.9	24.0	49.7	0.3	0.1	0.1
137.	2.0	3.3	4.6	18.8	70.8	0.4	0.1	0.0

DEPTH cm	SAND %	SILT %	CLAY %	HORIZON	
8.	34.9	45.5	19.6	B 1 11	10=k
23.	33.7	34.8	31.5	B 2 11	11=t
38.	35.0	35.0	30.0	B 8 12	12=sa
54.	34.8	38.7	26.5	B 8 12	
76.	22.2	41.1	36.7	BC 8	
107.	74.2	15.3	10.5	BC	
137.	90.1	7.9	2.0	C	

DEPTH cm	SA/SI	GMEAN mm	GDEV mm	Z	F-INDEX	BD g/cc	OC %
8.	0.769	0.0204	5.5	0.0037	0.418	1.23	4.20
23.	0.968	0.0139	6.8	0.0020	0.369	1.46	1.10
38.	1.000	0.0148	6.6	0.0023	0.427	1.61	0.60
54.	0.897	0.0166	6.2	0.0027	0.431	1.72	0.40
76.	0.538	0.0093	6.7	0.0014	0.203	1.56	0.81
107.	4.850	0.0592	5.1	0.0117	0.724	1.72	0.07
137.	11.405	0.1146	2.5	0.0452	1.321	1.46	0.07

DEPTH	MOISTURE/SUCTION SLOPE		GARDNER CM/DAY-KPA		K-PARAMETERS (JAYNE & TYLER) CM/HR-BAR	
cm	GHOSH	BLOEMEN	K-SLOPE	K-INT	K-SLOPE	K-INT
8.	4.129	1.739	-0.2034	1.0150	-2.03	-0.37
23.	3.674	1.916	-0.2526	0.9773	-2.53	-0.40
38.	3.638	2.119	-0.2695	1.0150	-2.70	-0.37
54.	3.835	2.204	-0.2420	1.0063	-2.42	-0.37
76.	4.651	1.697	-0.0505	0.6409	-0.50	-0.74
107.	2.036	3.690	-0.9424	2.1518	-9.42	0.77
137.	1.508	6.720	-1.2116	2.6129	-12.12	1.23

Table K-2.3 Soil saturation extract water chemistry data, gravimetric water content at saturation and at 15 bar, pH, texture class, and carbonate clay fraction for site K, replication 2

Depth (cm)	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO4
			Saturation Extract Soluble Ions meq/l					
0 - 15	1.14	1.06	23.94	0.23	0.40	16.24	1.30	8.43
15 - 30	0.76	1.24	53.76	0.40	1.68	7.40	2.00	45.08
30 - 46	1.27	3.69	94.82	0.92	0.56	4.04	3.90	92.20
46 - 61	0.85	3.15	120.39	0.78	0.88	3.40	4.10	116.79
61 - 91	0.42	1.58	44.52	0.27	2.96	4.40	3.40	36.03
91 - 122	0.30	0.30	16.20	0.07	1.04	5.16	1.30	9.37
122 - 152	0.42	0.50	8.67	0.06	0.00	3.84	0.90	4.91

Depth (cm)	ECE mmhos/cm	SAR	H_2O at Sat. %	pH	CO_3 clay %	Texture class	θ 15 bar g/g x 100
0 - 15	2.48	22.8	65	8.4	4.9	l	26.66
15 - 30	5.66	53.8	117	9.1	5.6	cl	22.25
30 - 46	11.76	60.2	105	8.7	8.5	cl	16.16
46 - 61	10.40	85.1	96	9.0	8.5	cl	15.31
61 - 91	4.75	44.5	81	9.5	25.0	cl	14.73
91 - 122	1.77	29.6	63	9.0	0.8	fsl	9.96
122 - 152	0.85	12.8	36	8.2	-	fs	4.87

Table K-2.4A SITE K-2 EXLINE SOIL 1985 NDSWC
Laboratory soil-water retention data, bulk density from water-retention sample.

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
10.	0.6419	0.0190	10.	0.6524	0.0147	10.	0.6069	0.0079	10.	0.3143	0.1422
40.	0.6203	0.0174	40.	0.6598	0.0190	40.	0.5742	0.0047	40.	0.2912	0.1469
60.	0.6166	0.0169	60.	0.6568	0.0179	60.	0.5757	0.0037	60.	0.2860	0.1496
80.	0.6077	0.0158	80.	0.6531	0.0195	80.	0.5682	0.0047	80.	0.2770	0.1517
100.	0.6002	0.0158	100.	0.6524	0.0200	100.	0.5637	0.0047	100.	0.2733	0.1532
150.	0.5779	0.0158	150.	0.6442	0.0216	150.	0.5422	0.0042	150.	0.2584	0.1553
200.	0.5541	0.0169	200.	0.6345	0.0242	200.	0.5287	0.0042	200.	0.2472	0.1559
334.	0.5399	0.0163	334.	0.6270	0.0253	334.	0.5235	0.0005	334.	0.2420	0.1564
534.	0.5146	0.0153	534.	0.6062	0.0253	534.	0.5027	0.0016	534.	0.2256	0.1553
834.	0.4692	0.0147	834.	0.5779	0.0253	834.	0.4520	0.0016	834.	0.1847	0.1559
BD =	1.42			1.51			1.56			1.86	
N =	2			2			2			2	

DEPTH (CM)

	76.			106.			106.			137.	
10.	0.5019	0.0074	10.	0.4647	******	10.	0.4543	******	10.	0.4357	0.0005
40.	0.4781	0.0074	20.	0.4721	******	40.	0.4721	******	20.	0.4386	0.0016
60.	0.4766	0.0074	30.	0.4796	******	60.	0.4662	******	30.	0.4155	0.0021
80.	0.4684	0.0079	40.	0.4692	******	80.	0.4647	******	40.	0.4133	0.0016
100.	0.4625	0.0068	50.	0.4692	******	100.	0.4617	******	50.	0.3783	0.0032
150.	0.4491	0.0079	60.	0.4677	******	150.	0.4498	******	60.	0.3448	0.0111
200.	0.4386	0.0079	80.	0.4647	******	200.	0.4379	******	80.	0.2726	0.0369
334.	0.4319	0.0084	100.	0.4632	******	334.	0.4245	******	100.	0.2547	0.0284
534.	0.4133	0.0090	120.	0.4602	******	534.	0.4111	******	120.	0.2368	0.0284
834.	0.3686	0.0079	180.	0.4349	******	834.	0.3664	******	180.	0.2011	0.0274
			334.	0.4096	******				334.	0.1795	0.0269
			534.	0.3813	******				534.	0.1571	0.0216
			834.	0.3336	******				834.	0.1333	0.0184
BD =	1.58			1.57			1.74			1.39	
N =	2			1			1			2	

Table K-2.4B SITE K-2 EXLINE SOIL 1985 NDSWC
Laboratory soil-water retention data, bulk density from field ring sample (non-wetted).

LAB PRESSURE (CM) AND WATER CONTENT (VOL. FRACTION)

DEPTH (CM)

	8.			23.			38.			53.	
CM	CC/CC	SE									
10.	0.5564	0.0018	10.	0.6356	0.0249	10.	0.6268	0.0197	10.	0.3057	0.1474
40.	0.5377	0.0010	40.	0.6424	0.0212	40.	0.5929	0.0158	40.	0.2847	0.1507
60.	0.5345	0.0006	60.	0.6396	0.0221	60.	0.5944	0.0148	60.	0.2801	0.1529
80.	0.5268	0.0001	80.	0.6358	0.0203	80.	0.5867	0.0157	80.	0.2720	0.1544
100.	0.5203	0.0000	100.	0.6350	0.0197	100.	0.5821	0.0156	100.	0.2687	0.1557
150.	0.5009	0.0006	150.	0.6268	0.0177	150.	0.5598	0.0147	150.	0.2551	0.1569
200.	0.4802	0.0020	200.	0.6170	0.0146	200.	0.5460	0.0144	200.	0.2448	0.1568
334.	0.4679	0.0019	334.	0.6096	0.0131	334.	0.5404	0.0105	334.	0.2400	0.1571
534.	0.4460	0.0015	534.	0.5892	0.0118	534.	0.5188	0.0079	534.	0.2247	0.1553
834.	0.4066	0.0021	834.	0.5616	0.0101	834.	0.4666	0.0070	834.	0.1867	0.1538
BD =	1.23			1.46			1.61			1.72	
N =	2			2			2			2	

DEPTH (CM)

	76.			106.			106.			137.	
10.	0.4945	0.0124	10.	0.5098	******	10.	0.4479	******	10.	0.4639	0.0027
40.	0.4711	0.0121	20.	0.5179	******	40.	0.4655	******	20.	0.4670	0.0038
60.	0.4696	0.0121	30.	0.5261	******	60.	0.4596	******	30.	0.4424	0.0002
80.	0.4615	0.0125	40.	0.5147	******	80.	0.4582	******	40.	0.4401	0.0003
100.	0.4557	0.0114	50.	0.5147	******	100.	0.4552	******	50.	0.4028	0.0052
150.	0.4425	0.0123	60.	0.5130	******	150.	0.4435	******	60.	0.3672	0.0134
200.	0.4322	0.0122	80.	0.5098	******	200.	0.4317	******	80.	0.2906	0.0406
334.	0.4256	0.0127	100.	0.5081	******	334.	0.4185	******	100.	0.2715	0.0315
534.	0.4073	0.0130	120.	0.5049	******	534.	0.4053	******	120.	0.2524	0.0314
834.	0.3632	0.0115	180.	0.4771	******	834.	0.3612	******	180.	0.2144	0.0301
			334.	0.4493	******				334.	0.1914	0.0295
			534.	0.4183	******				534.	0.1675	0.0237
			834.	0.3660	******				834.	0.1421	0.0203
BD =	1.56			1.72			1.72			1.48	
N =	2			1			1			2	

Table K-2.4C. Bulk density calculated from wetted 1-step diffusivity samples following trimming, measurement, and drainage. * (Before) indicates sample was wetted in ring, then trimmed. (After) indicates sample was wetted without constraint, then placed in ring and trimmed.. $BD_{(nw)}$ is the oven-dry bulk density for a field sample not wetted. % + vol. is percent increase in sample volume caused by wetting the sample with distilled water.

DEPTH (cm)	BD (g/cc)	Ring Placement*	$BD_{(nw)}$ g/cc	$BD_{(nw)}$ /BD	% + vol.
8.0	1.07	After	1.23	1.150	15.0
23.0	0.83	After	1.46	1.759	75.9
38.0	1.08	After	1.61	1.491	49.1
53.0	0.98	After	1.72	1.755	75.5
76.0	0.96	After	1.56	1.625	62.5
107.0	1.15	After	1.72	1.496	49.6

Table K-2.5 EXLINE SERIES SITE K-2 NDSWC 1985

laboratory D(θ) data.

1STEP OUTFLOW DETERMINATIONS

DEPTH (CM)
7.6

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.4850	8.967

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.0359	0.0000	-0.0741	-467.230	1.081

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.6419	38.621	.6166	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.98	0.0435	0.0000	-0.0914	21192.221	0.889

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5411	****	******	178.	*******	*******	0.27E+00
0.2	.5381	****	******	178.	*******	*******	0.24E+00
0.5	.5351	****	******	178.	*******	*******	0.22E+00
0.8	.5321	****	******	178.	*******	*******	0.20E+00
1.1	.5291	****	******	178.	*******	*******	0.19E+00
1.4	.5261	****	******	178.	*******	*******	0.17E+00
1.8	.5231	****	******	178.	*******	*******	0.16E+00
2.2	.5201	****	******	178.	*******	*******	0.15E+00
2.6	.5171	****	******	178.	*******	*******	0.15E+00
3.1	.5141	****	******	178.	*******	*******	0.14E+00
3.5	.5111	****	******	178.	*******	*******	0.14E+00
4.1	.5081	****	******	178.	*******	*******	0.13E+00
4.6	.5051	****	******	178.	*******	*******	0.13E+00
5.2	.5021	****	******	178.	*******	*******	0.12E+00
5.8	.4991	****	******	178.	*******	*******	0.12E+00
6.4	.4961	****	******	178.	*******	*******	0.12E+00
7.1	.4931	****	******	178.	*******	*******	0.11E+00
7.7	.4901	****	******	178.	*******	*******	0.11E+00
8.4	.4871	****	******	178.	*******	*******	0.11E+00
9.0	.4850	****	******	178.	*******	*******	0.11E+00
9.5	.4831	****	******	178.	*******	*******	0.10E+00
10.0	.4812	****	******	178.	*******	*******	0.99E-01
10.5	.4795	****	******	178.	*******	*******	0.95E-01
11.0	.4778	****	******	178.	*******	*******	0.91E-01
13.0	.4719	****	******	178.	*******	*******	0.80E-01

DEPTH (CM) CONT.
7.6

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
17.0	.4626	****	******	178.	*******	*******	0.65E-01
21.0	.4554	****	******	178.	*******	*******	0.55E-01
25.0	.4495	****	******	178.	*******	*******	0.48E-01
29.0	.4446	****	******	178.	*******	*******	0.43E-01
33.0	.4404	****	******	178.	*******	*******	0.39E-01
37.0	.4366	****	******	178.	*******	*******	0.36E-01
41.0	.4333	****	******	178.	*******	*******	0.34E-01
45.0	.4303	****	******	178.	*******	*******	0.32E-01
49.0	.4276	****	******	178.	*******	*******	0.30E-01
53.0	.4252	****	******	178.	*******	*******	0.28E-01
57.0	.4229	****	******	178.	*******	*******	0.27E-01
122.0	.3997	****	******	178.	*******	*******	0.17E-01
194.0	.3861	****	******	178.	*******	*******	0.14E-01
266.0	.3772	****	******	178.	*******	*******	0.13E-01

DEPTH (CM)
23.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.2175	8.947

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
1.00	0.0042	0.0250	-0.3183	36.056	-0.401

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.6524	82.601	.6531	80.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.97	0.0320	0.0000	-0.0350	*********	1.002

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.2746	****	******	178.	*******	*******	0.11E+00
0.5	.2716	****	******	178.	*******	*******	0.12E+00
1.1	.2686	****	******	178.	*******	*******	0.12E+00
1.6	.2656	****	******	178.	*******	*******	0.13E+00
2.1	.2626	****	******	178.	*******	*******	0.13E+00
2.7	.2596	****	******	178.	*******	*******	0.14E+00
3.2	.2566	****	******	178.	*******	*******	0.14E+00
3.7	.2536	****	******	178.	*******	*******	0.15E+00
4.1	.2506	****	******	178.	*******	*******	0.15E+00
4.6	.2476	****	******	178.	*******	*******	0.16E+00
5.1	.2446	****	******	178.	*******	*******	0.16E+00

DEPTH (CM) CONT.
23.0

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/
5.5	.2416	****	******	178.	*******	*******	0.17E+00
6.0	.2386	****	******	178.	*******	*******	0.18E+00
6.4	.2356	****	******	178.	*******	*******	0.18E+00
6.9	.2326	****	******	178.	*******	*******	0.19E+00
7.3	.2296	****	******	178.	*******	*******	0.20E+00
7.7	.2266	****	******	178.	*******	*******	0.21E+00
8.1	.2236	****	******	178.	*******	*******	0.22E+00
8.5	.2206	****	******	178.	*******	*******	0.23E+00
8.9	.2175	****	******	178.	*******	*******	0.21E+00
9.4	.2142	****	******	178.	*******	*******	0.21E+00
9.9	.2111	****	******	178.	*******	*******	0.20E+00
10.4	.2082	****	******	178.	*******	*******	0.19E+00
10.9	.2055	****	******	178.	*******	*******	0.18E+00
12.9	.1961	****	******	178.	*******	*******	0.16E+00
16.9	.1821	****	******	178.	*******	*******	0.13E+00
20.9	.1718	****	******	178.	*******	*******	0.11E+00
24.9	.1639	****	******	178.	*******	*******	0.10E+00
28.9	.1575	****	******	178.	*******	*******	0.94E-01
32.9	.1521	****	******	178.	*******	*******	0.88E-01
36.9	.1476	****	******	178.	*******	*******	0.83E-01
40.9	.1436	****	******	178.	*******	*******	0.79E-01
44.9	.1402	****	******	178.	*******	*******	0.76E-01
48.9	.1371	****	******	178.	*******	*******	0.74E-01
52.9	.1343	****	******	178.	*******	*******	0.72E-01
56.9	.1318	****	******	178.	*******	*******	0.71E-01

DEPTH (CM)
53.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.1829	54.870

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.0049	0.1110	-1.1459	16.117	-6.139

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.3143	24.927	.2860	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
0.99	0.0084	0.0000	-0.1073	584.868	-0.230

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.3762	****	******	178.	*******	*******	0.47E-01
0.9	.3732	****	******	178.	*******	*******	0.48E-01
1.8	.3702	****	******	178.	*******	*******	0.48E-01
2.7	.3672	****	******	178.	*******	*******	0.49E-01
3.7	.3642	****	******	178.	*******	*******	0.50E-01
4.6	.3612	****	******	178.	*******	*******	0.50E-01
5.5	.3582	****	******	178.	*******	*******	0.51E-01
6.4	.3552	****	******	178.	*******	*******	0.52E-01
7.3	.3522	****	******	178.	*******	*******	0.53E-01
8.2	.3492	****	******	178.	*******	*******	0.53E-01
9.1	.3462	****	******	178.	*******	*******	0.54E-01
10.0	.3432	****	******	178.	*******	*******	0.55E-01
10.9	.3402	****	******	178.	*******	*******	0.56E-01
11.8	.3372	****	******	178.	*******	*******	0.57E-01
12.6	.3342	****	******	178.	*******	*******	0.58E-01
13.5	.3312	****	******	178.	*******	*******	0.59E-01
14.4	.3282	****	******	178.	*******	*******	0.60E-01
15.3	.3252	****	******	178.	*******	*******	0.61E-01
16.2	.3222	****	******	178.	*******	*******	0.62E-01
17.1	.3192	****	******	178.	*******	*******	0.63E-01
17.9	.3162	****	******	178.	*******	*******	0.64E-01
18.8	.3132	****	******	178.	*******	*******	0.65E-01
19.7	.3102	****	******	178.	*******	*******	0.66E-01
20.6	.3072	****	******	178.	*******	*******	0.68E-01
21.4	.3042	****	******	178.	*******	*******	0.69E-01
22.3	.3012	****	******	178.	*******	*******	0.70E-01
23.2	.2982	****	******	178.	*******	*******	0.72E-01
24.0	.2952	****	******	178.	*******	*******	0.73E-01
24.9	.2922	****	******	178.	*******	*******	0.75E-01
25.7	.2892	****	******	178.	*******	*******	0.76E-01
26.6	.2862	****	******	178.	*******	*******	0.78E-01

DEPTH (CM) CONT.
53.0

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
27.5	.2832	****	******	178.	*******	*******	0.79E-01
28.3	.2802	****	******	178.	*******	*******	0.81E-01
29.2	.2772	****	******	178.	*******	*******	0.83E-01
30.0	.2742	****	******	178.	*******	*******	0.85E-01
30.9	.2712	****	******	178.	*******	*******	0.86E-01
31.7	.2682	****	******	178.	*******	*******	0.88E-01
32.5	.2652	****	******	178.	*******	*******	0.91E-01
33.4	.2622	****	******	178.	*******	*******	0.93E-01
34.2	.2592	****	******	178.	*******	*******	0.95E-01
35.1	.2562	****	******	178.	*******	*******	0.97E-01
35.9	.2532	****	******	178.	*******	*******	0.10E+00
36.7	.2502	****	******	178.	*******	*******	0.10E+00
37.6	.2472	****	******	178.	*******	*******	0.11E+00
38.4	.2442	****	******	178.	*******	*******	0.11E+00
39.2	.2412	****	******	178.	*******	*******	0.11E+00
40.0	.2382	****	******	178.	*******	*******	0.11E+00
40.9	.2352	****	******	178.	*******	*******	0.12E+00
41.7	.2322	****	******	178.	*******	*******	0.12E+00
42.5	.2292	****	******	178.	*******	*******	0.12E+00
43.3	.2262	****	******	178.	*******	*******	0.13E+00
44.1	.2232	****	******	178.	*******	*******	0.13E+00
44.9	.2202	****	******	178.	*******	*******	0.14E+00
45.7	.2172	****	******	178.	*******	*******	0.14E+00
46.6	.2142	****	******	178.	*******	*******	0.15E+00
47.4	.2112	****	******	178.	*******	*******	0.15E+00
48.2	.2082	****	******	178.	*******	*******	0.16E+00
49.0	.2052	****	******	178.	*******	*******	0.16E+00
49.8	.2022	****	******	178.	*******	*******	0.17E+00
50.6	.1992	****	******	178.	*******	*******	0.18E+00
51.4	.1962	****	******	178.	*******	*******	0.18E+00
52.2	.1932	****	******	178.	*******	*******	0.19E+00
52.9	.1902	****	******	178.	*******	*******	0.20E+00
53.7	.1872	****	******	178.	*******	*******	0.21E+00
54.5	.1842	****	******	178.	*******	*******	0.22E+00
54.9	.1829	****	******	178.	*******	*******	0.89E-01
55.4	.1822	****	******	178.	*******	*******	0.89E-01
55.9	.1814	****	******	178.	*******	*******	0.88E-01
56.4	.1807	****	******	178.	*******	*******	0.87E-01
56.9	.1800	****	******	178.	*******	*******	0.87E-01
58.9	.1773	****	******	178.	*******	*******	0.84E-01
62.9	.1725	****	******	178.	*******	*******	0.80E-01
66.9	.1683	****	******	178.	*******	*******	0.77E-01
70.9	.1646	****	******	178.	*******	*******	0.73E-01
74.9	.1614	****	******	178.	*******	*******	0.71E-01
78.9	.1584	****	******	178.	*******	*******	0.68E-01
82.9	.1558	****	******	178.	*******	*******	0.66E-01
86.9	.1535	****	******	178.	*******	*******	0.64E-01
90.9	.1513	****	******	178.	*******	*******	0.62E-01
94.9	.1494	****	******	178.	*******	*******	0.61E-01
98.9	.1476	****	******	178.	*******	*******	0.59E-01
102.9	.1460	****	******	178.	*******	*******	0.58E-01
122.0	.1398	****	******	178.	*******	*******	0.54E-01

DEPTH (CM)
76.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.5456	0.500

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.1363	0.0000	-0.0919	161.296	0.883

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.5019	26.547	.4766	60.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
1.00	0.0063	0.0000	-0.0635	3840.268	0.640

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5688	****	******	178.	*******	*******	0.42E+00
0.1	.5658	****	******	178.	*******	*******	0.47E+00
0.2	.5628	****	******	178.	*******	*******	0.53E+00
0.3	.5598	****	******	178.	*******	*******	0.60E+00
0.3	.5568	****	******	178.	*******	*******	0.70E+00
0.4	.5538	****	******	178.	*******	*******	0.82E+00
0.4	.5508	****	******	178.	*******	*******	0.10E+01
0.5	.5478	****	******	178.	*******	*******	0.13E+01
0.5	.5456	****	******	178.	*******	*******	0.15E+01
1.0	.5119	****	******	178.	*******	*******	0.85E+00
1.5	.4932	****	******	178.	*******	*******	0.60E+00
2.0	.4803	****	******	178.	*******	*******	0.47E+00
2.5	.4706	****	******	178.	*******	*******	0.39E+00
4.5	.4458	****	******	178.	*******	*******	0.24E+00
8.5	.4205	****	******	178.	*******	*******	0.15E+00
12.5	.4059	****	******	178.	*******	*******	0.11E+00
16.5	.3956	****	******	178.	*******	*******	0.93E-01
20.5	.3878	****	******	178.	*******	*******	0.81E-01
24.5	.3815	****	******	178.	*******	*******	0.72E-01
28.5	.3762	****	******	178.	*******	*******	0.66E-01
32.5	.3717	****	******	178.	*******	*******	0.61E-01
36.5	.3678	****	******	178.	*******	*******	0.58E-01
40.5	.3643	****	******	178.	*******	*******	0.55E-01
44.5	.3611	****	******	178.	*******	*******	0.53E-01
48.5	.3583	****	******	178.	*******	*******	0.51E-01
52.5	.3557	****	******	178.	*******	*******	0.49E-01
122.0	.3292	****	******	178.	*******	*******	0.46E-01

DEPTH (CM)
106.0

DESORPTION PARAMETERS AND STATS

W-INF VOL-FR	TIME-INF HOURS
.4942	0.649

R**2	MSE	RES-MOI	DES-EXP	DES M	DES N
0.99	0.1665	0.0000	-0.0846	1307.649	0.955

BROOKS & COREY PARAMETERS AND STATS

W-SAT VOL-FR	S-AE CM	W-INF VOL-FR	SUC-INF CM
.4647	110.890	.4602	120.

R**2	MSE	RES-MOI	B&C-EXP	C&H M	C&H N
1.00	0.0010	0.0000	-0.1233	*********	0.980

TIME (HR)	WATER (CM3/CM3)	MAT-POT (CM)	MAT-POT (KPA)	HYD-GRAD (CM/CM)	HYD-CON (CM/HR)	SP-MOIS (1/CM)	DIFF (CM2/HR)
0.0	.5040	****	******	178.	*******	*******	0.14E+00
0.3	.5010	****	******	178.	*******	*******	0.19E+00
0.5	.4980	****	******	178.	*******	*******	0.30E+00
0.6	.4942	****	******	178.	*******	*******	0.11E+01
1.1	.4709	****	******	178.	*******	*******	0.64E+00
1.6	.4567	****	******	178.	*******	*******	0.47E+00
2.1	.4466	****	******	178.	*******	*******	0.37E+00
4.6	.4184	****	******	178.	*******	*******	0.19E+00
8.6	.3970	****	******	178.	*******	*******	0.12E+00
12.6	.3844	****	******	178.	*******	*******	0.85E-01
16.6	.3756	****	******	178.	*******	*******	0.69E-01
20.6	.3688	****	******	178.	*******	*******	0.59E-01
24.6	.3633	****	******	178.	*******	*******	0.51E-01
28.6	.3587	****	******	178.	*******	*******	0.46E-01
32.6	.3548	****	******	178.	*******	*******	0.42E-01
36.6	.3513	****	******	178.	*******	*******	0.39E-01
40.6	.3483	****	******	178.	*******	*******	0.36E-01
44.6	.3455	****	******	178.	*******	*******	0.34E-01
48.6	.3430	****	******	178.	*******	*******	0.32E-01
52.6	.3407	****	******	178.	*******	*******	0.30E-01
122.0	.3173	****	******	178.	*******	*******	0.19E-01
194.0	.3051	****	******	178.	*******	*******	0.16E-01
266.0	.2971	****	******	178.	*******	*******	0.15E-01

Table K-2.6. Brooks and corey b and specific moisture (sp_m) calculated from laboratory cores, and estimated hydraulic conductivity (K), and Mualem theory pore-interaction factor (ρ_m) for site K, replication 2. N is the slope of the log (K/K_i) versus log (ψ/ψ_i) curve used to calculate ρ_m. In "ring" column (+) indicates samples wetted initially in a brass ring, and (-) indicates samples were placed in rings after wetting.

Depth (cm)	Ring	b	% sat	ψ	sp_m	K	N	ρ_m
7.6	-	0.1468	0.96	60	0.00038	$5.7x10^{-5}$		
			0.95	68	0.00033	$4.6x10^{-5}$	1.70	-3.96
			0.90	93.8	0.00023	$2.5x10^{-5}$	1.80	-3.32
			0.85	138.5	0.00015	$8.1x10^{-6}$	2.33	0.248
			0.80	209	9.1x10	$3.1x10^{-6}$	2.33	0.248
			0.70	534	3.1x10	$4.1x10^{-7}$	2.26	-0.229
53	-	0.4093	0.91	60	$8.2x10^{-5}$	$4.5x10^{-6}$		
			0.90	62	$7.9x10^{-5}$	$4.5x10^{-6}$		
			0.85	71	$6.5x10^{-5}$	$4.1x10^{-6}$	0.58	-5.46
			0.80	82	$5.3x10^{-5}$	$3.7x10^{-6}$	0.59	-5.44
			0.70	114	$3.3x10^{-5}$	$3.1x10^{-6}$	0.68	-5.22
			0.50	337	$7.2x10^{-6}$	$6.6x10^{-7}$	1.11	-4.17
			0.37	535	$3.7x10^{-6}$	$2.0x10^{-7}$	1.41	-3.44
76	-	0.226	0.95	60	0.00032	$4.5x10^{-4}$		
			0.90	76	0.00024	$2.0x10^{-4}$	3.37	4.06
			0.85	101	0.00017	$7.9x10^{-5}$	3.34	3.94
			0.80	140	0.00011	$2.7x10^{-5}$	3.32	3.82
			0.70	238	$5.9x10^{-5}$	$5.5x10^{-6}$	3.20	3.30
			0.58	535	$2.2x10^{-5}$	$1.0x10^{-6}$	2.79	1.50
106	-	0.237	0.99	60	0.00027	$2.6x10^{-4}$		
			0.95	77	0.00021	$1.3x10^{-4}$	3.86	5.85
			0.90	87	0.00018	$8.4x10^{-5}$	3.69	5.13
			0.85	127	0.00011	$2.1x10^{-5}$	3.52	4.41
			0.80	158	$9.0x10^{-5}$	$1.0x10^{-5}$	3.47	4.20
			0.70	264	$4.5x10^{-5}$	$1.8x10^{-6}$	3.45	4.11
			0.59	535	$1.9x10^{-5}$	$2.8x10^{-6}$	3.18	2.96

REFERENCES

Adriano, D.C., and H.E. Doner. 1986. Bromine, chlorine, and flourine. In A.L. Page (ed.) Methods of soil analysis, part 2, 2nd ed., Agronomy 9:449-479.

Alessi, R.S. 1989. Sensitivy analysis of five hydraulic property models used in numerical solution of the one-dimensional Richards' equation. Ph.D. diss. North Dakota State Univ., Fargo, ND. (Diss. Abstr. 89-DA8923923).

Alessi, Sam, Lyle Prunty, and William Schuh. (In review a) Comparison of infiltration and drainage simulations among five power-function soil-water retention functions.

Alessi, Sam, Lyle Prunty, and W.M. Schuh. (In review b). Analysis of five soil-water retention functions for a loamy-fine sand. Soil Sci. Soc. Am. J.

Allison, L.E. 1947. Effect of microorgainsms on permeability of soil under prolonged submergence, Soil Sci., 63:439-450.

Armstrong, C.A. 1980. Ground-water resources of Dickey and La Moure counties, North Dakota. County Ground-Water Studies 28 - Part III. North Dakota State Water Commission, Bismarck ND.

Arya , L.M. and J.F. Paris. 1981. A physicoempirical model to predict the soil moisture characteristic from particle-size distribution and bulk density data. Soil Sci. Soc. Am. J. 45:1023-1030.

Blake, G.R., and K.H. Hartge. 1986. Bulk density. In A. Klute (ed.) Methods of soil analysis. Part 1. 2nd ed. Agronomy 9:363-375.

Bloemen, G.W. 1980. Calculation of hydraulic conductivities from texture and organic matter content. Z. Plfanzenernaehr. Boidenkd. 143:581-605.

Brooks, R.M. and A.T. Corey. 1964. Hydraulic properties of porous media. Hydro. pap. 3. Colorado State Univ., Fort Collins.

Burdine, N.T. 1953. Relative permeability calculations from pore size distribution data. Petroleum Trans. AIME. 198:71-87.

Campbell, G.S. 1974. A simple method for determining unsaturated hydraulic conductivity for moisture retention data. Soil Sci. 117:>311-314.

Cassel, D.K. 1974. In situ unsaturated soil hydraulic conductivity for selected North Dakota soils. Bull. 494. Agricultural experiment station, NDSU, Fargo.

Clapp, and Hornberger. 1978. Empirical equations for some soil hydraulic properties. Water Resour. Res. 14:601-604.

Doering, E. J. 1965. Soil-water diffusivity by the one step method. Soil Sci. 99:322

Gee, G.W. and J.W. Bauder. 1986. Particle-size analysis. In A. Klute (ed.) Methods of soil analysis. Part 1. 2nd ed. Agronomy 9:363-375.

Gosh, R.K. 1980. Estimation of soil-moisture characteristics from mechanical properties of soils. Soil Sci. 130:60-67.

Gupta, S.C., D.A. Farrell, and W.E. Larson. 1974. Determining effective soil water diffusivities from one-step method outflow experiments. Soil Sci. Soc. Am. Proc., 38:710-716.

Haines, W.B. 1930. Studies in the physical properties of soil. V. The hysteresis effect in capillary properties and the modes of moisture distribution associated therewith. J. Agric. Sci. 20:97-116.

Hanks, R.J. and S.A. Bouwers. 1962. Numerical solution of the moisture flow equation for infiltration into layered soils. Soil Sci. Soc. Am. Proc. 530-534.

Hillel, D., V.D. Krentos, and Y. Stylianou. 1972. Procedure and test of internal drainage method for measuring soil hydraulic characteristics in situ. Soil Sci. 114:395-400.

Hutson, J.L. and A. Cass. 1987. A retentivity function for use in soil-water simulation models. J. Soil Sci. 38:105-113.

Johnson, C.E., 1957. Utilizing the decomposition of organic residues to increase rates in water spreading. Trans. Amer. Geophys. Union., 38:322-326.

Klute, A. 1986. Water retention: laboratory methods. In A. Klute (ed.) Methods of soil analysis (2nd. ed.) : Agronomy 9:635-622.

Kohl, R.A., P.A. Mulomeli, and S.T. Chu. 1989. Infiltration rate sensitivity to surface soil water content. ASAE Paper No. 89-405.

McClean, E.O. 1986. Soil pH and lime requirement. In A.L. Page (ed.). Methods of soil analysis. part2, (2nd ed.), Agronomy 9:199-223.

Marshall, T.J. 1958. A relation between permeability and size distribution of pores. J. Soil; Sci. 9:1-8.

Millington, R.J., and J.P. Quirk. 1961. Permeability of porous solids. Trans. Faraday Soc. 57:1200-1207.

Mualem. Y. I. 1976a. A catalogue of the hydraulic properties of unsaturated soils. Technion Israel Institute of Technology. Research Project 442. Jerusalem, Israel.

Mualem, Y. I. 1976b. A new model for predicting the hydraulic conductivity of unsaturated porous media. Water Resour. Res. 12:513-522.

Mualem, Y. 1978. Hydraulic conductivity of unsaturated porous media: generalized macroscopic approach. Water Resour. Res. 14:325-334.

Nelson, R.E. 1986. Carbonate and gypsum. In A.L. Page (ed.). Methods of soil analysis. part2, (2nd ed.), Agronomy 9:539-577.

Nelson, D.W. and L.E. Sommers. 1986. Total carbon, organic carbon, and organic matter. In A.L. Page (ed.). Methods of soil analysis. part 2, (2nd ed.), Agronomy 9:539-577.

Okubo, T. and J. Matsumoto. 1979. Effect of infiltration rate on biological clogging and water quality changes during artificial recharge. Water Resour. Res. 15:1536-1542.

Rhoades, J.D. 1986. Soluble salts. In A.L. Page (ed.). Methods of soil analysis. part2, (2nd ed.), Agronomy 9:167-178.

Rogers, D.F. and J.A. Adams. 1976. Mathematical elements for computer graphics. McGraw Hill Inc., New York.

Schuh, W.M. and J.W. Bauder. 1986. Effect of soil properties on hydraulic conductivity-moisture relationship. Soil Sci.. Soc. Am. J. 50:848-855.

Schuh, W.M., and R.L. Cline. 1986. Compendium of selected North Dakota unsaturated flow data in functional format. Water Resources Investigation No. 4. North Dakota State Water Commission, Bismarck,ND.

Schuh, W.M., R.L. Cline, and M.D. Sweeney. 1988. Comparison of a laboratory procedure and a textural model for predicting in situ soil water retention. Soil; Sci. Soc. Am. J. 52:1218-1227.

Schuh W.M., and R.L. Cline. (In press). Effect of soil properties onK(θ) pore-interaction factors. Soil Sci. Soc. Am. J.

Schuh, W.M. , In review. Effects of an organic-mat filter on artificial recharge during application of turbid water. Water Resour. Res.??

Shirazi, M.S., and L. Boersma. 1984. A unifying quantitative analysis of soil texture. Soil Sci. Soc. Am. J. 48:142-147.

Skarie, R.L., J. L. Arndt, and J.L. Richardson. 1987. Sulfate and gypsum determination in saline soils. Soil Sci. Soc. Am. J. 51:901-905.

Suarez, D.L. 1981. Relation between pHc and sodium adsorption ratio (SAR) and an alternative method of estimating SAR of soil or drainage waters. Soil Sci. Soc. Am. J. 45:469-475.

Swartzendruber, Dale and Tamlin C. Olson. 1961a. Sand-model study of buffer effects in the double-ring infiltrometer. Soil Sci. Soc. Am. Proc. 25:5-8.

Swartzendruber, Dale and Tamlin C. Olson. 1961b. Model study of the double-ring infiltrometer as affected by depth of wetting and particle size. Soil Sci. 92:219-225.

USDA-SCS. 1971. Soil Survey of La Moure county and parts of James River valley North Dakota.

USDA-SCS. 1977. Soil Survey of Eddy county and parts of Benson and Nelson counties, North Dakota.

van Genuchten, R. 1978. Calculating the unsaturated hydraulic conductivity with a new closed-form analytical model. Research Report 78-WR-08. Water Resources Program. Department of Civil Engineering. Princton University.

van Genuchten, M. Th. 1980. A closed-form equation for predicting hydraulic conductivy of unsaturated soils. Soil Sci. Soc. Am. J. 44:892-897.

van Genuchten M. Th., and D.R. Nielsen. 1984. On describing and predicting the hydraulic properties of unsaturated soils. EGS; Annales Geophysicae.

Watson, K.K. 1966. An instantaneous profile method for determining the hydraulic conductivity of unsaturated porous material. Water Resour. Res. 2:709-715.

Worcester, B.K., 1967. The effect of cyclic flooding on biological activity and hydraulic conductivity of a soil surface. M.S. thesis, University of Arizona.

Youngs, E.G. and A. J. Peck. 1964. Moisture development and air compression during water uptake by bounded porous bodies: 1. theoretical introduction. Soil Sci., 98:290-294.

APPENDIX 1 Brooks and Corey Parameters for Field Data.

DEFINITION OF OUTPUT VARIABLES

W-SAT ....SATURATION WATER CONTENT

W-INF ....INFLECTION WATER CONTENT

W-SEG ....WATER CONTENT AT INTERSECTION OF TWO LOG-LINEAR SEGMENTS (WHERE REQUIRED) WHEN EXPONENTS ARE CALCULATED WITHOUT RESIDUAL MOISTURE PARAMETER. (EXPONENTS NOT PROVIDED WITH THESE OUTPUT DATA)

S-AE ....AIR-ENTRY SUCTION (REVISED ON MARCH 13, 2012)

S-INF ....INFLECTION SUCTION

MUALEM ρ ....MUALEM PORE-INTERACTION FACTOR

MSD ....MEAN SQUARE DEVIATION FOR DATA FROM THE BROOKS AND COREY MODEL

RES-MOIS.............RESIDUAL WATER CONTENT

B&C-b ....BROOKS AND COREY EXPONENT

C&H M ....CLAPP AND HORNBERGER PARAMETER

C&H N ....CLAPP AND HORNBERGER PARAMETER

APPENDIX 1-A HAMAR SERIES SITE A-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.4800	.3179	.1980	26.5	51.	1.79
30.	.3943	.3271	.1640	33.1	44.	1.50
53.	.3612	.2882	.0887	38.0	44.	2.89
69.	.3612	.2731	.0887	39.3	47.	2.42
84.	.3493	.2896	.1450	36.4	42.	1.48
99.	.3577	.3157	.0860	33.0	36.	0.33
114.	.3687	.3377	.1018	24.0	27.	1.94
130.	.3691	.3622	.1030	16.5	17.	0.61

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.027	.07100	-0.769	.14979E+03	-0.339995
30.	0.066	.06900	-0.809	.11275E+04	0.601116
53.	0.011	.06100	-1.898	.93346E+03	0.564666
69.	0.012	.06100	-1.930	.65380E+03	0.463244
84.	0.005	.05900	-1.615	.12423E+04	0.633168
99.	0.007	.06100	-1.771	.23882E+04	0.755628
114.	0.257	.03100	-0.808	.34353E+04	0.821058
130.	0.187	.03300	-0.697	.48150E+05	0.962086

HAMAR SERIES SITE A-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.4146	.3238	.1589	37.7	53.	0.24
23.	.3910	.3119	.1589	39.5	51.	0.49
38.	.4050	.2897	.1418	35.8	49.	1.72
53.	.3582	.2960	.1035	39.3	45.	2.12
69.	.3544	.2534	.1203	34.3	47.	2.30
84.	.3526	.3021	.1064	34.1	39.	0.66
99.	.3720	.3040	.0870	31.9	36.	1.42
114.	.3960	.3193	.0997	24.0	29.	0.35
130.	.3921	.3141	.1196	25.2	31.	0.99

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.027	.06000	-0.866	.74437E+03	0.457109
23.	0.016	.09900	-1.233	.98991E+03	0.543030
38.	0.030	.08300	-1.411	.43050E+03	0.318764
53.	0.016	.06700	-1.771	.13270E+04	0.629329
69.	0.008	.06000	-1.336	.40689E+03	0.308835
84.	0.012	.05900	-1.399	.16869E+04	0.694113
99.	0.004	.06700	-2.097	.95445E+03	0.612584
114.	0.012	.05200	-1.327	.63530E+03	0.569824
130.	0.030	.04800	-1.232	.61745E+03	0.551942

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 1-B HECLA SERIES SITE B-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
7.	.3904	.2931	.1360	40.7	52.	2.15
22.	.3787	.3340	.1360	32.7	37.	0.77
38.	.3616	.2772	.1245	32.0	41.	1.26
53.	.3516	.2995	.0918	31.9	36.	1.12
68.	.3527	.2943	.0776	31.6	36.	2.10
83.	.3426	.3231	.0927	29.6	31.	0.77
98.	.3521	.3208	.0953	28.9	31.	1.32

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
7.	0.002	.08200	-1.554	.65957E+03	0.433829
22.	0.003	.07700	-1.294	.24003E+04	0.750309
38.	0.012	.06400	-1.351	.58155E+03	0.465276
53.	0.003	.05700	-1.623	.14638E+04	0.685850
68.	0.005	.05200	-1.667	.11535E+04	0.646465
83.	0.002	.06000	-1.532	.90734E+04	0.883830
98.	0.003	.06200	-1.614	.36501E+04	0.816490

HECLA SERIES SITE B-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
15.	.3437	.2978	.1471	46.4	54.	0.52
45.	.3386	.2938	.1137	47.6	52.	1.63
68.	.3341	.2727	.1074	42.3	50.	3.18
83.	.3311	.2662	.1091	42.5	50.	2.21
98.	.3341	.2933	.1337	46.4	50.	2.69
114.	.3458	.2781	.0969	41.7	48.	-1.4
130.	.3629	.2924	.1372	40.8	44.	***

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
15.	0.067	.07300	-1.221	.26602E+04	0.713607
45.	0.005	.06900	-2.043	.27435E+04	0.724711
68.	0.023	.05000	-1.465	.12654E+04	0.599066
83.	0.011	.06000	-1.681	.11148E+04	0.57472
98.	0.013	.06400	-2.191	.31588E+04	0.747485
114.	0.038	.06200	-1.924	.10961E+04	0.580081
130.	0.000	.11200	-4.327	.10934E+04	0.6

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 1-C HECLA SERIES SITE C-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.3641	.3420	.2014	42.1	46.	0.86
23.	.3834	.3457	.2006	37.6	44.	1.44
38.	.3980	.3659	.1706	31.9	36.	0.79
53.	.3755	.3199	.1495	30.2	38.	3.51
69.	.3506	.3369	.1293	25.5	27.	-2.84
84.	.3430	.3364	.1371	27.3	28.	0.37
99.	.3526	.2921	.1255	33.4	40.	1.01
114.	.3621	.3217	.1235	34.2	38.	-0.07

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.041	.14600	-1.203	.11841E+05	0.875160
23.	0.025	.08400	-0.860	.40006E+04	0.789056
38.	0.011	.06600	-0.851	.50049E+04	0.829420
53.	0.020	.04700	-0.802	.13647E+04	0.662886
69.	0.044	.04100	-0.786	.16892E+05	0.919717
84.	0.024	.05800	-0.981	.74641E+05	0.961123
99.	0.023	.06000	-1.294	.11354E+04	0.624128
114.	0.012	.05900	-1.354	.27767E+04	0.765448

HECLA SERIES SITE C-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.3807	.3080	.2212	45.1	62.	3.29
23.	.3801	.3329	.2100	45.2	53.	1.56
38.	.3836	.3454	.2058	42.2	47.	2.22
53.	.3816	.3430	.1318	38.1	42.	1.58
68.	.3657	.3169	.1150	37.5	42.	0.26
84.	.3522	.3245	.1263	36.4	39.	1.59
99.	.3448	.2925	.0910	36.8	41.	1.76
114.	.3497	.3411	.0861	36.5	37.	0.20
130.	.4038	.3762	.1020	31.4	33.	3.08

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.020	.07800	-0.866	.12390E+04	0.546569
23.	0.002	.10600	-1.193	.30115E+04	0.734901
38.	0.003	.08200	-1.253	.43489E+04	0.791197
53.	0.002	.07700	-1.379	.37878E+04	0.788706
68.	0.009	.07200	-1.598	.21111E+04	0.718888
84.	0.041	.06200	-1.469	.59691E+04	0.837852
99.	0.005	.06100	-1.897	.16023E+04	0.680852
114.	0.003	.06500	-2.288	.60504E+05	0.950541
130.	0.005	.06500	-1.665	.68343E+04	0.860149

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 1-D   HECLA SERIES   SITE D-1 FIELD   DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
** 8.	.5064	.3609	.1678	35.6	48.	2.84
23.	.4817	.3783	.1736	33.0	45.	2.13
38.	.4287	.3513	.1671	43.9	52.	1.09
53.	.4198	.3520	.1377	45.1	52.	-0.64
76.	.4159	.3820	.1440	46.1	49.	1.60
107.	.3890	.3818	.1251	32.4	33.	1.44
137.	.3575	.3310	.1364	29.5	33.	1.87
168.	.3548	.3227	.1432	29.8	34.	1.28
198.	.3391	.3405	.1696	24.1	24.	2.78
228.	.3437	.3459	.1194	15.1	15.	2.39
259.	.3313	.3555	.1157	16.4	15.	0.17

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.030	.11700	-1.565	.43162E+03	0.325622
23.	0.043	.07100	-0.938	.39362E+03	0.482434
38.	0.002	.09300	-1.542	.13725E+04	0.608802
53.	0.006	.07900	-1.560	.17407E+04	0.654239
76.	0.005	.07200	-1.688	.70445E+04	0.832457
107.	0.022	.06800	-1.170	.94488E+05	0.962679
137.	0.013	.05800	-0.828	.53919E+04	0.843809
168.	0.021	.05900	-0.880	.36841E+04	0.80752
198.	0.007	.00000	-0.762	.12415E+07	1.008235
228.	0.003	.00000	-0.742	.37170E+06	1.012747
259.	0.004	.00000	-0.772	.31203E+04	1.140173

HECLA SERIES   SITE D-2 FIELD   DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
** 8.	.5061	.4537	.1730	32.2	36.	1.56
23.	.4860	.4079	.1799	32.6	41.	2.62
38.	.4424	.3535	.1734	41.2	50.	2.45
53.	.4230	.3801	.1514	38.1	42.	1.76
76.	.4159	.3581	.1421	42.1	47.	1.38
107.	.4170	.4026	.1636	32.7	34.	1.10
** 137.	.3947	.3814	.1845	27.7	29.	0.82

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.014	.11200	-1.278	.30548E+04	0.782640
23.	0.037	.06200	-0.888	.12482E+04	0.634404
38.	0.008	.08400	-1.473	.10350E+04	0.556725
53.	0.014	.09100	-1.436	.37804E+04	0.788514
76.	0.002	.07700	-1.712	.21900E+04	0.707583
107.	0.008	.06700	-1.101	.27586E+05	0.929776
137.	0.010	.13000	-1.143	.24761E+05	0.931546

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION
** FINAL DATA 834 CM RATHER THAN 15300

APPENDIX 1-E ULEN SERIES SITE E-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.3787	.3290	.2204	50.1	60.	3.60
23.	.3759	.3174	.2103	52.6	69.	2.48
38.	.3722	.3467	.1834	48.1	52.	0.89
53.	.3784	.3507	.1390	50.0	53.	1.60
76.	.3622	.3413	.1680	37.4	41.	-1.39
104.	.3004	.2650	.1410	29.2	34.	1.23
** 135.	.2576	.1922	.0510	23.9	30.	2.43

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.027	.08000	-1.013	.29593E+04	0.714530
23.	0.032	.09500	-0.861	.22258E+04	0.646336
38.	0.005	.07600	-1.141	.10424E+05	0.858256
53.	0.005	.07800	-1.677	.94070E+04	0.849977
76.	0.055	.04400	-0.729	.11417E+05	0.879302
104.	0.027	.08300	-1.165	.21677E+04	0.749055
135.	0.048	.03000	-1.487	.36134E+03	0.416915

ULEN SERIES SITE E-2 (IN SITU) NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
** 8.	.4167	.3477	.2255	45.4	58.	3.16
23.	.4115	.3449	.2189	39.8	56.	1.76
38.	.3920	.3261	.2031	51.0	66.	0.38
53.	.3860	.3426	.2044	53.8	61.	5.13
76.	.3724	.3296	.2215	45.4	54.	0.77
** 104.	.3331	.3092	.1613	37.3	41.	1.64
135.	.2814	.2849	.1579	24.5	24.	0.18
168.	.2533	.2600	.1125	29.6	29.	3.11
198.	.2656	.2224	.1163	35.5	38.	1.47

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.015	.15100	-1.227	.17732E	0.636876
23.	0.023	.06600	-0.625	.14697E	0.603994
38.	0.031	.07000	-0.889	.18071E	0.614303
53.	0.002	.00000	-0.949	.41949E	0.757809
76.	0.000	.14600	-1.203	.36672E	0.756234
104.	0.033	.07500	-1.042	.73733E	0.850751
135.	0.029	.10900	-0.888	.15794E	1.024706
168.	0.011	.03500	-1.603	.42842E	1.052483
198.	0.003	.08700	-4.067	.13858E	0.666542

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
38.	.3761	.3675	.2410	38.5	42.	5.93
53.	.3407	.3347	.2621	41.4	43.	8.32
76.	.2948	.2640	.1256	43.7	49.	5.69
** 106.	.3799	.2734	.1335	23.7	35.	3.00
** 137.	.4200	.2984	.1854	30.3	45.	2.94
167.	.3710	.2739	.1996	45.1	56.	6.26

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
38.	0.037	.11500	-0.383	.75599E+05	0.952780
53.	0.036	.08000	-0.611	.13458E+06	0.964246
76.	0.009	.07500	-1.309	.40640E+04	0.780826
106.	0.008	.08300	-1.139	.29298E+03	0.293525
137.	0.008	.13900	-1.434	.38728E+03	0.306011
167.	0.013	.07400	-1.821	.65723E+03	0.432980

ARVESON SERIES SITE F-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
7.	.4678	.4492	.1375	29.4	36.	-5.94
** 38.	.3710	.3645	.1660	48.1	51.	-6.16
** 53.	.3407	.3361	.1015	43.1	44.	3.49
** 76.	.3029	.2913	.1260	37.5	40.	4.43
** 106.	.2784	.2691	.0950	31.6	33.	1.40
** 136.	.4139	.3344	.0825	22.4	33.	5.29

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
7.	0.005	.01700	-0.208	.18288E+05	0.910594
38.	0.024	.00000	-0.297	.15616E+06	0.963839
53.	0.061	.08100	-0.914	.23776E+06	0.972792
76.	0.004	.11800	-0.998	.26186E+05	0.921816
106.	0.008	.09100	-1.210	.28728E+05	0.932207
136.	0.036	.00000	-0.549	.50703E+03	0.469077

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION
** LAST VALUE 834 CM, RATHER THAN 15300 CM

APPENDIX 1-G HEIMDAL SERIES SITE G-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.4785	.3852	.2645	35.0	77.	1.75
23.	.4444	.3785	.2870	39.3	84.	6.81
38.	.4146	.3927	.3115	42.2	59.	8.79
53.	.4383	.4063	.3227	34.8	51.	-3.71
76.	.4267	.4006	.3220	40.9	55.	5.45
107.	.4009	.3559	.3004	93.4	149.	-3.88
137.	.3881	.3639	.3158	115.1	133.	2.46

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.125	.10700	-0.367	.68595E+03	0.231555
23.	0.030	.00000	-0.211	.66650E+03	0.003829
38.	0.072	.00000	-0.162	.14004E+05	0.866745
53.	0.212	.00000	-0.198	.58108E+04	0.805834
76.	0.206	.00000	-0.213	.10298E+05	0.850721
107.	0.011	.00300	-0.257	.60121E+04	0.666663
137.	0.040	.09500	-0.597	.30442E+05	0.867473

HEIMDAL SERIES SITE G-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.4914	.4423	.2686	30.9	46.	6.64
23.	.4488	.3947	.3150	42.9	80.	10.31
38.	.4370	.4039	.3265	40.8	62.	9.14
53.	.4418	.4098	.3349	57.3	79.	1.83
76.	.4220	.3991	.3409	63.3	81.	8.81
107.	.3999	.3886	.3351	53.8	62.	5.81
137.	.4175	.4032	.3674	44.5	76.	-7.30

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.036	.08800	-0.325	.30050E+04	0.748212
23.	0.037	.00000	-0.206	.18494E+04	0.519255
38.	0.338	.00000	-0.188	.60733E+04	0.790130
53.	0.127	.00000	-0.234	.10039E+05	0.818927
76.	0.112	.00000	-0.227	.20558E+05	0.873125
107.	0.205	.00000	-0.203	.66933E+05	0.938750
137.	0.008	.00000	-0.065	.29216E+05	0.890200

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 1-H STIRUM SERIES SITE H-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.4027	.3720	.1213	40.2	53.	2.84
23.	.3918	.3676	.1213	39.7	55.	2.72
38.	.3602	.3506	.1958	54.3	60.	0.95
53.	.3432	.3332	.1578	59.2	64.	8.34
69.	.3612	.3482	.1551	45.0	49.	8.69
84.	.3245	.3032	.1336	27.0	34.	-1.80
99.	.2420	.2066	.1532	27.2	32.	-0.26
114.	.1998	.1990	.1637	23.9	24.	0.38

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.019	.04300	-0.323	.67507E+04	0.821363
23.	0.014	.00000	-0.195	.96274E+04	0.844901
38.	0.039	.09400	-0.369	.77805E+05	0.944558
53.	0.016	.06200	-0.461	.70694E+05	0.939695
69.	0.062	.07000	-0.531	.35529E+05	0.925298
84.	0.008	.05000	-0.350	.63248E+04	0.852223
99.	0.001	.12000	-2.116	.13614E+04	0.694546
114.	0.000	.00000	-0.700	.14822E+07	0.991969

STIRUM SERIES SITE H-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
** 8.	.4119	.3841	.2900	23.5	32.	1.59
** 23.	.3907	.3685	.3047	31.6	46.	4.79
** 38.	.3551	.3423	.3008	52.6	64.	6.33
** 53.	.3520	.3374	.3130	50.1	53.	15.32
** 68.	.3516	.3394	.2076	27.3	32.	8.26
** 84.	.3348	.3362	.2928	12.6	12.	14.03
99.	.2852	.2708	.2320	20.6	26.	0.47
114.	.2148	.2173	.1582	18.7	18.	1.97
** 130.	.2081	.2037	.1569	18.5	19.	6.90

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.033	.00000	-0.225	.41648E+04	0.833001
23.	0.085	.19500	-0.320	.11563E+05	0.873168
38.	0.016	.17700	-0.382	.44432E+05	0.923994
53.	0.022	.11100	-1.120	.29617E+05	0.915379
68.	0.099	.00000	-0.224	.22323E+05	0.923988
84.	0.173	.00000	-0.085	.72003E+06	1.008167
99.	0.001	.11100	-0.372	.88409E+04	0.890591
114.	0.003	.00000	-0.291	.13506E+06	1.022835
130.	0.057	.05500	-1.066	.41639E+05	0.957275

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

** LAST DATA 834 TO 850 CM, NO 15300 CM DATA/POOR FIT

APPENDIX 1-I ECKMAN LOAM SITE I-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-FINAL	S-AE	S-INF	MUALEM - p
8.	3883	.3705	.1729	63.5	88.	-18.96
** 23.	.4075	.3806	.2584	58.4	89.	-17.62
** 38.	.4152	.4070	.2712	43.7	50.	1.27
** 53.	.4455	.4036	.3257	19.2	62.	-8.55
** 69.	.4497	.3958	.3612	117.1	340.	*****
** 91.	.4651	.4141	.3739	334.6	544.	16.51
** 106.	.4757	.4659	.3272	59.9	67.	*****

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.045	.00000	-0.144	.27931E+05	0.885430
23.	0.011	.00000	-0.162	.11519E+05	0.816945
38.	0.008	.00000	-0.149	.11087E+06	0.957415
53.	0.001	.05500	-0.097	**********	2.338790
69.	INF	.22400	-0.256	.11098E+05	0.624535
91.	0.000	.00000	-0.239	.21928E+05	0.664108
106.	0.019	.23700	-0.375	.14902E+06	0.957574

ECKMAN LOAM SITE I-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-FINAL	S-AE	S-INF	MUALEM - p
** 8.	.3883	.3522	.3358	218.0	544.	24.88
** 23.	.4058	.3657	.2371	69.8	120.	****
** 38.	.4117	.3664	.2388	69.0	119.	****
** 53.	.4351	.3778	.2942	68.0	180.	****
** 69.	.4625	.3879	.3007	170.7	334.	****
** 84.	.4848	.4447	.3740	206.2	334.	****
** 99.	.4935	.4591	.4062	410.6	534.	****
** 106.	.4925	.4624	.3458	270.5	334.	****

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.000	.00100	-0.107	.27359E+04	-1.231751
23.	0.051	.00000	-0.192	.52725E+04	0.670861
38.	0.011	.00000	-0.214	.41493E+04	0.629321
53.	0.175	.00000	-0.145	**********	3.923550
69.	INF	.00000	-0.262	.34164E+04	0.232594
84.	INF	.00000	-0.179	.24167E+05	0.750196
99.	0.000	.00000	-0.275	.79911E+05	0.834428
106.	INF	.00000	-0.299	.69953E+05	0.860760

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION
** LAST DATA 834 TO 850 CM, NO 15300 CM DATA BECAUSE OF VERY POOR FIT

APPENDIX 1-J GARDENA LOAM SITE J-1 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
8.	.4410	.4212	.1608	31.2	42.	-6.21
** 23.	.4310	.4218	.3080	22.0	26.	2.19
38.	.4042	.4026	.1329	23.3	24.	3.71
53.	.3835	.3808	.1123	24.3	26.	12.74
69.	.4261	.4068	.1999	28.7	39.	0.95
** 84.	.4570	.4361	.3114	19.1	29.	2.23
** 99.	.4410	.4286	.3835	22.2	36.	7.11
130.	.4695	.4502	.1405	100.5	120.	****
145	.4836	.4390	.1688	387.4	544.	****

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.034	.00000	-0.154	.14456E+05	0.890394
23.	0.079	.00000	-0.130	.47512E+05	0.953018
** 38.	0.087	.00000	-0.140	.40000E+05	0.952924
** 53.	0.005	.00000	-0.102	.42082E+04	0.826466
69.	0.022	.11600	-0.209	.14698E+05	0.896122
84.	0.123	.00000	-0.112	.79516E+04	0.874521
99.	0.043	.22000	-0.120	.34581E+05	0.934859
130.	0.027	.00000	-0.237	.58171E+05	0.908710
145	*****	.00000	-0.285	.41196E+05	0.764589

GARDENA LOAM SITE J-2 FIELD DATA NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	MUALEM - p
** 8.	.4363	.4306	.3686	23.8	28.	2.96
** 23.	.4256	.4218	.3080	24.0	26.	-2.39
** 38.	.4041	.3954	.2623	18.8	22.	20.05
53.	.3969	.3757	.3296	15.7	27.	4.35
** 69.	.4194	.4035	.3513	23.1	38.	8.20
** 84.	.4423	.4361	.3114	25.9	29.	4.72
** 99.	.4419	.4286	.3835	19.8	36.	13.13
** 114.	.4503	.4439	.3967	17.9	22.	13.80
** 130.	.4503	.4591	.4096	17.9	32.	*****
** 145.	.4667	.4785	.3877	25.0	36.	*****

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.039	.15000	-0.124	.14652E+06	0.972308
23.	0.078	.00000	-0.113	.20022E+06	0.981372
38.	0.087	.00000	-0.140	.40000E+05	0.952924
53.	0.005	.00000	-0.101	.41736E+04	0.825920
69.	0.034	.20900	-0.158	.19862E+05	0.911625
84.	0.130	.00000	-0.125	.13081E+06	0.970167
99.	0.045	.00000	-0.051	.15479E+05	0.892626
114.	0.776	.00000	-0.069	86246E+05	0.967840
130.	0.494	.00000	-0.067	.90854E+05	0.962087
145.	0.012	.19700	-0.186	.37654E+06	0.980437

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION
** LAST DATA 834 TO 850 CM, NO 15300 CM DATA BECAUSE OF POOR FIT

APPENDIX 2 Brooks and Corey Parameters for Lab Data.

DEFINITION OF OUTPUT VARIABLES

W-SAT ....SATURATION WATER CONTENT

W-INF ....INFLECTION WATER CONTENT

W-SEG ....WATER CONTENT AT INTERSECTION OF TWO LOG-LINEAR SEGMENTS (WHERE REQUIRED) WHEN EXPONENTS ARE CALCULATED WITHOUT RESIDUAL MOISTURE PARAMETER. (EXPONENTS NOT PROVIDED WITH THESE OUTPUT DATA)

S-AE ....AIR-ENTRY SUCTION (REVISED ON MARCH 13, 2012)

S-INF ....INFLECTION SUCTION

S-SEG .... SUCTION AT INTERSECTION OF TWO LOG-LINEAR SEGMENTS (WHERE REQUIRED) WHEN EXPONENTS ARE CALCULATED WITHOUT RESIDUAL MOISTURE PARAMETER. (EXPONENTS NOT PROVIDED WITH THESE OUTPUT DATA)

MSD ....MEAN SQUARE DEVIATION FOR DATA FROM THE BROOKS AND COREY MODEL

RES-MOIS........... ..RESIDUAL WATER CONTENT

B&C-b ....BROOKS AND COREY EXPONENT

C&H M ....CLAPP AND HORNBERGER PARAMETER

C&H N ....CLAPP AND HORNBERGER PARAMETER

* Note (no Mualem ρ is calculated or provided for the laboratory data alone)

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4811	.4800	.1120	23.9	24.	834.
23.	.3743	.3743	.1170	34.0	34.	834.
38.	.4797	.4797	.1122	15.0	15.	834.
53.	.2975	.2750	.0618	20.2	22.	834.
69.	.3280	.3280	.0629	29.0	29.	834.
99.	.3338	.3066	.0610	20.2	22.	834.
114.	.4200	.4200	.0806	18.0	18.	834.
130.	.3766	.3766	.0821	24.0	24.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.026	.09400	-0.858	.49077E+07	0.9956
23.	0.011	.10800	E-1.043	.43747E+10	0.9998
38.	0.043	.10000	-0.836	.33501E+10	0.9999
53.	0.019	.05800	-1.166	.36525E+04	0.8429
69.	0.001	.06400	-1.728	.14986E+10	1.0003
99.	0.011	.05800	-1.244	.31566E+04	0.8310
114.	0.095	.07900	-1.417	.33610E+10	1.0001
130.	0.081	.08100	-1.608	.25372E+11	1.0001

HAMAR SERIES SITE A-2 LAB NDSWC:84

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
23.	.3856	.3424	.0750	20.8	26.	15300.
38.	.4054	.3690	.0635	17.0	20.	15300.
53.	.3356	.3124	.0453	20.7	23.	15300.
69.	.3496	.3267	.0445	23.5	25.	15300.
84.	.3597	.3555	.0544	20.8	21.	15300.
99.	.3538	.3361	.0483	21.0	22.	15300.
114.	.3640	.3442	.0331	18.1	19.	15300.
130.	.3590	.3517	.0356	18.7	19.	15300.
165.	.3862	.3540	.0672	15.4	19.	15300.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
23.	0.091	.07100	-0.664	.16767E+04	0.7497
38.	0.013	.06000	-0.682	.21057E+04	0.8055
53.	0.091	.04400	-0.799	.43636E+04	0.8549
69.	0.005	.06200	-1.330	.54634E+04	0.8656
84.	0.022	.06100	-1.410	.15690E+06	0.9768
99.	0.042	.06200	-1.340	.85068E+04	0.8979
114.	0.076	.05500	-1.346	.65604E+04	0.8890
130.	0.034	.05400	-1.328	.45606E+05	0.9587
165.	0.023	.05600	-0.490	.22784E+04	0.8144

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
23.	.3418	.3180	.0817	21.4	24.	800.
38.	.3616	.3480	.0673	19.0	20.	800.
53.	.3293	.3019	.0583	20.0	22.	800.
69.	.3392	.3208	.0533	21.9	23.	800.
84.	.3473	.3186	.0618	24.0	26.	800.
99.	.3427	.3151	.0636	24.2	26.	800.
114.	.3202	.2940	.0582	24.2	26.	800.
130.	.3482	.3104	.0674	25.4	28.	800.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
23.	0.012	.06200	-0.762	.45311E+04	0.8533
38.	0.003	.05800	-0.929	.13480E+05	0.9229
53.	0.012	.05300	-1.093	.29595E+04	0.8262
69.	0.009	.05100	-1.335	.75702E+04	0.8894
84.	0.003	.05900	-1.325	.35150E+04	0.8285
99.	0.006	.06200	-1.454	.37184E+04	0.8333
114.	0.020	.05600	-1.438	.36400E+04	0.8312
130.	0.021	.06500	-1.475	.21598E+04	0.7729

HECLA SERIES SITE B-2 LAB NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
23.	.3613	.3139	.0885	22.3	28.	834.
38.	.3647	.3467	.0680	17.9	19.	834.
53.	.3407	.3057	.0560	22.6	25.	834.
69.	.3549	.3118	.0559	21.5	24.	834.
84.	.3767	.3367	.0580	17.3	19.	834.
99.	.3876	.3803	.0591	18.7	19.	834.
114.	.3322	.2910	.0651	22.9	26.	834.
130.	.3354	.3041	.0654	21.1	23.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
23.	.0050	.07200	-0.791	.13189E+04	0.7067
38.	.0080	.06100	-1.003	.75925E+04	0.8989
53.	.0260	.05200	-1.269	.21675E+04	0.7844
69.	.0090	.05400	-1.385	.14762E+04	0.7435
84.	.0210	.05500	-1.195	.15518E+04	0.7760
99.	.0200	.05600	-1.235	.54476E+05	0.9622
114.	.0600	.06000	-1.277	.14778E+04	0.7363
130.	.0070	.06400	-1.424	.25862E+04	0.8061

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4769	.5038	.1441	26.0	24.	834.
23.	.4192	.3980	.1144	23.0	25.	834.
38.	.3499	.3240	.0852	28.0	31.	834.
53.	.3592	.3613	.0841	20.0	20.	834.
69.	.3978	.3817	.0746	19.0	20.	834.
84.	.4025	.3835	.0669	23.0	24.	834.
99.	.3699	.3699	.0654	24.0	24.	834.
114.	.3685	.3494	.0631	19.0	20.	834.
130.	.3877	.3581	.0621	19.0	20.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.009	.12100	-0.783	.80707E+04	1.1091
23.	0.010	.07600	-0.633	.88792E+04	0.8940
38.	0.002	.08000	-0.852	.51667E+04	0.8443
53.	0.005	.06800	-0.801	.59304E+06	1.0116
69.	0.004	.06600	-0.994	.11636E+05	0.9171
84.	0.003	.06000	-1.095	.10543E+05	0.9036
99.	0.011	.06400	-1.500	.88036E+10	1.0001
114.	0.012	.06000	-1.234	.72475E+04	0.8939
130.	0.004	.06000	-1.303	.32168E+04	0.8422

HECLA SERIES SITE C-2 NDSWC:84

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.3421	.3421	.1141	31.0	31.	834.
23.	.4192	.3980	.1144	23.0	25.	834.
38.	.3394	.3633	.0892	32.0	29.	834.
53.	.3633	.3386	.0813	20.0	22.	834.
69.	.3752	.3752	.0741	21.0	21.	834.
84.	.3173	.3173	.0647	34.0	34.	834.
99.	.3335	.3280	.0821	26.0	26.	834.
114.	.3417	.3165	.0623	20.0	22.	834.
130.	.3480	.3230	.0663	20.4	22.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.001	.09100	-0.730	.37690E+10	1.0002
23.	0.010	.07600	-0.633	.88792E+04	0.8940
38.	0.003	.08000	-1.012	.62189E+04	1.1366
53.	0.009	.06700	-0.823	.43213E+04	0.8576
69.	0.005	.06800	-1.070	.38387E+11	1.0000
84.	0.000	.04500	-0.818	.39412E+11	0.9999
99.	0.016	.05900	-1.388	.93221E+05	0.9667
114.	0.006	.06000	-1.304	.37150E+04	0.8477
130.	0.007	.06300	-1.199	.38942E+04	0.8513

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.5172	.5172	.1198	24.0	24.	834.
23.	.4983	.4980	.1090	34.0	34.	834.
38.	.3611	.3611	.0097	34.0	34.	834.
53.	.3943	.3943	.0823	34.0	34.	834.
76.	.4065	.3315	.0743	42.3	50.	834.
99.	.3874	.2618	.0787	48.0	61.	834.
137.	.3922	.3146	.0852	31.7	40.	834.
168.	.3667	.2978	.0804	24.7	30.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.004	.10300	-0.899	.68377E+10	1.0001
23.	0.015	.10300	-1.259	.96642E+08	0.9988
38.	0.006	.09000	-1.177	.12880E+11	1.0001
53.	0.006	.07700	-1.258	.39171E+10	0.9998
76.	0.014	.07100	-1.522	.12508E+04	0.5988
99.	0.009	.07800	-2.172	.45226E+03	0.2598
137.	0.012	.08000	-1.233	.81815E+03	0.5550
168.	0.022	.08300	-1.432	.71158E+03	0.5877

HECLA SERIES SITE D-2 LAB NDSWC:1985

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4928	.4811	.1169	29.1	30.	834.
23.	.3780	.3291	.1067	33.2	40.	800.
38.	.3520	.3090	.0896	34.8	40.	800.
53.	.4000	.3539	.0953	35.8	40.	800.
76.	.3759	.3377	.0792	36.5	40.	800.
107.	.4225	.3685	.0773	34.9	40.	834.
137.	.3862	.3523	.1349	26.2	30.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.018	.10300	-0.981	.52027E+05	0.9520
23.	0.004	.09500	-1.013	.20392E+04	0.7190
38.	0.009	.08300	-1.239	.23797E+04	0.7402
53.	0.001	.09200	-1.449	.27458E+04	0.7583
76.	0.006	.07600	-1.491	.35800E+04	0.7884
107.	0.030	.07000	-1.210	.21487E+04	0.7265
137.	0.012	.12800	-1.034	.35237E+04	0.8152

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4182	.3106	.0960	26.8	40.	834.
23.	.3911	.3911	.1349	35.0	35.	834.
38.	.3555	.3043	.0904	42.7	50.	834.
53.	.3655	.2919	.0810	41.1	50.	834.
76.	.3444	.3024	.0945	41.6	50.	834.
107.	.3728	.3421	.1329	44.4	50.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.006	.08500	-0.971	.38853E+03	0.3426
23.	0.003	.11900	-0.895	.27369E+11	0.9999
38.	0.004	.08500	-1.321	.21031E+04	0.6909
53.	0.005	.07800	-1.508	.10279E+04	0.5571
76.	0.009	.08000	-0.946	.28645E+04	0.7349
107.	0.004	.12200	-1.091	.67807E+04	0.8281

ULEN SERIES SITE E-2 LAB NDSWC:85
DEPTH 106.68 RESID. MOIS. ITERATED TO DEFAULT

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.3482	.3244	.1578	45.2	53.	834.
23.	.4225	.3501	.1308	36.3	50.	834.
38.	.3637	.3637	.1129	34.0	34.	834.
137.	.3255	.3255	.1160	24.0	24.	834.
168.	.3534	.3534	.0362	25.0	25.	834.
107.	.3994	.3322	.0868		50.	834.
107.	.2938	.2938	.1297		30.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.013	.13200	-0.733	.10229E+05	0.8558
23.	0.003	.10700	-0.815	.12699E+04	0.5989
38.	0.008	.09900	-0.926	.65566E+10	0.9999
137.	0.033	.11100	-1.038	.59130E+11	1.0000
168.	0.039	.03800	-2.182	.50029E+10	1.0001
107.	0.009	.08300	-1.456	.15205E+04	0.6363
107.	0.007	.11800	-0.800	.26769E+10	1.0002

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.5381	.5381	.2411	30.0	30.	834.
23.	.4101	.4101	.2426	27.0	27.	834.
38.	.4352	.4025	.1951	24.8	30.	834.
53.	.3327	.2597	.1235	32.1	54.	834.
76.	.4211	.3525	.0795	44.1	50.	834.
107.	.3799	.3416	.0879	27.4	30.	834.
137.	.4204	.3842	.1413	27.1	30.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.008	.17800	-0.544	.54844E+10	0.9999
23.	0.006	.10700	-0.243	.30871E+10	0.9998
38.	0.012	.17500	-0.707	.46929E+04	0.8398
53.	0.016	.10400	-0.738	.70091E+03	0.4262
76.	0.012	.07800	-1.781	.16767E+04	0.6540
107.	0.011	.09500	-1.599	.27446E+04	0.7908
137.	0.047	.13900	-1.331	.37621E+04	0.8213

ARVESON SERIES SITE F-2 LAB NDSWC:1985
DEPTH 7.62 RESID. MOIS. ITERATED TO DEFAULT

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4017	.3630	.2487	67.6	98.	835.
23.	.3587	.3217	.2012	39.0	70.	835.
38.	.3716	.3597	.1656	19.9	22.	835.
53.	.4508	.3086	.1015	24.0	40.	834.
76.	.3345	.2948	.1265	37.9	46.	834.
107.	.3728	.3728	.0946	34.0	34.	834.
137.	.4139	.4139	.1625	32.0	32.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.002	.20000	-0.573	.83717E+04	0.7850
23.	0.004	.00000	-0.186	.25054E+04	0.6259
38.	0.007	.12700	-0.494	.20310E+05	0.9339
53.	0.078	.09100	-0.983	.21344E+03	0.0905
76.	0.004	.11800	-1.047	.28427E+04	0.7450
107.	0.067	.09300	-1.614	.30072E+10	1.0002
137.	0.052	.08000	-1.748	.79954E+11	1.0000

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 2-G HEIMDAL SERIES SITE G-1 LAB NDSWC:1985

DEPTH 7.62 RESID. MOIS. ITERATED TO DEFAULT

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.5531	.5538	.2702	60.2	60.	834.
23.	.5280	.4241	.2593	27.7	60.	834.
38.	.4900	.4152	.2652	18.6	55.	834.
53.	.4271	.3553	.2459	37.5	98.	835.
76.	.4046	.3330	.2232	26.3	80.	834.
107.	.4362	.3409	.2410	29.8	120.	835.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.137	.20000	-0.692	.36460E+08	1.0026
23.	0.001	.19400	-0.481	.76019E+03	0.4022
38.	0.083	.00000	-0.153	**********	1.7099
53.	0.002	.09800	-0.256	.73475E+03	0.0383
76.	0.001	.03000	-0.191	**********	2.2108
107.	0.002	.00000	-0.177	**********	1.1602

HEIMDAL LOAM SITE G-2 LAB NDSWC:1985

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.5073	.4350	.2568	18.6	40.	834.
23.	.5116	.4350	.2583	30.4	60.	834.
38.	.4697	.3613	.2551	32.0	100.	834.
76.	.4359	.3540	.2472	22.7	80.	834.
76.	.4359	.3540	.2472	22.7	80.	834.
107.	.3734	.3282	.2376	41.7	98.	834.
130.	.3156	.2877	.2034	34.9	70.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.007	.10600	-0.260	.70983E+03	0.4622
23.	0.002	.13300	-0.332	.12600E+04	0.5322
38.	0.002	.18000	-0.411	.50780E+03	-.0842
76.	0.004	.08100	-0.208	**********	2.4588
76.	0.004	.08100	-0.208	**********	2.4588
107.	0.002	.00000	-0.151	.59206E+03	-.4878
130.	0.016	.00000	-0.133	.24324E+04	0.5857

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.5288	.4605	.1868	31.5	40.	850.
23.	.3757	.3593	.2266	21.7	30.	850.
38.	.3615	.3615	.1958	14.0	14.	850.
53.	.3412	.3251	.1579	53.9	60.	850.
69.	.3281	.2809	.1551	39.5	60.	850.
84.	.2935	.2478	.1336	34.6	60.	834.
99.	.3239	.2888	.1434	28.5	40.	834.
114.	.4707	.4581	.1740	29.5	30.	850.
137.	.6463	.3840	.1159	19.1	30.	850.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.005	.16800	-0.878	.19902E+04	0.7152
23.	0.048	.00000	-0.137	.10507E+05	0.8909
38.	0.252	.00000	-0.141	.10388E+11	1.0001
53.	0.026	.13300	-0.751	.25319E+05	0.9026
69.	0.014	.12900	-0.647	.21479E+04	0.6620
84.	0.025	.08400	-0.447	.14513E+04	0.5788
99.	0.032	.10900	-0.528	.26161E+04	0.7506
114.	0.014	.18200	-2.575	.41471E+05	0.9462
137.	0.068	.12300	-1.532	.10091E+03	-0.1383

STIRUM SERIES SITE H-2 NDSWC:1985

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
23.	.4070	.3828	.2703	23.9	40.	850.
38.	.3641	.3367	.2356	33.3	60.	834.
53.	.3859	.3604	.1212	36.0	40.	850.
69.	.4028	.3725	.1545	52.7	60.	850.
84.	.3904	.3261	.2198	19.2	60.	834.
99.	.4082	.3605	.2475	17.3	40.	834.
114.	.4123	.2928	.0672	23.9	30.	850.
137.	.3857	.2040	.0573	31.0	40.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
23.	0.003	.08300	-0.151	.66133E+04	0.8387
38.	0.051	.00000	-0.133	.40889E+04	0.7299
53.	0.047	.10400	-0.906	.84292E+04	0.8621
69.	0.021	.13500	-0.923	.96645E+04	0.8422
84.	0.028	.04700	-0.182	**********	2.7606
99.	0.025	.13900	-0.232	.12530E+04	0.6101
114.	0.055	.07300	-1.895	.28033E+03	0.3409
137.	0.008	.06600	-3.290	.13144E+03	-0.1171

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4650	.4655	.3517	60.7	60.	850.
23.	.4457	.4317	.2584	32.7	40.	850.
38.	.4382	.4313	.2712	17.6	20.	850.
58.	.5081	.4857	.3258	42.7	60.	850.
69.	.5270	.4948	.3612	35.9	60.	850.
84.	.6026	.5955	.4171	26.7	30.	850.
99.	.6148	.6007	.3739	25.5	30.	850.
114.	.5558	.4481	.3272	393.4	534.	850.
137.	.5159	.4965	.4147	30.6	60.	850.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.023	.00000	-0.099	.55535E+08	1.0021
23.	0.028	.00000	-0.159	.32449E+05	0.9293
38.	0.026	.00000	-0.124	.69700E+05	0.9660
58.	0.068	.00000	-0.133	.20186E+05	0.8885
69.	0.006	.00000	-0.123	.75867E+04	0.8094
84.	0.008	.00000	-0.101	.19136E+06	0.9749
99.	0.010	.07100	-0.161	.49108E+05	0.9504
114.	0.000	.00000	-0.705	.93819E+04	0.5125
137.	0.126	.00000	-0.057	.13254E+05	0.8422

SITE I-2 ECKMAN SERIES1985 NDSWC

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4370	.4289	.3358	48.7	60.	850.
23.	.4148	.3974	.3720	46.4	60.	834.
38.	.4341	.3912	.2388	13.9	30.	834.
53.	.5193	.5180	.2942	19.7	20.	834.
69.	.4994	.5063	.3007	22.6	20.	834.
84.	.5487	.5611	.3740	25.4	20.	834.
99.	.5733	.5814	.3740	23.9	20.	834.
114.	.5204	.4319	.3458	367.5	534.	834.
137.	.6904	.6842	.5418	25.8	30.	850.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.006	.00000	-0.090	.13671E+06	0.9578
23.	0.109	.00000	-0.167	.25264E+05	0.9014
38.	0.054	.00000	-0.135	.56614E+03	0.3654
53.	0.039	.00000	-0.143	.30438E+07	0.9949
69.	0.216	.00000	-0.112	.11882E+06	1.0260
84.	0.091	.00000	-0.094	.48108E+05	1.0410
99.	0.170	.00000	-0.079	.11904E+06	1.0260
114.	0.000	.00100	-0.500	.10898E+05	0.5418
137.	0.063	.00000	-0.060	.31366E+06	0.9804

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 2-J GARDENA SERIES SITE J-1 LAB NDSWC:85

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.8217	.6019	.3301	5.6	20.	850.
69.	.4294	.4294	.2723	14.0	14.	850.
99.	.4881	.4881	.3599	14.0	14.	850.
130.	.5302	.5302	.3493	14.0	14.	850.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.003	.24300	-0.373	.57875E+01	******
69.	0.007	.23400	-0.388	.62657E+10	0.9999
99.	0.019	.00000	-0.073	.18208E+10	1.0002
130.	0.028	.00000	-0.080	.13519E+11	1.0001

GARDENA SERIES SITE J-2 LAB NDSWC:1985

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.3944	.3870	.2698	25.0	30.	850.
23.	.4612	.4244	.2712	23.1	40.	834.
38.	.4472	.4251	.2292	15.3	20.	834.
53.	.3895	.3639	.2083	23.5	30.	850.
69.	.5361	.4850	.3387	11.1	20.	850.
84.	.4216	.4216	.2935	14.0	14.	850.
99.	.5356	.4955	.3784	15.8	40.	850.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.016	.00000	-0.104	.70179E+05	0.9584
23.	0.002	.04200	-0.168	.30461E+04	0.7556
38.	0.002	.09900	-0.244	.64592E+04	0.8879
53.	0.011	.17500	-0.520	.59868E+04	0.8580
69.	0.010	.30100	-0.418	.16486E+04	0.7774
84.	0.010	.23400	-0.277	.10562E+10	1.0002
99.	0.007	.00000	-0.084	.26178E+03	******

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

SITE K-1 EXLINE SOIL 1985 NDSWC

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.5121	.4861	.3963	33.8	60.	534.
23.	.7057	.6909	.5782	41.6	60.	834.
38.	.6121	.5882	.4939	56.6	100.	834.
53.	.5657	.5399	.4414	42.6	80.	834.
76.	.6131	.5860	.4348	37.8	60.	834.
106.	.7874	.7598	.3619	88.8	100.	834.
137.	.4476	.4227	.1181	36.8	40.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.029	.00000	-0.091	.95981E+04	0.8260
23.	0.124	.00000	-0.058	.86822E+05	0.9460
38.	0.139	.00000	-0.070	.27764E+05	0.8687
53.	0.103	.00000	-0.074	.13696E+05	0.8263
76.	0.082	.00000	-0.098	.16156E+05	0.8718
106.	0.884	.00000	-0.299	.71641E+05	0.9251
137.	0.026	.09800	-0.892	.12083E+05	0.8849

SITE K-2 EXLINE SOIL 1985 NDSWC

CURVE INFLECTION POINTS

DEPTH	W-SAT	W-INF	W-SEG	S-AE	S-INF	S-SEG
8.	.4840	.4560	.3537	29.3	60.	834.
23.	.3618	.3619	.3196	80.5	80.	834.
38.	.4209	.3991	.3133	30.1	60.	834.
53.	.1735	.1590	.1060	30.2	60.	834.
69.	.3034	.2881	.2228	31.7	60.	834.
107.	.3408	.3376	.2447	112.6	120.	834.
107.	.2995	.3044	.2415	119.1	100.	834.
137.	.4493	.4264	.1367	36.3	40.	834.

BROOKS AND COREY PARAMETERS

DEPTH	MSD	RES-MOIS	B&C - b	C&H M	C&H N
8.	0.175	.00000	-0.083	.46963E+04	0.7214
23.	0.164	.00000	-0.045	.76636E+09	1.0006
38.	0.154	.00000	-0.077	.65307E+04	0.7706
53.	0.171	.00000	-0.127	.24770E+04	0.6260
69.	0.163	.00000	-0.081	.81317E+04	0.8031
107.	0.080	.00000	-0.149	.12438E+08	0.9803
107.	0.145	.00000	-0.093	.43051E+06	1.0306
137.	0.019	.10000	-0.697	.14172E+05	0.8937

* NOTE: B&C CURVES ARE MATCHED AT INFLECTION SUCTION

APPENDIX 3. Van Genuchten parameters for field data.

APPENDIX 3-A. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site A data.

Site A. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.124	0.439	0.020	3.008	0.085	1.680	0.980
30.000	0.132	0.400	0.020	4.125	-0.800	1.120	0.980
61.000	0.067	0.365	0.020	4.269	2.670	16.120	0.980
84.000	0.067	0.350	0.020	4.760	-0.022	2.820	0.990
99.000	0.066	0.351	0.023	4.070	-0.420	4.960	0.990
114.000	0.084	0.358	0.027	4.950	0.084	5.330	0.980
130.000	0.084	0.369	0.029	4.400	1.690	22.540	0.990

Site A. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.104	0.430	0.019	2.880	-1.490	0.733	0.980
23.000	0.118	0.394	0.019	3.390	-0.964	1.910	0.980
38.000	0.098	0.366	0.019	4.480	1.150	5.320	0.970
53.000	0.090	0.363	0.020	5.680	1.510	7.860	0.980
69.000	0.088	0.360	0.020	5.220	4.820	411.000	0.980
83.000	0.086	0.357	0.021	5.110	-0.650	2.630	0.980
98.000	0.074	0.373	0.024	5.550	1.630	28.460	0.990
114.000	0.058	0.398	0.028	2.870	-0.429	12.300	0.990
130.000	0.062	0.392	0.029	3.450	-0.565	5.069	0.990

Site A, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.113	0.443	0.021	2.800	1.580	3.070	0.980
30.000	0.119	0.407	0.020	3.344	2.760	13.300	0.990
61.000	0.078	0.364	0.020	4.494	2.320	14.930	0.990
84.000	0.039	0.352	0.019	4.180	2.450	8.750	0.990
99.000	0.056	0.361	0.026	2.880	0.000	10.000	0.980
114.000	0.072	0.358	0.027	4.456	2.019	19.620	0.990
130.000	0.083	0.369	0.029	4.280	1.710	22.640	0.970

Site A, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.023	0.456	0.022	1.890	-0.542	3.420	0.980
23.000	0.036	0.414	0.021	1.860	0.134	10.260	0.980
38.000	0.092	0.365	0.019	4.310	1.330	5.531	0.970
53.000	0.068	0.365	0.019	5.190	1.880	8.860	0.950
69.000	0.092	0.359	0.020	5.420	1.070	16.410	0.980
83.000	0.055	0.367	0.021	3.640	1.150	10.960	0.990
98.000	0.084	0.372	0.025	5.870	1.360	26.970	0.960
114.000	0.034	0.401	0.029	2.364	0.931	47.290	0.990
130.000	0.028	0.394	0.031	2.461	2.147	37.370	0.980

APPENDIX 3-B. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site B data.

Site B. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.086	0.405	0.019	3.365	1.980	4.120	0.990
8.000	0.086	0.405	0.019	3.365	0.000	0.000	0.000
23.000	0.095	0.389	0.020	3.850	1.430	9.210	0.990
38.000	0.081	0.365	0.022	3.960	-0.140	1.930	0.990
53.000	0.069	0.361	0.023	4.170	1.840	11.540	0.990
69.000	0.062	0.366	0.023	4.240	2.220	16.480	0.990
84.000	0.073	0.359	0.024	4.470	1.660	15.020	0.990
99.000	0.073	0.384	0.026	4.147	0.860	13.020	0.990

Site B. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.114	0.350	0.016	7.830	-0.750	0.449	0.960
45.000	0.086	0.348	0.017	6.950	-0.088	1.560	0.980
68.000	0.074	0.351	0.018	6.010	0.314	4.0300	0.990
83.000	0.076	0.390	0.020	4.840	0.177	4.390	0.980
98.000	0.071	0.367	0.018	5.770	1.550	11.010	0.990
114.000	0.069	0.390	0.020	5.280	1.350	20.630	0.998
130.000	0.068	0.386	0.021	5.950	0.379	9.450	0.990

Site B, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.114	0.401	0.019	3.801	1.210	3.180	0.980
23.000	0.112	0.387	0.021	4.288	0.980	7.800	0.970
38.000	0.058	0.367	0.022	3.460	2.251	10.770	0.990
53.000	0.085	0.358	0.023	4.670	1.380	9.910	0.980
69.000	0.071	0.365	0.023	4.470	1.950	15.260	0.980
84.000	0.085	0.356	0.024	4.890	1.300	13.260	0.980
99.000	0.055	0.407	0.028	3.420	2.190	47.280	.

Site B, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.114	0.350	0.016	7.830	-0.750	0.449	0.960
68.000	0.068	0.352	0.016	5.930	2.270	8.020	0.990
68.000	0.047	0.361	0.018	4.900	2.750	18.800	0.990
83.000	0.057	0.482	0.025	3.380	1.780	67.530	0.990
98.000	0.034	0.388	0.018	4.560	3.011	25.410	0.970
114.000	0.087	0.378	0.019	6.130	0.898	15.610	0.880
130.000	0.060	0.388	0.021	5.740	1.640	20.480	0.980

APPENDIX 3-C. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site C data.

Site C. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.169	0.366	0.016	5.340	1.008	10.200	0.990
23.000	0.128	0.404	0.018	3.100	-1.450	0.966	0.990
38.000	0.101	0.436	0.021	2.770	0.281	6.740	0.990
53.000	0.100	0.405	0.023	3.130	1.160	8.170	0.990
69.000	0.078	0.457	0.032	3.160	-0.720	22.920	0.990
84.000	0.109	0.352	0.025	6.520	0.968	4.430	0.960
99.000	0.085	0.360	0.022	6.165	0.263	4.380	0.990
114.000	0.000	0.405	0.021	2.194	1.673	27.320	0.940

Site C. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.108	0.385	0.015	2.880	1.579	0.930	0.990
23.000	0.117	0.388	0.015	3.220	1.410	2.470	0.980
38.000	0.092	0.412	0.017	3.220	2.190	8.730	0.980
53.000	0.086	0.422	0.020	3.420	1.990	13.920	0.980
68.000	0.086	0.413	0.022	4.190	0.656	12.970	0.980
84.000	0.088	0.376	0.021	5.090	1.680	9.650	0.970
99.000	0.000	0.390	0.022	3.080	2.920	29.940	0.970
114.000	0.082	0.361	0.022	6.300	0.864	6.540	0.970
130.000	0.124	0.394	0.022	6.000	0.961	21.060	0.970

Site C, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.189	0.365	0.016	6.080	0.000	1.400	0.990
23.000	0.073	0.450	0.024	1.947	14.160	0.966	0.990
38.000	0.075	0.454	0.023	2.340	1.665	26.800	0.990
53.000	0.074	0.431	0.025	2.440	2.930	48.150	0.990
69.000	0.166	0.371	0.028	6.970	-1.590	6.330	0.990
84.000	0.109	0.352	0.025	6.510	0.978	4.450	0.960
99.000	0.056	0.364	0.021	5.289	2.546	12.870	0.990
114.000	0.053	0.374	0.021	5.203	0.673	5.420	0.940

Site C, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.082	0.583	0.050	1.799	-0.525	6.800	0.990
23.000	0.085	0.519	0.045	1.800	0.000	25.630	0.980
38.000	0.063	0.309	0.050	1.620	0.000	3.370	0.980
53.000	0.046	0.337	0.096	1.504	0.000	18.303	0.980
68.000	0.095	0.168	0.011	5.580	-20.570	0.074	0.980
84.000	0.125	0.214	0.018	5.092	-1.370	0.069	0.980
99.000	0.056	1.090	0.071	2.530	0.000	305.800	0.970
114.000	0.060	1.520	0.067	2.960	0.000	266.200	0.970
130.000	0.064	2.088	0.053	3.260	0.000	163.800	0.970

APPENDIX 3-D. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site D data.

Site D. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.111	0.504	0.023	2.980	1.800	14.300	0.990
23.000	0.104	0.476	0.021	2.740	-0.044	3.550	0.990
38.000	0.099	0.427	0.017	3.370	-0.422	2.199	0.990
53.000	0.090	0.419	0.017	3.850	-0.660	3.110	0.990
76.000	0.087	0.417	0.017	3.970	0.738	5.970	0.990
107.000	0.075	0.390	0.017	3.590	1.100	4.680	0.990
137.000	0.082	0.362	0.020	2.750	-0.038	2.640	0.990
168.000	0.073	0.395	0.026	2.380	2.450	28.660	0.990
198.000	0.159	0.347	0.028	6.340	-0.405	12.160	0.990
228.000	0.000	0.502	0.070	1.970	3.159	935.000	0.990
259.000	0.000	0.476	0.066	1.960	2.185	246.000	0.990

Site D. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.125	0.507	0.019	3.600	-0.650	0.762	0.990
23.000	0.120	0.486	0.019	3.200	0.266	4.430	0.990
38.000	0.092	0.441	0.017	3.290	-0.620	1.550	0.990
53.000	0.102	0.423	0.017	3.760	2.000	17.600	0.990
76.000	0.086	0.415	0.016	4.200	0.430	3.960	0.990
107.000	0.091	0.418	0.107	3.670	0.776	5.570	0.990
137.000	0.149	0.398	0.023	3.610	0.940	11.290	0.980

Site D, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.095	0.505	0.023	2.790	2.350	20.530	0.990
23.000	0.043	0.482	0.022	2.096	2.063	2.790	0.990
38.000	0.049	0.433	0.017	2.520	1.790	10.640	0.990
53.000	0.075	0.420	0.017	2.920	0.000	6.040	0.990
76.000	0.062	0.417	0.017	3.330	2.460	17.700	0.990
107.000	0.047	0.390	0.016	3.160	1.850	5.760	0.990
137.000	0.015	0.371	0.022	1.920	2.200	12.200	0.990
168.000	0.099	0.384	0.025	2.770	1.920	18.580	0.990
198.000	0.145	0.353	0.028	5.360	0.236	16.920	0.990
228.000	0.092	0.437	0.055	2.830	0.609	88.980	0.990
259.000	0.088	0.396	0.048	2.890	0.110	20.680	0.990

Site D, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.089	0.512	0.019	3.070	2.650	21.120	0.990
23.000	0.076	0.490	0.019	2.730	2.900	41.710	0.990
38.000	0.027	0.446	0.017	2.361	2.521	16.500	0.990
53.000	0.117	0.423	0.017	4.120	1.500	14.770	0.990
76.000	0.064	0.416	0.016	3.650	2.350	13.560	0.990
107.000	0.062	0.419	0.017	3.105	2.760	16.260	0.990
137.000	0.142	0.399	0.023	3.400	1.196	12.770	0.980

APPENDIX 3-E. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site E data.

Site E. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.087	0.371	0.011	2.810	3.480	0.384	0.990
23.000	0.142	0.374	0.013	3.450	0.020	0.399	0.990
38.000	0.099	0.373	0.013	3.840	-1.190	0.419	0.990
53.000	0.088	0.379	0.013	4.890	0.000	0.911	0.990
76.000	0.104	0.363	0.016	4.510	0.756	4.410	0.980
107.000	0.101	0.303	0.024	4.070	1.220	2.280	0.990
137.000	0.029	0.288	0.035	2.930	0.185	4.190	0.990

Site E. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.134	0.411	0.014	2.583	1.063	0.871	0.980
23.000	0.105	0.408	0.016	2.139	-0.381	1.960	0.990
38.000	0.109	0.387	0.013	3.136	-0.009	1.724	0.990
53.000	0.078	0.383	0.012	4.499	3.840	6.370	0.990
76.000	0.207	0.369	0.016	4.840	0.324	5.070	0.990
107.000	0.089	0.328	0.013	3.454	-0.733	0.463	0.990
137.000	0.118	0.517	0.078	2.170	-1.132	22.370	0.990
167.000	0.033	0.305	0.025	3.620	3.940	24.140	0.990
198.000	0.040	0.290	0.025	4.170	2.930	11.420	0.980

Site E, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23.000	0.123	0.376	0.013	2.740	1.577	1.358	0.990
38.000	0.052	0.346	0.014	2.360	0.000	1.357	0.990
53.000	0.006	0.380	0.013	3.690	1.641	2.038	0.990
76.000	0.158	0.365	0.017	8.590	0.000	4.160	0.980
107.000	0.090	0.306	0.024	3.720	1.760	2.930	0.990
137.000	0.013	0.321	0.044	2.365	1.542	24.420	0.990

Site E, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.089	0.414	0.016	2.013	2.116	1.636	0.980
23.000	0.013	0.410	0.018	1.587	0.482	5.077	0.990
38.000	0.044	0.391	0.014	1.997	1.425	4.680	0.990
53.000	0.160	0.383	0.013	5.996	1.283	5.480	0.990
76.000	0.208	0.372	0.016	5.420	0.390	5.340	0.990
107.000	0.051	0.332	0.014	2.287	0.287	0.921	0.990
137.000	0.093	1.087	0.428	1.720	0.563	110000.0	0.990
167.000	0.037	0.303	0.025	3.712	3.775	21.950	0.990
198.000	0.106	0.274	0.026	6.570	0.126	4.740	0.980

APPENDIX 3-F. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site F data.

Site F. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
38.000	0.155	0.377	0.010	2.005	3.091	0.377	0.990
53.000	0.115	0.341	0.011	2.996	5.781	0.255	0.990
76.000	0.078	0.297	0.014	3.479	3.654	0.614	0.990
107.000	0.088	0.408	0.032	2.643	1.293	8.394	0.980
137.000	0.135	0.438	0.028	2.698	-0.326	2.380	0.990
168.000	0.075	0.351	0.016	7.538	4.557	2.050	0.980

Site F. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.106	0.469	0.015	1.413	-3.569	0.291	0.990
38.000	0.000	0.389	0.015	1.290	6.840	10.260	0.910
53.000	0.102	0.341	0.011	3.697	-6294.0	0.089	0.990
76.000	0.109	0.325	0.019	2.432	3.970	7.270	0.970
107.000	0.083	0.381	0.036	2.240	0.922	7.100	0.970
137.000	0.062	0.414	0.023	2.180	7.940	88.170	0.970
167.000	0.109	0.386	0.022	2.660	5.028	11.750	0.950

Site F, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
38.000	0.176	0.379	0.010	2.521	3.572	0.368	0.990
53.000	0.119	0.342	0.011	3.286	5.870	0.263	0.990
76.000	0.080	0.298	0.015	3.540	3.620	0.625	0.980
107.000	0.058	0.425	0.036	2.185	4.150	192.300	0.990
137.000	0.115	0.449	0.031	2.350	0.651	7.880	0.990
168.000	0.079	0.351	0.017	7.640	4.420	2.022	0.980

Site F, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.114	0.470	0.014	1.431	-3.455	0.276	0.990
38.000	0.149	0.373	0.009	2.483	5.784	0.838	0.980
53.000	0.092	0.341	0.010	3.377	-0.382	0.101	0.970
76.000	0.114	0.320	0.018	2.650	3.850	5.390	0.990
107.000	0.069	0.481	0.060	1.940	1.780	127.150	0.990
137.000	0.065	0.414	0.023	2.200	7.830	84.390	0.980
167.000	0.198	0.363	0.023	4.330	1.110	2.856	0.990

APPENDIX 3-G. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site G data.

Site G. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.150	0.483	0.023	1.485	2.087	5.094	0.990
23.000	0.015	0.442	0.017	1.282	1.350	2.750	0.950
38.000	0.008	0.418	0.001	1.209	9.200	12.780	0.960
53.000	0.000	0.438	0.010	1.278	4.680	3.860	0.960
76.000	0.000	0.428	0.008	1.328	4.140	2.150	0.990
107.000	0.000	0.408	0.008	1.284	0.000	1.440	0.980
137.000	0.117	0.384	0.004	2.375	3.130	0.189	0.950
168.000	0.011	0.382	0.002	2.283	16.360	0.107	0.960

Site G. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.152	0.494	0.014	1.699	4.320	4.580	0.990
23.000	0.000	0.461	0.179	1.225	13.150	108.300	0.970
38.000	0.045	0.436	0.012	1.249	8.420	10.810	0.990
53.000	0.000	0.450	0.008	1.303	0.000	2.490	0.820
76.000	0.000	0.428	0.006	1.322	9.160	4.690	0.930
107.000	0.000	0.407	0.006	1.309	5.200	2.420	0.930
137.000	0.140	0.419	0.006	1.247	4.400	3.070	0.920

Site G, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.108	0.486	0.028	1.366	2.595	9.425	0.990
23.000	0.066	0.432	0.014	1.323	5.629	6.023	0.990
38.000	0.009	0.410	0.010	1.203	4.465	3.619	0.980
53.000	0.000	0.451	0.012	1.262	6.739	13.003	0.970
76.000	0.075	0.426	0.006	1.527	4.088	1.074	0.990
107.000	0.000	0.402	0.007	1.287	-1.040	0.988	0.990
137.000	0.097	0.386	0.004	1.938	2.294	0.227	0.960
168.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
198.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Site G, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.150	0.494	0.014	1.693	4.340	4.690	0.990
23.000	0.028	0.464	0.018	1.249	12.360	105.600	0.970
38.000	0.126	0.430	0.009	1.447	7.150	3.250	0.990
53.000	0.000	0.430	0.005	1.411	0.000	0.618	0.850
76.000	0.083	0.433	0.006	1.520	8.770	3.710	0.930
107.000	0.099	0.410	0.005	1.608	5.960	1.396	0.930
137.000	0.000	0.416	0.003	1.296	11.310	1.168	0.920

APPENDIX 3-H. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site H data.

Site H. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.096	0.407	0.012	1.633	2.040	0.025	0.990
23.000	0.090	0.397	0.012	1.408	5.190	0.171	0.990
38.000	0.141	0.368	0.008	1.961	1.180	0.059	0.990
53.000	0.093	0.379	0.012	1.776	6.200	2.370	0.990
69.000	0.145	0.382	0.014	2.783	3.580	0.490	0.980
84.000	0.072	0.361	0.029	1.520	4.460	15.480	0.940
99.000	0.000	0.262	0.026	2.221	3.030	0.602	0.960
106.000	0.000	0.291	0.041	2.257	4.360	6.580	0.970

Site H. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.148	0.413	0.016	1.816	1.460	0.018	0.990
23.000	0.000	0.407	0.035	1.143	0.234	1.860	0.990
38.000	0.000	0.368	0.014	1.195	5.770	3.420	0.990
53.000	0.114	0.352	0.010	3.588	14.800	1.480	0.980
69.000	0.108	0.352	0.010	1.904	5.490	0.889	0.980
84.000	0.000	0.331	0.009	1.251	1.960	1.150	0.980
99.000	0.126	0.290	0.022	1.968	3.420	0.479	0.990
106.000	0.038	0.249	0.036	1.748	6.340	12.390	0.980
137.000	0.057	0.208	0.027	3.362	6.780	0.621	0.960

Site H, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.099	0.402	0.011	1.668	1.680	0.018	0.990
23.000	0.090	0.395	0.011	1.410	4.950	0.144	0.990
38.000	0.130	0.362	0.007	1.870	1.138	0.052	0.990
53.000	0.050	0.390	0.015	1.532	8.360	8.400	0.990
84.000	0.066	0.438	0.025	1.605	7.140	22.630	0.990
99.000	0.094	0.248	0.028	3.450	0.647	0.281	0.960
106.000	0.000	0.237	0.029	3.290	4.940	0.759	0.970

Site H, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.150	0.412	0.015	1.844	1.437	0.017	0.990
23.000	0.000	0.410	0.039	1.140	0.000	2.260	0.990
38.000	0.000	0.377	0.018	1.184	5.736	7.320	0.990
53.000	0.111	0.352	0.010	3.580	14.840	1.541	0.980
69.000	0.048	0.342	0.009	1.529	6.843	0.829	0.990
84.000	0.000	0.332	0.007	1.302	4.759	0.971	0.980
99.000	0.127	0.291	0.022	1.980	3.446	0.496	0.990
106.000	0.145	0.222	0.034	3.957	0.124	0.703	0.980
137.000	0.057	0.209	0.027	3.338	6.791	0.672	0.960

APPENDIX 3-I. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site I data.

Site I. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.000	0.385	0.004	1.176	0.000	0.054	0.980
23.000	0.014	0.414	0.007	1.275	-3.760	0.153	0.990
38.000	0.000	0.451	0.018	1.210	-0.594	4.113	0.990
53.000	0.000	0.440	0.011	1.840	-9.310	1.482	0.960
69.000	0.000	0.440	0.002	1.322	-19.800	0.073	0.970
91.000	0.000	0.455	0.001	1.376	2.250	0.382	0.960
106.000	0.000	0.473	0.114	1.420	-27.540	0.335	0.260
137.000	0.000	0.496	0.001	1.576	-55.800	0.069	0.960

Site I. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.000	0.380	0.001	1.310	-15.160	0.006	0.990
23.000	0.000	0.406	0.005	1.281	-2.740	0.089	0.990
38.000	0.000	0.417	0.007	1.299	15.890	1.790	0.980
53.000	0.000	0.431	0.004	1.299	-8.470	0.163	0.980
69.000	0.000	0.466	0.004	1.300	0.000	0.448	0.980
84.000	0.000	0.481	0.002	1.360	10.310	0.173	0.890
99.000	0.000	0.485	0.001	1.380	5.460	0.183	0.960
106.000	0.000	0.487	0.001	1.530	-112.600	0.064	0.970

Site I, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.000	0.388	0.053	1.164	-7.213	0.069	0.990
23.000	0.000	0.408	0.006	1.263	-7.060	0.098	0.990
38.000	0.066	0.415	0.007	1.347	-1.950	0.340	0.990
53.000	0.125	0.416	0.003	1.574	-3.151	0.138	0.950
69.000	0.020	0.444	0.002	1.360	-16.630	0.069	0.980
91.000	0.000	0.458	0.003	1.213	-24.430	0.415	0.960
106.000	0.000	0.455	0.001	1.971	-8.280	0.257	0.900
137.000	0.000	0.506	0.001	1.406	-43.960	0.092	0.970

Site I, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.000	0.387	0.002	1.269	-15.590	0.008	0.990
23.000	0.065	0.405	0.005	1.400	-1.310	0.055	0.990
38.000	0.078	0.407	0.005	1.500	10.260	0.301	0.980
53.000	0.000	0.443	0.006	1.259	-1.620	0.547	0.990
69.000	0.054	0.463	0.003	1.400	72.600	24.620	0.990
84.000	0.085	0.481	0.002	1.577	21.180	0.166	0.990
99.000	0.000	0.481	0.001	1.357	29.050	0.146	0.960
106.000	0.000	0.481	0.001	1.550	-376.400	0.071	0.990

APPENDIX 3-J. Van Genuchten parameters for $\theta(\psi)$ and $K(\theta,\psi)$ for site J data.

Site J. Replication 1 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.094	0.448	0.014	1.302	-1.350	0.200	0.990
23.000	0.000	0.445	0.019	1.210	0.260	2.880	0.970
38.000	0.103	0.417	0.015	1.422	4.940	3.040	0.970
53.000	0.088	0.393	0.011	1.477	6.960	1.790	0.990
69.000	0.178	0.434	0.018	1.409	3.104	5.020	0.990
84.000	0.000	0.465	0.017	1.190	3.570	6.730	0.980
99.000	0.000	0.426	0.002	1.270	13.880	0.552	0.970
114.000	0.211	0.444	0.010	2.080	-133.10	0.299	0.000
130.000	0.000	0.468	0.005	1.293	0.000	0.288	0.990
145.000	0.000	0.478	0.001	1.416	0.000	0.122	0.990

Site J. Replication 2 θ_r, θ_s, α, and n determined first, ρ and K_s determined separately.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.000	0.412	0.004	1.208	0.000	0.104	0.950
23.000	0.000	0.430	0.010	1.233	-3.080	0.628	0.990
38.000	0.058	0.413	0.019	1.279	11.800	43.800	0.990
53.000	0.296	0.395	0.027	2.038	-0.690	0.505	0.990
69.000	0.000	0.415	0.011	1.135	-8.730	1.780	0.970
84.000	0.164	0.449	0.012	1.402	6.230	1.190	0.980
99.000	0.000	0.428	0.002	1.297	0.000	0.137	0.990
114.000	0.000	0.443	0.002	1.336	0.000	0.225	0.990
130.000	0.000	0.464	0.002	1.284	0.000	0.194	0.990
145.000	0.000	0.484	0.008	1.201	93.440	0.855	0.980

Site J, Replication 1, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.091	0.456	0.017	1.286	-1.065	0.312	0.990
23.000	0.000	0.446	0.019	1.210	0.310	3.026	0.990
38.000	0.088	0.421	0.017	1.372	5.175	4.540	0.990
53.000	0.081	0.387	0.010	1.464	6.540	1.161	0.980
69.000	0.169	0.424	0.015	1.402	2.470	2.310	0.970
84.000	0.000	0.465	0.017	1.191	3.555	6.531	0.980
99.000	0.049	0.428	0.002	1.349	16.530	0.056	0.960
114.000	0.429	0.444	0.050	1.464	-18.970	0.517	0.990
130.000	0.105	0.471	0.004	1.572	0.000	0.173	0.990
145.000	0.000	0.478	0.001	1.478	0.000	0.112	0.950

Site J, Replication 2, θ_r, θ_s, α, n, ρ, and K_s determined simultaneously.

Depth (cm)	θ_r	θ_s	α	n	ρ	K_s	R^2
8.000	0.102	0.410	0.002	1.480	12.169	0.041	0.990
23.000	0.000	0.447	0.016	1.213	0.000	2.127	0.970
38.000	0.144	0.389	0.008	1.674	11.229	2.798	0.960
53.000	0.289	0.389	0.020	2.296	0.180	0.337	0.990
69.000	0.177	0.413	0.008	1.337	0.000	0.640	0.990
84.000	0.171	0.446	0.011	1.434	5.480	0.799	0.990
99.000	0.064	0.429	0.002	1.415	0.000	0.123	0.990
114.000	0.062	0.439	0.002	1.469	0.000	0.137	0.990
130.000	0.000	0.469	0.003	1.277	13.315	0.482	0.990
145.000	0.000	0.484	0.008	1.201	92.450	0.816	0.950

APPENDIX 4 Computer Program used to calculated field hydraulic properties from field data. An example input file is included on the end. Output files are those given in the text for field flow data.

```
C         FLOB5 (WM SCHUH: 1985)
C         FLOB5 CALCULATES UNSATURATED HYDRAULIC CONDUCTIVITY AND DIFFUSIVITY
C         ACCORDING TO THE INSTANTANEOUS PROFILE METHOD (WATSON, HILLEL)
C         REQUIRED INPUT INCLUDES VOLUMETRIC MOISTURE AND TENSIOMETER
C         READINGS FOR EACH TIME AND DEPTH NODAL POINT.  TENSIOMETER
C         READINGS (MBAR) CAN BE INPUT DIRECTLY.  PROGRAM CALCULATES
C         MATRIC AND HYDRAULIC POTENTIAL. ARRAY DIMENSIONS I AND J
C         CORRESPOND TO DEPTH AND TIME RESPECTIVELY.
C             REQUIRED INPUT:
C          HO = HEIGHT OF MERCURY SUPPLY SURFACE ABOVE SOIL SURFACE
C               (0 IF SCALE IS SET TO 0 AT LAND SURFACE)
C          L =  NUMBER OF DEPTH NODAL POINTS
C          M =  NUMBER OF TIME NODAL POINTS
C          T(J)= TIME OF READING RELATIVE TO INITIAL TIME (T(1)) (HOURS)
C          Z(I)= DEPTH OF READING FROM SURFACE (Z = 0)    (CM)
C          TEMP(I)= SOIL TEMPERATURE FOR EACH DEPTH (USED TO CALCULATE
C                   INTRINSIC PERMEABILITY - NOT K)   - CENTIGRADE
C          W(I,J) = NEUTRON COUNT RATIO CORRESPONDING TO I & J
C                   * PROBE CALIBRATION EQ. MUST BE INCLUDED IN PROGRAM
C                   * WHERE DESIGNATED.
C          H(I,J)= TENSIOMETRIC READINGS CORRESPONDING TO I & J (MBAR)
C              ERRORS IN K OR OTHER VARIABLES ARE INDICATED BY
C          VERY LARGE OR SMALL VALUES (E-50 OR E50). THESE OFTEN MEAN THAT
C          A NEGATIVE NUMBER WAS ENCOUNTERED PREPARATORY TO A LOG
C          CONVERSION.  THEY DO NOT NECESSARILY MEAN THAT ALL RESULTS
C          ARE INCORRECT.
C               FLUX CONSISTS OF INTEGRATED WATER LOSS (MASS BALANCE)
C          FROM THE SURFACE THROUGH THE MIDPOINT OF THE LAYER (BETWEEN
C          NODAL POINTS) BEING MEASURED. METHOD IS FINITE DIFFERENCE.
C          AMPLE VALUES IN VERY WET RANGE ARE NECESSARY TO INSURE
C          THE ACCURACY OF K VALUES IN THAT RANGE, AND ALSO TO
C          AVOID EXCESSIVE ERROR IN CALCULATION OF SPECIFIC MOISTURE.
C          PRESMOOTHED DATA VALUES ARE SUGGESTED TO PREVENT NEGATIVE
C          K VALUES.
C               FROM SURFACE TO DEPTH OF FIRST TENSIOMETER AND NEUTRON
C          READING, GRADIENT IS CONSIDERED SAME AS NEXT INTERVAL:
C
C               TWO OUTPUT FILES ARE GENERATED.  ONE FORMATED FILE
C          INCLUDING TIME,MOISTURE, MATRIC POTENTIAL, HYDRAULIC GRADIENT,
C          HYDRAULIC CONDUCTIVITY, SPECIFIC MOISTURE, AND DIFFUSIVITY,
C          AND ONE UNFORMATED FILE WITH MOISTURE, MATRIC POTENTIAL,
C          HYDRAULIC CONDUCTIVITY, DIFFUSIVITY, AND INTRINSIC
C          PERMEABILITY, FOR DATA PROCESSING REFERENCE. INTRINSIC
C          PERMEABILITY CALCULATED HERE ACCOUNTS ONLY FOR VISCOSITY,
C          CONSIDERING THAT GRAVITATIONAL AND WATER DENSITY EFFECTS
C          SHOULD BE MINIMAL.
C
C             OUTPUT UNITS ARE
C                 HYD-CON  (CM/HR)    DIFF(CM2/HR2)   PERM(CM2)
C                 MAT-POT  (CM & KPA) TIME (HR)    DEPTH (CM)
C                 MOIS (VOLUME WATER/VOLUME SOIL)
C                 GRAD (LENGTH HEAD/LENGTH SOIL)
C         PROGRAM FLO
          CHARACTER*15   INFILE,OUTFILE
          CHARACTER*80         HEAD
          DIMENSION W(12,80),H(12,80),Z(12), HM(12,80),T(80),R(80),
     1          HMA(12,80),WA(12,80),CON(12,80),ADP(12),
     2          GRAD(12,80),TA(80),DIFF(12,80),SM(12,80),HMA1(12,80)
     3         ,TEMP(12),VIS(12),PERM(12,80)
C
```

```
C
C             Begin I/O specifications
C
           WRITE (*,*) 'ENTER INPUT FILE'
            READ (*,'(A15)') INFILE
            OPEN (15,FILE = INFILE)
c           WRITE (*,*) 'ENTER OUTPUT FILE1'
c           READ (*,'(A15)') OUTFILE
c           OPEN (16,FILE = OUTFILE)
            WRITE (*,*) 'ENTER OUTPUT FILE2'
            READ (*,'(A15)') OUTFILE
            OPEN (17,FILE = OUTFILE)
C
C             Read data input
C
            READ (15,'(A80)')  HEAD
           WRITE (16,'(A80)')  HEAD
           WRITE (16,'(1X/)')
5          FORMAT (F5.2,2(1X,I4))
            READ (15,*) HO,L,M
            READ (15,*)  (Z(I),I=1,L)
            READ (15,*)  (TEMP(I),I=1,L)
            READ (15,*)  (T(J),J=1,M)
          DO 30 I=1,L
            WRITE (*,*) H(I,1),Z(I)
            READ (15,*)  (H(I,J),J=1,M)
30        CONTINUE
          DO 50 I=1,L
            READ (15,*)  (W(I,J),J=1,M)
            WRITE (*,*) W(I,1),Z(I),W(I,M)
50        CONTINUE
C            End data input
*
           WRITE (16,89)
89           FORMAT (2X,'RICHARDS PARAMETERS')
C
C            Following loop to 119 calculates matric potential, viscosity,
C            and includes calibration curve for neutron probe
C
          DO 119 I=1,L
                WRITE (*,*) Z(I)
C
C             calculate viscosity from temperature for each depth
C               (Hardy and Codington equation)
C
                  VIS(I)= 10**(1301/(998.333+8.1855*(TEMP(I)-20)+
     *                 .00585*(TEMP(I)-20)**2 - 1.30233))
             DO 118 J=1,M
                HM(I,J)=H(I,J)*1.02 -HO-Z(I)
C
C               neutron probe calibration curve (must be adjusted for probe)
             x = (w(i,j)+.01577)/.37694
c           x = w(i,j)
            w(i,j) = .0986*(x**3) - .1215*(x**2) + .522*(x) -.00775
C
C
118       CONTINUE
119       CONTINUE
C
C
          DO 400 J=1,M-1
           DT = T(J+1) - T(J)
           TA(J)=(T(J)+T(J+1))/2
            SUM=0
          DO 300 I=1,L
```

```
          WRITE (*,*) Z(I)
*
*             initiate depth functions
*
         IF (I .EQ. 1) THEN
            DZ=Z(I)
         ELSE
           DZ=Z(I)-Z(I-1)
         ENDIF
           IF (DZ .EQ. 0) GO TO 120
              IF (I .EQ. 1) THEN
                   ADP(I) = Z(I)/2
              ELSE
                   ADP(I)=Z(I)-DZ/2
              ENDIF
            GO TO 130
120           ADP(I)=0
130        CONTINUE
*
*                begin time functions
*
              TA(J)=(T(J)+T(J+1))/2
*
*                 iniate head functions
*
           IF (I .EQ. 1) THEN
                XB=(HM(1,J)+HM(1,J+1)-HM(2,J)-HM(2,J+1))/2-(Z(2)-Z(1))
           ELSE
               XB=(HM(I-1,J)+HM(I-1,J+1)-HM(I,J)-HM(I,J+1))/2-DZ
           ENDIF
           IF((HM(I-1,J+1) .LE. 0) .OR.
     1        (HM(I,J+1) .LE. 0) .OR.
     2        (HM(I-1,J) .LE. 0) .OR.
     3        (HM(I,J) .LE. 0))GO TO 135
           IF (I.EQ.1) THEN
                HAD = ALOG (HM(I,J)*HM(I,J+1))
                HMA(I,J)=EXP(.5*HAD)
           ELSE
                HAD = ALOG( HM(I,J)*HM(I,J+1)*HM(I-1,J)*HM(I-1,J+1))
                HMA(I,J)=EXP(.25*HAD)
           ENDIF
                 GO TO 137
135        IF (I.EQ.1) THEN
                 HAD=(HM(I,J)+HM(I,J+1))
                 HMA(I,J)=HAD/2
           ELSE
                 HAD = HM(I,J)+HM(I-1,J)+HM(I-1,J+1)+HM(I,J+1)
                 HMA(I,J)=.25*HAD
           ENDIF
137         CONTINUE
           IF ((XB.EQ.0).OR.(DZ.EQ.0)) GO TO 150
           IF (I.EQ.1) THEN
             GRAD(I,J) = XB/(Z(2)-Z(1))
           ELSE
             GRAD(I,J) = XB/(DZ)
           ENDIF
           GO TO 151
150          GRAD(I,J) = -10**(-50)
151         CONTINUE
*
*               begin moisture functions
*
              IF (I .EQ. 1) THEN
                 WA(I,J)=(W(I,J)+W(I,J+1))*.5
                 DW=W(I,J)-W(I,J+1)
```

```
                SM(I,J)=(W(I,J)-W(I,J+1))/(H(I,J)-H(I,J+1))
             ELSE
                WA(I,J) =( W(I,J)+W(I,J+1)+W(I-1,J+1)+W(I-1,J))*.25
                DW=(W(I,J)+W(I-1,J)-W(I,J+1)-W(I-1,J+1))*.5
                SM(I,J)=(W(I,J)+W(I-1,J)-W(I,J+1)-W(I-1,J+1))/
     *             (H(I,J)+H(I-1,J)-H(I,J+1)-H(I-1,J+1))
             ENDIF
                  WL=.5*DZ*DW+SUM
*
*            NEGATIVE GRADIENT REQUIRED FOR INCLUSION OF FLUX
*            IN LOWER PROFILE MATERIALS.
*            assumed negative as data input
C            IF (GRAD(I,J) .LT. 0) THEN
                  SUM=DZ*DW + SUM
C            ELSE
C                 CONTINUE
C            ENDIF
*
           IF ((WL .LE. 0) .OR. (DT .LE. 0) ) GO TO 180
                  FLUX=-WL/DT
               GO TO 185
180               FLUX =-10**50
185            CONTINUE
                   CON(I,J)=FLUX/GRAD(I,J)
                   DIFF(I,J)=CON(I,J)/(- SM(I,J))
                   HMA1(I,J)=.098*HMA(I,J)
C         Permeability calculated from conductivity in cm/sec
                   PERM(I,J) = (CON(I,J)/3600)*VIS(I)/(980*1)
300          CONTINUE
400          CONTINUE
                DO 500 I=1,L
                  GRAD(I,J) = - GRAD(I,J)
                   SM(I,J) = - SM(I,J)
CC                WRITE (16,'(1X/)')
CC                WRITE (16,580) ADP(I)
                    MMM=M-1
                  WRITE (17,*) ADP(I),MMM
c                 WRITE (16,550)
c                 WRITE (16,575)
c                 WRITE (16,600) (TA(J),WA(I,J),HMA(I,J),
c    *       HMA1(I,J),GRAD(I,J),CON(I,J), SM(I,J),DIFF(I,J),J=1,M-1)
                  WRITE (17,625)(TA(J),WA(I,J),HMA1(I,J),
     *              CON(I,J),DIFF(I,J),PERM(I,J),J=1,M-1)
c                 WRITE (16,650)
c                 WRITE (16,*) char(12)
 500         CONTINUE
 550        FORMAT (1X,'TIME',3X,'WATER',3X,'MAT-POT',2X,
     *   'MAT-POT',2X ,'HYD-GRAD',2X,'HYD-CON',3X,'SP-MOIS',4X,'DIFF')
 575        FORMAT (1X,'(HR)',2X,'(CM3/CM3)',1X,'(CM)',
     *         3X,'(KPA)',5X,'(CM/CM)',2X,'(CM/HR)',3X,'(1/CM)',
     *         3X,'(CM2/HR)')
 580        FORMAT(1X,'DEPTH',2X,F6.0,2X,'CM')
 600       FORMAT (1X,F6.1,2X,F5.4,2X,F5.0,4X,F5.2,4X,F5.2,5X,E8.2,
     *                 2X,E8.2,3X,E8.2)
 625         FORMAT (F6.1,1X,F5.4,1X,F6.2,1X,E10.4,1X,E10.4,1X,E10.4)
650              FORMAT ('1')
          STOP
          END
```

Example Data Input File

```
HECLA SANDY LOAM      SITE B-1
18.25,4,34                                  [HO,L,and M]

15,30,46,61,                                [Z(I)]

7.3,7.3,7.3,7.3,                            [Temp(i)]

.6,.7,.8,.9,1,1.1,1.2,1.35,1.5,1.8,2.0,2.25,2.5,3.0,3.5,4.0,4.5,5.0,        [H(1,J)]  (15 cm )
10,15,20,25,30,40,46,60,70,80,90,100,110,120,130,140,

51,59,66,69,70,72,73,75,76.5,80,81.5,83,84.5,86,87,88,88.5,90,              [H(2,J)]  (30 cm)
92.5,96,99,102,104.5,107.5,109.5,113.5,115.5,117,118,119.5,120,121,122,
123.5,

60,72,77,80,81.5,83,84,85,85.5,87,88,89,90,91.8,92.8,93.5,94,94.2,          [H(3,J)]  (46 cm)
97,100,104,107,110,113,116,117.5,119.5,120.5,122,123,124,125,126,128,

78,82,86,89,91,93,95,98,99.5,102,104,105,106,108,108.5,109.5,109.8,110,  [H(4,J)]  (61 cm)
112,114,116.5,119,121,123,123.5,127.5,129,130,130.8,131.5,132,
132.5,134,135,
          comment.... the following data are entered as water contents, no
                    ..adjustment in calibration in program is necessary

.2993,.2835,.278,.265,.2541,.2475,.243,.2375,.233,.2266,.2235,.2205,       [W(1,J)]  (15 cm )
.216,.2045,.197,.194,.1925,.187,.172,.16,.151,.145,.141,.1375,.1365,
.135,.1335,.133,.1295,.1275,.126,.125,.123,.121,

.2769,.272,.266,.259,.2516,.2453,.2408,.2335,.2275,.2132,.208,.199,        [W(2,J)]  (30 cm )
.194,.1865,.1816,.177,.174,.172,.151,.1385,.13,.125,.121,.12,.119,.1165,
.1155,.1145,.1135,.1105,.1100,.1085,.107,.106,

.2625,.26,.257,.2518,.243,.2395,.2325,.224,.2174,.2063,.1958,.1904,        [W(3,J)]  (46cm )
.1826,.1737,.1685,.164,.1603,.157,.141,.129,.12,.115,.110,.108,.107,
.105,.104,.1025,.1005,.0995,.098,.096,.095,.094,

.2665,.2625,.258,.2523,.246,.2414,.2345,.2283,.2233,.2105,.203,.1986,      [W(4,J)]  (61 cm )
.185,.173,.1658,.16,.155,.152,.133,.125,.118,.115,.111,.1075,.1065,
.104,.1015,.10,.098,.096,.094,.0925,.09,.089,
```