GUIDELINES FOR IMPROVED IRRIGATION PRACTICES FOR VEGETABLE PRODUCTION IN THE YUMA AREA

Charles A. Sanchez and Dawit Zerihun

Yuma Agricultural Center
The University of Arizona
6425 W. 8th Street
Yuma, AZ 85364

A report submitted to

The USBR Yuma Area Office
P.O. Box D
Yuma, AZ 85366

January, 2001

CONTENTS

INTRODUCTION

Irrigated desert soils are commonly used for the production of high value horticultural crops. During the fall-winter months, vegetables (such as lettuce and broccoli) are the predominant crops grown in the Irrigation Districts of the Gila and Colorado River Valley. Dyked-end level furrows are widely used to irrigate vegetables in the moderately coarse to heavy textured soils of these Valleys. Application efficiency of furrows in these areas is often low. The inefficient irrigation practices as well as their attendant water quality and drainage problems are sources of environmental concern in the region. Recently, researchers have identified the lack of management guidelines as the main cause of low irrigation performance in the desert southwest (Sanchez and Bali, 1997). In 1997, the Yuma Agricultural Center initiated a project aimed at developing a management package (management tools as well as guidelines) for improved irrigation practices for the furrow irrigated vegetable production units of the irrigated river valleys. The project had field experimental, modelling, and outreach/educational components. The field experimental study was conducted over a period of 27 months (10/1998–12/2000), the objective of which was to develop a database for model calibration and validation. The modelling components include model calibration, validation, and simulation experiments. The database generated using simulation experiments was used to develop management tools (performance charts and tables) for dyked-end level furrows. In addition, management guidelines that facilitate effective use of the performance charts and tables were developed.

The principal objective of this study was to develop management tools as well as guidelines for the efficient management of furrow irrigated vegetable production units of the Yuma Valley Irrigation District. The development of management tools and guidelines had been undertaken in four stages: (1) experimental studies (10/1998–

12/2000), (2) model[1] calibration and validation (12/2000), (3) simulation experiments to develop management tools [i.e., performance charts and lookup tables] (1/2001), and (4) development of guidelines that facilitates effective use of the management tools (1/2001).

LITERATURE REVIEW

Furrow irrigation processes are governed by universal physical laws: conservation of mass, energy, and momentum; which in turn can be expressed as a function of a number of physical quantities. The physical quantities affecting the outcomes of an irrigation event are generally of two types: (1) *system variables* - those physical quantities whose magnitude can be varied, within a relatively wide band, by the decision maker; and (2) *system parameters* - those physical quantities that measure the intrinsic physical characteristics of the system under study and hence little or no modification is practically possible. Generally, furrow length, L, inlet flow rate, Q_o, and cutoff time, t_{co}, are considered as system variables, while the furrow geometry, the net irrigation requirement, Z_r, hydraulic roughness coefficient, n, bed slope, S_o, and infiltration parameters, I, can be considered as system parameters. A description of surface irrigation system variables and parameters as related to their influence, methods of quantification, and their dimensions are presented in the sequel.

[1]The model used in this study is SRFR (Strelkoff et al., 1998). SRFR is commonly used by researchers in real-life applications. SRFR has been extensively validated, has a well-developed user-interface, and has capabilities to analyze the effects of various management scenarios. In addition, SRFR has capabilities to simulate processes in any of the three primary surface irrigation systems at two levels of complexity and accuracy (zero-inertia and kinematic-wave models) in the framework of a single integrated model.

System parameters and variables

System parameters

A detailed description of the surface irrigation system parameters is presented in an earlier report by Sanchez and Zerihun (2000). For sake of completeness and convenience, that section of Sanchez and Zerihun's report is reproduced herein with some modification to make it relevant to furrow irrigation. The principal difference between dyked-end level furrows and basins arise from channel geometry, this topic will be dealt with first.

Furrow geometry parameters: while irrigation borders and basins can be described as wide rectangular channels, which lends them selves to the simplified unit width analysis[2]; furrows, on the other hand, can have different geometric sections. In addition, furrows are minature channels with flow depths that are of the same order of magnitude as their corresponding top width, hence changes in flow depth have a significant effect on the wetted area and the cumulative infiltration. At any instant, the area of infiltration depends on the geometry as well as the flow depth. In addition, furrow irrigation hydraulics requires information on such geometric elements as cross-sectional area and hydraulic radius. Consequently, in furrow irrigation modelling, parameters that characterize the geometry of the furrow cross-section must be specified as an input. This involves specification of the type of geometric section and the cross-sectional dimensions explicitly or empirical shape fitting parameters commonly described as furrow geometry parameters.

Required amount of application (Z_r): required amount of application represents the amount of water that needs to be stored in the crop root zone reservoir, during every irrigation event, in order to sustain normal crop growth and obtain satisfactory yield. The following simple expression can be used to estimate Z_r.

$$Z_r = TAW(P)D_r \quad (1)$$

where TAW = total available soil moisture (L/L. e.g. cm/m, mm/m, inch/ft) which represents the amount of water that a soil takes into storage as its water content rises from wilting coefficient to field capacity; P = represents the fraction of TAW held between field capacity and a certain management allowed deficit level, its value ranges from 0 to 1 (-); D_r = effective crop root depth (L). Z_r can be expressed in depth units (e.g. millimetre, inch) or in units of area (e.g. m^3/m, ft^3/ft). Z_r expressed in depth units can be converted to area units by multiplying it by the characteristic width of the channel. For furrows, the characteristic width is the furrow spacing.

Among other things crop type, stage of growth, presence or absence of shallow water table and limiting soil horizons (such as hard pans) determine the effective crop root depth, D_r. Soil physical properties such as texture and structure are the factors that determine the quantity of water that can be stored per unit depth of soil. The parameter P in Eq. 1, also known as P-factor, is an index that symbolizes the fraction of the total available water that a plant can extract from its root-zone without experiencing water stress and unacceptable levels of yield loss. Crop water stress is dependent on soil moisture content, soil type (i.e., the unsaturated hydraulic conductivity of the soil), crop type and stage of growth, and atmospheric demand. Therefore, the P-factor is a function of all these factors. Given the complex interrelationship between these factors, the determination of D_r and P is not a simple matter. In addition, for a specific soil-crop-atmosphere continuum experimental determination of D_r and P requires a costly experiment that spans over the life cycle of the crop. In case of citrus, the subject crop in this study, it might take a couple of years to collect one complete data set on D_r and P. It is therefore practical and makes economic sense to use literature data from the same irrigation district or an irrigation district that is in a similar agro-climatological zone for management purposes.

[2] An implicit assumption in the unit width analysis is that inlet flow rate is uniformly distributed over the width of the strip.

The procedure for the determination of TAW on the other hand is straightforward. Standard soil moisture determination techniques can be used to determine the moisture content at field capacity and at wilting coefficient and the difference yields TAW. TAW values for different soil textural classes can also be obtained from literature sources (e.g. NRCS, 1998).

Manning's roughness coefficient (n): Manning's equation is among the most commonly used equations for estimating the friction slope, S_f, of water flow in a hydraulic conduit:

$$S_f = \frac{q^2\left(\frac{n}{c_u}\right)^2}{A^2 R^{\frac{4}{3}}} \qquad (2)$$

where q = furrow inlet flow rate (m^3/min), n = Manning's roughness coefficient ($m^{1/6}$), c_u = dimensional constant (60 $m^{1/2}$/min), A = cross-sectional area of flow (m^2), and R = hydraulic radius (m). Manning's *n* is used as a measure of the resistance effects that flow might encounter as it moves down a channel, which is in fact a representation, in a lumped form, of the effects of the roughness of the physical boundaries of the flow as well as irregularities caused by tillage and vegetative growth. Recommended n values can be obtained from literature sources or can be estimated based on field measurements (e.g. Strelkoff et al., 1999).

C*hannel bed slope (S_o)*: bed slope is the average slope in the direction of irrigation and is an easy to measure quantity. In level furrows, the type of furrow which is under consideration here, bed slope is zero.

Infiltration parameters (I): infiltration affects not only the quantity of water that enters the soil profile and its rate of entry but also the overland flow processes itself. Over the years several infiltration models have been developed. Owing to their simplicity and minimal data requirement the most commonly used infiltration equations are those based on empirical relationships, particularly those of the Kostiakov-Lewis, modified

Kostiakov-Lewis equations, and their variants. The advantages, limitations as well as ways of estimating parameters of these two equations are briefly discussed in an earlier report by Sanchez and Zerihun (2000), thus will not be repeated herein. One important difference between furrows and basins pertaining infiltration is that in furrows, besides soil physical properties of importance, infiltration is affected both by intake opportunity time and changes in flow depth. In surface irrigation modelling, the effect of wetted perimeter variation on infiltration is commonly taken into account by multiplying the cumulative infiltration function by a characteristic length[3]over which infiltration takes place. Although there exists no sound theoretic basis for this approach, existing empirical evidence suggests that it yields satisfactory results.

System variables

Channel length (L): the length of a dyked-end level furrow needs to be known in order to estimate advance and recession over the length of run of the channel, the ultimate distribution of infiltrated water, and system performance. Generally, too long a furrow may result in a too slow advance, which in turn leads to a decline in uniformity and efficiency of irrigation water application. On the other hand, too short a furrow could be uneconomical due mainly to increased farm machinery idle runs, increased number of field supply/drainage channels as well as access roads, and reduced cultivated area.

Inlet flow rate (Q_o): inlet flow rate is the discharge diverted into a furrow. Inflow rate is one of the key variables that influences the out come of an irrigation event, it affects the rate of advance to a significant degree and also recession to a lesser but appreciable extent. It has a significant effect on uniformity, efficiency, and adequacy of irrigation. Like length, flow rate is a variable whose value can be fixed by the irrigator at the deign phase or prior to or following the initiation of every irrigation event such that system performance is maximized. The inlet flow rate should generally be constrained within a certain range. It should not be too high as to cause scouring and should not be too small as otherwise the water will not advance to the downstream end.

[3] The characteristic length could be top width, local wetted perimeter, wetted perimeter at the inlet end, wetted

Cutoff time (t_{co}): unlike in basins, in furrows cutoff time is commonly used as a cutoff criteria. Cutoff time is the duration between the beginning of irrigation and supply cutoff. It is one of the three decision variables, the other two being L and Q_o, over which the engineer and irrigator has a degree of control. The most important effect of cutoff time is reflected on the quantity of deep percolation loss and efficiency as well as adequacy of irrigation. In general, for any given factor level combination the selection of an appropriate value of t_{co} is made on the basis of the target application depth and acceptable level of deficit.

Furrow irrigation management criteria and objectives

Performance indices are the most important category of furrow irrigation dependent variables. Field experiments or equations that describe relevant universal physical laws, (i.e., mass, momentum, and energy conservation) can be used to evaluate the dependent furrow irrigation variables as functions of the system parameters and variables. In furrow irrigation, performance indices measure how close an irrigation event (scenario) is to an ideal one (Zerihun et al., 1997). A complete picture of the performance of an irrigation event can be obtained using three performance indices: (1) application efficiency, E_a[4]; (2) water requirement efficiency, E_r[5]; and (3) distribution uniformity, D_u[6]. The objective of furrow irrigation management is to maximize application efficiency, E_a; while closely satisfying the irrigation requirement ($Z_r \sim Z_{min}$, which means E_r = 100 %) and maintaining satisfactory levels of uniformity (D_u). Generally, furrow irrigation systems management involves the selection of Q_o-t_{co} pairs for maximum E_a prior to the initiation of every irrigation event.

Economic and practical considerations limit the scope of application of field experiments in system design and management. On the other hand, mathematical models

perimeter corresponding to the normal depth at the inlet, etc.

[4] Application efficiency is a measure of the effectiveness of an irrigation event in minimizing unavoidable losses.

[5] Water requirement efficiency is a measure of the adequacy of irrigation. It is expressed as the ratio of the average depth of water stored in the crop root zone to the target depth of application.

[6] Distribution uniformity measures the evenness of irrigation water application along the length of run of a furrow.

are far more flexible, less expensive, and more general than field experiments. This feature of mathematical models makes them the primary research as well as design, management, and analytical tools in many engineered systems including surface irrigation systems, such as dyked-end level furrows.

During the last couple of decades surface irrigation hydraulic modeling has been an area of intensive research. Depending on the form of the momentum/energy equation used, surface irrigation models can broadly be classified into three major groups: the hydrodynamic, zero-inertia, and kinematic-wave models, all of which are based on the numerical solution of the continuity and a variant of the momentum/energy conservation equation (Bassett and Ftzsimons, 1976; Sakkas and Strelkofff, 1974; Strelkoff and Katopodes, 1977; Katopodes and Strelkoff, 1977; Elliott et al., 1982; Walker and Humphereys, 1983; Bautista and Wallender, 1992; Strelkoff et al., 1998). A fourth class of surface irrigation model is the volume-balance model, which is based on the analytical or numerical solution of the spatially and temporally lumped form of the continuity equation, while the dynamic equation is supplanted by gross assumptions (Lewis and Milne, 1938; Davis, 1961; Hall, 1956; Philip and Farrel, 1964; Christiansen et al., 1966; Walker and Skogerboe, 1987). Among these four classes of models, strictly speaking, only the hydrodynamic and the zero-inertia models are applicable to level dyked-end furrow irrigation processes.

The selection of a model, for any application, involves a process of reconciling the conflict between accuracy on the one hand and cost and complexity on the other. Work to date suggests that models based on the theory of zero-inertia are the most preferred choice of modelers for both theoretical as well as practical studies. The potential for accuracy is good, because Froude numbers in surface irrigation are typically quite low, at the same time the diffusive character of the governing equations is conducive to stability of computation. Moreover, computation times are much less than that incurred with the fully dynamic model.

Although the literature in surface irrigation is voluminous, currently only few surface irrigation models are widely used by researchers in real-life applications. SRFR (Strelkoff et al., 1998) is perhaps the most commonly used surface irrigation model. SRFR has been extensively validated, has a well developed user-interface, and has capabilities to analyze the effects of various management scenarios. In addition, SRFR has capabilities to simulate processes in any of the primary surface irrigation systems at two levels of complexity and accuracy (the zero-inertia and the kinematic-wave models) in the framework of a single integrated model.

METHODOLOGY

The development of a management package for the furrow irrigated vegetable production units of the Yuma area had been undertaken in four stages: (1) experimental studies (10/1998 – 12/2000), (2) model[7] calibration and validation (12/2000), (3) simulation experiment and development of management tools [i.e., performance charts and lookup tables (1/2001)], and (4) development of management guidelines that facilitate effective use of the management tools (1/2001). The primary objective of the field experimental study was to develop a complete database that would be used in the modeling studies (i.e., model calibration and validation). A complete data set required to perform model calibration, validation, and simulation experiments for a dyked-end level furrow system includes data on: furrow length, L; inlet flow rate, Q_o; cutoff time, t_{co}; Manning's roughness coefficient, n; furrow geometry parameters, infiltration parameters; target application depth, Z_r; and advance and recession trajectories

Field experimentation

Description of the experimental site and procedure: Soils that are used to grow vegetables in the Yuma area exhibit relatively wide textural variation. Therefore, infiltration parameters can not be assumed constant without incurring significant errors

in design and management calculations. In order to overcome this difficulty, the soils of the area were categorized into four main textural groups and, it is assumed that, within each group the variation in infiltration can be considered relatively negligible. The four textural groups are: moderately coarse textured, medium textured, moderately fine textured, and fine textured soils (Table 1).

The experimental study lasted for 27 months (10/1998-12/2000). During each irrigation event, data on Q_o, t_{co}, depth hydrograph, cross-sectional dimensions, advance, and recession were collected on each of the test furrows. The field experimental study had been undertaken on seven experimental sites both within and outside the Yuma Agricultural Center of the University of Arizona (Figures 1-8). The seven experimental sites were selected such that a spectrum of the soil textural variation in the area are covered. Two of the sites are located within the experimental farms of the Yuma Agricultural Center (one in the Valley farm and another one in the Mesa farm) and the remaining five are located in private farms. The furrows used in the experiments are of variable length. Those within the university farm are 600 ft long, the standard length in the area (Tables 1 and 2). On the other hand, the length of furrows in the private farms vary from 585 ft to 874 ft (Table 1). The test furrows were used to irrigate carrot, lettuce, and broccoli. Within the University farm water had been pumped from field supply channels into gated pipes, which would then distribute them into the individual furrows. In the private farms, on the other hand, water was applied into the individual furrows using gated pipes and syphones. During each experiment, two or three experimental furrows were operated concurrently with a section of a field or an entire field.

Determination of system variables: all system variables (Q_o, t_{co}, and L) were determined based on direct field measurements (Table 1). L represents a known physical dimension of the furrow. The flow rate into the gated pipes had been measured using a flow meter fitted into the discharge end of the pump. Flow rates into the individual furrows were measured using portable flumes. Inlet flow rates into a furrow during an experiment vary during an irrigation event, however, an average value has been used in model calibration

[7] That is SRFR

and validation. t_{co} is monitored using a stop watch. Owing to the limited surface storage volume of furrows, adequate irrigation of furrows requires that cutoff time be set well in excess of the advance time. This has been the practice in all the experiments conducted within the framework of this study.

Determination of system parameters: among the system parameters, S_o and Z_r are relatively easy to quantify. Bed slopes were determined based on levelling runs conducted using standard surveyor's level along the centre line of each experimental furrow prior to the initiation of every irrigation event. Nevertheless, variations in measured elevation variations were generally low enough to assume zero bed slope. The target amount of application, Z_r, was calculated as a function of the total available water holding capacity of the soil, TAW; the P-factor; and crop root depth, D_r (Sanchez and Zerihun, 2000) (Table 2). For each of the soil textural groups the corresponding TAW values were obtained from the NRCS handbook (1998). Typical D_r for the vegetable crops grown in the Yuma area is about 1.64 ft (0.5 m) and the optimal P value for vegetable crops in the Yuma has been found out to be 0.4 (Sanchez et al., 1998). Substituting these values in equation 1 resulted in the target depth of application for each soil group as shown in Tables 1 and 2.

While determination of the system variables and some of the system parameters such as S_o and Z_r is straightforward, the estimation of such parameters as Manning's hydraulic resistance coefficient, n, and infiltration is not. In surface irrigation applications an n value of 0.4 is commonly used for situations in which flow occurs over bare soils, such as furrows. Therefore, n = 0.04 has been used in this study as well (Table 1 and 2). There are a variety of methods that can be used to estimate infiltration in irrigation furrows. These include approaches that require input data on advance, recession, and/or flow depth (Katopodes et al., 1990; Strelkoff et al., 1999, Walker and Busman, 1990). In this study, however, the two-point method of Elliott and Walker (1982) was modified to extend its scope of applicability to dyked-end level furrows (Zerihun et al., 2001). The reasons for the adoption of this approach are: (1) simplicity, (2) robustness, (3) minimal data requirement, and (4) "accurate" parameter estimates.

The infiltration parameter estimation model of Zerihun et al., ModKost, uses the modified Kostiakov-Lewis intake function (Eq. 3).

$$Z = k\tau^{a} + f_{o}\tau \qquad (3)$$

where Z = cumulative infiltration (mm, in, m^3/m), a = exponent of the power-law term in the modified Kostiakov-Lewis infiltration function, and k (mm/hr^a,in/hr^a,$m^3/m/min^a$) and f_o (mm/hr,in/hr,m^3/m/min) = coefficients of the Modified Kostiakov-Lewis infiltration function. The input data to ModKost includes inlet flow rate, flow cross-section dimensions, Manning's roughness coefficient, advance time to two points along the furrow, flow depth measured at regular spatial intervals at least at two instants of time. The following is an outline of the field measurement procedure used in the experimental study:

1. The test furrows were staked out at regular intervals that range from 60 ft to 176 ft in the longitudinal direction, which resulted in 5 to 11 measurement stations. Staff gauges[8] were setup at each of the measuring stations (Figure 9).
2. Flow rate into a furrow was measured regularly using a flume located at the head end of the furrow.
3. Advance time had been recorded at each of the measurement stations. Stopwatches were used to determine advance times.
4. During advance water surface depths were recorded whenever the advancing front arrives at a new measurement station. Once advance is completed, flow depth were measured at each station every 3 minutes. Notice that flow depths were measured at the same times at all the measurement stations. This resulted in a data set that shows the temporal change of the water surface profile.

[8] The staff gauges were used to measure flow depths at each measuring station.

Modeling

Model calibration: in the current study, model calibration involves estimation of infiltration parameters. For each soil group two/three data sets were used in estimating infiltration parameters using ModKost. The type of infiltration function implemented in ModKost is the modified Kostiakov-Lewis infiltration function. The parameters of the modified Kostikov-Lewis infiltration function are: k, a, and f_o (Eq. 3). ModKost employs a modified version of a simple inverse solution technique, which is commonly known as the two-point method. Although the original two-point method was developed for sloping free-draining furrows (Elliott and Walker, 1982), Zerihun et al. (2001) have modified it to extend its scope of application to dyked-end level furrows. The two most important modifications made to the two-point method of Elliott and Walker (1982) are: (1) during advance inlet cross-sectional area is calculated as a function of an assumed linear profile along the length of the channel[9] (2) basic intake rate is calculated as the quotient of the change in volumetric surface storage between two selected time lines[10] and the length of the furrow.

Once the basic intake rate, f_o, (Eq. 3) is determined, there remain two infiltration parameters (k and a) to estimate. At least two equations are needed to estimate the two unknown infiltration parameters. The two equations can be formed by applying the principle of mass balance to two instants of time during the advance phase. Mathematically any two points will do, in practice, however, some pairs will give better results than others. Elliott and Walker (1982) used the mid-distance and downstream points. Although the question of how to locate the two points for minimal parameter estimation error is still an issue that merits further investigation, in the current study the approach proposed by Elliott and Walker has been used in this study.

[9] This assumption has been made to obviate the difficulty associated with the growth without bound of normal depth in level bed channels.

[10] The two time lines that are used in the calculation of basic intake rate (f_o) are selected such that they occur some time after inflow ceases and the infiltration rate, presumably, settles to the steady state rate.

The parameter estimates, obtained using ModKost, for each soil textural group (i.e. moderately coarse textured soils, medium textured soils, moderately fine textured soils, and fine textured soils) are given in Tables 3. For each soil textural group, with the exception of moderately coarse textured soils, temporally and spatially averaged infiltration parameters have been calculated by taking the arithmetic mean of the parameter estimates obtained using ModKost (Table 3). However, for moderately coarse textured soils, the average infiltration parameter have been adjusted such that advance predicted by SRFR matches reasonably well with field observed advance (Table 3). Existing infiltration parameter estimation models lack the capability to forecast soil infiltration properties. Instead, they are used to analyze situations on a post-facto basis. Hence, a way to test the accuracy of estimates of soil infiltration parameters is to compare model predicted advance with field observed advance for the same data set as the one used in estimating the infiltration parameters, the accuracy of which is being evaluated. Comparison of advance predicted by SRFR, based on infiltration parameters estimated using ModKost, with field observed advance for each of the nine data sets used in model calibration is shown in Figures 10a-10i. The mean absolute residual is 3.9 min with a confidence interval of $\forall$1.1 min at the 5% level (Figure 11a). Excluding, only, three outliers, the mean absolute error drops to 3.1 min with a confidence interval of $\forall$0.7 min at the 5 % level (Figure 11b). The results of the evaluation of ModKost shows that infiltration parameter estimates of ModKost are highly accurate. Note that parameter values as calculated by ModKost have been used in evaluating the accuracy of the parameters estimates.

Model validation: the capability of the SRFR model to simulate dyked-end level furrow irrigation processes with an acceptable level of accuracy had been evaluated by comparing its output with field data. Seventeen data sets, that are not used in model calibration, were used in the model verification exercise. The temporally and spatially averaged infiltration parameters were used in this application (Table 3). Comparison of model predicted and field observed advance for the 17 data sets is shown in Figures 12-15. The mean absolute error in the advance predicted by SRFR is 4.7 minute with a confidence interval of $\forall$1.2 min at the 5 % confidence level. Excluding, only, eight

outliers the mean absolute residual drops to 3.1 min with a confidence interval of ∀0.5 minute at the 5 % level (Figures 16a and 16b). The results of model verification clearly demonstrate that SRFR is capable of simulating the furrow irrigation processes in the Yuma area with acceptable accuracy. In addition, it shows that the spatially and temporally averaged parameter estimates resulted in a consistent and reasonably accurate estimate of advance, even when used to analyze irrigation events that occurred in different temporal and spatial coordinates than the ones used in their estimation. This result, to a degree, validates the assumption that has been made earlier about the homogeneity of infiltration properties in a textural group. It is important to point out that most of the outliers shown in Figure 16a are associated with data related to experiment 44C (medium textured soils). All the experimental units in this soil group are located in a private farm, in which there is inadequate control over the water supply. This might have contributed to the relatively large error margin in estimated advance.

Simulation experiments

In the Yuma area reconfiguring (redesigning) most existing systems may entail significant capital expenditure, hence improvements in furrow performance can best be realised through improved management practices. Management tools (performance charts and lookup tables) are central to the management package developed for the Yuma area. A prime consideration in developing the management tools was that they should be simple enough to be understood and used by growers without the aid of trained irrigation technicians or experts. This practical constraint requires a direct and simplified graphical and tabular presentation of the relationships between performance indicators and system variables. In the management tools developed in this study, irrigation performance indicators are expressed as direct functions of the two management variables: unit inlet flow rate, Q_o, and cut off time, t_{co}. Q_o is the inlet flow rate into the individual furrows and the system parameters and variables have been set at typical values given in Table 2.

Selection of typical values for system variables and parameters: in the Yuma area a standard irrigation block[11] constitutes a tract of land that is 0.5 mile wide and about 660 ft long. After making allowances for canals and access roads, the average length of a furrow is about 600 ft. Therefore, 600 ft has been taken as the typical length of a furrow throughout the simulation experiment. For each soil textural group a spatially and temporally averaged infiltration parameters have been used in the simulation experiment (Table 2). This implies that temporal and spatial variation in infiltration are insignificant within a textural group. The fact that (1) soil textural variation within a group is relatively minimal, (2) more or less similar cultural practices and land grading methods/tools are used in the area, and (3) the management tools are developed for a narrow range of crop types (lettuce, broccoli, and carrot), make the forgoing assumption plausible. Throughout the simulation experiment the target depth of application have been maintained at the values indicated in Table 2. Although the effective crop root depth generally varies between 0-1.64 ft (0.5 m) during the life cycle of the crop, given the simplification that have already been made, the development of management tools for different target application depths is unwarranted.

Simulation experiments were performed to generate the database required to develop the management tools. Systematic variation of furrow inlet flow rate and cutoff time combinations within the range indicated in Tables 4–7 results in a database summarized in a series of graphs and tables (Tables 4 –7 and Figures 17-20). Figures 17a, 18a, 19a, and 20a, respectively, represent the application efficiency contours expressed as a function of furrow inlet flow rate and cutoff time for fine textured, moderately fine textured, medium textured, and moderately coarse textured soils. Figures 17b, 18b, 19b, and 20b, respectively, depict low quarter distribution uniformity as a function of cutoff time and inlet flow for fine textured, moderately fine textured, medium textured, and moderately coarse textured soils. In management decision-making applications, Figures 17-20 have to be used in conjunction with Tables 4-7 (See management guidelines section). Notice that all irrigation scenarios summarized in

[11] One that receives its supply from the same field supply channel.

Figures 17 and 20 and Table 4-7 (i.e., level basin option) replenish the root zone fully, which means the corresponding water requirement efficiency is 100 %.

In general, the lookup tables are more comprehensive than the charts in terms of the type of information they provide. They contain information on application efficiency, low quarter distribution uniformity, water requirement efficiency, maximum, average, as well as applied depths, and maximum surface depth. The performance charts have to be used in conjunction with the lookup tables in making management decisions. A guideline on how to make effective use of the management tools is outlined in the next section.

Management guidelines

The following procedure is proposed to facilitate effective use of the management tools (i.e., performance curves and lookup tables) in making management decisions. In order to avoid injudicious use of the management tools, it is important to recognize the assumptions based on which the management tools are developed. Therefore, pertinent assumptions are stated first:

1. It has been assumed that the furrows are installed in a uniform level bed. This implies that the presence of micro-topographic deviations from the theoretically assumed surfaces, which are common in real-life situations, might introduce some error in the predictions of the management charts and tables. So periodic land levelling is important to minimize the prediction error associated with micro-topographic variations.
2. It is important to recognize that the management tools were developed based on spatially and temporally averaged infiltration and roughness parameters. Discrepancies between actual infiltration and roughness parameters and the assumed spatial and temporal average values will introduce some error to the estimated performance indices.
3. It is assumed that the irrigators have adequate control over the water supply into the field supply conduit and flumes used to measure flow rates into a field supply

channel and the individual furrows are well maintained and regularly calibrated. Deviation from these assumptions might contribute to flow measurement errors that are not accounted for in the management tools.

A procedure for dyked-end level furrow management

1. Determine the duration, t_i, for which a specified amount of flow rate, Q_c, can be diverted from the main canal onto the field supply channel. t_i might be determined based on agreements between individual growers and irrigation district personnel.
2. Set a target level of application efficiency, E_{at}.
3. Use either Tables 4-7 or Figures 15-18 to determine Q_o and t_{co} that correspond to E_{at}
4. Calculate the number of furrows in a set, N_{fps}.

$$N_{fps} = \frac{Q_c}{Q_o} \tag{4}$$

5. Calculate the number of sets in a field, N_{sif}:

$$N_{sif} = \frac{W_f}{f_s(N_{fps})} \tag{5}$$

where W_f = field width (m) and f_s = furrow spacing (m).

6 Calculate the time required to cover a field, T_f:

$$T_f = N_{sif}(t_{co}) \tag{6}$$

7. Check if the available time, T_a, after allowing for downtime, is greater than the time required to cover the field, T_f.

$$T_f \leq \Psi(T_a) \tag{7}$$

where Θ = a dimensionless constant that represents a fraction of T_a that is actually used in irrigating the field. The value of Θ varies between 0 and 1, $\Theta \sim 0.85$ can be used in most cases.

8. equation 7 is satisfied, the irrigation scenario is feasible. If equation 7 is not satisfied, the chosen target E_a can not be realized. Select another target E_a and go through steps 1 to 7, above, until a feasible management scenario is obtained.

An example problem for dyked-end level furrow management

Given: Consider a rectangular field, which is 328 ft (100 m) wide and 600 ft (183 m) long, on the fine textured soils of the Yuma Valley. The field supply channel runs perpendicular to the width of the field (i.e., along the 328 ft long side) and the furrows are laid parallel to the field supply channel. The furrows are 600 ft long and are laid at 3.28 ft (1 m) spacing. Gated-pipe is installed across the head-end of the field. A pump with a capacity of 600 GPM is used to pump water from the field supply channel into a gated- pipe, which in turn distribute water among individual furrows. At any one irrigation session, the farmer is allowed, by the irrigation district, to withdraw a flow rate of about 10 cfs (4280 GPM) for a period of 8 hrs. The furrows are used to irrigate lettuce, thus every furrow is irrigated during each irrigation event.

Required: to determine the inflow rate and cutoff time combination for that yields a feasible and a near optimal irrigation scenario.

Solution

1. Available flow rate at the field supply channel, Q_c = 4280 GPM, and available time to irrigate the field, T_a = 8 hr.
2. Set a target E_a of 90 %.
3. Since the soil of the site under consideration is fine textured, Tables 4a-4i or Figures 15a-15b are to be used in this analysis. There are four options in Table 4f that The corresponding Qo and tco are

OUTREACH AND EDUCATION

The outreach component of this project included field day presentations and demonstrations. Field day presentations had been organized for growers throughout the project period. In the framework of this project an irrigation and water quality web site has been established. The web site is still evolving and hopefully in the future it might serve as an important resource, for stakeholders, on water management and water quality issues of the area.

SUMMARY

A management guideline is developed for the dyked-end level furrows that are used to irrigate vegetables (lettuce, broccoli, and carrot) in the Yuma area. Field experiment had been performed over a period of twenty-seven months. During each experiment, data on Q_o, t_{co}, advance, and flow depths were measured at regular spatial and temporal intervals. One or two instrumented furrows have been used in the field measurements during each of the experimental studies.

Nine data sets randomly selected from the data pool were used in model calibration. Seventeen other data sets, from the database developed during the experimental study, were used to validate SRFR – i.e., the simulation model used in the study reported herein. The validation results indicate that SRFR is capable of simulating the surface irrigation process with acceptable levels of accuracy.

Simulation experiments were performed using the SRFR model and the results are summarized in the form of management charts and tables, collectively referred to as management tools. The management tools were tested in the test furrows and were found to be satisfactory.

RECOMMENDATION

1. An extensive test of the management tools in real-life settings (i.e., in selected growers fields) is needed. Such tests would help gather feed back information, which will be useful to refine and improve the management package and enhance its practical utility.
2. Once the management package is tested in growers' fields and the necessary improvements are incorporated, it can be implemented in real-life irrigation management practices. Implementation needs to be preceded by training and field demonstration. In addition, a manual of practices that describes the management package proposed herein must be developed and distributed among local growers. The manual of practices must be prepared in a format and language that is simple enough to be understood and used by growers in their day-to-day management decisions without the aid of trained technicians and experts.
3. Impact monitoring and evaluation needs to be an important component of the implementation phase.
4. The principal problems of irrigation system management could be summed up using the following questions: (1) how much to irrigate? (2) when to irrigate ? (3) at what rate to irrigate? and (4) for how long to irrigate? Questions 3 and 4 can be answered using the management package developed in this project. However, the first two questions are the domains of irrigation scheduling and cannot be addressed by the management package under discussion. In order for the management package developed herein to have maximum impact, it needs to be complemented by an irrigation scheduling decision support system. Future research must therefore address this aspect of irrigation management. The development of a decision support system that integrates an irrigation scheduling model, like AZSCHED, with the management packages developed herein in a GIS environment could be the way forward.
5. In order to prevent wide variation in furrow geometry as a result of erosion and deposition, the furrows need to be reshaped at least twice in a season.
6. Effective management of irrigation systems requires satisfactory control over discharge delivered to the field supply channel and to the individual furrows. Therefore, growers must place emphasise on installing water measuring devices that have satisfactory levels of accuracy. Periodic calibration of water measuring devices

must be part of a sound irrigation management practice. The use of pump and gated pipe as field supply conduit enhances control over water supply to the individual furrows and hence to the irrigated field.

7. Further breakdown of the soil textural groups into a more homogeneous subgroups might enhance the validity of management tools of the type proposed herein.
8. Periodic land levelling would help maintain high levels of irrigation performance. It should therefore be part of an effective irrigation management strategy**.**
9. The management tools developed in this study are based on assumed average field conditions (spatially and temporally averaged infiltration, roughness, furrow geometry parameters and average bed slope). Although soils in the in textural group is assumed relatively uniform and laser levelling is common, deviations of actual field conditions from assumed spatial and temporal averages would naturally exist. What that means is that the performance predictions of the management tools would invariable contain a degree of error. Therefore, a sound management strategy must involve the use of the management tools developed herein in conjunction with good judgement and the benefit of experience. In fact, it is crucially important for growers to recognize that the management tools proposed herein are meant to complement and reinforce experience and good judgement instead of replacing them.

REFERENCES

Bassett, D. L., and Fitzsimmons, D. W. (1976). " Simulating overland flow in border irrigation." *Transactions of the ASAE*, 19(4):666-671.

Bautista, E., and Wallender, W. W. (1992). "Hydrodynamic model with specified space steps." *J. Irri. and Drain. Eng., ASCE*, 118(3):450-465.

Bautista, E. and Wallender, W.W. (1994). “Identification of furrow intake parameters from advance times and rates.” J. Irrig. and Drain. Eng., ASCE, 119(2):295-311.

Christiansen, J.E., Bishop, A.A., Kiefer, F.W., and Fok, Y.A. (1966). “Evaluation of intake rates as related to advance of water in surface irrigation.” *Trans. ASAE,9(5):671-674*.

Clemmens, A.J. (1981) “Evaluation of infiltration measurements for border irrigation.” Agric. Water Mgmt., 3:251-267.

Davis, J.R. (1961). “Estimating rate of advance for irrigation furrows.” *Trans. ASAE:52-57.*

Elliott, R. L., and Walker, W. R. (1982). "Field evaluation of furrow infiltration and advance functions." *Transactions of the ASAE*, 25(2):396-400.

Elliott, R. L., Walker, W. R., and Skogerboe, G. V. (1982). " Zero-inertia modeling of furrow irrigation advance." *J. Irri. and Drain. Eng., ASCE*, 108(3):179-195.

Fedkiw, J. 1991. *Nitrate occurrence in U.S. waters (and related questions)*. USDA Working Group on Water Quality.

Hall, W. A., (1956). "Estimating irrigation border flow." *Agric. Engr.*, 37(4):263-265.

Hart W.E., Collins, H.G, Woodward, G., Humphereys. A.S. (1980). *Design and operation of gravity or surface systems.* In Design and Operation of Farm Irrigation Systems, Ed. M.E., Jensen. American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph Michigan 49085.

Hartley, D. M. (1992). "Interpretation of Kostiakov infiltration parameters for borders." *J. Irri. and Drain. Eng., ASCE*, 118(1):156-165.

Katopodes, N.D., and Strelkoff, T. (1977). "Dimensionless Solution of border irrigation advance." *J. Irri. and Drain. Div., ASCE*, 103(4):401-407.

Katopodes, N.D., and Clemmens, A.J. (1990). “ Estimation of surface irrigation parameters.” *J. Irrig. and Drain. Eng. ASCE, 116(5):676-695.*

Kostiakov, A.N. (1932).On the dynamics of the coefficient of water percolation in soils and the necessity for studying it from a hydraulic point of view purposes of amelioration. Trans. Sixth Comm. International Society of Soil Science, Moscow. *Russian Part A:17-21.*

Lewis, M. R., and Milne, W. E. (1938)."Analysis of border irrigation." *Agri. Engr.*, 19:267-272.

Merriam, J.L., Shearer, M.N., Burt, C.M. (1980). *Evaluating irrigation systems and practices.*

In Design and Operation of Farm Irrigation Systems, Ed. M.E., Jensen. American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085.

Merriam, J.L., and Keller, J. (1978). *Farm irrigation system evaluation: A guide for management.* Utah State University, Logan, UT, 271 pp.

Natural Resources Conservation Service (NRCS, USDA) (1998). *National Engineering Handbook, Part 652, Arizona Irrigation Guide*. 3003 N. Central Avenue, Suite 800, Phoenix, AZ:85012-2945.

Philip, J.R. (1957). "The theory of Infiltration: 5. The influence of initial moisture content." *Soil Sci. 84: 257-264.*

Philip, J. R., and Farrell, D. A. (1964). "General solution of the infiltration-advance problem in irrigation hydraulics." *Geop. Res.*, 69(4):621-631.

Reddy, J.M. and Clyma, W. (1993). Surface Irrigation, Lecture Note. Center for Irrigation Engineering, Katholiek Universiteit Leuven, Leuven, Belgium.

Sanchez, C.A. 2001. Personal communications.

Sanchez, C.A., and Bali, K.M. 1997. Demonstration of Irrigation practices for lemons on sand under conventional and no-tillage cultural practices. *Project proposal submitted to the United States Bureau of Reclamation.*

Sakkas. J. G., and Strelkoff T. (1974). "Hydrodynamics of surface irrigation-Advance phase." *J. Irri. and Drain. Div., ASCE*, 100(10422):31-48.

Strelkoff, T., Clemmens, A.J., El-Ansary, M. and Awad, M. 1999. "Surface-irrigation evaluation models: application to level basin in Egypt" *Transactions of the ASAE, 42(4):1027-036.*

Strelkoff, T. S. Clemmens, A.J., and Schmidt, B.V. (1998). *SRFR v 3.31. Computer Program For Simulating Flow in Surface Irrigation, Furrows-Basins and Borders.* US Water Conservation Laboratory, 4331 E. Broadway, Phoenix, AZ. 85040.

Strelkoff, T., and Katopodes, N. D. (1977). "Border irrigation hydraulics with zero-inertia." *J. Irri. and Drain. Div., ASCE*, 103(3):325-342.

United States Bureau of Reclamation. (1991). *Groundwater status report, Yuma area-rizona- Arizona-California.* Lower Colorado River Region. Boulder Vity, NV.

*Walker, W.*R. and Busman

Walker, W. R., and Humpherys, A.S. (1983). "Kinematic wave furrow irrigation model. " *J. Irri. and Drain. Eng., ASCE*, 109(4): 377-392.

Walker, W. R., and Skogerboe, G. V. (1987). *Surface Irrigation: Theory and Practice*. Prentice Hall, Inc, Englewood Cliffs, N. J.

Zerihun, D., Wang, Z., Rimal, S., Feyen, J., and Reddy, J.M. (1997). "Analysis of

surface irrigation performance terms and indices." *Agricultural Water Management,* 34:25-46.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the financial support of the United States Bureau of Reclamation, the collaboration of Dr. A.J. Clemmens and Dr. T.S. Strelkoff of the United States Department of Agriculture, Water Conservation Laboratory, in Phoenix and the technical support of Manuel Peralta, Ramiro Galvez, Jorge Rivera, and Michelle Inman.

LIST OF TABLES

Table 7c. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 7d. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 7e. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 7f. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 7g. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 7h. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 7i. Lookup table for dyked-end level furrows, moderately-coarse textured soils

Table 1. Crop, soil, geometry data on the experimental units

Field characteristics	**Data**							
Experiment Ids	44E[12]	44F[12]	44A[13]	44B[13]	44C[14]	44D[15]	44G[16]	44H[16]
Furrow length	183 m (600 ft)	183 m (600 ft)	174 m (585 ft)	183 m (600 ft)	266.4 m (874 ft)	215 m (706 ft)	183 m (600 ft)	183 ft (600 ft)
Crop type	Lettuce	Broccoli	Lettuce	Lettuce	Lettuce	Carrot	Carrot	Carrot
Effective crop root depth	0.5 m (1.64 ft)	0.5 m (1.64 ft)	0.5 m (1.64 ft)	0.5 m (1.64 ft)	0.5 m (1.64 ft)	0.5 m (1.64 ft)	0.5 m (1.64 ft)	0.5 m (1.64 ft)
Target depth of application	93 mm (3.66 in)		93 mm (3.66 in)		72 mm (2.83 in)	44.5 mm (1.75 in)		
Soil textural groups used in the study	Fine textured soils		Moderately fine textured soils		Medium textured soils	Moderately coarse textured soils		
Soil textural classes based on the USDA soil textural triangle	Silty clay		Clay loam[17]		Silt loam[18]	Sand[19]		
Furrow cross-section	Symmetric trapezoid		Symmetric trapezoid		Symmetric trapezoid	Symmetric trapezoid		

[12] Experiments 44E and 44F were performed in the same field within the Yuma Agricultural Center, Valley farm.
[13] Experiments 44A and 44B were performed in two adjacent plots within the same farm.
[14] Experiment 44C was performed in a private farm in Cocopah Ranch.
[15] Experiment 44D was performed in a private farm.
[16] Experiments 44G and 44H were performed in the same field within the Yuma Agricultural Center, Mesa farm.
[17] Nearly evenly divided between the sand, silt, and clay fractions.
[18] About 65 % silt fraction, and the remaining 35 % is nearly evenly divided between the sand and clay fractions
[19] Over 90 % sand fraction.

Table 2. Input variables and parameters used in the simulation experiment

Variables and parameters	Unit	Fine textured.	Moderately fine textured	Medium textured	Moderately coarse textured
Length	m	183	183	183	183
Longitudinal slope	m	0.0	0.0	0.0	0.0
Furrow spacing	m	1.0	1.0	1.0	1.0
Bottom width	mm	150	200	200	200
Side slope	-	0.9	0.7	0.7	0.7
k^1	mm/hr^a	39.88	45.17	9.20	7.7
a	-	0.174	0.527	0.424	0.182
f_o^1	mm/hr	6.3	6.9	3.1	6.3
Manning's n	-	0.04	0.04	0.04	0.04
Target depth of application	mm	93	93	72	44.5

[1]Exponent and coefficients of the modified Kostiakov-Lewis infiltration function (Eq. 3).
Inlet flow rate and cutoff time combinations used in the simulation experiments are given in Tables4-7.

Table 3. Estimates of infiltration parameters

Soil textural groups	Infiltration parameters			
	Data ID	k (mm/hr[a])	a (-)	f_o (mm/hr)
Fine textured				
	44E-10-10-99	41.55	0.063	6.0
	44F-10-10-99	38.21	0.247	6.6
	Average	39.88	0.155	6.3
Moderatley fine textured				
	44A-11-21-98	51.77	0.586	7.8
	44A-12-16-98	38.57	0.467	6.0
	Average	45.17	0.527	6.9
Medium textured				
	44C-11-26-98	1.55	0.041	1.6
	44C-12-16-98	13.40	0.758	5.4
	44C-1-20-99	12.50	0.474	2.4
	Average	9.20	0.424	3.1
Moderately coarse textured				
	44D	8.1	0.123	12.0
	44D	11.3	0.264	4.6
	Average	9.7 (5)[20]	0.1935	8.3 (4)[20]

[20] Adjusted such that advance predicted by SRFR matches field observed advance. These values have been used in model verification (Figures -).

Table 4a Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
50.0	94.0	95.6	0.96	0.17	3.83	3.64	3.82	6.89
49.9	95.0	94.8	0.96	0.20	3.86	3.67	3.86	6.93
49.8	95.0	95.0	0.96	0.19	3.85	3.67	3.85	6.91
49.7	95.0	95.2	0.96	0.18	3.84	3.66	3.84	6.90
49.6	95.0	95.4	0.96	0.17	3.83	3.65	3.83	6.89
49.5	96.0	94.7	0.96	0.20	3.87	3.68	3.87	6.93
49.4	96.0	94.9	0.96	0.20	3.86	3.67	3.85	6.91
49.2	96.0	95.1	0.96	0.19	3.85	3.67	3.85	6.90
49.1	96.0	95.3	0.96	0.18	3.84	3.65	3.84	6.88
49.0	96.0	95.5	0.96	0.17	3.83	3.65	3.83	6.87
48.9	97.0	94.7	0.96	0.20	3.87	3.68	3.86	6.91
48.8	97.0	94.9	0.96	0.20	3.86	3.67	3.85	6.89
48.7	97.0	95.1	0.96	0.19	3.85	3.66	3.85	6.88
48.6	97.0	95.3	0.96	0.18	3.84	3.65	3.84	6.86
48.5	97.0	95.5	0.96	0.17	3.83	3.64	3.83	6.85
48.4	98.0	94.7	0.96	0.20	3.86	3.67	3.86	6.89
48.3	98.0	95.0	0.96	0.19	3.85	3.67	3.85	6.87
48.2	98.0	95.2	0.96	0.19	3.85	3.65	3.84	6.85
48.1	98.0	95.4	0.96	0.18	3.84	3.65	3.83	6.84
48.0	99.0	94.6	0.96	0.21	3.87	3.68	3.87	6.88
47.9	99.0	94.8	0.96	0.20	3.86	3.67	3.86	6.87
47.8	99.0	95.0	0.96	0.19	3.85	3.66	3.85	6.85
47.7	99.0	95.2	0.96	0.18	3.84	3.65	3.84	6.83
47.6	99.0	95.4	0.96	0.17	3.83	3.64	3.83	6.81
47.5	100.0	94.7	0.96	0.20	3.87	3.67	3.86	6.86
47.3	100.0	94.9	0.96	0.20	3.86	3.66	3.85	6.84
47.2	100.0	95.1	0.96	0.19	3.85	3.65	3.85	6.83
47.1	100.0	95.3	0.96	0.18	3.84	3.64	3.83	6.81
47.0	101.0	94.6	0.96	0.21	3.87	3.67	3.87	6.85
46.9	101.0	94.8	0.96	0.20	3.86	3.67	3.86	6.83
46.8	101.0	95.0	0.96	0.19	3.85	3.65	3.85	6.81
46.7	101.0	95.3	0.96	0.18	3.84	3.65	3.84	6.80
46.6	102.0	94.5	0.96	0.21	3.87	3.67	3.87	6.84
46.5	102.0	94.8	0.96	0.20	3.86	3.67	3.86	6.82
46.4	102.0	95.0	0.96	0.19	3.85	3.66	3.85	6.81
46.3	102.0	95.2	0.96	0.19	3.85	3.65	3.84	6.79
46.2	103.0	94.5	0.96	0.21	3.87	3.68	3.87	6.83
46.1	103.0	94.7	0.96	0.20	3.87	3.67	3.86	6.81
46.0	103.0	94.9	0.96	0.20	3.86	3.66	3.85	6.80
45.9	103.0	95.1	0.96	0.19	3.85	3.65	3.85	6.78
45.8	104.0	94.4	0.96	0.22	3.88	3.68	3.87	6.81
45.7	104.0	94.7	0.96	0.20	3.87	3.67	3.87	6.80
45.5	104.0	94.9	0.96	0.20	3.86	3.66	3.85	6.78
45.4	104.0	95.1	0.96	0.19	3.85	3.65	3.85	6.76
45.3	105.0	94.4	0.96	0.22	3.88	3.68	3.87	6.80
45.2	105.0	94.6	0.96	0.21	3.87	3.67	3.87	6.78
45.1	105.0	94.9	0.96	0.20	3.86	3.66	3.86	6.77

Table 4b Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
45.0	105.0	95.1	0.96	0.19	3.85	3.65	3.85	6.75
44.9	106.0	94.4	0.96	0.22	3.88	3.67	3.87	6.79
44.8	106.0	94.6	0.96	0.21	3.87	3.67	3.87	6.77
44.7	106.0	94.8	0.96	0.20	3.86	3.65	3.86	6.75
44.6	106.0	95.1	0.96	0.19	3.85	3.65	3.85	6.74
44.5	107.0	94.4	0.96	0.22	3.88	3.67	3.87	6.77
44.4	107.0	94.6	0.96	0.21	3.87	3.66	3.87	6.76
44.3	107.0	94.9	0.96	0.20	3.86	3.65	3.86	6.74
44.2	107.0	95.1	0.96	0.19	3.85	3.64	3.85	6.72
44.1	108.0	94.4	0.96	0.22	3.88	3.67	3.87	6.76
44.0	108.0	94.7	0.96	0.20	3.87	3.66	3.87	6.74
43.9	108.0	94.9	0.96	0.20	3.86	3.65	3.85	6.72
43.8	109.0	94.2	0.96	0.22	3.89	3.68	3.88	6.76
43.6	109.0	94.5	0.96	0.21	3.87	3.67	3.87	6.74
43.5	109.0	94.7	0.96	0.20	3.87	3.66	3.86	6.72
43.4	109.0	94.9	0.96	0.20	3.86	3.65	3.85	6.70
43.3	110.0	94.3	0.96	0.22	3.88	3.67	3.88	6.74
43.2	110.0	94.5	0.96	0.21	3.87	3.66	3.87	6.72
43.1	110.0	94.8	0.96	0.20	3.86	3.65	3.86	6.70
43.0	111.0	94.1	0.96	0.23	3.89	3.68	3.89	6.73
42.9	111.0	94.4	0.96	0.22	3.88	3.67	3.88	6.72
42.8	111.0	94.6	0.96	0.21	3.87	3.66	3.87	6.74
42.7	111.0	94.8	0.96	0.20	3.86	3.65	3.86	6.68
42.6	112.0	94.2	0.96	0.22	3.89	3.67	3.88	6.71
42.5	112.0	94.5	0.96	0.22	3.88	3.66	3.87	6.69
42.4	112.0	94.7	0.96	0.20	3.87	3.65	3.86	6.67
42.3	113.0	94.1	0.96	0.23	3.89	3.68	3.89	6.71
42.2	113.0	94.3	0.96	0.22	3.88	3.67	3.88	6.69
42.1	113.0	94.6	0.96	0.21	3.87	3.65	3.87	6.67
42.0	113.0	94.8	0.95	0.20	3.86	3.65	3.86	6.65
41.8	114.0	94.2	0.95	0.22	3.89	3.67	3.88	6.69
41.7	114.0	94.4	0.95	0.22	3.88	3.66	3.87	6.67
41.6	114.0	94.7	0.95	0.20	3.87	3.65	3.86	6.65
41.5	115.0	94.1	0.95	0.23	3.89	3.67	3.89	6.68
41.4	115.0	94.3	0.95	0.22	3.88	3.66	3.88	6.66
41.3	115.0	94.6	0.95	0.21	3.87	3.65	3.87	6.64
41.2	116.0	94.0	0.95	0.23	3.89	3.67	3.89	6.67
41.1	116.0	94.2	0.95	0.22	3.89	3.67	3.88	6.65
41.0	116.0	94.5	0.95	0.21	3.87	3.65	3.87	6.63
40.9	117.0	93.9	0.95	0.24	3.90	3.68	3.89	6.66
40.8	117.0	94.2	0.95	0.22	3.89	3.67	3.89	6.65
40.7	117.0	94.4	0.95	0.22	3.88	3.65	3.87	6.63
40.6	118.0	93.9	0.95	0.24	3.90	3.68	3.90	6.65
40.5	118.0	94.1	0.95	0.23	3.89	3.67	3.89	6.63
40.4	118.0	94.3	0.95	0.22	3.88	3.65	3.88	6.61
40.3	119.0	93.8	0.95	0.24	3.90	3.68	3.90	6.65
40.2	119.0	94.0	0.95	0.23	3.89	3.67	3.89	6.63

Table 4c Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
40.1	119.0	94.3	0.95	0.22	3.88	3.66	3.88	6.61
39.9	119.0	94.5	0.95	0.21	3.87	3.65	3.87	6.59
39.8	120.0	94.0	0.95	0.23	3.89	3.67	3.89	6.61
39.7	120.0	94.3	0.95	0.22	3.89	3.66	3.88	6.59
39.6	120.0	94.5	0.95	0.21	3.87	3.65	3.87	6.57
39.5	121.0	94.0	0.95	0.24	3.90	3.67	3.89	6.60
39.4	121.0	94.2	0.95	0.22	3.89	3.65	3.88	6.58
39.3	122.0	93.7	0.95	0.24	3.91	3.68	3.91	6.61
39.2	122.0	94.0	0.95	0.24	3.90	3.67	3.89	6.59
39.1	122.0	94.2	0.95	0.22	3.89	3.65	3.88	6.57
39.0	123.0	93.7	0.95	0.24	3.91	3.68	3.91	6.60
38.9	123.0	94.0	0.95	0.24	3.90	3.67	3.89	6.58
38.8	123.0	94.2	0.95	0.22	3.89	3.65	3.88	6.56
38.7	124.0	93.7	0.95	0.24	3.91	3.67	3.91	6.58
38.6	124.0	94.0	0.95	0.24	3.90	3.66	3.89	6.56
38.5	124.0	94.2	0.95	0.22	3.89	3.65	3.88	6.54
38.4	125.0	93.7	0.95	0.24	3.91	3.67	3.90	6.57
38.3	125.0	94.0	0.95	0.23	3.89	3.66	3.89	6.55
38.2	126.0	93.5	0.95	0.26	3.92	3.68	3.91	6.57
38.0	126.0	93.8	0.95	0.24	3.91	3.67	3.90	6.55
37.9	126.0	94.0	0.95	0.23	3.89	3.65	3.89	6.53
37.8	127.0	93.5	0.95	0.25	3.91	3.67	3.91	6.56
37.7	127.0	93.8	0.95	0.24	3.90	3.66	3.90	6.54
37.6	127.0	94.1	0.95	0.23	3.89	3.65	3.89	6.51
37.5	128.0	93.6	0.95	0.25	3.91	3.67	3.91	6.54
37.4	128.0	93.9	0.95	0.24	3.90	3.66	3.90	6.52
37.3	128.0	94.1	0.95	0.23	3.89	3.65	3.89	6.50
37.2	129.0	93.7	0.95	0.25	3.91	3.67	3.91	6.52
37.1	129.0	93.9	0.95	0.24	3.90	3.65	3.89	6.50
37.0	130.0	93.5	0.95	0.26	3.92	3.67	3.91	6.52
36.9	130.0	93.7	0.95	0.24	3.91	3.66	3.90	6.50
36.8	130.0	94.0	0.95	0.23	3.89	3.65	3.89	6.48
36.7	131.0	93.6	0.95	0.25	3.91	3.67	3.91	6.50
36.6	131.0	93.8	0.95	0.24	3.90	3.65	3.90	6.48
36.5	132.0	93.4	0.95	0.26	3.92	3.67	3.92	6.50
36.4	132.0	93.7	0.95	0.25	3.91	3.66	3.91	6.48
36.2	132.0	93.9	0.95	0.24	3.90	3.65	3.89	6.46
36.1	133.0	93.5	0.95	0.26	3.92	3.67	3.91	6.48
36.0	133.0	93.8	0.95	0.24	3.91	3.65	3.90	6.46
35.9	134.0	93.3	0.95	0.26	3.92	3.67	3.92	6.48
35.8	134.0	93.6	0.95	0.25	3.91	3.66	3.91	6.46
35.7	135.0	93.2	0.95	0.27	3.93	3.68	3.93	6.48
35.6	135.0	93.5	0.95	0.26	3.92	3.66	3.91	6.46
35.5	135.0	93.7	0.95	0.24	3.91	3.65	3.90	6.43
35.4	136.0	93.3	0.95	0.26	3.92	3.67	3.92	6.45
35.3	136.0	93.6	0.95	0.25	3.91	3.65	3.91	6.43
35.2	137.0	93.2	0.95	0.27	3.93	3.67	3.93	6.45

Table 4d Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
35.1	137.0	93.5	0.95	0.26	3.92	3.66	3.91	6.43
35.0	138.0	93.1	0.95	0.27	3.93	3.68	3.93	6.45
34.9	138.0	93.4	0.95	0.26	3.92	3.66	3.92	6.43
34.8	138.0	93.7	0.95	0.25	3.91	3.65	3.91	6.40
34.7	139.0	93.3	0.95	0.26	3.93	3.67	3.92	6.42
34.6	139.0	93.6	0.95	0.25	3.91	3.65	3.91	6.40
34.5	140.0	93.2	0.95	0.27	3.93	3.67	3.93	6.42
34.3	140.0	93.5	0.95	0.26	3.92	3.65	3.91	6.39
34.2	141.0	93.1	0.95	0.27	3.93	3.67	3.93	6.41
34.1	141.0	93.4	0.95	0.26	3.92	3.66	3.92	6.39
34.0	142.0	93.0	0.95	0.28	3.94	3.66	3.93	6.41
33.9	142.0	93.3	0.95	0.26	3.93	3.66	3.92	6.38
33.8	143.0	92.9	0.95	0.28	3.94	3.67	3.94	6.40
33.7	143.0	93.2	0.95	0.26	3.93	3.66	3.93	6.37
33.6	144.0	92.9	0.95	0.28	3.94	3.67	3.94	6.39
33.5	144.0	93.2	0.95	0.27	3.93	3.66	3.93	6.37
33.4	145.0	92.8	0.95	0.28	3.94	3.67	3.94	6.38
33.3	145.0	93.1	0.95	0.27	3.93	3.66	3.93	6.36
33.2	146.0	92.8	0.95	0.28	3.95	3.67	3.94	6.37
33.1	146.0	93.1	0.95	0.27	3.93	3.66	3.93	6.35
33.0	147.0	92.7	0.95	0.29	3.95	3.68	3.94	6.37
32.9	147.0	93.0	0.95	0.28	3.94	3.66	3.93	6.34
32.8	147.0	93.3	0.94	0.26	3.93	3.65	3.92	6.31
32.7	148.0	93.0	0.95	0.28	3.94	3.66	3.93	6.33
32.5	148.0	93.3	0.94	0.26	3.93	3.65	3.92	6.31
32.4	149.0	93.0	0.94	0.28	3.94	3.66	3.93	6.32
32.3	150.0	92.7	0.94	0.29	3.95	3.67	3.95	6.33
32.2	150.0	93.0	0.94	0.28	3.94	3.66	3.94	6.31
32.1	151.0	92.6	0.94	0.29	3.95	3.67	3.95	6.32
32.0	151.0	92.9	0.94	0.28	3.94	3.66	3.94	6.30
31.9	152.0	92.6	0.94	0.29	3.95	3.67	3.95	6.31
31.8	152.0	92.9	0.94	0.28	3.94	3.65	3.94	6.28
31.7	153.0	92.7	0.94	0.29	3.95	3.67	3.95	6.30
31.6	153.0	93.0	0.94	0.28	3.94	3.65	3.93	6.27
31.5	154.0	92.7	0.94	0.29	3.95	3.67	3.95	6.28
31.4	154.0	93.0	0.94	0.28	3.94	3.65	3.93	6.26
31.3	155.0	92.7	0.94	0.29	3.95	3.66	3.95	6.27
31.2	156.0	92.4	0.94	0.30	3.96	3.67	3.96	6.28
31.1	156.0	92.7	0.94	0.29	3.95	3.66	3.94	6.26
31.0	157.0	92.4	0.94	0.30	3.96	3.67	3.96	6.27
30.9	157.0	92.8	0.94	0.28	3.95	3.65	3.94	6.24
30.8	158.0	92.5	0.94	0.30	3.96	3.67	3.96	6.25
30.6	158.0	92.8	0.94	0.28	3.94	3.65	3.94	6.22
30.5	159.0	92.5	0.94	0.30	3.96	3.66	3.95	6.24
30.4	160.0	92.3	0.94	0.31	3.97	3.67	3.96	6.24
30.3	160.0	92.6	0.94	0.29	3.96	3.66	3.95	6.22
30.2	161.0	92.4	0.94	0.30	3.96	3.67	3.96	6.23

Table 4e Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
30.1	161.0	92.7	0.94	0.29	3.95	3.65	3.95	6.20
30.0	162.0	92.4	0.94	0.30	3.96	3.66	3.96	6.21
29.9	163.0	92.2	0.94	0.31	3.97	3.67	3.97	6.22
29.8	163.0	92.5	0.94	0.30	3.96	3.65	3.96	6.19
29.7	164.0	92.3	0.94	0.31	3.97	3.67	3.96	6.20
29.6	165.0	92.0	0.94	0.31	3.98	3.67	3.98	6.21
29.5	165.0	92.4	0.94	0.30	3.96	3.66	3.96	6.18
29.4	166.0	92.2	0.94	0.31	3.98	3.67	3.97	6.19
29.3	166.0	92.5	0.94	0.30	3.96	3.65	3.96	6.16
29.2	167.0	92.3	0.94	0.31	3.97	3.66	3.96	6.17
29.1	168.0	92.0	0.94	0.31	3.98	3.67	3.98	6.17
29.0	168.0	92.4	0.94	0.30	3.96	3.65	3.96	6.14
28.9	169.0	92.2	0.94	0.31	3.97	3.66	3.97	6.15
28.7	170.0	92.0	0.94	0.32	3.98	3.67	3.98	6.16
28.6	170.0	92.3	0.94	0.30	3.97	3.65	3.96	6.13
28.5	171.0	92.1	0.94	0.31	3.98	3.66	3.97	6.13
28.4	172.0	91.9	0.94	0.32	3.98	3.67	3.98	6.14
28.3	173.0	91.7	0.94	0.33	3.99	3.67	3.99	6.14
28.2	173.0	92.1	0.94	0.31	3.98	3.66	3.98	6.11
28.1	174.0	91.9	0.94	0.32	3.99	3.67	3.98	6.12
28.0	175.0	91.7	0.94	0.33	4.00	3.67	3.99	6.12
27.9	175.0	92.0	0.94	0.31	3.98	3.65	3.98	6.09
27.8	176.0	91.9	0.94	0.32	3.99	3.66	3.98	6.09
27.7	177.0	91.7	0.94	0.33	4.00	3.67	3.99	6.10
27.6	178.0	91.5	0.94	0.34	4.00	3.67	4.00	6.10
27.5	178.0	91.9	0.94	0.32	3.98	3.66	3.98	6.07
27.4	179.0	91.7	0.94	0.33	3.99	3.66	3.99	6.07
27.3	180.0	91.6	0.94	0.33	4.00	3.67	4.00	6.07
27.2	181.0	91.4	0.94	0.34	4.01	3.67	4.00	6.08
27.1	181.0	91.8	0.94	0.33	3.99	3.66	3.99	6.05
26.9	182.0	91.6	0.94	0.33	4.00	3.66	3.99	6.05
26.8	183.0	91.5	0.94	0.34	4.00	3.67	4.00	6.05
26.7	184.0	91.4	0.94	0.35	4.01	3.67	4.01	6.05
26.6	184.0	91.7	0.93	0.33	3.99	3.65	3.99	6.02
26.5	185.0	91.6	0.93	0.33	4.00	3.66	4.00	6.02
26.4	186.0	91.5	0.93	0.34	4.00	3.66	4.00	6.02
26.3	187.0	91.3	0.93	0.35	4.01	3.67	4.01	6.02
26.2	188.0	91.2	0.93	0.35	4.02	3.67	4.01	6.02
26.1	188.0	91.6	0.93	0.33	4.00	3.65	4.00	5.98
26.0	189.0	91.5	0.93	0.34	4.00	3.66	4.00	5.98
25.9	190.0	91.4	0.93	0.35	4.01	3.66	4.00	5.98
25.8	191.0	91.3	0.93	0.35	4.02	3.66	4.01	5.98
25.7	192.0	91.1	0.93	0.35	4.02	3.67	4.02	5.98
25.6	193.0	91.1	0.93	0.36	4.02	3.67	4.02	5.98
25.5	194.0	91.0	0.93	0.36	4.03	3.67	4.02	5.98
25.4	194.0	91.3	0.93	0.35	4.01	3.65	4.01	5.94
25.3	195.0	91.2	0.93	0.35	4.02	3.66	4.01	5.94

Table 4f Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea%**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
25.2	196.0	91.2	0.93	0.35	4.02	3.66	4.02	5.93
25.0	197.0	91.1	0.93	0.36	4.02	3.66	4.02	5.93
24.9	198.0	91.0	0.93	0.36	4.02	3.66	4.02	5.93
24.8	199.0	90.9	0.93	0.36	4.03	3.66	4.02	5.92
24.7	200.0	90.9	0.93	0.37	4.03	3.66	4.03	5.92
24.6	201.0	90.8	0.93	0.37	4.04	3.67	4.03	5.91
24.5	202.0	90.7	0.93	0.37	4.04	3.67	4.03	5.91
24.4	203.0	90.7	0.93	0.37	4.04	3.67	4.04	5.90
24.3	204.0	90.6	0.93	0.38	4.04	3.67	4.04	5.89
24.2	205.0	90.6	0.93	0.38	4.04	3.67	4.04	5.89
24.1	206.0	90.5	0.93	0.38	4.04	3.67	4.04	5.88
24.0	207.0	90.5	0.93	0.38	4.05	3.67	4.04	5.87
23.9	208.0	90.5	0.93	0.39	4.05	3.67	4.04	5.87
23.8	209.0	90.4	0.93	0.39	4.05	3.67	4.05	5.86
23.7	210.0	90.4	0.93	0.39	4.05	3.67	4.05	5.85
23.6	211.0	90.4	0.93	0.39	4.06	3.67	4.05	5.84
23.5	212.0	90.4	0.93	0.39	4.06	3.67	4.05	5.83
23.4	213.0	90.3	0.93	0.39	4.06	3.67	4.05	5.83
23.2	214.0	90.3	0.93	0.39	4.06	3.66	4.05	5.81
23.1	215.0	90.3	0.93	0.39	4.06	3.66	4.05	5.81
23.0	216.0	90.3	0.93	0.39	4.06	3.66	4.05	5.80
22.9	217.0	90.3	0.93	0.39	4.06	3.66	4.05	5.79
22.8	218.0	90.3	0.93	0.39	4.06	3.65	4.05	5.78
22.7	219.0	90.3	0.93	0.39	4.06	3.65	4.05	5.76
22.6	221.0	89.9	0.93	0.41	4.07	3.67	4.07	5.78
22.5	222.0	89.9	0.92	0.41	4.07	3.67	4.07	5.77
22.4	223.0	90.0	0.92	0.41	4.07	3.67	4.07	5.76
22.3	224.0	90.0	0.92	0.41	4.07	3.66	4.07	5.74
22.2	225.0	90.0	0.92	0.41	4.07	3.66	4.07	5.73
22.1	226.0	90.0	0.92	0.41	4.07	3.65	4.06	5.72
22.0	228.0	89.7	0.92	0.42	4.09	3.67	4.08	5.73
21.9	229.0	89.7	0.92	0.42	4.08	3.67	4.08	5.72
21.8	230.0	89.8	0.92	0.42	4.08	3.66	4.08	5.70
21.7	231.0	89.8	0.92	0.41	4.08	3.65	4.07	5.69
21.6	233.0	89.5	0.92	0.43	4.09	3.67	4.09	5.70
21.5	234.0	89.5	0.92	0.43	4.09	3.66	4.09	5.68
21.3	235.0	89.6	0.92	0.43	4.09	3.66	4.09	5.67
21.2	237.0	89.3	0.92	0.44	4.10	3.67	4.10	5.67
21.1	238.0	89.3	0.92	0.44	4.10	3.67	4.09	5.66
21.0	239.0	89.4	0.92	0.43	4.09	3.66	4.09	5.64
20.9	241.0	89.1	0.92	0.45	4.11	3.67	4.11	5.65
20.8	242.0	89.2	0.92	0.44	4.11	3.67	4.10	5.63
20.7	243.0	89.3	0.92	0.44	4.10	3.66	4.10	5.61
20.6	245.0	89.0	0.92	0.45	4.11	3.67	4.11	5.62
20.5	246.0	89.1	0.92	0.45	4.11	3.66	4.11	5.60
20.4	248.0	88.8	0.92	0.46	4.12	3.67	4.12	5.60
20.3	249.0	89.0	0.92	0.45	4.12	3.66	4.11	5.58

Table 4g Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea%**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
20.2	250.0	89.1	0.92	0.45	4.11	3.65	4.11	5.56
20.1	252.0	88.8	0.92	0.46	4.12	3.66	4.12	5.56
20.0	254.0	88.6	0.92	0.47	4.13	3.67	4.13	5.57
19.9	255.0	88.7	0.92	0.46	4.13	3.66	4.13	5.54
19.8	257.0	88.5	0.92	0.48	4.14	3.67	4.13	5.54
19.7	258.0	88.6	0.91	0.47	4.13	3.66	4.13	5.52
19.6	260.0	88.4	0.91	0.48	4.15	3.67	4.14	5.52
19.4	261.0	88.5	0.91	0.47	4.14	3.66	4.13	5.50
19.3	263.0	88.4	0.91	0.48	4.15	3.66	4.14	5.50
19.2	264.0	88.5	0.91	0.48	4.14	3.65	4.13	5.47
19.1	266.0	88.3	0.91	0.48	4.15	3.66	4.14	5.47
19.0	268.0	88.2	0.91	0.49	4.15	3.66	4.15	5.47
18.9	270.0	88.0	0.91	0.50	4.16	3.67	4.16	5.46
18.8	272.0	87.8	0.91	0.51	4.17	3.67	4.17	5.46
18.7	273.0	88.0	0.91	0.50	4.16	3.66	4.16	5.43
18.6	275.0	87.9	0.91	0.50	4.17	3.66	4.17	5.43
18.5	277.0	87.7	0.91	0.51	4.17	3.67	4.17	5.42
18.4	278.0	87.9	0.91	0.50	4.17	3.65	4.16	5.39
18.3	280.0	87.8	0.91	0.51	4.17	3.66	4.17	5.38
18.2	282.0	87.7	0.91	0.52	4.18	3.66	4.17	5.37
18.1	284.0	87.6	0.91	0.52	4.19	3.66	4.18	5.37
18.0	286.0	87.5	0.91	0.52	4.19	3.66	4.19	5.36
17.9	288.0	87.4	0.91	0.53	4.19	3.66	4.19	5.35
17.8	290.0	87.3	0.91	0.53	4.20	3.66	4.19	5.33
17.6	292.0	87.2	0.91	0.54	4.20	3.66	4.20	5.32
17.5	294.0	87.1	0.91	0.54	4.20	3.66	4.20	5.31
17.4	296.0	87.1	0.91	0.54	4.20	3.66	4.20	5.30
17.3	298.0	87.0	0.90	0.55	4.21	3.66	4.20	5.28
17.2	300.0	87.0	0.90	0.55	4.21	3.66	4.21	5.27
17.1	303.0	86.6	0.90	0.57	4.23	3.67	4.22	5.28
17.0	305.0	86.6	0.90	0.57	4.23	3.67	4.23	5.26
16.9	307.0	86.6	0.90	0.57	4.23	3.67	4.23	5.24
16.8	309.0	86.6	0.90	0.57	4.23	3.66	4.23	5.22
16.7	311.0	86.5	0.90	0.57	4.23	3.65	4.23	5.20
16.6	314.0	86.3	0.90	0.58	4.24	3.67	4.24	5.20
16.5	316.0	86.3	0.90	0.58	4.24	3.66	4.24	5.19
16.4	319.0	86.0	0.90	0.59	4.26	3.67	4.26	5.19
16.3	321.0	86.0	0.90	0.59	4.26	3.66	4.26	5.16
16.2	323.0	86.0	0.90	0.59	4.26	3.66	4.25	5.14
16.1	326.0	85.8	0.90	0.61	4.27	3.66	4.26	5.14
16.0	328.0	85.9	0.90	0.60	4.27	3.66	4.26	5.11
15.9	331.0	85.6	0.90	0.61	4.28	3.66	4.27	5.11
15.7	334.0	85.5	0.90	0.62	4.29	3.67	4.28	5.10
15.6	336.0	85.5	0.89	0.62	4.28	3.66	4.28	5.07
15.5	339.0	85.3	0.89	0.63	4.29	3.66	4.29	5.06
15.4	342.0	85.2	0.89	0.64	4.30	3.67	4.30	5.05
15.3	345.0	85.0	0.89	0.65	4.31	3.67	4.30	5.04

Table 4h Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
15.2	348.0	84.9	0.89	0.65	4.32	3.67	4.31	5.03
15.1	350.0	85.0	0.89	0.65	4.31	3.66	4.31	5.00
15.0	353.0	84.8	0.89	0.65	4.32	3.66	4.31	4.98
14.9	356.0	84.7	0.89	0.66	4.32	3.66	4.32	4.97
14.8	359.0	84.6	0.89	0.67	4.33	3.66	4.33	4.95
14.7	363.0	84.3	0.89	0.68	4.35	3.67	4.34	4.95
14.6	366.0	84.2	0.89	0.69	4.35	3.67	4.35	4.93
14.5	369.0	84.1	0.89	0.69	4.35	3.66	4.35	4.91
14.4	372.0	84.1	0.88	0.69	4.36	3.66	4.35	4.89
14.3	375.0	84.0	0.88	0.70	4.36	3.65	4.36	4.87
14.2	379.0	83.7	0.88	0.71	4.37	3.66	4.37	4.86
14.1	383.0	83.5	0.88	0.72	4.39	3.67	4.38	4.85
13.9	386.0	83.5	0.88	0.72	4.39	3.66	4.39	4.82
13.8	390.0	83.2	0.88	0.74	4.40	3.67	4.40	4.81
13.7	393.0	83.2	0.88	0.74	4.40	3.66	4.40	4.78
13.6	397.0	83.0	0.88	0.75	4.41	3.66	4.41	4.77
13.5	401.0	82.8	0.88	0.76	4.42	3.66	4.42	4.76
13.4	405.0	82.7	0.88	0.77	4.43	3.66	4.43	4.74
13.3	409.0	82.5	0.87	0.78	4.44	3.66	4.43	4.72
13.2	413.0	82.4	0.87	0.78	4.44	3.66	4.44	4.70
13.1	417.0	82.2	0.87	0.79	4.45	3.66	4.45	4.68
13.0	421.0	82.1	0.87	0.80	4.46	3.66	4.46	4.65
12.9	426.0	81.8	0.87	0.81	4.48	3.67	4.47	4.64
12.8	430.0	81.7	0.87	0.81	4.48	3.66	4.48	4.61
12.7	435.0	81.5	0.87	0.83	4.50	3.66	4.49	4.60
12.6	439.0	81.4	0.87	0.83	4.50	3.66	4.50	4.57
12.5	444.0	81.2	0.87	0.85	4.51	3.66	4.51	4.56
12.4	449.0	80.9	0.86	0.86	4.52	3.66	4.52	4.54
12.3	454.0	80.7	0.86	0.87	4.54	3.66	4.53	4.51
12.2	459.0	80.6	0.86	0.88	4.55	3.66	4.54	4.49
12.0	464.0	80.4	0.86	0.89	4.56	3.66	4.55	4.46
11.9	470.0	80.1	0.86	0.91	4.57	3.67	4.57	4.45
11.8	475.0	79.9	0.86	0.92	4.58	3.66	4.58	4.42
11.7	481.0	79.6	0.86	0.93	4.60	3.67	4.59	4.40
11.6	486.0	79.5	0.86	0.94	4.61	3.66	4.60	4.37
11.5	492.0	79.3	0.85	0.96	4.62	3.66	4.61	4.35
11.4	498.0	79.1	0.85	0.97	4.63	3.66	4.63	4.32
11.3	505.0	78.7	0.85	0.99	4.65	3.67	4.65	4.31
11.2	511.0	78.5	0.85	1.00	4.67	3.66	4.66	4.28
11.1	517.0	78.3	0.85	1.01	4.67	3.66	4.67	4.24
11.0	524.0	78.0	0.85	1.03	4.69	3.66	4.69	4.22
10.9	531.0	77.7	0.85	1.05	4.71	3.66	4.70	4.19
10.8	538.0	77.5	0.84	1.06	4.73	3.66	4.72	4.17
10.7	545.0	77.2	0.84	1.07	4.74	3.66	4.74	4.13
10.6	553.0	76.9	0.84	1.10	4.76	3.66	4.76	4.11
10.5	561.0	76.6	0.84	1.12	4.78	3.66	4.78	4.08
10.4	569.0	76.3	0.84	1.14	4.80	3.66	4.80	4.06

Table 4i Lookup table for dyked-end level furrow, fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**DP**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
10.3	576.0	76.1	0.83	1.15	4.81	3.65	4.81	4.01
10.1	586.0	75.6	0.83	1.18	4.85	3.67	4.84	4.00
10.0	594.0	75.4	0.83	1.20	4.86	3.66	4.85	3.96

Table 5a Lookup table for dyked-end level furrow, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
50.0	103.0	87.2	0.91	0.54	4.20	3.68	4.19	6.21
49.9	103.0	87.4	0.91	0.53	4.19	3.67	4.19	6.20
49.9	103.0	87.5	0.91	0.52	4.19	3.66	4.18	6.19
49.8	103.0	87.7	0.91	0.52	4.18	3.65	4.17	6.18
49.7	103.0	87.8	0.91	0.51	4.17	3.64	4.17	6.17
49.6	104.0	87.1	0.91	0.54	4.20	3.68	4.20	6.19
49.5	104.0	87.2	0.91	0.54	4.20	3.67	4.20	6.18
49.5	104.0	87.4	0.91	0.53	4.19	3.66	4.19	6.17
49.4	104.0	87.5	0.91	0.52	4.19	3.65	4.18	6.16
49.3	105.0	86.8	0.91	0.56	4.22	3.69	4.22	6.19
49.2	105.0	87.0	0.91	0.55	4.21	3.68	4.21	6.17
49.1	105.0	87.1	0.91	0.54	4.21	3.67	4.20	6.16
49.1	105.0	87.2	0.91	0.54	4.20	3.66	4.19	6.15
49.0	105.0	87.4	0.91	0.53	4.19	3.65	4.19	6.14
48.9	105.0	87.5	0.91	0.52	4.19	3.65	4.18	6.12
48.8	106.0	86.8	0.91	0.56	4.22	3.68	4.21	6.15
48.7	106.0	87.0	0.91	0.55	4.21	3.67	4.21	6.14
48.7	106.0	87.1	0.91	0.54	4.20	3.66	4.20	6.13
48.6	106.0	87.3	0.91	0.54	4.20	3.65	4.19	6.11
48.5	106.0	87.4	0.91	0.53	4.19	3.65	4.19	6.10
48.4	107.0	86.7	0.91	0.56	4.22	3.68	4.22	6.13
48.3	107.0	86.9	0.91	0.56	4.22	3.67	4.21	6.11
48.3	107.0	87.0	0.91	0.55	4.21	3.66	4.20	6.10
48.2	107.0	87.2	0.91	0.54	4.20	3.65	4.20	6.09
48.1	107.0	87.3	0.91	0.54	4.20	3.65	4.19	6.08
48.0	108.0	86.6	0.91	0.57	4.23	3.68	4.22	6.11
48.0	108.0	86.8	0.91	0.56	4.22	3.67	4.22	6.09
47.9	108.0	86.9	0.91	0.55	4.22	3.66	4.21	6.08
47.8	108.0	87.1	0.91	0.54	4.21	3.65	4.20	6.07
47.7	108.0	87.2	0.91	0.54	4.20	3.64	4.20	6.05
47.6	109.0	86.6	0.91	0.57	4.23	3.68	4.23	6.08
47.6	109.0	86.7	0.91	0.56	4.22	3.67	4.22	6.07
47.5	109.0	86.8	0.91	0.56	4.22	3.66	4.21	6.06
47.4	109.0	87.0	0.91	0.55	4.21	3.65	4.21	6.04
47.3	110.0	86.3	0.91	0.58	4.24	3.68	4.24	6.07
47.2	110.0	86.5	0.91	0.57	4.24	3.67	4.23	6.06
47.2	110.0	86.6	0.91	0.56	4.23	3.66	4.22	6.04
47.1	110.0	86.8	0.91	0.56	4.22	3.65	4.22	6.03
47.0	110.0	86.9	0.91	0.55	4.21	3.65	4.21	6.02
46.9	111.0	86.3	0.91	0.58	4.24	3.68	4.24	6.04
46.8	111.0	86.4	0.91	0.57	4.24	3.67	4.23	6.03
46.8	111.0	86.6	0.91	0.57	4.23	3.66	4.23	6.01
46.7	111.0	86.7	0.91	0.56	4.22	3.65	4.22	6.00
46.6	112.0	86.1	0.91	0.59	4.25	3.68	4.25	6.02
46.5	112.0	86.2	0.91	0.58	4.25	3.67	4.24	6.01
46.4	112.0	86.4	0.91	0.57	4.24	3.67	4.24	6.00
46.4	112.0	86.5	0.90	0.57	4.23	3.65	4.23	5.98

Table 5b Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
46.3	112.0	86.7	0.90	0.56	4.22	3.65	4.22	5.97
46.2	113.0	86.1	0.90	0.59	4.26	3.68	4.25	6.00
46.1	113.0	86.2	0.90	0.58	4.25	3.67	4.24	5.98
46.1	113.0	86.4	0.90	0.58	4.24	3.65	4.24	5.97
46.0	113.0	86.5	0.90	0.57	4.24	3.65	4.23	5.96
45.9	114.0	85.9	0.90	0.60	4.26	3.68	4.26	5.98
45.8	114.0	86.1	0.90	0.59	4.26	3.67	4.25	5.96
45.7	115.0	85.4	0.90	0.62	4.29	3.70	4.28	5.99
45.7	114.0	86.3	0.90	0.58	4.24	3.65	4.24	5.94
45.6	115.0	85.7	0.90	0.61	4.27	3.68	4.27	5.96
45.5	115.0	85.9	0.90	0.60	4.27	3.67	4.26	5.95
45.4	115.0	86.0	0.90	0.59	4.26	3.67	4.25	5.94
45.3	115.0	86.2	0.90	0.59	4.25	3.65	4.24	5.92
45.3	115.0	86.3	0.90	0.58	4.24	3.65	4.24	5.91
45.2	115.0	86.5	0.90	0.57	4.24	3.63	4.23	5.89
45.1	116.0	85.9	0.90	0.60	4.26	3.67	4.26	5.92
45.0	116.0	86.1	0.90	0.59	4.26	3.65	4.25	5.90
44.9	116.0	86.2	0.90	0.59	4.25	3.65	4.24	5.89
44.9	117.0	85.6	0.90	0.61	4.28	3.67	4.28	5.91
44.8	117.0	85.8	0.90	0.61	4.27	3.67	4.27	5.90
44.7	117.0	85.9	0.90	0.60	4.26	3.66	4.26	5.89
44.6	117.0	86.1	0.90	0.59	4.26	3.65	4.25	5.87
44.5	118.0	85.5	0.90	0.62	4.28	3.68	4.28	5.89
44.5	118.0	85.7	0.90	0.61	4.28	3.67	4.27	5.88
44.4	118.0	85.8	0.90	0.61	4.27	3.66	4.26	5.86
44.3	118.0	86.0	0.90	0.60	4.26	3.65	4.26	5.85
44.2	119.0	85.4	0.90	0.63	4.29	3.68	4.29	5.87
44.1	119.0	85.5	0.90	0.62	4.28	3.67	4.28	5.86
44.1	119.0	85.7	0.90	0.61	4.27	3.65	4.27	5.84
44.0	119.0	85.8	0.90	0.60	4.26	3.65	4.26	5.83
43.9	120.0	85.3	0.90	0.63	4.30	3.67	4.29	5.85
43.8	120.0	85.4	0.90	0.62	4.29	3.66	4.28	5.83
43.8	120.0	85.6	0.90	0.61	4.28	3.65	4.28	5.82
43.7	121.0	85.0	0.90	0.64	4.31	3.68	4.30	5.84
43.6	121.0	85.2	0.90	0.63	4.30	3.67	4.30	5.83
43.5	121.0	85.4	0.90	0.63	4.29	3.66	4.29	5.81
43.4	121.0	85.5	0.90	0.62	4.28	3.65	4.28	5.80
43.4	121.0	85.7	0.90	0.61	4.28	3.64	4.27	5.78
43.3	122.0	85.1	0.90	0.64	4.30	3.67	4.30	5.81
43.2	122.0	85.3	0.90	0.63	4.30	3.66	4.29	5.79
43.1	122.0	85.4	0.90	0.62	4.29	3.65	4.28	5.78
43.0	123.0	84.9	0.90	0.65	4.31	3.68	4.31	5.80
43.0	123.0	85.1	0.90	0.64	4.31	3.67	4.30	5.78
42.9	123.0	85.2	0.90	0.63	4.30	3.65	4.30	5.77
42.8	123.0	85.4	0.90	0.63	4.29	3.65	4.29	5.75
42.7	124.0	84.8	0.90	0.65	4.31	3.67	4.31	5.77
42.6	124.0	85.0	0.90	0.65	4.31	3.66	4.31	5.76

Table 5c Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
42.6	124.0	85.1	0.90	0.64	4.30	3.65	4.30	5.74
42.5	125.0	84.6	0.90	0.67	4.33	3.68	4.32	5.76
42.4	125.0	84.8	0.90	0.66	4.32	3.67	4.31	5.75
42.3	125.0	84.9	0.90	0.65	4.31	3.66	4.31	5.73
42.2	126.0	84.4	0.90	0.68	4.34	3.69	4.33	5.75
42.2	126.0	84.6	0.90	0.67	4.33	3.67	4.33	5.74
42.1	127.0	84.1	0.90	0.69	4.36	3.70	4.35	5.75
42.0	126.0	84.9	0.90	0.65	4.31	3.65	4.31	5.70
41.9	127.0	84.4	0.90	0.68	4.34	3.68	4.33	5.72
41.8	127.0	84.6	0.89	0.67	4.33	3.67	4.33	5.71
41.8	127.0	84.7	0.89	0.66	4.32	3.66	4.32	5.69
41.7	127.0	84.9	0.89	0.65	4.31	3.65	4.31	5.68
41.6	128.0	84.4	0.89	0.68	4.34	3.67	4.34	5.70
41.5	128.0	84.5	0.89	0.67	4.33	3.66	4.33	5.68
41.5	128.0	84.7	0.89	0.66	4.33	3.65	4.32	5.67
41.4	129.0	84.2	0.89	0.69	4.35	3.68	4.35	5.68
41.3	129.0	84.4	0.89	0.68	4.34	3.67	4.34	5.67
41.2	129.0	84.5	0.89	0.67	4.33	3.65	4.33	5.65
41.1	130.0	84.0	0.89	0.70	4.36	3.68	4.35	5.67
41.1	130.0	84.2	0.89	0.69	4.35	3.67	4.35	5.65
41.0	130.0	84.4	0.89	0.68	4.34	3.66	4.34	5.64
40.9	130.0	84.5	0.89	0.67	4.33	3.65	4.33	5.62
40.8	131.0	84.0	0.89	0.69	4.36	3.67	4.35	5.64
40.7	131.0	84.2	0.89	0.69	4.35	3.66	4.35	5.62
40.7	131.0	84.4	0.89	0.68	4.34	3.65	4.34	5.61
40.6	132.0	83.9	0.89	0.70	4.37	3.67	4.36	5.63
40.5	132.0	84.1	0.89	0.69	4.36	3.66	4.35	5.61
40.4	132.0	84.2	0.89	0.69	4.35	3.65	4.35	5.59
40.3	133.0	83.8	0.89	0.71	4.37	3.67	4.37	5.61
40.3	133.0	83.9	0.89	0.70	4.36	3.66	4.36	5.59
40.2	133.0	84.1	0.89	0.69	4.35	3.65	4.35	5.58
40.1	134.0	83.6	0.89	0.72	4.38	3.68	4.38	5.59
40.0	134.0	83.8	0.89	0.71	4.37	3.67	4.37	5.57
39.9	134.0	83.9	0.89	0.70	4.36	3.65	4.36	5.56
39.9	135.0	83.5	0.89	0.72	4.39	3.68	4.38	5.57
39.8	135.0	83.7	0.89	0.71	4.38	3.66	4.37	5.56
39.7	135.0	83.8	0.89	0.71	4.37	3.65	4.37	5.54
39.6	136.0	83.4	0.89	0.73	4.39	3.67	4.39	5.56
39.6	136.0	83.5	0.89	0.72	4.39	3.66	4.38	5.54
39.5	136.0	83.7	0.89	0.71	4.37	3.65	4.37	5.53
39.4	137.0	83.3	0.89	0.74	4.40	3.67	4.39	5.54
39.3	137.0	83.4	0.89	0.73	4.39	3.66	4.39	5.52
39.2	137.0	83.6	0.89	0.72	4.38	3.65	4.38	5.51
39.2	138.0	83.2	0.89	0.74	4.40	3.67	4.40	5.52
39.1	138.0	83.3	0.89	0.73	4.40	3.66	4.39	5.50
39.0	138.0	83.5	0.89	0.72	4.39	3.65	4.38	5.49
38.9	139.0	83.1	0.89	0.75	4.41	3.67	4.41	5.50

Table 5d Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
38.8	139.0	83.2	0.89	0.74	4.40	3.66	4.40	5.49
38.8	139.0	83.4	0.88	0.73	4.39	3.65	4.39	5.47
38.7	140.0	83.0	0.88	0.75	4.41	3.67	4.41	5.48
38.6	140.0	83.2	0.88	0.74	4.41	3.66	4.40	5.47
38.5	140.0	83.3	0.88	0.73	4.40	3.65	4.39	5.45
38.4	141.0	82.9	0.88	0.76	4.42	3.67	4.41	5.46
38.4	141.0	83.1	0.88	0.74	4.41	3.65	4.41	5.44
38.3	142.0	82.7	0.88	0.77	4.43	3.68	4.43	5.46
38.2	142.0	82.8	0.88	0.76	4.42	3.66	4.42	5.44
38.1	142.0	83.0	0.88	0.75	4.41	3.65	4.41	5.43
38.0	143.0	82.6	0.88	0.77	4.43	3.67	4.43	5.44
38.0	143.0	82.8	0.88	0.76	4.43	3.66	4.42	5.42
37.9	143.0	82.9	0.88	0.75	4.41	3.65	4.41	5.41
37.8	144.0	82.5	0.88	0.77	4.44	3.67	4.43	5.41
37.7	144.0	82.7	0.88	0.76	4.43	3.65	4.43	5.40
37.6	145.0	82.3	0.88	0.78	4.45	3.67	4.44	5.41
37.6	145.0	82.5	0.88	0.78	4.44	3.66	4.44	5.39
37.5	145.0	82.7	0.88	0.77	4.43	3.65	4.43	5.37
37.4	146.0	82.3	0.88	0.79	4.45	3.67	4.45	5.39
37.3	146.0	82.5	0.88	0.78	4.44	3.66	4.44	5.37
37.3	146.0	82.6	0.88	0.77	4.43	3.65	4.43	5.35
37.2	147.0	82.2	0.88	0.79	4.45	3.67	4.45	5.36
37.1	147.0	82.4	0.88	0.78	4.44	3.65	4.44	5.35
37.0	148.0	82.0	0.88	0.80	4.46	3.67	4.46	5.35
36.9	148.0	82.2	0.88	0.80	4.46	3.65	4.45	5.34
36.9	149.0	81.8	0.88	0.81	4.48	3.67	4.47	5.35
36.8	149.0	82.0	0.88	0.80	4.47	3.66	4.46	5.33
36.7	149.0	82.2	0.88	0.80	4.46	3.65	4.45	5.31
36.6	150.0	81.8	0.88	0.81	4.48	3.67	4.47	5.32
36.5	150.0	82.0	0.88	0.80	4.47	3.65	4.46	5.31
36.5	151.0	81.6	0.88	0.83	4.49	3.67	4.48	5.31
36.4	151.0	81.8	0.88	0.81	4.48	3.66	4.47	5.30
36.3	151.0	82.0	0.88	0.81	4.47	3.65	4.46	5.28
36.2	152.0	81.6	0.88	0.83	4.49	3.67	4.48	5.29
36.1	152.0	81.8	0.88	0.81	4.48	3.65	4.47	5.27
36.1	153.0	81.4	0.88	0.83	4.50	3.67	4.49	5.28
36.0	153.0	81.6	0.88	0.83	4.49	3.65	4.48	5.26
35.9	154.0	81.3	0.88	0.84	4.51	3.67	4.50	5.27
35.8	154.0	81.5	0.87	0.83	4.50	3.66	4.49	5.25
35.7	154.0	81.6	0.87	0.82	4.49	3.65	4.48	5.24
35.7	155.0	81.3	0.87	0.84	4.51	3.67	4.50	5.24
35.6	155.0	81.5	0.87	0.83	4.50	3.65	4.49	5.22
35.5	156.0	81.1	0.87	0.85	4.52	3.67	4.51	5.23
35.4	156.0	81.3	0.87	0.84	4.50	3.65	4.50	5.21
35.4	157.0	81.0	0.87	0.86	4.52	3.67	4.52	5.22
35.3	157.0	81.2	0.87	0.85	4.51	3.65	4.51	5.20
35.2	158.0	80.8	0.87	0.87	4.53	3.67	4.53	5.21

Table 5e Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
35.1	158.0	81.0	0.87	0.86	4.52	3.66	4.52	5.19
35.0	159.0	80.7	0.87	0.87	4.54	3.67	4.54	5.20
35.0	159.0	80.9	0.87	0.87	4.53	3.66	4.52	5.18
34.9	160.0	80.5	0.87	0.88	4.55	3.68	4.54	5.19
34.8	160.0	80.7	0.87	0.87	4.54	3.66	4.53	5.17
34.7	161.0	80.4	0.87	0.89	4.56	3.68	4.55	5.18
34.6	161.0	80.6	0.87	0.88	4.54	3.67	4.54	5.16
34.6	161.0	80.8	0.87	0.87	4.53	3.65	4.53	5.14
34.5	162.0	80.5	0.87	0.89	4.55	3.67	4.55	5.15
34.4	162.0	80.6	0.87	0.88	4.54	3.65	4.54	5.13
34.3	163.0	80.3	0.87	0.90	4.56	3.66	4.56	5.13
34.2	163.0	80.5	0.87	0.89	4.55	3.65	4.54	5.11
34.2	164.0	80.2	0.87	0.91	4.57	3.66	4.56	5.12
34.1	164.0	80.4	0.87	0.89	4.56	3.65	4.55	5.10
34.0	165.0	80.1	0.87	0.91	4.57	3.67	4.57	5.10
33.9	165.0	80.3	0.87	0.90	4.56	3.65	4.56	5.08
33.8	166.0	80.0	0.87	0.92	4.58	3.66	4.57	5.09
33.8	166.0	80.2	0.87	0.91	4.57	3.65	4.56	5.07
33.7	167.0	79.9	0.87	0.92	4.59	3.66	4.58	5.07
33.6	167.0	80.1	0.87	0.91	4.57	3.65	4.57	5.06
33.5	168.0	79.8	0.87	0.93	4.59	3.66	4.59	5.06
33.4	168.0	80.0	0.86	0.92	4.58	3.65	4.57	5.04
33.4	169.0	79.7	0.86	0.93	4.60	3.66	4.59	5.04
33.3	170.0	79.4	0.86	0.95	4.61	3.67	4.61	5.05
33.2	170.0	79.6	0.86	0.94	4.60	3.66	4.60	5.03
33.1	171.0	79.3	0.86	0.95	4.62	3.67	4.61	5.03
33.1	171.0	79.5	0.86	0.94	4.61	3.65	4.60	5.01
33.0	172.0	79.2	0.86	0.96	4.62	3.67	4.62	5.02
32.9	172.0	79.4	0.86	0.95	4.61	3.65	4.61	5.00
32.8	173.0	79.2	0.86	0.96	4.63	3.67	4.62	5.00
32.7	173.0	79.3	0.86	0.95	4.61	3.65	4.61	4.98
32.7	174.0	79.1	0.86	0.97	4.63	3.66	4.63	4.98
32.6	175.0	78.8	0.86	0.98	4.65	3.67	4.64	4.98
32.5	175.0	79.0	0.86	0.97	4.63	3.66	4.63	4.96
32.4	176.0	78.8	0.86	0.98	4.65	3.67	4.65	4.97
32.3	176.0	79.0	0.86	0.98	4.64	3.65	4.63	4.94
32.3	177.0	78.7	0.86	0.99	4.65	3.67	4.65	4.95
32.2	178.0	78.5	0.86	1.00	4.67	3.68	4.67	4.95
32.1	178.0	78.6	0.86	0.99	4.66	3.66	4.65	4.93
32.0	179.0	78.4	0.86	1.01	4.67	3.67	4.67	4.93
31.9	179.0	78.6	0.86	1.00	4.66	3.65	4.66	4.91
31.9	180.0	78.4	0.86	1.01	4.67	3.66	4.67	4.91
31.8	181.0	78.1	0.86	1.03	4.69	3.67	4.69	4.91
31.7	181.0	78.3	0.86	1.02	4.68	3.65	4.67	4.89
31.6	182.0	78.1	0.86	1.03	4.69	3.67	4.69	4.89
31.5	182.0	78.3	0.85	1.02	4.68	3.65	4.67	4.87

Table 5f Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea%**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
31.4	184.0	77.8	0.85	1.04	4.71	3.67	4.70	4.87
31.3	184.0	78.0	0.85	1.03	4.69	3.65	4.69	4.85
31.2	185.0	77.8	0.85	1.04	4.71	3.67	4.70	4.85
31.1	186.0	77.6	0.85	1.06	4.72	3.67	4.72	4.85
31.0	187.0	77.5	0.85	1.06	4.72	3.66	4.72	4.83
30.9	188.0	77.3	0.85	1.07	4.74	3.67	4.73	4.83
30.8	188.0	77.5	0.85	1.06	4.72	3.65	4.72	4.81
30.8	189.0	77.3	0.85	1.07	4.74	3.67	4.73	4.81
30.7	190.0	77.1	0.85	1.09	4.75	3.67	4.74	4.81
30.6	190.0	77.3	0.85	1.07	4.74	3.65	4.73	4.79
30.5	191.0	77.1	0.85	1.09	4.75	3.66	4.74	4.78
30.4	192.0	76.9	0.85	1.10	4.76	3.67	4.76	4.78
30.4	192.0	77.1	0.85	1.09	4.75	3.65	4.75	4.76
30.3	183.0	76.9	0.85	1.10	4.76	3.66	4.76	4.76
30.2	194.0	76.7	0.85	1.11	4.78	3.67	4.77	4.76
30.1	194.0	76.9	0.85	1.10	4.76	3.65	4.76	4.74
30.0	195.0	76.7	0.85	1.11	4.77	3.66	4.77	4.74
30.0	196.0	76.5	0.85	1.12	4.78	3.67	4.78	4.73
29.9	197.0	76.3	0.85	1.13	4.80	3.67	4.80	4.73
29.8	197.0	76.5	0.85	1.12	4.78	3.65	4.78	4.71
29.7	198.0	76.4	0.85	1.13	4.79	3.66	4.79	4.70
29.6	199.0	76.2	0.85	1.14	4.81	3.66	4.80	4.70
29.6	200.0	76.0	0.85	1.16	4.82	3.67	4.81	4.70
29.5	201.0	75.8	0.84	1.17	4.83	3.67	4.83	4.70
29.4	201.0	76.0	0.84	1.15	4.82	3.65	4.81	4.67
29.3	202.0	75.9	0.84	1.17	4.83	3.66	4.82	4.67
29.2	203.0	75.7	0.84	1.18	4.84	3.67	4.83	4.67
29.2	204.0	75.5	0.84	1.19	4.85	3.67	4.85	4.66
29.1	204.0	75.7	0.84	1.17	4.84	3.65	4.83	4.64
29.0	205.0	75.6	0.84	1.18	4.85	3.66	4.84	4.63
28.9	206.0	75.4	0.84	1.19	4.85	3.67	4.85	4.63
28.9	207.0	75.2	0.84	1.20	4.87	3.67	4.86	4.63
28.8	208.0	75.1	0.84	1.21	4.88	3.67	4.87	4.62
28.7	208.0	75.3	0.84	1.20	4.87	3.65	4.86	4.60
28.6	209.0	75.1	0.84	1.21	4.87	3.65	4.87	4.59
28.5	210.0	75.0	0.84	1.22	4.88	3.66	4.88	4.59
28.5	211.0	74.8	0.84	1.23	4.89	3.67	4.89	4.58
28.4	212.0	74.7	0.84	1.24	4.90	3.67	4.90	4.57
28.3	213.0	74.6	0.84	1.25	4.91	3.67	4.91	4.57
28.2	214.0	74.4	0.84	1.26	4.92	3.67	4.92	4.56
28.1	214.0	74.6	0.83	1.24	4.91	3.65	4.90	4.54
28.1	215.0	74.5	0.83	1.25	4.91	3.65	4.91	4.54
28.0	216.0	74.4	0.83	1.26	4.93	3.66	4.92	4.53
27.9	217.0	74.2	0.83	1.27	4.93	3.66	4.93	4.52
27.8	218.0	74.1	0.83	1.28	4.94	3.66	4.94	4.52
27.7	219.0	74.0	0.83	1.29	4.95	3.67	4.95	4.51

Table 5g Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
27.7	220.0	73.8	0.83	1.30	4.96	3.67	4.96	4.50
27.6	221.0	73.7	0.83	1.30	4.97	3.67	4.96	4.50
27.5	222.0	73.6	0.83	1.31	4.98	3.67	4.97	4.49
27.4	223.0	73.5	0.83	1.32	4.98	3.68	4.98	4.48
27.3	223.0	73.7	0.83	1.31	4.99	3.64	4.99	4.46
27.2	226.0	73.1	0.83	1.34	5.01	3.67	5.00	4.46
27.1	227.0	73.0	0.83	1.35	5.02	3.67	5.01	4.45
27.0	228.0	72.9	0.83	1.36	5.02	3.67	5.02	4.44
26.9	229.0	72.8	0.83	1.37	5.03	3.67	5.02	4.43
26.9	230.0	72.7	0.83	1.37	5.04	3.67	5.03	4.42
26.8	231.0	72.6	0.83	1.38	5.04	3.67	5.04	4.41
26.7	232.0	72.5	0.83	1.39	5.05	3.67	5.05	4.41
26.6	233.0	72.4	0.82	1.39	5.06	3.67	5.05	4.39
26.6	234.0	72.3	0.82	1.40	5.06	3.67	5.06	4.39
26.5	235.0	72.2	0.82	1.41	5.07	3.67	5.07	4.38
26.4	236.0	72.1	0.82	1.41	5.07	3.67	5.07	4.37
26.3	237.0	72.1	0.82	1.42	5.08	3.67	5.08	4.36
26.2	238.0	72.0	0.82	1.43	5.09	3.66	5.08	4.35
26.2	239.0	71.9	0.82	1.43	5.09	3.66	5.09	4.34
26.1	240.0	71.8	0.82	1.44	5.10	3.66	5.09	4.33
26.0	241.0	71.7	0.82	1.44	5.11	3.65	5.10	4.31
25.9	242.0	71.6	0.82	1.45	5.11	3.65	5.11	4.31
25.8	244.0	71.3	0.82	1.47	5.14	3.67	5.13	4.31
25.8	245.0	71.2	0.82	1.48	5.14	3.67	5.14	4.30
25.7	246.0	71.1	0.82	1.48	5.15	3.67	5.15	4.29
25.6	247.0	71.1	0.82	1.49	5.15	3.66	5.15	4.28
25.5	249.0	70.7	0.82	1.52	5.18	3.68	5.17	4.28
25.4	250.0	70.6	0.82	1.52	5.19	3.67	5.18	4.28
25.4	251.0	70.6	0.81	1.52	5.19	3.67	5.19	4.26
25.3	252.0	70.5	0.81	1.53	5.19	3.66	5.19	4.24
25.2	253.0	70.5	0.81	1.53	5.20	3.65	5.19	4.23
25.1	255.0	70.1	0.81	1.56	5.22	3.67	5.22	4.23
25.0	256.0	70.1	0.81	1.56	5.22	3.67	5.22	4.22
25.0	257.0	70.0	0.81	1.57	5.23	3.66	5.22	4.20
24.9	258.0	70.0	0.81	1.57	5.23	3.65	5.23	4.19
24.8	259.0	69.9	0.81	1.57	5.24	3.65	5.23	4.18
24.7	261.0	69.6	0.81	1.59	5.26	3.67	5.26	4.18
24.6	262.0	69.6	0.81	1.60	5.26	3.65	5.26	4.17
24.6	264.0	69.3	0.81	1.62	5.29	3.67	5.28	4.17
24.5	265.0	69.2	0.81	1.63	5.29	3.66	5.28	4.15
24.4	266.0	69.2	0.81	1.63	5.29	3.65	5.29	4.14
24.3	268.0	68.9	0.81	1.65	5.31	3.67	5.31	4.14
24.3	269.0	68.9	0.80	1.65	5.31	3.66	5.31	4.12
24.2	271.0	68.6	0.80	1.67	5.34	3.67	5.33	4.12
24.1	272.0	68.6	0.80	1.68	5.34	3.66	5.34	4.11
24.0	273.0	68.5	0.80	1.68	5.34	3.65	5.34	4.09
23.9	275.0	68.3	0.80	1.70	5.36	3.66	5.36	4.09

Table 5h Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
23.8	278.0	68.0	0.80	1.72	5.39	3.66	5.38	4.07
23.7	280.0	67.7	0.80	1.74	5.41	3.67	5.40	4.07
23.6	281.0	67.7	0.80	1.74	5.41	3.65	5.41	4.05
23.5	283.0	67.4	0.80	1.76	5.43	3.67	5.43	4.05
23.4	286.0	67.2	0.80	1.79	5.45	3.66	5.44	4.03
23.3	288.0	67.0	0.80	1.80	5.47	3.67	5.46	4.02
23.2	289.0	66.9	0.79	1.81	5.47	3.66	5.46	4.00
23.1	291.0	66.7	0.79	1.82	5.49	3.67	5.48	4.00
23.1	292.0	66.7	0.79	1.82	5.49	3.65	5.48	3.98
23.0	294.0	66.5	0.79	1.84	5.50	3.66	5.50	3.98
22.9	296.0	66.3	0.79	1.86	5.52	3.65	5.52	3.97
22.8	297.0	66.3	0.79	1.86	5.52	3.65	5.52	3.95
22.7	299.0	66.1	0.79	1.88	5.54	3.65	5.54	3.95
22.7	301.0	65.9	0.79	1.90	5.56	3.66	5.56	3.94
22.6	303.0	65.6	0.79	1.91	5.58	3.67	5.57	3.93
22.5	305.0	65.4	0.79	1.93	5.59	3.67	5.59	3.93
22.4	307.0	65.3	0.79	1.94	5.61	3.67	5.61	3.92
22.4	308.0	65.3	0.79	1.94	5.61	3.65	5.61	3.90
22.3	310.0	65.1	0.78	1.96	5.63	3.66	5.62	3.89
22.2	312.0	64.9	0.78	1.98	5.64	3.66	5.64	3.88
22.1	315.0	64.5	0.78	2.01	5.67	3.68	5.67	3.88
22.0	317.0	64.3	0.78	2.03	5.69	3.69	5.69	3.87
22.0	318.0	64.4	0.78	2.02	5.69	3.65	5.69	3.85
21.9	320.0	64.2	0.78	2.04	5.70	3.65	5.70	3.84
21.8	322.0	64.0	0.78	2.06	5.72	3.65	5.72	3.83
21.7	324.0	63.9	0.78	2.07	5.73	3.65	5.73	3.82
21.6	326.0	63.7	0.78	2.08	5.75	3.65	5.74	3.81
21.6	328.0	63.5	0.78	2.10	5.76	3.65	5.76	3.80
21.5	331.0	63.2	0.78	2.13	5.79	3.67	5.79	3.80
21.4	333.0	63.1	0.78	2.14	5.81	3.67	5.80	3.79
21.3	335.0	62.9	0.77	2.16	5.82	3.66	5.81	3.78
21.2	338.0	62.6	0.77	2.19	5.85	3.68	5.85	3.78
21.2	340.0	62.4	0.77	2.20	5.86	3.66	5.86	3.76
21.1	342.0	62.3	0.77	2.21	5.87	3.67	5.87	3.75
21.0	344.0	62.2	0.77	2.22	5.89	3.66	5.88	3.74
20.9	346.0	62.1	0.77	2.24	5.90	3.65	5.89	3.72
20.8	349.0	61.8	0.77	2.26	5.93	3.67	5.93	3.72
20.8	351.0	61.6	0.77	2.28	5.94	3.66	5.94	3.71
20.7	354.0	61.4	0.77	2.30	5.96	3.67	5.96	3.70
20.6	356.0	61.2	0.77	2.31	5.98	3.66	5.97	3.69
20.5	359.0	61.0	0.77	2.34	6.00	3.67	6.00	3.68
20.4	362.0	60.7	0.76	2.37	6.03	3.66	6.03	3.68
20.4	365.0	60.4	0.76	2.39	6.06	3.67	6.06	3.67
20.3	367.0	60.3	0.76	2.40	6.06	3.65	6.06	3.65
20.2	369.0	60.2	0.76	2.41	6.07	3.65	6.07	3.64
20.1	372.0	60.0	0.76	2.44	6.10	3.66	6.10	3.63
20.1	375.0	59.7	0.76	2.46	6.13	3.67	6.12	3.63

Table 5i Lookup table for dyked-end level furrows, moderately-fine textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
20.0	378.0	59.5	0.76	2.49	6.15	3.67	6.15	3.61

Table 6a Lookup table for dyke-end level furrow, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
50.0	71.0	98.0	0.98	0.06	2.89	2.85	2.89	7.49
49.9	71.0	98.2	0.98	0.05	2.89	2.84	2.88	7.48
49.8	71.0	98.5	0.98	0.04	2.88	2.83	2.88	7.47
49.7	71.0	98.7	0.98	0.04	2.87	2.83	2.87	7.46
49.6	71.0	98.9	0.98	0.03	2.87	2.82	2.86	7.44
49.5	71.0	99.0	0.98	0.03	2.86	2.81	2.86	7.43
49.4	72.0	97.9	0.98	0.06	2.89	2.85	2.89	7.49
49.2	72.0	98.1	0.98	0.05	2.89	2.84	2.89	7.48
49.1	72.0	98.3	0.98	0.05	2.88	2.83	2.88	7.46
49.0	72.0	98.6	0.98	0.04	2.87	2.83	2.87	7.45
48.9	72.0	98.8	0.98	0.04	2.87	2.82	2.87	7.44
48.8	72.0	98.9	0.98	0.03	2.86	2.82	2.86	7.42
48.7	73.0	97.8	0.98	0.06	2.90	2.85	2.89	7.48
48.6	73.0	98.0	0.98	0.06	2.89	2.84	2.89	7.47
48.5	73.0	98.3	0.98	0.05	2.88	2.84	2.88	7.45
48.4	73.0	98.5	0.98	0.04	2.88	2.83	2.87	7.44
48.3	73.0	98.7	0.98	0.04	2.87	2.83	2.87	7.43
48.2	73.0	98.9	0.98	0.03	2.87	2.82	2.86	7.41
48.1	74.0	97.8	0.98	0.06	2.90	2.85	2.90	7.47
48.0	74.0	98.0	0.98	0.06	2.89	2.85	2.89	7.46
47.9	74.0	98.2	0.98	0.05	2.89	2.84	2.88	7.44
47.8	74.0	98.4	0.98	0.04	2.88	2.83	2.88	7.43
47.7	74.0	98.6	0.98	0.04	2.87	2.83	2.87	7.42
47.6	74.0	98.8	0.98	0.03	2.87	2.82	2.86	7.41
47.5	75.0	97.8	0.98	0.06	2.90	2.85	2.90	7.46
47.3	75.0	98.0	0.98	0.06	2.89	2.85	2.89	7.44
47.2	75.0	98.2	0.98	0.05	2.89	2.84	2.88	7.43
47.1	75.0	98.4	0.98	0.04	2.88	2.83	2.88	7.42
47.0	75.0	98.6	0.98	0.04	2.87	2.83	2.87	7.41
46.9	75.0	98.8	0.98	0.03	2.87	2.82	2.86	7.39
46.8	76.0	97.8	0.98	0.06	2.90	2.85	2.89	7.44
46.7	76.0	98.0	0.98	0.06	2.89	2.84	2.89	7.43
46.6	76.0	98.2	0.98	0.05	2.89	2.84	2.88	7.42
46.5	76.0	98.5	0.98	0.04	2.88	2.83	2.87	7.41
46.4	76.0	98.7	0.98	0.04	2.87	2.82	2.87	7.39
46.3	76.0	98.9	0.98	0.03	2.87	2.81	2.86	7.38
46.2	77.0	97.8	0.98	0.06	2.89	2.85	2.89	7.43
46.1	77.0	98.1	0.98	0.06	2.89	2.84	2.89	7.42
46.0	77.0	98.3	0.98	0.05	2.88	2.83	2.88	7.40
45.9	77.0	98.5	0.98	0.04	2.87	2.83	2.87	7.39
45.8	77.0	98.7	0.98	0.04	2.87	2.82	2.87	7.37
45.7	78.0	97.7	0.98	0.06	2.90	2.85	2.90	7.43
45.5	78.0	97.9	0.98	0.06	2.89	2.85	2.89	7.41
45.4	78.0	98.2	0.98	0.05	2.89	2.84	2.89	7.40
45.3	78.0	98.4	0.98	0.04	2.88	2.83	2.88	7.39
45.2	78.0	98.6	0.98	0.04	2.87	2.82	2.87	7.37
45.1	78.0	98.8	0.98	0.03	2.87	2.82	2.87	7.35
45.0	79.0	97.8	0.98	0.06	2.89	2.85	2.89	7.41

Table 6b Lookup table for dyke-end level furrow, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
44.9	79.0	98.1	0.98	0.06	2.89	2.84	2.89	7.39
44.8	79.0	98.3	0.98	0.05	2.88	2.83	2.88	7.38
44.7	79.0	98.5	0.98	0.04	2.87	2.83	2.87	7.36
44.6	79.0	98.7	0.98	0.04	2.87	2.82	2.87	7.35
44.5	80.0	97.8	0.98	0.06	2.90	2.85	2.90	7.40
44.4	80.0	98.0	0.98	0.06	2.89	2.84	2.89	7.39
44.3	80.0	98.2	0.98	0.05	2.88	2.83	2.88	7.37
44.2	80.0	98.5	0.98	0.04	2.88	2.83	2.88	7.36
44.1	80.0	98.7	0.98	0.04	2.87	2.82	2.87	7.34
44.0	81.0	97.7	0.98	0.06	2.90	2.85	2.90	7.39
43.9	81.0	97.9	0.98	0.06	2.89	2.84	2.89	7.38
43.8	81.0	98.2	0.98	0.05	2.89	2.83	2.89	7.36
43.6	81.0	98.4	0.98	0.04	2.88	2.83	2.88	7.35
43.5	81.0	98.6	0.98	0.04	2.87	2.82	2.87	7.33
43.4	82.0	97.7	0.98	0.06	2.90	2.85	2.90	7.38
43.3	82.0	97.9	0.98	0.06	2.89	2.84	2.89	7.37
43.2	82.0	98.2	0.98	0.05	2.89	2.83	2.89	7.35
43.1	82.0	98.4	0.98	0.04	2.88	2.83	2.88	7.33
43.0	82.0	98.6	0.98	0.04	2.87	2.82	2.87	7.32
42.9	83.0	97.7	0.98	0.06	2.90	2.85	2.90	7.37
42.8	83.0	97.9	0.98	0.06	2.89	2.84	2.89	7.35
42.7	83.0	98.2	0.98	0.05	2.89	2.83	2.88	7.34
42.6	83.0	98.4	0.98	0.04	2.88	2.83	2.88	7.32
42.5	83.0	98.7	0.98	0.04	2.87	2.82	2.87	7.31
42.4	84.0	97.7	0.98	0.06	2.90	2.85	2.90	7.35
42.3	84.0	98.0	0.98	0.06	2.89	2.84	2.89	7.34
42.2	84.0	98.2	0.98	0.05	2.88	2.83	2.88	7.32
42.1	84.0	98.5	0.98	0.04	2.87	2.83	2.87	7.31
42.0	84.0	98.7	0.98	0.04	2.87	2.82	2.87	7.30
41.8	85.0	97.8	0.98	0.06	2.89	2.84	2.89	7.34
41.7	85.0	98.1	0.98	0.05	2.89	2.84	2.89	7.32
41.6	85.0	98.3	0.98	0.05	2.88	2.83	2.88	7.31
41.5	85.0	98.5	0.98	0.04	2.87	2.82	2.87	7.30
41.4	86.0	97.7	0.98	0.06	2.90	2.85	2.90	7.34
41.3	86.0	97.9	0.98	0.06	2.89	2.84	2.89	7.32
41.2	86.0	98.2	0.98	0.05	2.89	2.83	2.89	7.31
41.1	86.0	98.4	0.98	0.04	2.88	2.83	2.88	7.29
41.0	86.0	98.6	0.98	0.04	2.87	2.82	2.87	7.28
40.9	87.0	97.8	0.98	0.06	2.90	2.84	2.89	7.32
40.8	87.0	98.0	0.98	0.06	2.89	2.84	2.89	7.30
40.7	87.0	98.3	0.98	0.05	2.88	2.83	2.88	7.29
40.6	87.0	98.5	0.98	0.04	2.87	2.82	2.87	7.27
40.5	88.0	97.7	0.98	0.06	2.90	2.85	2.90	7.31
40.4	88.0	97.9	0.98	0.06	2.89	2.84	2.89	7.30
40.3	88.0	98.2	0.98	0.05	2.88	2.83	2.88	7.28
40.2	88.0	98.4	0.98	0.04	2.88	2.82	2.87	7.27
40.1	89.0	97.6	0.98	0.07	2.90	2.85	2.90	7.31
39.9	89.0	97.9	0.98	0.06	2.89	2.84	2.89	7.29
39.8	89.0	98.1	0.98	0.05	2.89	2.83	2.89	7.28

Table 6c Lookup table for dyked-end level furrow, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
39.7	89.0	98.4	0.98	0.04	2.88	2.83	2.88	7.26
39.6	89.0	98.6	0.98	0.04	2.87	2.82	2.87	7.24
39.5	90.0	97.8	0.98	0.06	2.89	2.84	2.89	7.29
39.4	90.0	98.1	0.98	0.05	2.89	2.83	2.89	7.27
39.3	90.0	98.3	0.98	0.04	2.88	2.83	2.88	7.25
39.2	90.0	98.6	0.98	0.04	2.87	2.82	2.87	7.24
39.1	91.0	97.8	0.98	0.06	2.90	2.84	2.90	7.28
39.0	91.0	98.1	0.98	0.06	2.89	2.83	2.89	7.26
38.9	91.0	98.3	0.98	0.05	2.88	2.83	2.88	7.24
38.8	91.0	98.6	0.98	0.04	2.87	2.82	2.87	7.23
38.7	92.0	97.8	0.98	0.06	2.90	2.84	2.90	7.27
38.6	92.0	98.0	0.98	0.06	2.89	2.83	2.89	7.25
38.5	92.0	98.3	0.98	0.05	2.88	2.83	2.88	7.23
38.4	92.0	98.6	0.98	0.04	2.87	2.82	2.87	7.22
38.3	93.0	97.8	0.98	0.06	2.89	2.84	2.89	7.26
38.2	93.0	98.1	0.98	0.05	2.89	2.83	2.89	7.24
38.0	93.0	98.3	0.98	0.04	2.88	2.83	2.88	7.22
37.9	93.0	98.6	0.98	0.04	2.87	2.82	2.87	7.20
37.8	94.0	97.8	0.98	0.06	2.89	2.84	2.89	7.24
37.7	94.0	98.1	0.98	0.05	2.89	2.83	2.89	7.22
37.6	94.0	98.4	0.98	0.04	2.88	2.82	2.88	7.21
37.5	95.0	97.6	0.98	0.07	2.90	2.85	2.90	7.25
37.4	95.0	97.9	0.98	0.06	2.89	2.84	2.89	7.23
37.3	95.0	98.2	0.98	0.05	2.89	2.83	2.89	7.21
37.2	95.0	98.4	0.98	0.04	2.88	2.82	2.87	7.19
37.1	96.0	97.7	0.98	0.06	2.90	2.84	2.90	7.23
37.0	96.0	98.0	0.98	0.06	2.89	2.83	2.89	7.21
36.9	96.0	98.3	0.98	0.05	2.88	2.83	2.88	7.20
36.8	97.0	97.5	0.98	0.07	2.90	2.85	2.90	7.23
36.7	97.0	97.8	0.98	0.06	2.89	2.84	2.89	7.21
36.6	97.0	98.1	0.98	0.05	2.89	2.83	2.89	7.20
36.5	97.0	98.4	0.98	0.04	2.88	2.82	2.88	7.18
36.4	98.0	97.7	0.98	0.06	2.90	2.84	2.90	7.21
36.2	98.0	97.9	0.98	0.06	2.89	2.83	2.89	7.20
36.1	98.0	98.2	0.98	0.05	2.88	2.83	2.88	7.18
36.0	99.0	97.5	0.98	0.07	2.90	2.85	2.90	7.21
35.9	99.0	97.8	0.98	0.06	2.89	2.84	2.89	7.19
35.8	99.0	98.1	0.98	0.05	2.89	2.83	2.89	7.18
35.7	99.0	98.4	0.98	0.04	2.88	2.82	2.88	7.16
35.6	100.0	97.7	0.98	0.06	2.90	2.84	2.90	7.19
35.5	100.0	98.0	0.98	0.06	2.89	2.83	2.89	7.17
35.4	100.0	98.3	0.98	0.05	2.88	2.82	2.88	7.15
35.3	101.0	97.6	0.98	0.07	2.90	2.85	2.90	7.19
35.2	101.0	97.9	0.98	0.06	2.89	2.83	2.89	7.17
35.1	101.0	98.2	0.98	0.05	2.89	2.83	2.88	7.15
35.0	102.0	97.5	0.98	0.07	2.91	2.85	2.91	7.19
34.9	102.0	97.8	0.98	0.06	2.89	2.84	2.89	7.17
34.8	102.0	98.1	0.98	0.05	2.89	2.83	2.89	7.15
34.7	103.0	97.5	0.98	0.07	2.91	2.85	2.91	7.18
34.6	103.0	97.8	0.98	0.06	2.90	2.84	2.90	7.16

6d Lookup table for dyked-end level furrow, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
34.5	103.0	98.1	0.98	0.06	2.89	2.83	2.89	7.14
34.3	103.0	98.3	0.98	0.04	2.88	2.82	2.88	7.12
34.2	104.0	97.7	0.98	0.06	2.90	2.84	2.90	7.15
34.1	104.0	98.0	0.98	0.06	2.89	2.83	2.89	7.13
34.0	104.0	98.3	0.98	0.05	2.88	2.82	2.88	7.11
33.9	105.0	97.7	0.98	0.06	2.90	2.84	2.90	7.15
33.8	105.0	98.0	0.98	0.06	2.89	2.83	2.89	7.13
33.7	105.0	98.3	0.98	0.05	2.88	2.82	2.88	7.11
33.6	106.0	97.7	0.98	0.06	2.90	2.84	2.90	7.13
33.5	106.0	98.0	0.98	0.06	2.89	2.83	2.89	7.12
33.4	106.0	98.3	0.98	0.05	2.88	2.82	2.88	7.10
33.3	107.0	97.7	0.98	0.06	2.90	2.84	2.90	7.13
33.2	107.0	98.0	0.98	0.06	2.89	2.83	2.89	7.11
33.1	107.0	98.3	0.98	0.05	2.88	2.82	2.88	7.09
33.0	108.0	97.7	0.98	0.06	2.90	2.84	2.90	7.11
32.9	108.0	98.0	0.98	0.06	2.89	2.83	2.89	7.09
32.8	109.0	97.4	0.98	0.07	2.91	2.85	2.91	7.12
32.7	109.0	97.8	0.98	0.06	2.90	2.84	2.90	7.10
32.5	109.0	98.1	0.98	0.05	2.89	2.83	2.89	7.08
32.4	110.0	97.5	0.98	0.07	2.91	2.85	2.91	7.11
32.3	110.0	97.8	0.98	0.06	2.89	2.83	2.89	7.09
32.2	110.0	98.1	0.98	0.05	2.89	2.83	2.89	7.07
32.1	111.0	97.6	0.98	0.07	2.90	2.84	2.90	7.09
32.0	111.0	97.9	0.98	0.06	2.89	2.83	2.89	7.07
31.9	111.0	98.2	0.98	0.05	2.88	2.82	2.88	7.06
31.8	112.0	97.7	0.98	0.06	2.90	2.84	2.90	7.08
31.7	112.0	98.0	0.98	0.06	2.89	2.83	2.89	7.06
31.6	113.0	97.4	0.98	0.07	2.91	2.85	2.91	7.09
31.5	113.0	97.8	0.98	0.06	2.90	2.83	2.90	7.06
31.4	113.0	98.1	0.98	0.05	2.89	2.83	2.89	7.04
31.3	114.0	97.6	0.98	0.07	2.90	2.84	2.90	7.07
31.2	114.0	97.9	0.98	0.06	2.89	2.83	2.89	7.05
31.1	115.0	97.4	0.98	0.07	2.91	2.85	2.91	7.07
31.0	115.0	97.7	0.98	0.06	2.90	2.83	2.90	7.05
30.9	115.0	98.0	0.98	0.06	2.89	2.83	2.89	7.03
30.8	116.0	97.5	0.98	0.07	2.90	2.84	2.90	7.05
30.6	116.0	97.9	0.98	0.06	2.89	2.83	2.89	7.03
30.5	117.0	97.4	0.98	0.07	2.91	2.85	2.91	7.06
30.4	117.0	97.7	0.98	0.06	2.90	2.83	2.90	7.03
30.3	117.0	98.0	0.98	0.06	2.89	2.83	2.89	7.01
30.2	118.0	97.6	0.98	0.07	2.90	2.84	2.90	7.04
30.1	118.0	97.9	0.98	0.06	2.89	2.83	2.89	7.01
30.0	119.0	97.4	0.98	0.07	2.91	2.84	2.91	7.04
29.9	119.0	97.8	0.98	0.06	2.90	2.83	2.90	7.01
29.8	119.0	98.1	0.98	0.05	2.89	2.82	2.89	6.99
29.7	120.0	97.6	0.98	0.07	2.90	2.83	2.90	7.01
29.6	120.0	98.0	0.98	0.06	2.89	2.83	2.89	6.99
29.5	121.0	97.5	0.98	0.07	2.91	2.84	2.90	7.01

Table 6e Lookup Table for dyked-end level furrow, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
29.4	121.0	97.9	0.98	0.06	2.89	2.83	2.89	6.99
29.3	122.0	97.4	0.98	0.07	2.91	2.84	2.91	7.01
29.2	122.0	97.8	0.98	0.06	2.90	2.83	2.90	6.98
29.1	123.0	97.3	0.98	0.07	2.91	2.84	2.91	7.00
29.0	123.0	97.7	0.98	0.06	2.90	2.83	2.90	6.98
28.9	123.0	98.0	0.98	0.06	2.89	2.82	2.89	6.96
28.7	124.0	97.6	0.98	0.07	2.90	2.83	2.90	6.98
28.6	124.0	98.0	0.98	0.06	2.89	2.82	2.89	6.95
28.5	125.0	97.6	0.98	0.07	2.90	2.84	2.90	6.97
28.4	125.0	97.9	0.98	0.06	2.89	2.83	2.89	6.95
28.3	126.0	97.5	0.98	0.07	2.91	2.84	2.91	6.97
28.2	126.0	97.9	0.98	0.06	2.89	2.83	2.89	6.94
28.1	127.0	97.5	0.98	0.07	2.91	2.84	2.91	6.96
28.0	127.0	97.8	0.98	0.06	2.89	2.83	2.89	6.94
27.9	128.0	97.4	0.98	0.07	2.91	2.84	2.91	6.95
27.8	128.0	97.8	0.98	0.06	2.89	2.83	2.89	6.93
27.7	129.0	97.4	0.98	0.07	2.91	2.84	2.91	6.95
27.6	129.0	97.8	0.98	0.06	2.90	2.83	2.89	6.92
27.5	130.0	97.4	0.98	0.07	2.91	2.84	2.91	6.94
27.4	130.0	97.8	0.98	0.06	2.90	2.83	2.90	6.91
27.3	131.0	97.4	0.98	0.07	2.91	2.84	2.91	6.93
27.2	131.0	97.8	0.98	0.06	2.90	2.83	2.89	6.91
27.1	132.0	97.4	0.98	0.07	2.91	2.84	2.91	6.92
26.9	132.0	97.8	0.98	0.06	2.89	2.83	2.89	6.90
26.8	133.0	97.5	0.98	0.07	2.91	2.84	2.91	6.91
26.7	133.0	97.8	0.98	0.06	2.89	2.83	2.89	6.89
26.6	134.0	97.5	0.98	0.07	2.91	2.83	2.91	6.90
26.5	134.0	97.9	0.98	0.06	2.89	2.82	2.89	6.87
26.4	135.0	97.6	0.98	0.07	2.90	2.83	2.90	6.89
26.3	135.0	97.9	0.98	0.06	2.89	2.82	2.89	6.86
26.2	136.0	97.6	0.98	0.07	2.90	2.83	2.90	6.87
26.1	137.0	97.3	0.98	0.07	2.91	2.84	2.91	6.89
26.0	137.0	97.7	0.98	0.06	2.90	2.83	2.90	6.86
25.9	138.0	97.4	0.98	0.07	2.91	2.84	2.91	6.87
25.8	138.0	97.8	0.98	0.06	2.90	2.83	2.90	6.85
25.7	139.0	97.5	0.98	0.07	2.91	2.83	2.91	6.86
25.6	139.0	97.9	0.98	0.06	2.89	2.82	2.89	6.83
25.5	140.0	97.6	0.98	0.07	2.90	2.83	2.90	6.84
25.4	141.0	97.3	0.98	0.07	2.91	2.84	2.91	6.85
25.3	141.0	97.7	0.98	0.06	2.90	2.83	2.90	6.83
25.2	142.0	97.4	0.98	0.07	2.91	2.83	2.91	6.84
25.0	142.0	97.8	0.98	0.06	2.89	2.82	2.89	6.81
24.9	143.0	97.6	0.98	0.07	2.90	2.83	2.90	6.82
24.8	144.0	97.3	0.98	0.07	2.91	2.84	2.91	6.83
24.7	144.0	97.7	0.98	0.06	2.90	2.83	2.90	6.80
24.6	145.0	97.5	0.98	0.07	2.91	2.83	2.91	6.81
24.5	146.0	97.2	0.98	0.08	2.91	2.84	2.91	6.82
24.4	146.0	97.6	0.98	0.07	2.90	2.83	2.90	6.79
24.3	147.0	97.4	0.98	0.07	2.91	2.83	2.91	6.80

Table 6f Lookup tables for dyked-end level furrows, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
24.2	147.0	97.8	0.98	0.06	2.89	2.82	2.89	6.77
24.1	148.0	97.6	0.98	0.07	2.90	2.83	2.90	6.78
24.0	149.0	97.3	0.98	0.07	2.91	2.83	2.91	6.79
23.9	150.0	97.1	0.98	0.08	2.92	2.84	2.92	6.79
23.8	150.0	97.6	0.98	0.07	2.90	2.83	2.90	6.76
23.7	151.0	97.3	0.98	0.07	2.91	2.83	2.91	6.77
23.6	152.0	97.1	0.98	0.08	2.92	2.84	2.91	6.78
23.5	152.0	97.6	0.98	0.07	2.90	2.83	2.90	6.75
23.4	153.0	97.4	0.98	0.07	2.91	2.83	2.91	6.75
23.2	154.0	97.2	0.98	0.08	2.91	2.84	2.91	6.76
23.1	155.0	97.0	0.98	0.09	2.92	2.84	2.92	6.76
23.0	155.0	97.4	0.98	0.07	2.91	2.83	2.91	6.73
22.9	156.0	97.3	0.98	0.08	2.91	2.83	2.91	6.74
22.8	157.0	97.1	0.98	0.08	2.92	2.84	2.92	6.74
22.7	158.0	96.9	0.98	0.09	2.92	2.84	2.92	6.74
22.6	158.0	97.4	0.98	0.07	2.91	2.83	2.91	6.71
22.5	159.0	97.2	0.98	0.08	2.91	2.83	2.91	6.72
22.4	160.0	97.1	0.98	0.08	2.92	2.84	2.92	6.72
22.3	161.0	96.9	0.98	0.09	2.92	2.84	2.92	6.72
22.2	161.0	97.4	0.98	0.07	2.91	2.83	2.91	6.69
22.1	162.0	97.2	0.98	0.08	2.91	2.83	2.91	6.69
22.0	163.0	97.1	0.98	0.08	2.92	2.83	2.92	6.69
21.9	164.0	97.0	0.98	0.09	2.92	2.84	2.92	6.69
21.8	165.0	96.9	0.98	0.09	2.93	2.84	2.93	6.69
21.7	165.0	97.3	0.98	0.07	2.91	2.83	2.91	6.66
21.6	166.0	97.2	0.98	0.08	2.91	2.83	2.91	6.66
21.5	167.0	97.1	0.98	0.08	2.92	2.83	2.92	6.66
21.3	168.0	97.0	0.98	0.08	2.92	2.84	2.92	6.66
21.2	169.0	96.9	0.98	0.09	2.92	2.84	2.92	6.66
21.1	170.0	96.8	0.98	0.09	2.93	2.84	2.93	6.65
21.0	171.0	96.8	0.98	0.09	2.93	2.84	2.93	6.65
20.9	171.0	97.2	0.97	0.08	2.91	2.83	2.91	6.62
20.8	172.0	97.2	0.97	0.08	2.91	2.83	2.91	6.62
20.7	173.0	97.1	0.97	0.08	2.92	2.83	2.92	6.61
20.6	174.0	97.0	0.97	0.08	2.92	2.83	2.92	6.61
20.5	175.0	97.0	0.97	0.09	2.92	2.83	2.92	6.61
20.4	176.0	96.9	0.97	0.09	2.92	2.83	2.92	6.60
20.3	177.0	96.9	0.97	0.09	2.92	2.84	2.92	6.60
20.2	178.0	96.8	0.97	0.09	2.93	2.84	2.93	6.59
20.1	179.0	96.8	0.97	0.09	2.93	2.84	2.93	6.59
20.0	180.0	96.8	0.97	0.09	2.93	2.84	2.93	6.58
19.9	181.0	96.8	0.97	0.09	2.93	2.84	2.93	6.57
19.8	182.0	96.7	0.97	0.09	2.93	2.84	2.93	6.57
19.7	183.0	96.7	0.97	0.09	2.93	2.84	2.93	6.56
19.6	184.0	96.7	0.97	0.09	2.93	2.84	2.93	6.56
19.4	185.0	96.7	0.97	0.09	2.93	2.84	2.93	6.55
19.3	186.0	96.7	0.97	0.09	2.93	2.84	2.93	6.54
19.2	187.0	96.7	0.97	0.09	2.93	2.84	2.93	6.53

Table 6g Lookup tables for dyked-end level furrows, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
19.1	188.0	96.8	0.97	0.09	2.93	2.84	2.93	6.52
19.0	189.0	96.8	0.97	0.09	2.93	2.83	2.93	6.52
18.9	190.0	96.8	0.97	0.09	2.93	2.83	2.93	6.50
18.8	191.0	96.8	0.97	0.09	2.93	2.83	2.93	6.50
18.7	192.0	96.9	0.97	0.09	2.93	2.83	2.92	6.48
18.6	193.0	96.9	0.97	0.09	2.92	2.83	2.92	6.48
18.5	194.0	97.0	0.97	0.09	2.92	2.83	2.92	6.46
18.4	195.0	97.0	0.97	0.08	2.92	2.83	2.92	6.45
18.3	197.0	96.6	0.97	0.10	2.93	2.84	2.93	6.47
18.2	198.0	96.7	0.97	0.09	2.93	2.83	2.93	6.46
18.1	199.0	96.8	0.97	0.09	2.93	2.83	2.93	6.44
18.0	200.0	96.8	0.97	0.09	2.93	2.83	2.93	6.43
17.9	201.0	96.9	0.97	0.09	2.92	2.83	2.92	6.42
17.8	203.0	96.5	0.97	0.10	2.93	2.84	2.93	6.43
17.6	204.0	96.6	0.97	0.09	2.93	2.83	2.93	6.41
17.5	205.0	96.7	0.97	0.09	2.93	2.83	2.93	6.40
17.4	206.0	96.9	0.97	0.09	2.93	2.83	2.93	6.38
17.3	208.0	96.5	0.97	0.10	2.93	2.83	2.93	6.39
17.2	209.0	96.6	0.97	0.09	2.93	2.83	2.93	6.38
17.1	210.0	96.8	0.97	0.09	2.93	2.83	2.93	6.36
17.0	212.0	96.5	0.97	0.10	2.94	2.84	2.94	6.37
16.9	213.0	96.6	0.97	0.10	2.93	2.83	2.93	6.35
16.8	214.0	96.8	0.97	0.09	2.93	2.83	2.93	6.33
16.7	216.0	96.5	0.97	0.10	2.94	2.83	2.94	6.34
16.6	217.0	96.6	0.97	0.09	2.93	2.83	2.93	6.32
16.5	219.0	96.4	0.97	0.10	2.94	2.83	2.94	6.32
16.4	220.0	96.6	0.97	0.10	2.93	2.83	2.93	6.30
16.3	222.0	96.3	0.97	0.11	2.94	2.84	2.94	6.31
16.2	223.0	96.5	0.97	0.10	2.94	2.83	2.93	6.28
16.1	225.0	96.3	0.97	0.11	2.94	2.84	2.94	6.29
16.0	226.0	96.5	0.97	0.10	2.94	2.83	2.93	6.26
15.9	228.0	96.3	0.97	0.11	2.94	2.83	2.94	6.26
15.7	229.0	96.5	0.97	0.10	2.94	2.83	2.93	6.24
15.6	231.0	96.3	0.97	0.11	2.94	2.83	2.94	6.24
15.5	232.0	96.5	0.97	0.10	2.93	2.83	2.93	6.22
15.4	234.0	96.4	0.97	0.10	2.94	2.83	2.94	6.21
15.3	236.0	96.2	0.97	0.11	2.94	2.83	2.94	6.21
15.2	238.0	96.1	0.97	0.11	2.95	2.84	2.95	6.21
15.1	239.0	96.3	0.97	0.11	2.94	2.83	2.94	6.18
15.0	241.0	96.2	0.97	0.11	2.94	2.83	2.94	6.18
14.9	243.0	96.1	0.97	0.11	2.95	2.83	2.94	6.17
14.8	245.0	96.0	0.97	0.11	2.95	2.84	2.95	6.16
14.7	247.0	95.9	0.97	0.12	2.95	2.84	2.95	6.15
14.6	248.0	96.2	0.97	0.11	2.94	2.83	2.94	6.13
14.5	250.0	96.1	0.97	0.11	2.94	2.83	2.94	6.12
14.4	252.0	96.1	0.97	0.11	2.95	2.83	2.95	6.11
14.3	254.0	96.0	0.97	0.11	2.95	2.83	2.95	6.10
14.2	256.0	96.0	0.97	0.12	2.95	2.83	2.95	6.09

Table 6h Lookup tables for dyked-end level furrows, medium textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
14.1	258.0	96.0	0.97	0.12	2.95	2.83	2.95	6.07
13.9	260.0	95.9	0.97	0.12	2.95	2.83	2.95	6.06
13.8	262.0	95.9	0.97	0.12	2.95	2.83	2.95	6.05
13.7	264.0	95.9	0.97	0.12	2.95	2.83	2.95	6.03
13.6	266.0	95.9	0.97	0.12	2.95	2.83	2.95	6.02
13.5	269.0	95.6	0.97	0.13	2.96	2.84	2.96	6.02
13.4	271.0	95.7	0.97	0.13	2.96	2.83	2.96	6.00
13.3	273.0	95.7	0.97	0.13	2.96	2.83	2.96	5.98
13.2	275.0	95.8	0.97	0.12	2.96	2.83	2.96	5.97
13.1	278.0	95.5	0.97	0.13	2.96	2.84	2.96	5.96
13.0	280.0	95.6	0.96	0.13	2.96	2.83	2.96	5.94
12.9	282.0	95.7	0.96	0.13	2.96	2.83	2.96	5.93
12.8	285.0	95.5	0.96	0.13	2.97	2.83	2.96	5.92
12.7	287.0	95.6	0.96	0.13	2.96	2.83	2.96	5.90
12.6	290.0	95.4	0.96	0.13	2.97	2.83	2.97	5.89
12.5	292.0	95.6	0.96	0.13	2.96	2.83	2.96	5.87
12.4	295.0	95.4	0.96	0.13	2.97	2.83	2.97	5.86
12.3	298.0	95.2	0.96	0.14	2.98	2.84	2.97	5.85
12.2	300.0	95.4	0.96	0.13	2.97	2.83	2.97	5.82
12.0	303.0	95.3	0.96	0.14	2.97	2.83	2.97	5.81
11.9	306.0	95.2	0.96	0.14	2.98	2.83	2.97	5.80
11.8	309.0	95.1	0.96	0.15	2.98	2.84	2.98	5.78
11.7	312.0	95.1	0.96	0.15	2.98	2.84	2.98	5.76
11.6	315.0	95.0	0.96	0.15	2.98	2.84	2.98	5.75
11.5	318.0	95.0	0.96	0.15	2.98	2.84	2.98	5.73
11.4	321.0	95.0	0.96	0.15	2.98	2.83	2.98	5.71
11.3	324.0	95.0	0.96	0.15	2.98	2.83	2.98	5.69
11.2	327.0	95.0	0.96	0.15	2.98	2.83	2.98	5.67
11.1	330.0	95.0	0.96	0.15	2.98	2.83	2.98	5.65
11.0	334.0	94.8	0.96	0.15	2.99	2.83	2.99	5.63
10.9	337.0	94.9	0.96	0.15	2.99	2.83	2.99	5.61
10.8	341.0	94.7	0.96	0.16	2.99	2.83	2.99	5.60
10.7	345.0	94.5	0.96	0.17	3.00	2.84	3.00	5.58
10.6	348.0	94.6	0.96	0.16	3.00	2.83	2.99	5.55
10.5	352.0	94.5	0.96	0.17	3.00	2.83	3.00	5.54
10.4	356.0	94.4	0.96	0.17	3.00	2.84	3.00	5.52
10.3	360.0	94.3	0.96	0.17	3.00	2.84	3.00	5.50
10.1	364.0	94.2	0.96	0.17	3.01	2.84	3.00	5.48
10.0	368.0	94.2	0.96	0.17	3.01	2.84	3.01	5.45

Table 7a Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
50.0	44.0	97.8	0.98	0.04	1.79	1.74	1.79	5.84
49.9	44.0	98.0	0.98	0.04	1.79	1.74	1.78	5.83
49.8	44.0	98.1	0.98	0.03	1.78	1.74	1.78	5.82
49.7	44.0	98.3	0.98	0.03	1.78	1.73	1.78	5.81
49.6	45.0	96.4	0.98	0.06	1.81	1.77	1.81	5.86
49.5	45.0	96.6	0.98	0.06	1.81	1.76	1.81	5.85
49.4	45.0	96.8	0.98	0.06	1.81	1.76	1.81	5.84
49.2	45.0	97.0	0.98	0.05	1.80	1.76	1.80	5.83
49.1	45.0	97.2	0.98	0.05	1.80	1.75	1.80	5.83
49.0	45.0	97.5	0.98	0.04	1.80	1.75	1.80	5.82
48.9	45.0	97.7	0.98	0.04	1.79	1.74	1.79	5.81
48.8	45.0	97.9	0.98	0.04	1.79	1.74	1.79	5.80
48.7	45.0	98.1	0.98	0.04	1.78	1.74	1.78	5.80
48.6	45.0	98.2	0.98	0.03	1.78	1.73	1.78	5.78
48.5	46.0	96.4	0.98	0.06	1.81	1.77	1.81	5.83
48.4	46.0	96.6	0.98	0.06	1.81	1.76	1.81	5.82
48.3	46.0	96.8	0.98	0.06	1.81	1.76	1.81	5.81
48.2	46.0	97.0	0.98	0.05	1.80	1.76	1.80	5.80
48.1	46.0	97.2	0.98	0.05	1.80	1.75	1.80	5.80
48.0	46.0	97.4	0.98	0.04	1.80	1.75	1.80	5.79
47.9	46.0	97.6	0.98	0.04	1.79	1.74	1.79	5.78
47.8	46.0	97.9	0.98	0.04	1.79	1.74	1.79	5.77
47.7	46.0	98.0	0.98	0.04	1.78	1.74	1.78	5.76
47.6	46.0	98.2	0.98	0.03	1.78	1.73	1.78	5.75
47.5	47.0	96.4	0.98	0.06	1.81	1.77	1.81	5.80
47.3	47.0	96.6	0.98	0.06	1.81	1.76	1.81	5.79
47.2	47.0	96.9	0.98	0.06	1.81	1.76	1.81	5.78
47.1	47.0	97.1	0.98	0.05	1.80	1.76	1.80	5.77
47.0	47.0	97.3	0.98	0.05	1.80	1.75	1.80	5.76
46.9	47.0	97.5	0.98	0.04	1.80	1.75	1.80	5.76
46.8	47.0	97.7	0.98	0.04	1.79	1.74	1.79	5.75
46.7	47.0	97.9	0.98	0.04	1.79	1.74	1.79	5.74
46.6	47.0	98.1	0.98	0.03	1.78	1.74	1.78	5.73
46.5	48.0	96.4	0.98	0.07	1.82	1.77	1.81	5.78
46.4	48.0	96.6	0.98	0.06	1.81	1.76	1.81	5.77
46.3	48.0	96.8	0.98	0.06	1.81	1.76	1.81	5.76
46.2	48.0	97.0	0.98	0.05	1.80	1.76	1.80	5.75
46.1	48.0	97.2	0.98	0.05	1.80	1.75	1.80	5.74
46.0	48.0	97.5	0.98	0.04	1.80	1.75	1.80	5.73
45.9	48.0	97.7	0.98	0.04	1.79	1.74	1.79	5.72
45.8	48.0	97.9	0.98	0.04	1.79	1.74	1.79	5.71
45.7	48.0	98.1	0.98	0.03	1.78	1.74	1.78	5.70
45.5	49.0	96.4	0.98	0.07	1.82	1.77	1.81	5.75
45.4	49.0	96.6	0.98	0.06	1.81	1.76	1.81	5.74
45.3	49.0	96.8	0.98	0.06	1.81	1.76	1.81	5.73
45.2	49.0	97.0	0.98	0.05	1.80	1.76	1.80	5.72
45.1	49.0	97.3	0.98	0.05	1.80	1.75	1.80	5.71

Table 7b Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
45.0	49.0	97.5	0.98	0.04	1.80	1.75	1.80	5.70
44.9	49.0	97.7	0.98	0.04	1.79	1.74	1.79	5.69
44.8	49.0	97.9	0.98	0.04	1.79	1.74	1.79	5.68
44.7	49.0	98.1	0.98	0.03	1.78	1.73	1.78	5.67
44.6	50.0	96.4	0.98	0.06	1.81	1.77	1.81	5.72
44.5	50.0	96.7	0.98	0.06	1.81	1.76	1.81	5.71
44.4	50.0	96.9	0.98	0.06	1.81	1.76	1.81	5.70
44.3	50.0	97.1	0.98	0.05	1.80	1.75	1.80	5.69
44.2	50.0	97.4	0.98	0.05	1.80	1.75	1.80	5.68
44.1	50.0	97.6	0.98	0.04	1.80	1.74	1.79	5.67
44.0	50.0	97.8	0.97	0.04	1.79	1.74	1.79	5.66
43.9	50.0	98.0	0.97	0.04	1.79	1.74	1.78	5.65
43.8	51.0	96.4	0.98	0.06	1.82	1.77	1.81	5.70
43.6	51.0	96.6	0.98	0.06	1.81	1.76	1.81	5.69
43.5	51.0	96.8	0.98	0.06	1.81	1.76	1.81	5.68
43.4	51.0	97.1	0.97	0.05	1.80	1.75	1.80	5.67
43.3	51.0	97.3	0.97	0.05	1.80	1.75	1.80	5.66
43.2	51.0	97.5	0.97	0.04	1.80	1.74	1.79	5.65
43.1	51.0	97.8	0.97	0.04	1.79	1.74	1.79	5.64
43.0	51.0	98.0	0.97	0.04	1.79	1.74	1.78	5.63
42.9	52.0	96.4	0.97	0.06	1.81	1.77	1.81	5.67
42.8	52.0	96.6	0.97	0.06	1.81	1.76	1.81	5.67
42.7	52.0	96.9	0.97	0.06	1.81	1.76	1.81	5.65
42.6	52.0	97.1	0.97	0.05	1.80	1.75	1.80	5.65
42.5	52.0	97.3	0.97	0.05	1.80	1.75	1.80	5.63
42.4	52.0	97.6	0.97	0.04	1.80	1.74	1.79	5.62
42.3	52.0	97.8	0.97	0.04	1.79	1.74	1.79	5.61
42.2	53.0	96.2	0.97	0.07	1.82	1.77	1.82	5.66
42.1	53.0	96.5	0.97	0.06	1.81	1.76	1.81	5.65
42.0	53.0	96.7	0.97	0.06	1.81	1.76	1.81	5.64
41.8	53.0	97.0	0.97	0.06	1.81	1.76	1.80	5.63
41.7	53.0	97.2	0.97	0.05	1.80	1.75	1.80	5.62
41.6	53.0	97.4	0.97	0.04	1.80	1.74	1.80	5.61
41.5	53.0	97.7	0.97	0.04	1.79	1.74	1.79	5.60
41.4	53.0	97.9	0.97	0.04	1.79	1.74	1.79	5.59
41.3	54.0	96.4	0.97	0.06	1.82	1.76	1.81	5.63
41.2	54.0	96.6	0.97	0.06	1.81	1.76	1.81	5.62
41.1	54.0	96.9	0.97	0.06	1.81	1.76	1.81	5.61
41.0	54.0	97.1	0.97	0.05	1.80	1.75	1.80	5.60
40.9	54.0	97.4	0.97	0.05	1.80	1.75	1.80	5.59
40.8	54.0	97.6	0.97	0.04	1.80	1.74	1.79	5.58
40.7	54.0	97.8	0.97	0.04	1.79	1.74	1.79	5.57
40.6	55.0	96.4	0.97	0.07	1.82	1.76	1.81	5.61
40.5	55.0	96.6	0.97	0.06	1.81	1.76	1.81	5.60
40.4	55.0	96.9	0.97	0.06	1.81	1.76	1.81	5.59
40.3	55.0	97.1	0.97	0.05	1.80	1.75	1.80	5.58
40.2	55.0	97.4	0.97	0.05	1.80	1.74	1.80	5.57

Table 7c Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
40.1	55.0	97.6	0.97	0.04	1.80	1.74	1.79	5.56
39.9	55.0	97.8	0.97	0.04	1.79	1.74	1.79	5.55
39.8	56.0	96.4	0.97	0.06	1.81	1.76	1.81	5.59
39.7	56.0	96.6	0.97	0.06	1.81	1.76	1.81	5.58
39.6	56.0	96.9	0.97	0.06	1.81	1.76	1.81	5.57
39.5	56.0	97.2	0.97	0.05	1.80	1.75	1.80	5.56
39.4	56.0	97.4	0.97	0.05	1.80	1.74	1.80	5.55
39.3	56.0	97.7	0.97	0.04	1.79	1.74	1.79	5.54
39.2	56.0	97.9	0.97	0.04	1.79	1.74	1.79	5.52
39.1	57.0	96.5	0.97	0.06	1.81	1.76	1.81	5.57
39.0	57.0	96.7	0.97	0.06	1.81	1.76	1.81	5.56
38.9	57.0	97.0	0.97	0.05	1.80	1.75	1.80	5.55
38.8	57.0	97.3	0.97	0.05	1.80	1.75	1.80	5.54
38.7	57.0	97.5	0.97	0.04	1.80	1.74	1.80	5.52
38.6	57.0	97.8	0.97	0.04	1.79	1.74	1.79	5.51
38.5	58.0	96.4	0.97	0.06	1.81	1.76	1.81	5.56
38.4	58.0	96.7	0.97	0.06	1.81	1.76	1.81	5.54
38.3	58.0	96.9	0.97	0.06	1.81	1.75	1.80	5.53
38.2	58.0	97.2	0.97	0.05	1.80	1.75	1.80	5.52
38.0	58.0	97.4	0.97	0.04	1.80	1.74	1.80	5.51
37.9	58.0	97.7	0.97	0.04	1.79	1.74	1.79	5.50
37.8	59.0	96.3	0.97	0.07	1.82	1.76	1.81	5.54
37.7	59.0	96.6	0.97	0.06	1.81	1.76	1.81	5.53
37.6	59.0	96.9	0.97	0.06	1.81	1.75	1.81	5.52
37.5	59.0	97.2	0.97	0.05	1.80	1.75	1.80	5.50
37.4	59.0	97.4	0.97	0.05	1.80	1.74	1.80	5.49
37.3	59.0	97.7	0.97	0.04	1.79	1.74	1.79	5.48
37.2	60.0	96.4	0.97	0.07	1.82	1.76	1.81	5.52
37.1	60.0	96.6	0.97	0.06	1.81	1.76	1.81	5.51
37.0	60.0	96.9	0.97	0.06	1.81	1.75	1.81	5.50
36.9	60.0	97.2	0.97	0.05	1.80	1.75	1.80	5.48
36.8	60.0	97.4	0.97	0.04	1.80	1.74	1.80	5.47
36.7	61.0	96.1	0.97	0.07	1.82	1.76	1.82	5.51
36.6	61.0	96.4	0.97	0.06	1.81	1.76	1.81	5.50
36.5	61.0	96.7	0.97	0.06	1.81	1.76	1.81	5.49
36.4	61.0	97.0	0.97	0.06	1.81	1.75	1.80	5.48
36.2	61.0	97.2	0.97	0.05	1.80	1.74	1.80	5.46
36.1	61.0	97.5	0.97	0.04	1.80	1.74	1.80	5.45
36.0	62.0	96.3	0.97	0.07	1.82	1.76	1.82	5.49
35.9	62.0	96.5	0.97	0.06	1.81	1.76	1.81	5.48
35.8	62.0	96.8	0.97	0.06	1.81	1.75	1.81	5.47
35.7	62.0	97.1	0.97	0.05	1.80	1.75	1.80	5.45
35.6	62.0	97.4	0.97	0.05	1.80	1.74	1.80	5.44
35.5	63.0	96.1	0.97	0.07	1.82	1.76	1.82	5.48
35.4	63.0	96.4	0.97	0.06	1.81	1.76	1.81	5.47
35.3	63.0	96.7	0.97	0.06	1.81	1.75	1.81	5.46
35.2	63.0	97.0	0.97	0.05	1.80	1.75	1.80	5.44

Table 7d Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
35.1	63.0	97.3	0.97	0.05	1.80	1.74	1.80	5.43
35.0	64.0	96.1	0.97	0.07	1.82	1.76	1.82	5.47
34.9	64.0	96.4	0.97	0.06	1.81	1.76	1.81	5.46
34.8	64.0	96.6	0.97	0.06	1.81	1.75	1.81	5.44
34.7	64.0	96.9	0.97	0.06	1.81	1.75	1.80	5.43
34.6	64.0	97.2	0.97	0.05	1.80	1.74	1.80	5.42
34.5	65.0	96.1	0.97	0.07	1.82	1.76	1.82	5.46
34.3	65.0	96.3	0.97	0.07	1.82	1.76	1.81	5.44
34.2	65.0	96.6	0.97	0.06	1.81	1.75	1.81	5.43
34.1	65.0	96.9	0.97	0.06	1.81	1.75	1.80	5.42
34.0	65.0	97.2	0.97	0.05	1.80	1.74	1.80	5.40
33.9	66.0	96.1	0.97	0.07	1.82	1.76	1.82	5.44
33.8	66.0	96.4	0.97	0.06	1.81	1.76	1.81	5.43
33.7	66.0	96.4	0.97	0.06	1.81	1.76	1.81	5.43
33.6	66.0	96.7	0.97	0.06	1.81	1.75	1.81	5.41
33.5	66.0	97.0	0.97	0.05	1.81	1.75	1.80	5.40
33.4	66.0	97.2	0.97	0.05	1.80	1.74	1.80	5.39
33.3	67.0	96.1	0.97	0.07	1.82	1.76	1.82	5.42
33.2	67.0	96.4	0.97	0.06	1.81	1.76	1.81	5.41
33.1	67.0	96.7	0.97	0.06	1.81	1.75	1.81	5.39
33.0	67.0	97.0	0.97	0.05	1.80	1.74	1.80	5.38
32.9	68.0	96.2	0.97	0.07	1.82	1.76	1.82	5.41
32.8	68.0	96.5	0.97	0.06	1.81	1.75	1.81	5.39
32.7	68.0	96.8	0.97	0.06	1.81	1.75	1.81	5.38
32.5	68.0	97.1	0.97	0.05	1.80	1.74	1.80	5.36
32.4	69.0	96.1	0.97	0.07	1.82	1.76	1.82	5.40
32.3	69.0	96.4	0.97	0.06	1.81	1.76	1.81	5.38
32.2	69.0	96.7	0.97	0.06	1.81	1.75	1.81	5.37
32.1	69.0	97.0	0.97	0.05	1.80	1.74	1.80	5.35
32.0	70.0	95.9	0.97	0.07	1.82	1.76	1.82	5.39
31.9	70.0	96.3	0.97	0.07	1.82	1.76	1.82	5.37
31.8	70.0	96.6	0.97	0.06	1.81	1.75	1.81	5.36
31.7	70.0	96.9	0.97	0.06	1.81	1.74	1.81	5.35
31.6	71.0	95.9	0.97	0.07	1.83	1.76	1.83	5.38
31.5	71.0	96.2	0.97	0.07	1.82	1.76	1.82	5.37
31.4	71.0	96.5	0.97	0.06	1.81	1.75	1.81	5.35
31.3	71.0	96.8	0.97	0.06	1.81	1.74	1.81	5.33
31.2	72.0	95.8	0.97	0.07	1.83	1.76	1.83	5.37
31.1	72.0	96.1	0.97	0.07	1.82	1.76	1.82	5.35
31.0	72.0	96.5	0.97	0.06	1.81	1.75	1.81	5.34
30.9	72.0	96.8	0.97	0.06	1.81	1.74	1.81	5.33
30.8	73.0	95.8	0.97	0.07	1.83	1.76	1.83	5.36
30.6	73.0	96.1	0.97	0.07	1.82	1.76	1.82	5.34
30.5	73.0	96.5	0.97	0.06	1.81	1.75	1.81	5.33
30.4	73.0	96.8	0.97	0.06	1.81	1.74	1.81	5.31
30.3	74.0	95.8	0.97	0.07	1.83	1.76	1.83	5.34
30.2	74.0	96.2	0.97	0.07	1.82	1.76	1.82	5.33

Table 7e Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
30.1	74.0	96.5	0.97	0.06	1.81	1.75	1.81	5.31
30.0	74.0	96.8	0.97	0.06	1.81	1.74	1.81	5.30
29.9	75.0	95.9	0.97	0.07	1.82	1.76	1.82	5.33
29.8	75.0	96.2	0.97	0.07	1.82	1.76	1.82	5.31
29.7	75.0	96.6	0.97	0.06	1.81	1.75	1.81	5.30
29.6	75.0	96.9	0.97	0.06	1.81	1.74	1.81	5.28
29.5	76.0	96.0	0.97	0.07	1.82	1.76	1.82	5.31
29.4	76.0	96.3	0.97	0.06	1.81	1.75	1.81	5.30
29.3	76.0	96.7	0.97	0.06	1.81	1.74	1.81	5.28
29.2	77.0	95.8	0.97	0.07	1.83	1.76	1.83	5.31
29.1	77.0	96.1	0.97	0.07	1.82	1.76	1.82	5.30
29.0	77.0	96.4	0.97	0.06	1.81	1.75	1.81	5.28
28.9	77.0	96.8	0.97	0.06	1.81	1.74	1.81	5.26
28.7	78.0	95.9	0.97	0.07	1.82	1.76	1.82	5.29
28.6	78.0	96.3	0.97	0.07	1.82	1.75	1.82	5.28
28.5	78.0	96.6	0.97	0.06	1.81	1.74	1.81	5.26
28.4	79.0	95.8	0.97	0.07	1.83	1.76	1.83	5.29
28.3	79.0	96.1	0.97	0.07	1.82	1.76	1.82	5.27
28.2	79.0	96.5	0.97	0.06	1.81	1.75	1.81	5.25
28.1	80.0	95.6	0.97	0.08	1.83	1.76	1.83	5.28
28.0	80.0	96.0	0.97	0.07	1.82	1.76	1.82	5.26
27.9	80.0	96.3	0.97	0.06	1.81	1.75	1.81	5.25
27.8	80.0	96.7	0.97	0.06	1.81	1.74	1.81	5.23
27.7	81.0	95.9	0.97	0.07	1.82	1.76	1.82	5.26
27.6	81.0	96.3	0.97	0.07	1.82	1.75	1.82	5.24
27.5	81.0	96.6	0.97	0.06	1.81	1.74	1.81	5.22
27.4	82.0	95.8	0.97	0.07	1.83	1.76	1.83	5.25
27.3	82.0	96.2	0.97	0.07	1.82	1.75	1.82	5.23
27.2	82.0	96.6	0.97	0.06	1.81	1.74	1.81	5.22
27.1	83.0	95.8	0.97	0.07	1.83	1.76	1.83	5.24
26.9	83.0	96.1	0.97	0.07	1.82	1.75	1.82	5.22
26.8	83.0	96.5	0.97	0.06	1.81	1.74	1.81	5.20
26.7	84.0	95.8	0.97	0.07	1.83	1.76	1.83	5.23
26.6	84.0	96.1	0.97	0.07	1.82	1.75	1.82	5.21
26.5	84.0	96.5	0.97	0.06	1.81	1.74	1.81	5.20
26.4	85.0	95.8	0.97	0.07	1.83	1.76	1.83	5.22
26.3	85.0	96.1	0.97	0.07	1.82	1.75	1.82	5.20
26.2	85.0	96.5	0.97	0.06	1.81	1.74	1.81	5.19
26.1	86.0	95.8	0.97	0.07	1.83	1.76	1.83	5.21
26.0	86.0	96.2	0.97	0.07	1.82	1.75	1.82	5.19
25.9	86.0	96.6	0.97	0.06	1.81	1.74	1.81	5.17
25.8	87.0	95.9	0.97	0.07	1.83	1.76	1.83	5.19
25.7	87.0	96.3	0.97	0.07	1.82	1.75	1.82	5.18
25.6	87.0	96.6	0.97	0.06	1.81	1.74	1.81	5.16
25.5	88.0	96.0	0.97	0.07	1.82	1.75	1.82	5.18
25.4	88.0	96.3	0.97	0.06	1.81	1.74	1.81	5.16
25.3	89.0	95.7	0.97	0.07	1.83	1.76	1.83	5.18

Table 7f Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
25.2	89.0	96.1	0.97	0.07	1.82	1.75	1.82	5.17
25.0	89.0	96.5	0.97	0.06	1.81	1.74	1.81	5.15
24.9	90.0	95.8	0.97	0.07	1.83	1.76	1.83	5.17
24.8	90.0	96.2	0.97	0.07	1.82	1.75	1.82	5.15
24.7	91.0	95.6	0.97	0.08	1.83	1.76	1.83	5.17
24.6	91.0	96.0	0.97	0.07	1.82	1.75	1.82	5.15
24.5	91.0	96.4	0.97	0.06	1.81	1.74	1.81	5.13
24.4	92.0	95.8	0.97	0.07	1.83	1.76	1.83	5.15
24.3	92.0	96.2	0.97	0.07	1.82	1.75	1.82	5.13
24.2	93.0	96.5	0.97	0.08	1.83	1.76	1.83	5.15
24.1	93.0	96.0	0.97	0.07	1.82	1.75	1.82	5.13
24.0	94.0	95.4	0.97	0.08	1.83	1.76	1.83	5.15
23.9	94.0	95.8	0.97	0.07	1.83	1.75	1.83	5.13
23.8	94.0	96.2	0.97	0.07	1.82	1.74	1.82	5.11
23.7	95.0	95.6	0.97	0.08	1.83	1.76	1.83	5.13
23.6	95.0	96.1	0.97	0.07	1.82	1.75	1.82	5.11
23.5	96.0	95.5	0.97	0.08	1.83	1.76	1.83	5.12
23.4	96.0	95.9	0.97	0.07	1.82	1.75	1.82	5.10
23.2	97.0	95.4	0.97	0.08	1.83	1.76	1.83	5.12
23.1	97.0	95.8	0.97	0.07	1.83	1.75	1.83	5.10
23.0	98.0	95.2	0.97	0.08	1.84	1.76	1.84	5.11
22.9	98.0	95.7	0.97	0.07	1.83	1.75	1.83	5.09
22.8	98.0	96.1	0.97	0.07	1.82	1.74	1.82	5.07
22.7	99.0	95.6	0.97	0.08	1.83	1.76	1.83	5.09
22.6	99.0	96.0	0.97	0.07	1.82	1.74	1.82	5.07
22.5	100.0	95.5	0.97	0.08	1.83	1.76	1.83	5.08
22.4	100.0	96.0	0.97	0.07	1.82	1.75	1.82	5.06
22.3	101.0	95.5	0.97	0.08	1.83	1.76	1.83	5.07
22.2	101.0	95.9	0.97	0.07	1.82	1.75	1.82	5.05
22.1	102.0	95.5	0.96	0.08	1.83	1.76	1.83	5.07
22.0	102.0	95.9	0.96	0.07	1.82	1.75	1.82	5.04
21.9	103.0	95.4	0.96	0.08	1.83	1.76	1.83	5.06
21.8	103.0	95.9	0.96	0.07	1.82	1.75	1.82	5.04
21.7	104.0	95.4	0.96	0.08	1.83	1.76	1.83	5.05
21.6	104.0	95.9	0.96	0.07	1.82	1.74	1.82	5.03
21.5	105.0	95.5	0.96	0.08	1.83	1.75	1.83	5.04
21.3	105.0	95.9	0.96	0.07	1.82	1.74	1.82	5.02
21.2	106.0	95.5	0.96	0.08	1.83	1.75	1.83	5.03
21.1	106.0	96.0	0.96	0.07	1.82	1.74	1.82	5.00
21.0	107.0	95.6	0.96	0.08	1.83	1.75	1.83	5.02
20.9	108.0	95.2	0.96	0.09	1.84	1.76	1.84	5.03
20.8	108.0	95.6	0.96	0.08	1.83	1.75	1.83	5.00
20.7	109.0	95.2	0.96	0.08	1.84	1.76	1.84	5.01
20.6	109.0	95.7	0.96	0.07	1.83	1.75	1.83	4.99
20.5	110.0	95.4	0.96	0.08	1.83	1.75	1.83	5.00
20.4	111.0	95.0	0.96	0.09	1.84	1.76	1.84	5.01
20.3	111.0	95.5	0.96	0.08	1.83	1.75	1.83	4.98

Table 7g Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
20.2	112.0	95.1	0.96	0.09	1.84	1.76	1.84	4.99
20.1	112.0	95.6	0.96	0.08	1.83	1.75	1.83	4.97
20.0	113.0	95.3	0.96	0.08	1.83	1.75	1.83	4.98
19.9	114.0	94.9	0.96	0.09	1.84	1.76	1.84	4.98
19.8	114.0	95.5	0.96	0.08	1.83	1.75	1.83	4.96
19.7	115.0	95.1	0.96	0.09	1.84	1.76	1.84	4.97
19.6	116.0	94.8	0.96	0.09	1.85	1.76	1.85	4.97
19.4	116.0	95.3	0.96	0.08	1.83	1.75	1.83	4.95
19.3	117.0	95.0	0.96	0.09	1.84	1.76	1.84	4.95
19.2	118.0	94.8	0.96	0.09	1.85	1.76	1.85	4.96
19.1	118.0	95.3	0.96	0.08	1.83	1.75	1.83	4.93
19.0	119.0	95.0	0.96	0.09	1.84	1.76	1.84	4.94
18.9	120.0	94.7	0.96	0.09	1.85	1.76	1.85	4.94
18.8	120.0	95.3	0.96	0.08	1.83	1.75	1.83	4.92
18.7	121.0	95.0	0.96	0.09	1.84	1.76	1.84	4.92
18.6	121.0	95.5	0.96	0.08	1.83	1.74	1.83	4.90
18.5	122.0	95.3	0.96	0.08	1.83	1.75	1.83	4.90
18.4	123.0	95.1	0.96	0.09	1.84	1.75	1.84	4.90
18.3	124.0	94.9	0.96	0.09	1.84	1.76	1.84	4.91
18.2	125.0	94.6	0.96	0.09	1.85	1.76	1.85	4.91
18.1	125.0	95.2	0.96	0.09	1.84	1.75	1.84	4.88
18.0	126.0	95.0	0.96	0.09	1.84	1.75	1.84	4.88
17.9	127.0	94.8	0.96	0.09	1.85	1.76	1.85	4.88
17.8	128.0	94.6	0.96	0.10	1.85	1.76	1.85	4.88
17.6	128.0	95.2	0.96	0.09	1.84	1.75	1.84	4.85
17.5	129.0	95.0	0.96	0.09	1.84	1.75	1.84	4.85
17.4	130.0	94.9	0.96	0.09	1.84	1.75	1.84	4.85
17.3	131.0	94.7	0.96	0.09	1.85	1.76	1.85	4.85
17.2	132.0	94.6	0.96	0.10	1.85	1.76	1.85	4.85
17.1	132.0	95.2	0.96	0.09	1.84	1.74	1.84	4.82
17.0	133.0	95.0	0.96	0.09	1.84	1.75	1.84	4.82
16.9	134.0	94.9	0.96	0.09	1.84	1.75	1.84	4.82
16.8	135.0	94.8	0.96	0.09	1.85	1.75	1.85	4.82
16.7	136.0	94.7	0.96	0.09	1.85	1.75	1.85	4.81
16.6	137.0	94.6	0.96	0.10	1.85	1.76	1.85	4.81
16.5	138.0	94.5	0.96	0.10	1.85	1.76	1.85	4.81
16.4	139.0	94.4	0.96	0.10	1.85	1.76	1.85	4.80
16.3	140.0	94.4	0.96	0.10	1.85	1.76	1.85	4.80
16.2	140.0	95.0	0.96	0.09	1.84	1.74	1.84	4.77
16.1	141.0	94.9	0.96	0.09	1.84	1.74	1.84	4.76
16.0	143.0	94.2	0.96	0.10	1.86	1.76	1.86	4.78
15.9	143.0	94.9	0.96	0.09	1.84	1.75	1.84	4.75
15.7	144.0	94.8	0.96	0.09	1.85	1.75	1.85	4.74
15.6	145.0	94.8	0.96	0.09	1.85	1.74	1.85	4.74
15.5	146.0	94.8	0.96	0.09	1.85	1.74	1.85	4.73
15.4	148.0	94.2	0.96	0.11	1.86	1.76	1.86	4.75
15.3	149.0	94.2	0.96	0.11	1.86	1.76	1.86	4.74

Table 7h Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
15.2	150.0	94.2	0.96	0.11	1.86	1.76	1.86	4.73
15.1	151.0	94.2	0.96	0.10	1.86	1.76	1.86	4.72
15.0	152.0	94.3	0.96	0.10	1.85	1.75	1.85	4.71
14.9	153.0	94.3	0.96	0.10	1.85	1.75	1.85	4.70
14.8	154.0	94.4	0.96	0.10	1.85	1.75	1.85	4.69
14.7	155.0	94.4	0.96	0.10	1.85	1.75	1.85	4.68
14.6	156.0	94.5	0.96	0.10	1.85	1.75	1.85	4.67
14.5	158.0	94.0	0.95	0.11	1.86	1.76	1.86	4.68
14.4	159.0	94.1	0.95	0.11	1.86	1.75	1.86	4.67
14.3	160.0	94.2	0.95	0.11	1.86	1.75	1.86	4.65
14.2	161.0	94.3	0.95	0.10	1.85	1.75	1.85	4.64
14.1	163.0	93.9	0.95	0.11	1.86	1.76	1.86	4.65
13.9	164.0	94.0	0.95	0.11	1.86	1.75	1.86	4.63
13.8	165.0	94.1	0.95	0.11	1.86	1.75	1.86	4.62
13.7	167.0	93.7	0.95	0.11	1.87	1.76	1.87	4.63
13.6	168.0	93.9	0.95	0.11	1.86	1.75	1.86	4.61
13.5	169.0	94.1	0.95	0.11	1.86	1.75	1.86	4.59
13.4	171.0	93.7	0.95	0.11	1.87	1.76	1.87	4.60
13.3	172.0	93.9	0.95	0.11	1.86	1.75	1.86	4.58
13.2	173.0	94.1	0.95	0.11	1.86	1.75	1.86	4.56
13.1	175.0	93.8	0.95	0.11	1.87	1.75	1.87	4.56
13.0	176.0	94.0	0.95	0.11	1.86	1.75	1.86	4.54
12.9	178.0	93.7	0.95	0.11	1.87	1.75	1.87	4.54
12.8	180.0	93.4	0.95	0.12	1.87	1.76	1.87	4.54
12.7	181.0	93.7	0.95	0.11	1.87	1.75	1.87	4.52
12.6	183.0	93.4	0.95	0.12	1.87	1.76	1.87	4.52
12.5	184.0	93.7	0.95	0.11	1.87	1.75	1.87	4.50
12.4	186.0	93.5	0.95	0.12	1.87	1.75	1.87	4.50
12.3	188.0	93.3	0.95	0.12	1.87	1.76	1.87	4.49
12.2	190.0	93.1	0.95	0.13	1.88	1.76	1.88	4.48
12.0	191.0	93.5	0.95	0.12	1.87	1.75	1.87	4.46
11.9	193.0	93.3	0.95	0.12	1.87	1.75	1.87	4.45
11.8	195.0	93.2	0.95	0.13	1.88	1.75	1.88	4.44
11.7	197.0	93.1	0.95	0.13	1.88	1.76	1.88	4.44
11.6	199.0	93.0	0.95	0.13	1.88	1.76	1.88	4.43
11.5	201.0	92.9	0.95	0.13	1.88	1.76	1.88	4.42
11.4	203.0	92.8	0.95	0.13	1.89	1.76	1.89	4.41
11.3	205.0	92.8	0.95	0.13	1.89	1.76	1.89	4.39
11.2	207.0	92.7	0.95	0.13	1.89	1.76	1.89	4.38
11.1	209.0	92.7	0.95	0.13	1.89	1.76	1.89	4.37
11.0	211.0	92.7	0.95	0.13	1.89	1.76	1.89	4.35
10.9	213.0	92.8	0.95	0.13	1.89	1.75	1.89	4.33
10.8	215.0	92.8	0.95	0.13	1.89	1.75	1.89	4.32
10.7	217.0	92.8	0.94	0.13	1.89	1.75	1.89	4.30
10.6	220.0	92.5	0.94	0.14	1.89	1.76	1.89	4.30
10.5	222.0	92.6	0.94	0.14	1.89	1.75	1.89	4.28
10.4	224.0	92.7	0.94	0.13	1.89	1.75	1.89	4.26

Table 7i Lookup table for dyked-end level furrows, moderately-coarse textured soils								
Qo	**Tco**	**Ea**	**Dulq**	**Dp**	**Davg**	**Dmin**	**Dapp**	**Ymax**
GPM	**min**	**%**	**-**	**in**	**in**	**in**	**in**	**in**
10.3	227.0	92.8	0.94	0.14	1.89	1.75	1.89	4.25
10.1	230.0	92.2	0.94	0.15	1.90	1.76	1.90	4.24
10.0	232.0	92.3	0.94	0.14	1.89	1.75	1.89	4.22

LIST OF FIGURES