GUIDELINES FOR IMPROVED IRRIGATION PRACTICES FOR ALFALFA GROWN ON THE SANDY SOILS OF THE YUMA MESA IRRIGATION DISTRICT

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EXECUTIVE SUMMARY

Alfalfa is a major crop in the desert southwestern United States. Basins are widely used to irrigate alfalfa in the coarse textured soils of the Yuma Mesa. Irrigation in the mesa district is characterized by low performance, application efficiency of basins in the Yuma mesa is typically below 40 %. The inefficient irrigation practices as well as their attendant water quality and drainage problems are sources of major 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 southwestern US. 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 basin irrigated alfalfa farms of the Yuma Mesa irrigation district. The project had field experimental, modeling, and outreach/educational components. The field experimental study was conducted over a period of ten months (6/99–4/2000), the principal objective of which was to develop a database for model calibration as well as validation. The modeling components included model calibration, validation, as well as simulation experiments. The database generated using simulation experiments was used to develop management tools (performance charts and tables) for level basins as well as for basins with 0.1% slope – typical bed slope used in the Yuma Mesa irrigation district. In addition, management guidelines that facilitate effective use of the performance charts and tables have been developed.

INTRODUCTION

Alfalfa is a major crop in the desert Southwestern United States. In the Yuma area alfalfa is mainly grown in the coarse textured soils of the Yuma Mesa irrigation district. Large basins are commonly used to irrigate alfalfa on the coarse textured soils of the Yuma Mesa. The minimal labor requirement associated with large basins, availability of large flow rates, crop type, and the exceptionally conducive topography (which requires only minimal land grading) have contributed to the wide spread use of large basins in the area.

In the desert southwestern United States in general and Yuma in particular, irrigation is the only source of water for agriculture. Irrigation, in the Yuma Mesa irrigation district, is characterized by low performance. Simulation studies conducted by the authors indicate that typical application efficiency for basin irrigated alfalfa fields in the Yuma Mesa is below 40 %. Although water scarcity is not yet a problem, it is expected that the increasing demand for fresh water from the municipal and industrial sectors of the region will significantly reduce the share of fresh water supply available for irrigation. The inefficient irrigation practices as well as their attendant water quality problems are sources of major environmental concern in the region (USBR, 1991; Fedkiw, 1991). In general, efficient irrigation not only saves water but also impacts positively on the environment and enhances the economic well-being of the agricultural system of the region by (1) reducing the transfer of pollutants (nutrients and pesticides) from irrigated lands to the groundwater and surface-water resources of the region and (2) enhancing on-site use of resources (soils, fertilizers, and pesticides) thereby minimizing the quantity of agricultural inputs required for optimal crop yield. Improvements in irrigation performance can be realized through the use of sound irrigation systems design and management practices. In the Yuma Mesa irrigation district reconfiguring (redesigning) most existing systems entails significant capital expenditure, hence improvements in basin performance can best be realised through improved management practices. Lack of management guidelines has in fact been identified as the most important factor contributing to the low performance of basin irrigation systems in the Yuma Mesa (Sanchez and Bali, 1997).

The principal objective of this study was to develop management tools as well as guidelines for optimal basin irrigation management for the alfalfa farms of the Yuma Mesa irrigation district. The development of management tools and guidelines had been undertaken in four stages: (1) experimental studies (6/1999–3/2000), (2) model[1] calibration and validation (4/2000), (3) simulation experiments to develop management tools [i.e., performance charts and lookup tables (4/2000)], and (4) development of guidelines that facilitates effective use of the management tools (5/2000).

LITERATURE REVIEW

Basin 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, basin dimension (basin length, L, and basin width, W), unit inlet flow rate, Q_o, cutoff criteria (cutoff time, t_{co}, or cutoff length, L_{co}) are considered as system variables, while the net irrigation requirement, Z_r, hydraulic roughness coefficient, n, bed slope, S_o, and infiltration parameters, I, can be considered as system parameters. For a review of the nature and influence of the basin irrigation system variables and parameters and methods to quantify them the reader is referred to an earlier publication by Sanchez and Zerihun (2000).

[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.

METHODOLOGY

The development of a management package for the basin irrigated alfalfa farms of the Yuma Mesa area had been undertaken in four stages: (1) experimental studies (4/1998 – 1/2000), (2) model[2] calibration and validation (4/2000), (3) simulation experiment and development of management tools [i.e., performance charts and lookup tables (4/2000)], and (4) development of management guidelines that facilitate effective use of the management tools (5/2000). 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 for calibration and validation of a basin irrigation model includes data on: basin length, L; unit inlet flow rate, Q_o; cutoff distance, L_{co}; Manning's roughness coefficient, n; infiltration parameters; target application depth, Z_r; and advance and recession trajectories

Field experimentation

Description of the experimental site and procedure: the field experimental study had been undertaken over a period of 10 months on a 6.5 acre facility at the University of Arizona Yuma Mesa experimental farm. The layout of the experimental basins is depicted in Figure 1. The experimental farm has four basins each 583 ft long and 110 ft wide. Each basin was used to grow alfalfa through out the experimental period. The soil of the experimental site is superstition sand, in which the sand fraction accounts for over 90 percent of the textural class. The soil of the Yuma Mesa irrigation district is relatively uniform. The experimental farm obtains its supply from canal 89w20 via a field supply

[2] That is SRFR

ditch (Figure 1). Canal 89w20 itself obtains its water supply from the Colorado River at the Imperial dam.

The experimental study lasted for 10 months (6/1999-4/2000). During each irrigation event, data on Q_o, L_{co}, advance, and recession had been collected on four experimental basins, i.e., basins A through D (Figure 1). Changes in soil moisture content had been monitored using neutron probe measurements throughout the experimental period.

Determination of system variables: all system variables (Q_o, L_{co}, L, and basin width, W) were determined based on direct field measurements (Table 1). L and W represent known physical dimensions of the basins. The flow rate in the field supply channel had been measured using a flume built into the head end of the field supply channel. Throughout the duration of the experimental study the entire discharge in the field supply channel had been used to irrigate a single basin. t_{co} is monitored using a stop watch and L_{co} is known.

Determination of system parameters: among the system parameters, S_o and Z_r are relatively easy to quantify. In the Yuma Mesa irrigation district, bed slope of basins range from zero (level bed) to a couple of inches drop over one hundred feet distance. Bed slopes were determined based on levelling runs conducted using standard surveyor's level along the centre line of each experimental basin prior to the initiation of every irrigation event. 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). A TAW value given in the NRCS handbook (1998) for the superstition sand of the Yuma mesa area was used in this study. According to the NRCS irrigation handbook, the TAW for the superstition sand of the Yuma mesa area is 0.9 in/ft. Typical D_r for alfalfa crop is about 3.28 ft (1 m) and the optimal P value for alfalfa crop in the Yuma Mesa area is taken to be about 0.5. Substituting these values in equation 1 (Sanchez and Zerihun, 2000) resulted in the target depth of application used in this study, which is 1.476 in.

While the 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 hydraulic resistance, n, and infiltration is not. As can be seen from Figure 1, the alfalfa experimental basins are adjacent to the citrus experimental basins (Sanchez and Zerihun, 2000) and have the same soil type as the basins used to irrigate citrus, i.e., superstition sand. Since the method of water application and the soils of the area are the same for the alfalfa and citrus blocks, the same infiltration parameters can be used to model irrigation processes in the alfalfa and citrus basins. The procedure used to determine infiltration parameters have been discussed in Sanchez and Zerihun (2000), hence will not be given additional treatment herein. However, the hydraulic resistance coefficient of the alfalfa basins could be much higher than the hydraulic resistance coefficients of the basins used to irrigate citrus. Therefore, the main objective of the field measurements as well as the model calibration exercise have been to determine an appropriate Manning's roughness coefficient for the alfalfa basins. The following is an outline of the field measurement procedure used in the experimental study:

1. The field had been staked out at regular intervals of 145 ft in the longitudinal direction, which resulted in five measurement stations. Stakes had been setup at each of the five measuring stations (Figure 1).
2. The elevation of the measurement stations had been determined using standard surveyor's level prior to every irrigation event and has been used to determine mean basin bed slopes. Figure 2, depicts longitudinal profile for four experimental basins.
3. Flow rate into the basin had been monitored regularly using a flume located at the head end of the field supply channel.
4. Advance and recession had been recorded at each of the measurement stations. Stopwatches were used to determine advance and recession times
5. Soil moisture content had been monitored using neutron probe measurements taken at four points along the centerline of the basins. The neutron probe readings were taken one day before and one day after each irrigation event.

Modeling

Model calibration: in the framework of this project model calibration involves estimation of infiltration and roughness parameters. The type of infiltration function used to evaluate infiltration is the branch infiltration function. The parameters of the branch infiltration function are: k, a, b, c and c_B (Eq. 5). The procedure used to determine the infiltration parameters has been discussed in detail in an earlier report by Sanchez and Zerihun (2000). A summary of the value of the infiltration parameters used in this study, obtained from Sanchez and Zerihun (2000), is given in Table 1. Manning's roughness coefficient, n, was estimated such that advance predicted by SRFR matches reasonably well with field observed advance. Eight data sets collected during two irrigation events (2/15/2000 and 6/3/2000) have been used in model calibration. An n value that is equal to 0.2 has been found to produce advance predictions that matches consistently well with field observed advance. The results of the calibration exercise is depicted in Figure 3, the correlation coefficient, r, between model predicted and field observed advance for the data used for model calibration is 0.996.

Model validation: the capability of the SRFR model to simulate basin irrigation processes[3] with an acceptable level of accuracy had been evaluated by comparing its output with field data. Twenty independent data sets randomly selected from the data pool developed in the experimental study had been used in the model verification exercise. The temporally and spatially averaged infiltration parameter values determined by Sanchez and Zerihun (2000) have been used in this application (Table 1). Comparison of model predicted and field observed advance for the 20 data sets is shown in Figures 4-23. The results of model verification (Figures 4-23) clearly demonstrate that SRFR is capable of simulating the basin irrigation processes in the Yuma Mesa irrigation district with acceptable accuracy. The results also show that the spatially and temporally averaged parameter estimates yielded consistent and reasonably accurate estimates of advance time.

[3] These particularly refer to basins used to irrigate alfalfa on the coarse textured soils of the Yuma mesa.

Simulation experiment

In the Yuma Mesa irrigation district reconfiguring (redesigning) most existing systems entails significant capital expenditure, hence improvements in basin 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 Mesa irrigation district. A prime consideration in developing the management tools (charts and lookup tables) had been 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 distance, L_{co}. Q_o was calculated as the quotient of the total inlet flow rate delivered into a basin and basin width and the system parameters and variables have been set at typical values given in Table 1.

Selection of typical values for system variables and parameters: in the Yuma Mesa irrigation district a standard irrigation block[4] 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 basin in the mesa area is about 600 ft. Therefore, 600 ft has been taken as the typical length of a basin throughout the simulation experiment. Spatially and temporally averaged infiltration and roughness parameters have been used in the simulation experiment (Sanchez and Zerihun, 2000). This implies that temporal and spatial variation in infiltration and roughness parameters are insignificant. The fact that (1) soil is relatively uniform over the mesa area; (2) more or less similar cultural practices and land grading methods/tools are used in the area; (3) for each experimental basin, measured advance times in different irrigation events did not show significant variations (Figures 4-23); and (4) the management tools are developed for a specific type of crop (alfalfa),

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

make the forgoing assumption plausible. Throughout the simulation experiment the target depth of application have been maintained at 1.476 in. Although the crop root depth generally varies between 0-3.28 ft (0-1 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.

Both level and graded basins are commonly used to irrigate alfalfa crop in the Yuma Mesa irrigation district. Apparently, the main reason for the use of graded basins is the anticipation by growers that some gradient in the direction of irrigation might improve uniformity and efficiency. The results of an analysis presented by Sanchez and Zerihun (2000) clearly demonstrate that level basins perform better than graded basins for the range of flow rates commonly used in the mesa area. Therefore, the authors recommend the gradual replacement of graded basins by level basins. For management applications in the interim period, however, two sets of performance charts and lookup tables, one for level basin and another for a basin with a bed slope of 0.1 %, have been developed (Figures 24-29). 0.1 % is typical bed slope used in the Yuma Mesa area.

Simulation experiments had been performed to generate the database required to develop the management tools. Systematic variation of unit inlet flow rate and cutoff distance combinations within the range indicated in Tables 2a-2k and 3a-3k results in a database summarized in a series of graphs and tables (Figures 24-29 and Tables 2 and 3). Figure 24 presents the application efficiency contours expressed as a function of unit inlet flow rate and cutoff distance for level basins. Figure 25 is application efficiency chart, for level basins, expressed as a function of cutoff time and unit inlet flow. In management decision-making applications, Figures 24 and 25 have to be used in conjunction with Tables 2 and 4 (See management guidelines section). Figures 26, 27, and 28 present charts for application efficiency, water requirement efficiency, and low quarter distribution uniformity all expressed as a function of unit inlet flow rate and cut off distance, respectively. Figure 29 is application efficiency chart, in which E_a is expressed as a function unit inlet flow rate and cutoff time. Figures 24-29 are all developed for a basin with 0.1 % slope. Figures 26-29 have to be used along with Tables 3 and 4 in management decision-making applications.

Notice that all irrigation scenarios summarized in Figures 24 and 25 and Table 2 (i.e., level basin option) replenish the root zone fully, which means the corresponding water requirement efficiency is 100%. On the other hand, such a stringent requirement is impossible to satisfy with graded basins without causing a significant decline in application efficiency. A good compromise is to accept a degree of under-irrigation (i.e., E_r < 100 %) so that acceptably high levels of application efficiency can be realized. The adoption of such a compromise requires the presentation of water requirement efficiency and distribution uniformity, for a basin with 0.1 % slope, in separate charts (Figures 27 and 28).

In general, the lookup tables (Tables 2a-2k and 3a-3k) 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

In order to avoid injudicious use of the management tools, it is important to recognize the assumptions on the basis of which the management tools are developed. Pertinent assumptions have been outlined in Sanchez and Zerihun (2000), interested readers are therefore referred to that report. The procedure for the management of level as well as graded basins has been dealt with in detail in Sanchez and Zerihun (2000), therefore it will not be given additional treatment herein.

OUTREACH AND EDUCATION

The outreach component of this project included the construction and maintenance of a field experiment-demonstration facility, organization of field day events, and setting up an irrigation and water quality web site. Construction of the experimental facility was completed in 1998. Over the last two years the facility had been used to conduct field experiments. It has also been used for irrigation management demonstrations to local growers. Field day presentations and demonstrations had been organized for growers throughout the project period and we plan on organizing another field day presentation on May 16, 2000. 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 as far as water management and water quality issues of the area are concerned.

SUMMARY

A management package (tools and guidelines) has been developed for the basin irrigated alfalfa farms of the Yuma Mesa. Field experiment had been performed over a period of ten months (6/1999-4/2000). Data on Q_o, L_{co}, advance, and recession had been collected on four instrumented experimental basins. In addition, changes in soil moisture content had been monitored using neutron probe measurements throughout the experimental period.

Eight data sets had been used in model calibration. Twenty randomly selected data sets from the database developed during the experimental study had been 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. The mean error in the advance time predicted by SRFR is ∀2.57 min at the 5 % confidence level.

Simulation experiments had been 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 have been tested in the experimental basins of the University of Arizona, Yuma Mesa experimental farm. Limitations of the tools have been identified and ways of taking into account the limitations of the management tools have been proposed. Management guidelines that facilitate effective use of the management tools have been developed.

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. Problems associated with the presence of furrows that run along the edges of the basins have been discussed earlier. This problem can be remedied in two ways (1) during the land preparation phase the basins can be prepared without the furrows or (2) the volume of water trapped in the furrows has to be estimated and allowances have to be made for it in estimating the volume of water that would be diverted into the basins.
6. Effective management of irrigation systems requires satisfactory control over discharge delivered to the field supply channel and to the individual basins. Therefore, growers must place emphasise on installing water measuring devices that have satisfactory levels of accuracy. Periodic calibration and recalibration of water measuring devices must be part of a sound irrigation management practice.
7. Periodic land levelling would help maintain high levels of irrigation performance. It should therefore be part of an effective irrigation management strategy.
8. Establishing a regular publication, both electronic and hard-copy versions, that addresses current and potential water management and water quality issues of the Yuma area is necessary. This would promote water resources and environmental stewardship and awareness among local growers, thereby facilitating and enhancing collaboration[5] between researchers and extension workers on one hand and stakeholders on the other.
9. The management tools developed in this study are based on assumed average field conditions (spatially and temporally averaged infiltration and roughness parameters and average bed slope). Although soils in the Yuma Mesa area are relatively uniform and laser levelling is common, deviations of actual field conditions from assumed spatial and temporal averages would naturally exist. Therefore, the performance predictions of the management tools would invariably contain a degree of error. A sound management strategy may involve the use of the management packages

[5] Collaboration promotes and facilitates the adoption and implementation of research results, such as the basin irrigation management package proposed herein, by local growers.

proposed herein in conjunction with good judgement and experience. In fact, it is crucially important for growers to recognize that the management packages proposed herein are meant to complement and reinforce experience and good judgement instead of replacing them.

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LIST OF TABLES

Table 1 Input variables and parameters used in the simulation experiment

Variables and parameters	Unit	Level basin
Length	ft	600
Width	ft	100
Depth of application	in	1.476
c[1]	in	0.197
k[1]	in/hr^a	0.432
a[1]	-	0.5
b[1]	in/hr	0.075
Manning's n	-	0.2
Bed slope	ft/ft	0.000/0.001

[1]Exponent and coefficients of the branch infiltration function (Eq. 5).
Inlet flow rate and cutoff distance combinations used in the simulation experiments are given in Tables 3a-3k and Tables 4a-4k.

Table 2a Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.04	**262.5**	35.35	86.9	0.93	100	0.2	1.6	1.4	1.6	4.8
	287.5	39.66	77.51	0.95	100	0.4	1.9	1.7	1.9	4.9
	312.5	44.16	69.6	0.96	100	0.6	2.1	1.9	2.1	5.0
	337.5	48.75	63.0	0.97	100	0.8	2.3	2.2	2.3	5.1
	362.5	52.76	58.2	0.97	100	1.0	2.5	2.4	2.5	5.2
	387.5	57.53	53.40	0.97	100	1.2	2.7	2.6	2.7	5.3
	412.5	62.38	49.2	0.98	100	1.5	2.9	2.9	2.9	5.4
	437.5	67.20	45.7	0.98	100	1.7	3.2	3.1	3.2	5.4
	462.5	72.18	42.6	0.98	100	1.9	3.4	3.3	3.4	5.5
	487.5	77.21	39.8	0.98	100	2.2	3.7	3.6	3.7	5.6
	512.5	81.61	37.6	0.98	100	2.4	3.9	3.8	3.9	5.6
	537.5	86.81	35.4	0.98	100	2.6	4.1	4.0	4.1	5.7
	562.5	92.08	33.3	0.98	100	2.9	4.4	4.3	4.4	5.7
	587.5	97.30	31.6	0.98	100	3.1	4.6	4.5	4.6	5.8
	600	99.61	30.8	0.98	100	3.3	4.7	4.7	4.7	5.8
0.05	**237.5**	27.10	90.3	0.91	100	0.1	1.6	1.2	1.6	5.2
	262.5	30.85	79.7	0.95	100	0.3	1.8	1.6	1.8	5.3
	287.5	34.61	71.0	0.96	100	0.6	2.0	1.9	2.0	5.5
	312.5	38.53	63.8	0.97	100	0.8	2.3	2.2	2.3	5.6
	337.5	42.53	57.8	0.97	100	1.0	2.5	2.4	2.5	5.7
	362.5	46.03	53.4	0.98	100	1.2	2.7	2.6	2.7	5.8
	387.5	50.18	49.0	0.98	100	1.5	3.0	2.9	3.0	5.9
	412.5	54.40	45.2	0.98	100	1.7	3.2	3.1	3.2	5.9
	437.5	58.60	41.9	0.98	100	2.0	3.5	3.4	3.5	6.0
	462.5	62.95	39.0	0.98	100	2.3	3.7	3.7	3.7	6.1
	487.5	67.31	36.5	0.98	100	2.5	3.9	3.9	3.9	6.2
	512.5	71.15	34.5	0.98	100	2.7	4.2	4.2	4.2	6.2
	537.5	75.66	32.5	0.98	100	3.0	4.5	4.4	4.5	6.3
	562.5	80.25	30.6	0.99	100	3.3	4.8	4.7	4.8	6.4
	587.5	84.78	29.0	0.99	100	3.6	5.0	5.0	5.0	6.4
	600	86.80	28.3	0.99	100	3.7	5.2	5.1	5.2	6.5

Table 2b Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.06	**237.5**	24.28	84.4	0.94	100	0.2	1.7	1.5	1.7	5.7
	262.5	27.65	74.1	0.96	100	0.5	1.9	1.8	1.9	5.8
	287.5	31.01	66.0	0.97	100	0.7	2.2	2.1	2.2	5.9
	312.5	34.53	59.3	0.97	100	1.0	2.4	2.3	2.4	6.1
	337.5	38.10	53.8	0.98	100	1.2	2.7	2.6	2.7	6.2
	362.5	41.23	49.7	0.98	100	1.4	2.9	2.8	2.9	6.3
	387.5	44.95	45.6	0.98	100	1.7	3.2	3.1	3.2	6.4
	412.5	48.71	42.0	0.98	100	2.0	3.5	3.4	3.5	6.5
	437.5	52.48	39.0	0.98	100	2.3	3.7	3.7	3.7	6.6
	462.5	56.36	36.3	0.99	100	2.5	4.0	3.9	4.0	6.6
	487.5	60.28	34.0	0.99	100	2.8	4.3	4.2	4.3	6.7
	512.5	63.70	32.1	0.99	100	3.1	4.5	4.5	4.5	6.8
	537.5	67.75	30.2	0.99	100	3.4	4.8	4.8	4.8	6.9
	562.5	71.83	28.5	0.99	100	3.6	5.1	5.1	5.1	6.9
	587.5	75.88	27.0	0.99	100	3.9	5.4	5.4	5.4	7.0
	600	77.70	26.3	0.99	100	4.1	5.5	5.5	5.5	7.0
0.07	**212.5**	19.16	91.1	0.91	100	0.1	1.6	1.1	1.6	5.9
	237.5	22.15	79.3	0.95	100	0.3	1.8	1.6	1.8	6.1
	262.5	25.21	69.6	0.96	100	0.6	2.1	1.9	2.1	6.2
	287.5	28.28	62.1	0.97	100	0.9	2.3	2.2	2.3	6.4
	312.5	31.48	55.8	0.98	100	1.1	2.6	2.5	2.6	6.5
	337.5	34.75	50.5	0.98	100	1.4	2.4	2.8	2.9	6.6
	362.5	37.60	46.7	0.98	100	1.6	3.1	3.0	3.1	6.7
	387.5	40.98	42.8	0.98	100	1.9	3.4	3.3	3.4	6.8
	412.5	44.43	39.5	0.98	100	2.2	3.7	3.6	3.7	6.9
	437.5	47.85	36.7	0.99	100	2.5	4.0	3.9	4.0	7.0
	462.5	51.83	34.1	0.99	100	2.8	4.3	4.2	4.3	7.1
	487.5	54.95	31.9	0.99	100	3.1	4.6	4.5	4.6	7.2
	512.5	58.06	30.2	0.99	100	3.4	4.8	4.8	4.8	7.3
	537.5	61.75	28.4	0.99	100	3.7	5.1	5.1	5.1	7.4
	562.5	65.48	26.8	0.99	100	4.0	5.4	5.4	5.4	7.5
	587.5	69.16	25.4	0.99	100	4.5	5.8	5.7	5.8	7.5
	600	70.81	24.8	0.99	100	4.4	5.9	5.8	5.9	7.6

Table 2c Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.08	**212.5**	17.7	86.8	0.93	100	0.2	1.7	1.4	1.7	6.3
	237.5	20.46	75.1	0.96	100	0.4	1.9	1.8	1.9	6.5
	262.5	23.30	65.9	0.97	100	0.7	2.2	2.1	2.2	6.7
	287.5	26.13	58.8	0.97	100	1.0	2.5	2.4	2.5	6.8
	312.5	29.10	52.8	0.98	100	1.3	2.7	2.7	2.7	6.9
	337.5	32.10	47.9	0.98	100	1.6	3.0	3.0	3.0	7.1
	362.5	34.73	44.2	0.98	100	1.8	3.3	3.2	3.3	7.2
	387.5	37.86	40.6	0.99	100	2.1	3.6	3.5	3.6	7.3
	412.5	41.03	37.4	0.99	100	2.4	3.9	3.8	3.9	7.4
	437.5	44.20	34.7	0.99	100	2.7	4.2	4.1	4.2	7.5
	462.5	47.46	32.3	0.99	100	3.0	4.5	4.5	4.5	7.6
	487.5	50.76	30.2	0.99	100	3.3	4.8	4.8	4.8	7.7
	512.5	53.63	28.6	0.99	100	3.6	5.1	5.1	5.1	7.8
	537.5	57.03	26.9	0.99	100	3.9	5.4	5.4	5.4	7.9
	562.5	60.48	25.4	0.99	100	4.3	5.8	5.7	5.8	7.9
	587.5	63.88	24.0	0.99	100	4.6	6.1	6.0	6.1	8.0
	600	65.40	23.5	0.99	100	4.8	6.2	6.2	6.2	8.1
0.09	**212.5**	16.52	82.7	0.94	100	0.3	1.7	1.5	1.7	6.7
	237.5	19.10	71.5	0.96	100	0.5	2.0	1.9	2.0	6.9
	262.5	21.73	62.8	0.98	100	0.8	2.3	2.2	2.3	7.0
	287.5	24.38	56.0	0.98	100	1.1	2.6	2.5	2.6	7.2
	312.5	27.15	50.3	0.98	100	1.4	2.9	2.8	2.9	7.3
	337.5	29.95	45.6	0.98	100	1.7	3.2	3.1	3.2	7.5
	362.5	32.40	42.1	0.98	100	2.0	3.4	3.4	3.4	7.6
	387.5	35.31	38.6	0.99	100	2.3	3.8	3.7	3.8	7.7
	412.5	38.28	35.7	0.99	100	2.6	4.1	4.0	4.1	7.8
	437.5	41.23	33.1	0.99	100	2.9	4.4	4.4	4.4	7.9
	462.5	44.28	30.8	0.99	100	3.3	4.7	4.7	4.7	8.0
	487.5	47.35	28.8	0.99	100	3.6	5.1	5.0	5.1	8.1
	512.5	50.01	27.3	0.99	100	3.9	5.4	5.3	5.4	8.2
	537.5	53.20	25.6	0.99	100	4.2	5.7	5.7	5.7	8.3
	562.5	56.40	24.2	0.99	100	4.6	6.0	6.0	6.0	8.4
	587.5	59.58	22.9	0.99	100	4.9	6.4	6.3	6.4	8.5
	600	60.98	22.4	0.99	100	5.1	6.5	6.5	6.5	8.5

Table 2d Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.10	**187.5**	13.50	90.6	0.92	100	0.1	1.6	1.2	1.6	6.8
	212.5	15.53	79.1	0.95	100	0.3	1.8	1.6	1.8	7.0
	237.5	17.95	68.5	0.97	100	0.6	2.1	2.0	2.1	7.2
	262.5	20.43	60.1	0.97	100	0.9	2.4	2.3	2.4	7.4
	287.5	22.93	53.6	0.98	100	1.2	2.6	2.7	2.6	7.5
	312.5	25.51	48.2	0.98	100	1.5	3.0	2.9	3.0	7.7
	337.5	28.15	43.6	0.98	100	1.9	3.3	3.3	3.3	7.8
	362.5	30.46	40.3	0.99	100	2.1	3.6	3.6	3.6	7.9
	387.5	33.20	37.0	0.99	100	2.5	3.9	3.9	3.9	8.1
	412.5	35.98	34.1	0.99	100	2.8	4.3	4.2	4.3	8.2
	437.5	38.75	31.7	0.99	100	3.1	4.6	4.6	4.6	8.3
	462.5	41.61	29.5	0.99	100	3.5	4.9	4.9	4.9	8.4
	487.5	44.50	27.6	0.99	100	3.8	5.3	5.2	5.3	8.5
	512.5	47.01	26.1	0.99	100	4.1	5.6	5.6	5.6	8.6
	537.5	50.00	24.6	0.99	100	4.5	5.9	5.9	5.9	8.7
	562.5	53.01	23.2	0.99	100	4.8	6.3	6.3	6.3	8.8
	587.5	56.00	21.9	0.99	100	5.2	6.7	6.6	6.7	8.9
	600	57.31	21.4	0.99	100	5.4	6.8	6.8	6.8	8.9
0.11	**187.5**	12.77	87.4	0.93	100	0.2	1.6	1.4	1.6	7.1
	212.5	14.69	76.0	0.96	100	0.4	1.9	1.7	1.9	7.3
	237.5	16.98	65.8	0.97	100	0.7	2.2	2.1	2.2	7.5
	262.5	19.33	57.8	0.98	100	1.0	2.5	2.4	2.5	7.7
	287.5	21.68	51.5	0.98	100	1.3	2.8	2.7	2.8	7.9
	312.5	24.13	46.3	0.98	100	1.7	3.1	3.1	3.1	8.0
	337.5	26.63	41.9	0.99	100	2.0	3.5	3.4	3.5	8.2
	362.5	28.81	38.8	0.99	100	2.3	3.8	3.7	3.7	8.3
	387.5	31.40	35.6	0.99	100	2.6	4.1	4.1	4.1	8.4
	412.5	34.03	32.8	0.99	100	3.0	4.4	4.4	4.4	8.6
	437.5	32.26	30.8	0.99	100	3.3	4.7	4.7	4.7	8.7
	462.5	39.36	28.4	0.99	100	3.7	5.1	5.1	5.1	8.8
	487.5	42.08	26.5	0.99	100	4.0	5.5	5.5	5.5	8.9
	512.5	44.46	25.1	0.99	100	4.3	5.8	5.8	5.8	9.0
	537.5	47.28	23.6	0.99	100	4.7	6.2	6.2	6.2	9.1
	562.5	50.13	22.3	0.99	100	5.1	6.6	6.5	6.6	9.2
	587.5	52.50	21.1	0.99	100	5.5	6.9	6.9	6.9	9.3
	600	54.20	20.6	0.99	100	5.6	7.1	7.1	7.1	9.3

Table 2e Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.12	**187.5**	12.4	84.3	0.94	100	0.2	1.7	1.5	1.7	7.4
	212.5	13.97	73.3	0.96	100	0.5	2.0	1.8	2.0	7.6
	237.5	16.14	63.4	0.97	100	0.8	2.3	2.2	2.3	7.8
	262.5	18.38	55.7	0.98	100	1.1	2.6	2.5	2.6	8.0
	287.5	20.64	49.7	0.98	100	1.4	2.9	2.9	2.9	8.2
	312.5	22.95	44.6	0.98	100	1.8	3.3	3.2	3.3	8.4
	337.5	25.31	40.4	0.99	100	2.1	3.6	3.5	3.6	8.5
	362.5	27.38	37.4	0.99	100	2.4	3.9	3.8	3.9	8.6
	387.5	29.85	34.3	0.99	100	2.8	4.2	4.2	4.2	8.8
	412.5	32.36	31.6	0.99	100	3.1	4.6	4.6	4.6	8.9
	437.5	34.85	29.4	0.99	100	3.5	4.9	4.9	4.9	9.0
	462.5	37.41	27.3	0.99	100	3.9	5.3	5.3	5.3	9.2
	487.5	40.01	25.6	0.99	100	4.2	5.7	5.7	5.7	9.3
	512.5	42.26	24.2	0.99	100	4.6	6.0	6.0	6.0	9.4
	537.5	44.95	22.8	0.99	100	4.9	6.4	6.4	6.4	9.5
	562.5	47.65	21.5	0.99	100	5.3	6.8	6.8	6.8	9.6
	587.5	50.33	20.3	0.99	100	5.7	7.2	7.2	7.2	9.7
	600	51.51	19.8	0.99	100	5.9	7.4	7.3	7.4	9.7
0.13	**187.5**	11.59	81.5	0.95	100	0.3	1.8	1.6	1.8	7.7
	212.5	13.34	70.9	0.96	100	0.6	2.0	1.9	2.0	7.9
	237.5	15.41	61.3	0.97	100	0.9	2.4	2.3	2.4	8.1
	262.5	17.55	53.9	0.98	100	1.2	2.7	2.6	2.7	8.3
	287.5	19.68	48.0	0.98	100	1.5	3.0	3.0	3.0	8.5
	312.5	21.90	43.1	0.99	100	1.9	3.4	3.3	3.4	8.7
	337.5	24.16	39.1	0.99	100	2.2	3.7	3.7	3.7	8.8
	362.5	26.15	36.1	0.99	100	2.6	4.0	4.0	4.0	9.0
	387.5	28.50	33.2	0.99	100	2.9	4.4	4.4	4.4	9.1
	412.5	30.88	30.6	0.99	100	3.3	4.8	4.7	4.7	9.3
	437.5	33.26	28.4	0.99	100	3.7	5.1	5.1	5.1	9.4
	462.5	35.71	26.4	0.99	100	4.0	5.5	5.5	5.5	9.5
	487.5	38.20	24.7	0.99	100	4.4	5.9	5.9	5.9	9.6
	512.5	40.35	23.4	0.99	100	4.8	6.2	6.2	6.2	9.7
	537.5	42.99	22.0	0.99	100	5.2	6.0	6.0	6.0	9.8
	562.5	45.48	20.8	0.99	100	5.6	7.0	7.0	7.0	9.9
	587.5	48.05	19.6	0.99	100	6.0	7.4	7.4	7.4	10.0
	600	49.18	19.2	0.99	100	6.1	7.6	7.6	7.6	10.1

Table 2f Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.14	**187.5**	11.11	79.0	0.95	100	0.3	1.8	1.7	1.8	8.0
	212.5	12.78	68.0	0.97	100	0.6	2.1	2.0	2.1	8.3
	237.5	14.77	59.4	0.98	100	1.0	2.4	2.3	2.4	8.4
	262.5	16.81	52.2	0.98	100	1.3	2.8	2.7	2.8	8.6
	287.5	18.85	46.5	0.98	100	1.6	3.1	3.1	3.1	8.8
	312.5	20.98	41.8	0.99	100	2.0	3.5	3.4	3.5	9.0
	337.5	23.15	37.9	0.99	100	2.4	3.8	3.8	3.8	9.1
	362.5	25.05	35.0	0.99	100	2.7	4.2	4.1	4.2	9.3
	387.5	27.03	32.1	0.99	100	3.1	4.5	4.5	4.5	9.4
	412.5	29.60	29.6	0.99	100	3.4	4.9	4.9	4.9	9.6
	437.5	31.86	27.5	0.99	100	3.8	5.3	5.3	5.3	9.7
	462.5	34.21	25.6	0.99	100	4.2	5.7	5.7	5.7	9.8
	487.5	36.58	24.0	0.99	100	4.6	6.1	6.1	6.1	10.0
	512.5	38.65	22.7	0.99	100	5.0	6.4	6.4	6.4	10.1
	537.5	41.10	21.3	0.99	100	5.4	6.9	6.8	6.9	10.2
	562.5	43.58	20.1	0.99	100	5.8	7.3	7.2	7.3	10.3
	587.5	46.03	19.0	0.99	100	6.2	7.7	7.7	7.7	10.4
	600	47.11	18.6	0.99	100	6.4	7.9	7.8	7.9	10.4
0.15	**187.5**	10.68	76.7	0.96	100	0.4	1.9	1.7	1.9	8.2
	212.5	12.28	66.7	0.97	100	0.7	2.2	2.1	2.2	8.5
	237.5	14.19	57.7	0.98	100	1.0	2.5	2.4	2.5	8.7
	262.5	16.15	50.7	0.98	100	1.4	2.9	2.8	2.9	8.8
	287.5	18.11	45.2	0.98	100	1.7	3.2	3.2	3.2	9.1
	312.5	20.16	40.6	0.99	100	2.1	3.6	3.5	3.6	9.3
	337.5	22.25	36.8	0.99	100	2.5	4.0	3.9	4.0	9.4
	362.5	24.06	34.0	0.99	100	2.8	4.3	4.2	4.3	9.6
	387.5	26.23	31.2	0.99	100	3.2	4.7	4.6	4.7	9.7
	412.5	28.43	28.8	0.99	100	3.6	5.0	5.0	5.1	9.9
	437.5	30.63	26.7	0.99	100	4.0	5.5	5.4	5.5	10.0
	462.5	32.88	24.9	0.99	100	4.4	5.9	5.8	5.9	10.2
	487.5	35.16	23.3	0.99	100	4.8	6.3	6.2	6.3	10.3
	512.5	37.15	22.0	0.99	100	5.2	6.6	6.6	6.6	10.4
	537.5	39.50	20.7	0.99	100	5.6	7.1	7.0	7.1	10.5
	562.5	41.88	19.5	0.99	100	6.0	7.5	7.5	7.5	10.6
	587.5	44.23	18.5	0.99	100	6.4	7.9	7.9	7.9	10.7
	600	45.26	18.1	0.99	100	6.6	8.1	8.1	8.1	10.8

Table 2g Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**In**
0.16	**162.5**	8.56	89.6	0.92	100	0.1	1.6	1.3	1.6	8.2
	187.5	10.29	74.7	0.96	100	0.4	1.9	1.8	1.9	8.5
	212.5	11.83	64.9	0.97	100	0.7	2.2	2.1	2.2	8.7
	237.5	13.67	56.2	0.98	100	1.1	2.6	2.5	2.6	8.9
	262.5	15.56	49.3	0.98	100	1.5	2.9	2.9	2.9	9.2
	287.5	17.46	44.0	0.99	100	1.8	3.3	3.2	3.3	9.4
	312.5	19.43	39.5	0.99	100	2.2	3.7	3.6	3.7	9.6
	337.5	21.43	35.8	0.99	100	2.6	4.1	4.0	4.1	9.7
	362.5	23.20	33.1	0.99	100	2.9	4.4	4.4	4.4	9.9
	387.5	25.28	30.4	0.99	100	3.3	4.8	4.8	4.8	10.0
	412.5	27.40	28.0	0.99	100	3.7	5.2	5.2	5.2	10.2
	437.5	29.51	26.0	0.99	100	4.1	5.6	5.6	5.6	10.3
	462.5	31.68	24.2	0.99	100	4.6	6.0	6.0	6.0	10.5
	487.5	33.88	22.6	0.99	100	5.0	6.5	6.4	6.5	10.6
	512.5	35.80	21.4	0.99	100	5.3	6.8	6.8	6.8	10.7
	537.5	38.05	20.2	0.99	100	5.8	7.3	7.2	7.3	10.8
	562.5	40.35	19.0	0.99	100	6.2	7.7	7.7	7.7	10.9
	587.5	42.61	18.0	0.99	100	6.7	8.1	8.1	8.1	11.1
	600	43.61	17.6	0.99	100	6.8	8.3	8.3	8.3	11.1
0.17	**162.5**	8.26	87.4	0.93	100	0.2	1.6	1.4	1.6	8.4
	187.5	9.93	72.8	0.96	100	0.5	2.0	1.8	2.0	8.7
	212.5	11.43	63.2	0.97	100	0.8	2.3	2.2	2.3	9.0
	237.5	13.21	54.7	0.98	100	1.2	2.6	2.6	2.6	9.2
	262.5	15.03	48.1	0.98	100	1.5	3.0	3.0	3.0	9.4
	287.5	16.86	42.9	0.99	100	1.9	3.4	3.3	3.4	9.6
	312.5	18.76	38.5	0.99	100	2.3	3.8	3.7	3.8	9.8
	337.5	20.70	34.9	0.99	100	2.7	4.2	4.1	4.2	10.0
	362.5	22.40	32.2	0.99	100	3.0	4.5	4.5	4.5	10.2
	387.5	24.41	29.6	0.99	100	3.5	4.9	4.9	4.9	10.3
	412.5	26.46	27.3	0.99	100	3.9	5.3	5.3	5.3	10.5
	437.5	28.50	25.3	0.99	100	4.3	5.8	5.7	5.8	10.6
	462.5	30.60	23.6	0.99	100	4.7	6.2	6.2	6.2	10.8
	487.5	32.71	22.1	0.99	100	5.2	6.6	6.6	6.6	10.9
	512.5	34.56	20.9	0.99	100	5.5	7.0	7.0	7.0	11.0
	537.5	36.75	19.6	0.99	100	6.0	7.4	7.4	7.4	11.1
	562.5	38.96	18.5	0.99	100	6.4	7.9	7.9	7.9	11.3
	587.5	41.15	17.5	0.99	100	6.9	8.3	8.3	8.3	11.4
	600	42.13	17.1	0.99	100	7.1	8.5	8.5	8.5	11.4

Table 2h Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.18	**162.5**	8.00	85.3	0.94	100	0.2	1.7	1.5	1.7	8.7
	187.5	9.61	71.0	0.96	100	0.6	2.0	1.9	2.0	9.0
	212.5	11.06	61.7	0.97	100	0.9	2.3	2.2	2.3	9.2
	237.5	12.78	53.4	0.98	100	1.2	2.7	2.6	2.7	9.4
	262.5	14.55	46.9	0.98	100	1.6	3.1	3.0	3.1	9.7
	287.5	16.32	41.8	0.99	100	2.0	3.5	3.4	3.5	9.9
	312.5	18.16	37.6	0.99	100	2.4	3.9	3.8	3.9	10.1
	337.5	20.03	34.1	0.99	100	2.8	4.3	4.2	4.3	10.3
	362.5	21.68	31.5	0.99	100	3.2	4.6	4.6	4.6	10.4
	387.5	23.63	28.9	0.99	100	3.6	5.1	5.0	5.1	10.6
	412.5	25.61	26.6	0.99	100	4.0	5.5	5.4	5.5	10.8
	437.5	27.58	24.7	0.99	100	4.4	5.9	5.9	5.9	10.9
	462.5	29.61	23.0	0.99	100	4.9	6.3	6.3	6.3	11.1
	487.5	31.66	21.5	0.99	100	5.3	6.8	6.8	6.8	11.2
	512.5	33.45	20.4	0.99	100	5.7	7.2	7.1	7.2	11.3
	537.5	35.56	19.2	0.99	100	6.2	7.6	7.6	7.6	11.4
	562.5	37.71	18.1	0.99	100	6.6	8.1	8.1	8.1	11.6
	587.5	39.83	17.1	0.99	100	7.1	8.6	8.5	8.6	11.7
	600	40.76	16.7	0.99	100	7.3	8.8	8.7	8.8	11.7
0.19	**162.5**	7.75	83.4	0.94	100	0.2	1.7	1.5	1.7	8.9
	187.5	9.32	69.4	0.96	100	0.6	2.1	2.3	2.1	9.2
	212.5	10.72	60.3	0.98	100	0.9	2.4	2.3	2.4	9.4
	237.5	12.39	52.2	0.98	100	1.3	2.8	2.7	2.8	9.7
	262.5	14.10	45.8	0.98	100	1.7	3.2	3.1	3.2	9.9
	287.5	15.82	40.9	0.98	100	2.1	3.6	3.5	3.6	10.1
	312.5	17.61	36.7	0.99	100	2.5	4.0	3.9	4.0	10.3
	337.5	19.43	33.3	0.99	100	2.9	4.4	4.3	4.4	10.5
	362.5	21.01	30.7	0.99	100	3.3	4.7	4.7	4.7	10.7
	387.5	22.91	28.2	0.99	100	3.7	5.2	5.1	5.2	10.9
	412.5	24.83	26.0	0.99	100	4.1	5.6	5.6	5.6	11.0
	437.5	26.75	24.2	0.99	100	4.6	6.0	6.0	6.0	11.2
	462.5	28.71	22.5	0.99	100	5.0	6.5	6.5	6.5	11.3
	487.5	30.70	21.0	0.99	100	5.5	6.9	6.9	6.9	11.5
	512.5	32.43	19.9	0.99	100	5.9	7.3	7.3	7.3	11.6
	537.5	34.48	18.7	0.99	100	6.3	7.8	7.8	7.8	11.7
	562.5	36.56	17.7	0.99	100	6.8	8.3	8.3	8.3	11.9
	587.5	38.61	16.7	0.99	100	7.3	8.8	8.7	8.8	12.0
	600	39.53	16.3	0.99	100	7.5	9.0	8.9	9.0	12.0

Table 2i Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**In**
0.20	**162.5**	7.53	81.6	0.95	100	0.3	1.8	1.6	1.8	9.1
	187.5	9.05	67.9	0.97	100	0.6	2.1	2.0	2.1	9.4
	212.5	10.41	59.0	0.98	100	1.0	2.5	2.4	2.5	9.7
	237.5	12.03	51.0	0.98	100	1.4	2.8	2.8	2.8	9.9
	262.5	13.70	44.8	0.99	100	1.8	3.2	3.2	3.2	10.2
	287.5	15.37	40.0	0.99	100	2.2	3.6	3.6	3.6	10.4
	312.5	17.10	35.9	0.99	100	2.6	4.1	4.0	4.1	10.6
	337.5	18.86	32.5	0.99	100	3.0	4.5	4.4	4.5	10.8
	362.5	20.41	30.1	0.99	100	3.4	4.9	4.8	4.9	10.9
	387.5	22.25	27.6	0.99	100	3.8	5.3	5.3	5.3	11.1
	412.5	24.11	25.5	0.99	100	4.3	5.7	5.7	5.7	11.3
	437.5	25.96	23.6	0.99	100	4.7	6.2	6.2	6.2	11.4
	462.5	27.88	22.0	0.99	100	5.2	6.6	6.6	6.6	11.6
	487.5	29.81	20.6	0.99	100	5.6	7.1	7.1	7.1	11.7
	512.5	31.50	19.5	0.99	100	6.0	7.5	7.5	7.5	11.9
	537.5	33.48	18.3	0.99	100	6.5	8.0	8.0	8.0	12.0
	562.5	35.50	17.3	0.99	100	7.0	8.5	8.4	8.5	12.1
	587.5	37.50	16.4	0.99	100	7.5	8.9	8.9	8.9	12.3
	600	38.38	16.0	0.99	100	7.7	9.2	9.1	9.2	12.3
0.21	**162.5**	7.32	79.9	0.95	100	0.3	1.8	1.6	1.8	9.3
	187.5	8.80	66.4	0.97	100	0.7	2.2	2.1	2.2	9.6
	212.5	10.13	57.8	0.98	100	1.0	2.5	2.4	2.4	9.9
	237.5	11.70	50.0	0.98	100	1.4	2.9	2.8	2.9	10.1
	262.5	13.32	43.9	0.99	100	1.8	3.3	3.3	3.3	10.4
	287.5	14.94	39.1	0.99	100	2.2	3.7	3.7	3.7	10.6
	312.5	16.63	35.2	0.99	100	2.7	4.1	4.1	4.1	10.8
	337.5	18.35	31.9	0.99	100	3.1	4.6	4.5	4.6	11.0
	362.5	19.85	29.5	0.99	100	3.5	5.0	4.9	5.0	11.2
	387.5	21.65	27.0	0.99	100	3.9	5.4	5.4	5.4	11.4
	412.5	23.45	24.9	0.99	100	4.4	5.9	5.8	5.9	11.6
	437.5	25.25	23.1	0.99	100	4.8	6.3	6.3	6.3	11.7
	462.5	27.11	38.3	0.99	100	5.3	6.8	6.8	6.8	11.9
	487.5	29.00	20.2	0.99	100	5.8	7.2	7.2	7.2	12.0
	512.5	30.63	19.1	0.99	100	6.2	7.7	7.6	7.7	12.1
	537.5	32.56	17.9	0.99	100	6.7	8.2	8.1	8.2	12.3
	562.5	34.53	16.9	0.99	100	7.2	8.7	8.6	8.7	12.4
	587.5	36.46	16.0	0.99	100	7.7	9.1	9.1	9.1	12.5
	600	37.33	15.6	0.99	100	7.9	9.4	9.3	9.4	12.6

Table 2j Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**In**
0.22	**162.5**	7.13	78.3	0.95	100	0.4	1.8	1.7	1.8	9.5
	187.5	8.57	65.1	0.97	100	0.7	2.2	2.1	2.2	9.8
	212.5	9.86	56.6	0.98	100	1.1	2.6	2.5	2.6	10.1
	237.5	11.40	49.0	0.98	100	1.5	3.0	2.9	3.0	10.4
	262.5	12.97	43.0	0.99	100	1.9	3.4	3.3	3.4	10.6
	287.5	14.55	38.4	0.99	100	2.3	3.8	3.8	3.8	10.9
	312.5	16.20	34.5	0.99	100	2.8	4.2	4.2	4.2	11.1
	337.5	17.86	31.2	0.99	100	3.2	4.7	4.6	4.7	11.3
	362.5	19.33	28.9	0.99	100	3.6	5.1	5.0	5.1	11.4
	387.5	21.08	26.5	0.99	100	4.0	5.5	5.5	5.5	11.6
	412.5	22.85	24.4	0.99	100	4.5	6.0	6.0	6.0	11.8
	437.5	24.80	22.7	0.99	100	5.0	6.4	6.4	6.4	12.0
	462.5	26.41	21.1	0.99	100	5.4	6.9	6.9	6.9	12.1
	487.5	28.23	19.8	0.99	100	5.9	7.4	7.4	7.4	12.3
	512.5	29.83	18.7	0.99	100	6.3	7.8	7.8	7.8	12.4
	537.5	31.71	17.6	0.99	100	6.8	8.3	8.3	8.3	12.5
	562.5	33.63	16.6	0.99	100	7.4	8.8	8.8	8.8	12.7
	587.5	35.51	15.7	0.99	100	7.9	9.3	9.3	9.3	12.8
	600	36.35	15.3	0.99	100	8.1	9.5	9.5	9.5	12.9
0.23	**162.5**	6.95	76.8	0.96	100	0.4	1.9	1.7	1.9	9.7
	187.5	8.36	63.9	0.97	100	0.8	2.3	2.2	2.3	10.0
	212.5	9.62	55.5	0.98	100	1.1	2.6	2.5	2.6	10.3
	237.5	11.11	48.1	0.98	100	1.5	3.0	3.0	3.0	10.6
	262.5	12.65	42.2	0.99	100	2.0	3.4	3.4	3.4	10.8
	287.5	14.19	37.6	0.99	100	2.4	3.9	3.8	3.9	11.1
	312.5	15.79	33.8	0.99	100	2.8	4.3	4.3	4.3	11.3
	337.5	17.43	30.6	0.99	100	3.3	4.8	4.7	4.8	11.5
	362.5	18.85	28.3	0.99	100	3.7	5.1	5.1	5.1	11.7
	387.5	20.55	26.0	0.99	100	4.1	5.6	5.6	5.6	11.8
	412.5	22.26	24.0	0.99	100	4.6	6.1	6.1	6.1	12.0
	437.5	23.98	22.3	0.99	100	5.1	6.6	6.5	6.6	12.2
	462.5	25.75	20.7	0.99	100	5.6	7.1	7.0	7.1	12.4
	487.5	27.53	19.4	0.99	100	6.1	7.5	7.5	7.5	12.5
	512.5	29.08	18.3	0.99	100	6.5	8.0	8.0	8.0	12.7
	537.5	30.93	17.2	0.99	100	7.0	8.5	8.5	8.5	12.8
	562.5	32.78	16.3	0.99	100	7.5	9.0	9.0	9.0	12.9
	587.5	34.63	15.4	0.99	100	8.0	9.5	9.5	9.5	13.1
	600	35.45	15.0	0.99	100	8.3	9.7	9.7	9.7	13.1

Table 2k Lookup table for level basin

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft		**min**	**%**	**%**	**%**	**in**	**in**	**In**	**in**	**in**
0.24	**162.5**	6.79	75.4	0.96	100	0.4	1.9	1.8	1.9	9.9
	187.5	8.16	62.7	0.97	100	0.8	2.3	2.2	2.3	10.2
	212.5	9.39	54.5	0.98	100	1.2	2.7	2.6	2.7	10.5
	237.5	10.85	47.2	0.98	100	1.6	3.1	3.0	3.1	10.8
	262.5	12.35	41.4	0.99	100	2.0	3.5	3.5	3.5	11.1
	287.5	13.85	36.9	0.99	100	2.5	3.9	3.9	3.9	11.3
	312.5	15.42	33.2	0.99	100	2.9	4.4	4.4	4.4	11.5
	337.5	17.01	30.1	0.99	100	3.4	4.8	4.8	4.8	11.7
	362.5	18.40	27.8	0.99	100	3.8	5.2	5.2	5.2	11.9
	387.5	20.06	25.5	0.99	100	4.3	5.7	5.7	5.7	12.1
	412.5	21.75	23.5	0.99	100	4.7	6.2	6.2	6.2	12.3
	437.5	23.41	21.8	0.99	100	5.2	6.7	6.7	6.7	12.5
	462.5	25.13	20.3	0.99	100	5.7	7.2	7.2	7.2	12.6
	487.5	26.88	19.0	0.99	100	6.2	7.7	7.7	7.7	12.8
	512.5	28.40	18.0	0.99	100	6.7	8.8	8.1	8.1	12.9
	537.5	30.18	16.9	0.99	100	7.2	8.6	8.6	8.6	13.1
	562.5	32.0	16.0	0.99	100	7.7	9.2	9.2	9.2	13.2
	587.5	33.8	15.1	0.99	100	8.2	9.7	9.7	9.7	13.3
	600	34.6	14.8	0.99	100	8.4	9.9	9.9	9.9	13.4
0.25	**162.5**	6.63	74.1	0.96	100	0.5	1.9	1.8	1.9	10.1
	187.5	7.97	61.6	0.97	100	0.9	2.3	2.3	2.3	10.4
	212.5	9.17	53.6	0.98	100	1.2	2.7	2.6	2.7	10.7
	237.5	10.60	46.4	0.98	100	1.7	3.1	3.1	3.1	11.0
	262.5	12.07	40.7	0.99	100	2.1	3.6	3.5	3.6	11.3
	287.5	13.53	36.3	0.99	100	2.5	4.0	4.0	4.0	11.5
	312.5	15.06	32.6	0.99	100	3.0	4.5	4.4	4.5	11.7
	337.5	16.62	29.6	0.99	100	3.5	4.9	4.9	4.9	12.0
	362.5	17.98	27.3	0.99	100	3.9	5.3	5.3	5.3	12.1
	387.5	19.60	25.1	0.99	100	4.4	5.8	5.8	5.8	12.3
	412.5	21.25	23.1	0.99	100	4.8	6.3	6.3	6.3	12.5
	437.5	22.88	21.5	0.99	100	5.3	6.8	6.8	6.8	12.7
	462.5	24.56	20.0	0.99	100	5.8	7.3	7.3	7.3	12.9
	487.5	26.26	18.7	0.99	100	6.4	7.8	7.8	7.8	13.0
	512.5	27.75	17.7	0.99	100	6.8	8.3	8.2	8.3	13.2
	537.5	29.50	16.6	0.99	100	7.3	8.8	8.8	8.8	13.3
	562.5	31.26	15.7	0.99	100	7.9	9.3	9.3	9.3	13.5
	587.5	33.03	14.9	0.99	100	8.4	9.9	9.8	9.8	13.6
	600	33.80	14.5	0.99	100	8.6	10.1	10.1	10.1	13.7

Table 3a Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	ft	min	%	%	%	in	in	in	in	in
0.04	**187.5**	21.38	98.8	0.77	68.7	0.0	1.0	0.6	1.0	3.7
	212.5	24.83	89.7	0.69	72.4	0.1	1.1	0.7	1.1	3.8
	237.5	28.41	82.2	0.62	75.9	0.2	1.3	0.7	1.3	3.8
	262.5	32.05	74.7	0.56	77.9	0.3	1.5	0.7	1.5	3.9
	287.5	35.65	68.8	0.51	79.7	0.5	1.7	0.7	1.7	3.9
	312.5	39.38	63.6	0.47	81.4	0.6	1.8	0.8	1.8	3.9
	337.5	43.15	59.2	0.43	83.1	0.8	2.0	0.8	2.0	4.0
	362.5	46.86	55.6	0.40	84.7	0.9	2.2	0.8	2.2	4.3
	387.5	50.68	52.1	0.37	85.9	1.1	2.4	0.8	2.4	4.6
	412.5	54.13	49.4	0.35	87	1.3	2.5	0.7	2.5	4.9
	437.5	57.93	47.1	0.34	88.7	1.4	2.7	0.8	2.7	5.2
	462.5	61.86	44.8	0.32	90.1	1.6	2.9	0.8	2.9	5.4
	487.5	65.8	42.7	0.31	91.4	1.8	3.1	0.8	3.1	5.7
	512.5	69.68	40.5	0.29	91.8	1.9	3.3	0.7	3.3	5.9
	537.5	73.68	39.0	0.31	93.4	2.1	3.5	0.9	3.5	6.2
	562.5	77.68	37.4	0.32	94.7	2.3	3.7	0.9	3.7	6.4
	587.5	81.63	36.0	0.34	95.6	2.5	3.9	0.9	3.9	6.6
	600.0	83.40	35.4	0.34	96.0	2.5	3.9	0.9	4.0	6.7
0.05	**162.5**	15.87	100.1	0.80	64.6	0.0	0.9	0.5	0.9	4.2
	187.5	18.95	91.8	0.69	70.7	0.0	1.1	0.5	1.1	4.2
	212.5	21.65	84.5	0.63	74.4	0.2	1.3	0.7	1.2	4.3
	237.5	24.85	75.8	0.55	76.6	0.3	1.4	0.6	1.4	4.3
	262.5	28.11	69.5	0.51	81.4	0.5	1.6	0.78	1.6	4.4
	287.5	31.33	64.0	0.47	81.5	0.6	1.8	0.7	1.8	4.4
	312.5	34.68	58.7	0.42	82.8	0.8	2.0	0.8	2.0	4.4
	337.5	38.03	54.4	0.38	84.1	1.0	2.2	0.8	2.2	4.5
	362.5	40.96	51.2	0.36	85.3	1.1	2.4	0.7	2.4	4.7
	387.5	44.40	48.1	0.33	86.8	1.3	2.6	0.7	2.6	5.0
	412.5	47.86	45.7	0.32	88.9	1.5	2.8	0.8	2.8	5.3
	437.5	51.3	43.4	0.31	90.5	1.7	3.0	0.8	3.0	5.6
	462.5	54.81	41.3	0.30	92.0	1.9	3.2	0.8	3.2	5.9
	487.5	58.33	38.9	0.29	92.2	2.1	3.4	0.7	3.4	6.2
	512.5	61.38	37.6	0.31	93.8	2.2	3.6	0.8	3.6	6.4
	537.5	64.96	36.1	0.33	95.3	2.4	3.8	0.9	3.8	6.6
	562.5	68.56	34.6	0.35	96.4	2.6	4.1	0.9	4.1	6.9
	587.5	72.11	33.3	0.38	97.6	2.8	4.3	0.8	4.3	7.1
	600.0	73.68	32.7	0.39	97.9	2.9	4.4	0.8	4.4	7.2

Table 3b Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft		min	%	%	%	in	in	in	in	in
0.06	**162.5**	14.30	96.8	0.73	67.5	0.0	1.0	0.5	1.0	4.6
	187.5	17.06	87.0	0.65	72.4	0.1	1.2	0.6	1.2	4.7
	212.5	19.51	79.6	0.59	75.7	0.3	1.4	0.7	1.4	4.7
	237.5	22.41	70.7	0.49	77.3	0.4	1.6	0.5	1.6	4.8
	262.5	25.35	65.1	0.47	80.5	0.6	1.8	0.7	1.8	4.8
	287.5	28.28	59.4	0.42	81.9	0.8	2.0	0.7	2.0	4.9
	312.5	28.35	59.4	0.42	82.1	0.8	2.0	0.7	2.0	4.9
	337.5	34.35	51.0	0.35	85.5	1.2	2.4	0.7	2.4	5.0
	362.5	37.0	48.0	0.32	86.6	1.3	2.6	0.7	2.6	5.0
	387.5	40.11	45.0	0.30	88.0	1.5	2.8	0.6	2.8	5.4
	412.5	43.26	42.8	0.30	90.3	1.7	3.1	0.8	3.1	5.7
	437.5	46.36	40.5	0.29	91.6	1.9	3.3	0.8	3.3	6.0
	462.5	49.55	38.7	0.31	93.5	2.2	3.5	0.8	3.5	6.3
	487.5	52.75	36.7	0.32	94.4	2.4	3.8	0.8	3.7	6.5
	512.5	55.51	35.3	0.34	95.6	2.5	3.9	0.8	3.9	6.8
	537.5	58.76	33.8	0.37	96.9	2.7	4.2	0.8	4.2	7.0
	562.5	62.5	32.5	0.40	99.0	3.0	4.4	0.9	4.4	7.3
	587.5	65.26	31.2	0.43	99.3	3.2	4.6	1.1	4.7	7.5
	600.0	66.68	30.6	0.44	99.5	3.3	4.8	1.2	4.8	7.7
0.07	**162.5**	13.09	93.7	0.70	69.8	0.0	1.1	0.5	1.0	4.9
	187.5	15.63	82.9	0.61	73.7	0.2	1.3	0.6	1.3	5.1
	212.5	17.88	75.2	0.53	76.5	0.3	1.5	0.6	1.5	5.1
	237.5	20.55	67.5	0.48	78.9	0.5	1.7	0.6	1.7	5.2
	262.5	23.25	61.1	0.43	80.8	0.7	1.9	0.6	1.9	5.3
	287.5	25.95	56.1	0.38	82.9	0.9	2.1	0.7	2.1	5.3
	312.5	28.71	51.7	0.35	84.5	1.1	2.4	0.7	2.4	5.4
	337.5	31.51	48.1	0.32	86.3	1.3	2.6	0.7	2.6	5.4
	362.5	33.96	45.3	0.29	87.6	1.5	2.8	0.6	2.8	5.4
	387.5	36.83	42.6	0.28	89.3	1.7	3.0	0.6	3.0	5.7
	412.5	39.73	40.1	0.28	90.7	1.9	3.3	0.5	3.3	6.0
	437.5	42.60	38.4	0.30	93.1	2.1	3.5	0.8	3.5	6.3
	462.5	45.53	36.5	0.32	94.6	2.4	3.8	0.8	3.8	6.6
	487.5	48.46	34.7	0.34	95.7	2.6	4.0	0.6	4.0	6.9
	512.5	51.01	33.5	0.37	97.3	2.8	4.2	0.8	4.2	7.1
	537.5	54.03	32.1	0.41	98.7	3.0	4.5	0.9	4.5	7.4
	562.5	57.05	30.6	0.44	99.3	3.3	4.7	1.2	4.7	7.7
	587.5	60.01	29.2	0.47	99.7	3.5	5.0	1.4	5.0	7.9
	600.0	61.33	28.6	0.48	99.8	3.6	5.1	1.5	5.1	8.0

Table 3c Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.08	**137.5**	9.83	99.2	0.71	63.4	0.0	0.9	0.3	0.9	5.2
	162.5	12.13	90.2	0.66	71.2	0.1	1.1	0.5	1.1	5.3
	187.5	14.50	79.5	0.57	74.9	0.3	1.4	0.6	1.3	5.4
	212.5	16.59	71.9	0.51	77.6	0.4	1.6	0.6	1.5	5.5
	237.5	19.06	64.4	0.45	79.8	0.6	1.8	0.6	1.8	5.6
	262.5	21.58	57.9	0.39	81.3	0.8	2.0	0.5	2.0	5.7
	287.5	24.08	53.2	0.35	83.3	1.0	2.3	0.6	2.3	5.7
	312.5	26.66	49.3	0.32	85.5	1.2	2.5	0.6	2.5	5.8
	337.5	29.26	45.7	0.29	90.8	1.5	2.8	0.6	2.8	5.8
	362.5	31.55	43.2	0.28	88.6	1.7	3.0	0.5	3.0	5.8
	387.5	34.21	41.1	0.29	91.4	1.9	3.3	0.8	3.2	5.9
	412.5	36.91	38.5	0.29	92.4	2.1	3.5	0.7	3.5	6.2
	437.5	39.58	36.7	0.32	94.5	2.4	3.8	0.8	3.8	6.6
	462.5	42.31	34.8	0.34	95.8	2.6	4.0	0.6	4.0	6.9
	487.5	45.06	33.3	0.38	97.6	2.8	4.3	0.8	4.3	7.2
	512.5	47.45	32.0	0.41	98.8	3.0	4.5	1.0	4.5	7.4
	537.5	50.25	30.4	0.44	99.4	3.3	4.8	1.2	4.8	7.7
	562.5	53.05	28.9	0.47	99.7	3.6	5.0	1.5	5.0	8.0
	587.5	55.81	27.5	0.50	99.8	3.8	5.3	1.7	5.3	8.3
	600.0	57.05	26.9	0.51	99.8	3.9	5.4	1.9	5.4	8.4
0.09	**137.5**	9.19	97.9	0.70	65.7	0.0	0.9	0.4	0.9	5.5
	162.5	11.35	86.3	0.62	71.7	0.1	1.2	0.4	1.2	5.6
	187.5	13.57	76.3	0.53	75.8	0.3	1.4	0.5	1.4	5.8
	212.5	15.52	68.9	0.49	78.2	0.5	1.6	0.6	1.6	5.9
	237.5	17.85	62.0	0.43	81.0	0.7	1.9	0.7	1.9	5.9
	262.5	20.21	55.8	0.38	82.5	0.9	2.1	0.7	2.1	6.0
	287.5	22.51	51.2	0.34	84.3	1.1	2.4	0.7	2.4	6.1
	312.5	24.98	47.4	0.32	86.6	1.4	2.6	0.7	2.6	6.1
	337.5	27.43	44.0	0.29	88.3	1.6	2.9	0.7	2.9	6.2
	362.5	29.56	41.6	0.28	90.0	1.8	3.1	0.6	3.1	6.2
	387.5	32.08	39.0	0.28	91.5	2.1	3.4	0.6	3.4	6.3
	412.5	64.61	36.8	0.30	93.2	2.3	3.7	0.6	3.7	6.5
	437.5	37.11	35.1	0.33	95.3	2.6	4.0	0.5	4.0	6.8
	462.5	39.68	33.5	0.37	97.3	2.8	4.2	0.8	4.2	7.1
	487.5	42.26	31.9	0.41	98.6	3.1	4.5	1.0	4.5	7.4
	512.5	44.50	30.5	0.44	99.3	3.3	4.8	4.8	1.2	7.7
	537.5	47.13	28.9	0.47	99.7	3.6	5.0	1.5	5.0	8.0
	562.5	49.78	27.4	0.50	99.8	3.9	5.3	1.8	5.3	8.3
	587.5	52.38	26.0	0.52	99.8	4.1	5.6	2.0	5.6	8.6
	600.0	53.53	25.5	0.53	99.9	4.3	5.7	2.2	5.7	8.7

Table 3d Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.10	**137.5**	8.66	95.9	0.67	67.5	0.0	1.0	0.4	1.0	5.8
	162.5	10.70	83.6	0.60	72.8	0.2	1.2	0.5	1.2	5.9
	187.5	12.79	72.9	0.50	75.8	0.4	1.5	0.4	1.5	6.1
	212.5	14.64	65.9	0.45	78.4	0.6	1.7	0.5	1.7	6.2
	237.5	16.83	58.7	0.39	80.3	0.8	2.0	0.5	2.0	6.3
	262.5	19.06	53.5	0.35	82.9	1.0	2.2	0.5	2.2	6.4
	287.5	21.28	49.2	0.32	85.0	1.2	2.5	0.6	2.5	6.4
	312.5	23.56	45.5	0.29	87.2	1.5	2.8	0.6	2.8	6.5
	337.5	25.88	42.3	0.27	89.0	1.7	3.1	0.6	3.1	6.6
	362.5	27.90	39.9	0.27	90.5	2.0	3.3	0.5	3.3	6.6
	387.5	30.28	37.5	0.29	92.3	2.2	3.6	0.5	3.6	6.6
	412.5	32.68	35.7	0.33	94.9	2.5	3.9	0.7	3.9	6.7
	437.5	35.05	33.9	0.36	96.6	2.7	4.2	0.8	4.2	7.0
	462.5	37.48	32.9	0.40	100	3.0	4.4	0.9	4.4	7.4
	487.5	39.91	30.6	0.44	99.3	3.3	4.7	1.2	4.7	7.7
	512.5	42.03	29.2	0.46	99.8	3.5	5.0	1.4	5.0	8.0
	537.5	44.53	27.6	0.49	99.9	3.8	5.3	1.7	5.3	8.3
	562.5	47.03	26.1	0.52	99.8	4.1	5.6	2.0	5.6	8.6
	587.5	49.50	24.8	0.54	99.8	4.4	5.9	2.3	5.9	8.9
	600.0	50.60	24.3	0.55	100	4.5	6.0	2.4	6.0	9.0
0.11	**137.5**	8.20	93.1	0.63	68.3	0.0	1.1	0.3	1.0	6.1
	162.5	10.14	80.8	0.55	73.2	0.2	1.3	0.4	1.3	6.2
	187.5	12.12	70.5	0.48	76.4	0.4	1.6	0.4	1.6	6.4
	212.5	13.88	63.8	0.43	79.2	0.6	1.8	0.5	1.8	6.5
	237.5	15.96	57.5	0.39	82.1	0.9	2.1	0.7	2.1	6.6
	262.5	18.08	52.0	0.35	84.1	1.1	2.6	0.6	2.3	6.7
	287.5	20.18	47.7	0.31	86.1	1.3	2.6	0.7	2.6	6.8
	312.5	22.36	44.1	0.29	88.2	1.6	2.9	0.7	2.9	6.8
	337.5	24.56	41.1	0.28	90.3	1.9	3.2	0.7	3.2	6.9
	362.5	26.48	38.7	0.28	91.7	2.1	3.4	0.6	3.4	6.9
	387.5	28.75	36.7	0.32	94.4	2.4	3.8	0.8	3.7	7.0
	412.5	31.03	34.6	0.35	96.0	2.6	4.0	0.8	4.0	7.0
	437.5	33.21	32.9	0.39	97.9	2.9	4.3	0.8	4.3	7.3
	462.5	35.60	31.2	0.60	99.3	3.2	4.6	1.1	4.6	7.6
	487.5	37.91	29.4	0.46	99.7	3.5	5.0	1.4	5.0	7.9
	512.5	39.93	28.0	0.49	100	3.7	5.2	1.6	5.2	8.2
	537.5	42.30	26.4	0.52	99.9	4.1	5.5	2.0	5.5	8.5
	562.5	44.68	25.0	0.54	99.9	4.4	5.8	2.3	5.8	8.8
	587.5	47.03	23.7	0.56	99.7	4.7	6.2	2.6	6.2	9.2
	600.0	48.06	23.2	0.57	99.7	4.8	6.3	2.7	6.3	9.3

Table 3e Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.12	**137.5**	7.81	90.4	0.63	68.9	0.1	1.1	0.3	1.1	6.3
	162.5	9.66	78.4	0.54	73.9	0.3	1.3	0.4	1.3	6.5
	187.5	11.55	68.4	0.46	77.1	0.5	1.6	0.4	1.6	6.7
	212.5	13.22	62.0	0.41	79.9	0.7	1.9	0.5	1.9	6.8
	237.5	15.20	54.9	0.35	81.4	0.9	2.1	0.4	2.1	6.9
	262.5	17.23	50.8	0.34	85.4	1.2	2.4	0.7	2.4	7.0
	287.5	19.25	46.0	0.29	86.4	1.4	2.7	0.5	2.7	7.1
	312.5	21.31	42.6	0.27	88.6	1.7	3.0	0.5	3.0	7.2
	337.5	23.41	39.6	0.27	90.4	2.0	3.3	0.5	3.3	7.2
	362.5	25.25	37.5	0.29	92.4	2.2	3.6	0.5	3.6	7.3
	387.5	27.41	35.4	0.32	94.7	2.5	3.9	0.5	3.9	7.3
	412.5	29.58	33.6	0.37	97.0	2.8	4.2	0.7	4.2	7.4
	437.5	31.75	31.9	0.41	98.8	3.1	4.5	1.0	4.5	7.5
	462.5	33.95	30.1	0.45	99.7	3.4	4.8	1.3	4.8	7.8
	487.5	36.16	28.3	0.48	99.8	3.7	5.2	1.6	5.2	8.1
	512.5	38.10	26.9	0.51	99.9	4.0	5.4	1.9	5.4	8.4
	537.5	40.36	25.3	0.53	99.6	4.3	5.8	2.2	5.8	8.8
	562.5	42.65	24.0	0.56	99.9	4.6	6.1	2.5	6.1	9.1
	587.5	44.88	22.8	0.58	99.8	4.9	6.4	2.8	6.4	9.4
	600.0	45.88	22.3	0.59	99.8	5.1	6.6	3.0	6.6	9.6
0.13	**137.5**	7.47	87.8	0.59	69.3	0.1	1.1	0.3	1.1	6.6
	162.5	9.23	75.8	0.51	73.9	0.3	1.4	0.4	1.4	6.8
	187.5	11.04	66.4	0.44	77.5	0.5	1.7	0.4	1.7	7.0
	212.5	12.65	60.3	0.40	80.6	0.8	0.2	0.6	1.9	7.1
	237.5	14.54	54.2	0.35	83.3	1.0	2.2	0.6	1.0	7.2
	262.5	16.48	48.9	0.32	85.2	1.3	2.5	0.6	2.5	7.3
	287.5	18.41	44.9	0.29	87.4	1.5	2.8	0.6	2.8	7.4
	312.5	20.40	41.5	0.27	89.5	1.8	3.1	0.6	3.1	7.5
	337.5	22.41	38.7	0.28	91.7	2.1	3.4	0.6	3.4	7.5
	362.5	24.16	36.5	0.30	93.2	2.3	3.7	0.6	3.7	7.6
	387.5	26.23	34.6	0.35	95.9	2.6	4.0	0.8	4.0	7.7
	412.5	28.33	32.7	0.39	97.9	2.9	4.4	0.8	4.4	7.7
	437.5	30.40	30.9	0.43	99.3	3.2	4.7	1.1	4.7	7.8
	462.5	32.51	29.1	0.47	100	3.5	5.0	1.4	5.0	8.0
	487.5	34.65	27.3	0.50	100	3.9	5.4	1.8	5.4	8.3
	512.5	36.48	25.9	0.52	100	4.2	5.6	2.1	5.6	8.6
	537.5	38.66	24.4	0.55	99.7	4.5	6.0	2.4	6.0	9.0
	562.5	40.85	23.1	0.57	99.7	4.8	6.3	2.7	6.3	9.3
	587.5	43.00	22.0	0.60	100	5.2	6.7	3.1	6.7	9.7
	600.0	43.96	21.5	0.60	99.9	5.3	6.8	3.2	6.8	9.8

Table 3f Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.14	**137.5**	7.16	87.3	0.60	71.1	0.1	1.2	0.4	1.2	6.9
	162.5	8.86	73.5	0.47	74.1	0.4	1.4	0.3	1.4	7.1
	187.5	10.59	64.6	0.42	77.9	0.6	1.7	0.4	1.7	7.2
	212.5	12.14	58.9	0.39	81.4	0.8	2.0	0.6	2.0	7.4
	237.5	13.96	53.4	0.35	84.8	1.1	2.4	0.7	2.3	7.5
	262.5	15.82	47.8	0.31	86.1	1.3	2.6	0.7	2.6	7.6
	287.5	17.68	44.1	0.29	88.7	1.6	2.9	0.7	2.9	7.7
	312.5	19.60	40.2	0.26	89.7	1.9	3.2	0.5	3.2	7.8
	337.5	21.53	37.6	0.28	92.1	2.2	3.6	0.5	3.6	7.8
	362.5	23.21	35.7	0.32	94.3	2.5	3.8	0.4	3.8	7.9
	387.5	25.20	33.7	0.36	96.7	2.7	4.2	0.7	4.2	8.0
	412.5	27.21	31.9	0.41	98.8	3.1	4.5	1.0	4.5	8.0
	437.5	29.20	30.0	0.45	99.7	3.4	4.9	1.3	4.9	8.1
	462.5	31.25	28.1	0.48	99.9	3.7	5.2	1.6	5.2	8.2
	487.5	33.28	26.3	0.52	99.6	4.1	5.5	2.0	5.5	8.5
	512.5	35.06	25.0	0.54	99.7	4.4	5.8	2.3	5.8	8.9
	537.5	37.15	23.6	0.57	99.8	4.7	6.2	2.6	6.2	9.2
	562.5	39.26	22.3	0.59	99.7	5.1	6.5	3.0	6.5	9.6
	587.5	41.33	21.2	0.61	99.7	5.4	6.9	3.3	6.9	9.9
	600.0	42.25	20.7	0.62	99.5	5.6	7.0	3.5	7.0	10.1
0.15	**112.5**	5.35	99.6	0.67	65.0	0.0	0.9	0.3	0.9	6.8
	137.5	6.89	84.0	0.55	70.6	0.2	1.2	0.3	1.2	7.1
	162.5	8.52	71.7	0.45	74.5	0.4	1.5	0.3	1.5	7.3
	187.5	10.20	62.9	0.40	78.2	0.6	1.8	0.4	1.8	7.5
	212.5	11.68	56.2	0.34	80.1	0.9	2.0	0.4	2.1	7.6
	237.5	13.44	50.8	0.31	83.3	1.1	2.4	0.4	2.4	7.7
	262.5	15.23	46.2	0.29	85.8	1.4	2.7	0.5	2.7	7.9
	287.5	17.07	42.6	0.27	88.4	1.7	3.0	0.5	3.0	8.0
	312.5	18.86	39.4	0.27	90.6	2.0	3.3	0.6	3.3	8.1
	337.5	20.73	36.8	0.30	93.0	2.3	3.7	0.6	3.7	8.1
	362.5	22.35	34.9	0.33	95.1	2.6	4.0	0.5	4.0	8.2
	387.5	24.28	33.0	0.38	97.7	2.9	4.3	0.8	4.3	8.3
	412.5	26.21	31.1	0.43	99.4	3.2	4.7	1.1	4.7	8.3
	437.5	28.13	29.1	0.47	99.8	3.5	5.0	1.4	5.0	8.4
	462.5	30.10	27.2	0.50	99.8	3.9	5.4	1.8	5.4	8.4
	487.5	32.08	25.5	0.53	99.8	4.2	5.7	2.1	5.7	8.7
	512.5	33.78	24.2	0.55	99.7	4.6	6.0	2.5	6.0	9.1
	537.5	35.80	22.9	0.58	100	4.9	6.4	2.8	6.4	9.4
	562.5	37.83	21.6	0.60	99.6	5.3	6.8	3.2	6.8	9.8
	587.5	39.83	20.5	0.62	99.6	5.6	7.1	3.5	7.1	10.2
	600.0	40.73	20.1	0.63	99.8	5.8	7.3	3.7	7.3	10.3

Table 3g Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.16	**112.5**	5.16	96.7	0.62	64.9	0.0	0.9	0.2	0.9	7.1
	137.5	6.65	82.8	0.54	71.6	0.2	1.2	0.3	1.2	7.3
	162.5	8.22	70.5	0.45	75.4	0.4	1.5	0.3	1.5	7.5
	187.5	9.84	61.9	0.40	79.2	0.7	1.9	0.4	1.8	7.7
	212.5	11.27	55.8	0.36	81.8	0.9	2.1	0.5	2.1	7.9
	237.5	12.97	50.4	0.32	85.0	1.2	2.5	0.6	2.4	8.0
	262.5	14.70	45.5	0.29	87.0	1.5	2.8	0.6	2.8	8.1
	287.5	16.43	41.7	0.27	89.1	1.8	3.1	0.6	3.1	8.2
	312.5	18.21	38.6	0.28	91.4	2.1	3.4	0.6	3.4	8.3
	337.5	20.01	36.2	0.32	94.2	2.4	3.8	0.7	3.8	8.4
	362.5	21.58	34.3	0.35	96.3	2.7	4.1	0.7	4.1	8.5
	387.5	23.45	32.2	0.40	98.2	3.0	4.4	0.9	4.4	8.6
	412.5	25.31	30.2	0.44	99.4	3.3	4.8	1.2	4.8	8.6
	437.5	27.16	28.3	0.48	100	3.7	5.2	1.6	5.2	8.7
	462.5	29.06	26.4	0.51	99.8	4.1	5.5	2.0	5.5	8.7
	487.5	30.98	24.8	0.54	99.9	4.4	5.9	2.3	5.9	8.9
	512.5	32.63	23.5	0.57	99.7	4.7	6.2	2.6	6.2	9.3
	537.5	34.58	22.2	0.59	99.9	5.1	6.6	3.0	6.6	9.6
	562.5	36.55	21.0	0.61	99.8	5.5	7.0	3.4	7.0	10.0
	587.5	38.48	19.9	0.63	99.6	5.9	7.3	3.8	7.3	10.4
	600.0	39.35	19.5	0.64	99.8	6.0	7.5	3.9	7.5	10.6
0.17	**112.5**	4.99	94.7	0.60	65.3	0.0	1.0	0.2	1.0	7.3
	137.5	6.43	80.4	0.52	71.5	0.2	1.3	0.3	1.3	7.5
	162.5	7.95	68.7	0.42	75.4	0.5	1.6	0.3	1.6	7.8
	187.5	9.51	60.4	0.39	79.4	0.7	1.9	0.4	1.9	8.0
	212.5	10.90	53.4	0.31	80.4	1.0	2.2	0.3	2.2	8.1
	237.5	12.54	49.7	0.32	86.1	1.3	2.6	0.7	2.5	8.3
	262.5	14.22	44.6	0.29	87.7	1.6	2.8	0.6	2.9	8.4
	287.5	15.89	41.2	0.28	90.5	1.9	3.2	0.7	3.2	8.5
	312.5	17.61	37.7	0.28	91.8	2.2	3.5	0.5	3.5	8.6
	337.5	19.36	35.3	0.32	94.5	2.5	3.9	0.5	3.9	8.7
	362.5	20.88	33.6	0.37	96.9	2.8	4.2	0.7	4.2	8.8
	387.5	22.68	31.6	0.42	99.0	3.1	4.6	1.0	4.6	8.8
	412.5	24.50	29.5	0.46	99.9	3.5	4.9	1.4	4.9	8.9
	437.5	26.30	27.5	0.50	100	3.8	5.3	1.7	5.3	9.0
	462.5	28.13	25.7	0.53	99.9	4.2	5.7	2.1	5.7	9.0
	487.5	19.98	24.1	0.56	99.9	4.6	6.1	2.5	6.1	9.1
	512.5	31.60	22.9	0.58	100	4.9	6.4	2.8	6.4	9.4
	537.5	33.48	21.6	0.60	100	5.3	6.8	3.2	6.8	9.8
	562.5	35.38	20.4	0.62	99.8	5.7	7.2	3.6	7.2	10.2
	587.5	37.26	19.4	0.64	99.9	6.1	7.6	4.0	7.6	10.6
	600.0	38.10	18.9	0.65	99.5	6.2	7.7	4.1	7.7	10.8

Table 3h Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.18	**112.5**	4.83	93.4	0.60	62.4	0.0	1.0	0.2	1.0	7.5
	137.5	6.22	78.0	0.46	67.1	0.3	1.3	0.1	1.3	7.8
	162.5	7.70	66.7	0.40	75.2	0.5	1.6	0.2	1.6	8.0
	187.5	9.22	59.1	0.37	79.7	0.8	2.0	3.0	1.9	8.2
	212.5	10.56	53.8	0.35	83.1	1.0	2.3	0.6	2.2	8.4
	237.5	12.15	48.1	0.31	85.5	1.3	2.6	0.6	2.6	8.5
	262.5	13.78	43.9	0.29	88.5	1.6	2.9	0.7	2.9	8.6
	287.5	15.40	40.0	0.27	90.1	1.9	3.3	0.5	3.3	8.8
	312.5	17.08	37.1	0.29	92.7	2.3	3.6	0.5	3.6	8.9
	337.5	18.76	34.7	0.34	95.3	2.6	4.0	0.5	4.0	9.0
	362.5	20.25	33.0	0.38	97.8	2.9	4.3	0.8	4.3	9.0
	387.5	22.00	30.9	0.43	99.5	3.2	4.7	1.1	4.7	9.1
	412.5	23.75	28.7	0.47	99.8	3.6	5.1	1.5	5.1	9.2
	437.5	25.50	26.8	0.51	100	4.0	5.5	1.9	5.5	9.2
	462.5	27.28	25.0	0.54	99.8	4.4	5.8	2.3	5.8	9.3
	487.5	29.08	23.5	0.57	100	4.8	6.2	2.7	6.2	9.4
	512.5	30.63	22.3	0.59	100	5.1	6.6	3.0	6.6	9.6
	537.5	32.48	21.0	0.61	99.8	5.5	7.0	3.4	7.0	10.0
	562.5	34.33	19.9	0.63	100	5.9	7.4	3.8	7.4	10.4
	587.5	36.15	18.9	0.65	100	6.3	7.8	4.2	7.8	10.8
	600	36.95	18.4	0.66	99.5	6.5	7.9	4.4	7.9	11.0
0.19	**112.5**	4.69	91.2	0.55	66.1	0.1	1.0	0.1	1.0	7.7
	137.5	6.04	773	0.47	72.1	0.3	1.4	0.2	1.3	8.0
	162.5	7.47	66.6	0.42	76.8	0.5	1.7	0.4	1.7	8.2
	187.5	8.94	58.8	0.38	81.2	0.8	2.0	0.5	2.0	8.4
	212.5	10.25	51.7	0.31	81.9	1.1	2.3	0.4	2.3	8.6
	237.5	11.80	47.5	0.31	86.6	1.4	2.7	0.7	2.6	8.7
	262.5	13.38	42.7	0.27	88.3	1.7	3.0	0.5	3.0	8.9
	287.5	14.95	39.3	0.27	90.8	2.0	3.4	0.6	3.4	9.0
	312.5	16.58	36.4	0.30	93.2	2.4	3.7	0.6	3.7	9.1
	337.5	18.23	34.2	0.35	96.3	2.7	4.1	0.7	4.1	9.2
	362.5	19.66	32.3	0.40	98.1	3.0	4.4	0.9	4.4	9.3
	387.5	21.36	30.2	0.44	99.6	3.3	4.8	1.2	4.8	9.4
	412.5	23.06	28.0	0.49	99.7	3.7	5.2	1.6	5.2	9.5
	437.5	24.76	26.1	0.52	99.8	4.1	5.6	2.0	5.6	9.5
	462.5	26.50	24.4	0.55	99.9	4.5	6.0	2.4	6.0	9.6
	487.5	28.25	22.9	0.58	99.9	4.9	6.4	2.8	6.4	9.6
	512.5	29.76	21.7	0.60	99.8	5.3	6.7	3.2	6.7	9.8
	537.5	31.55	20.5	0.62	99.9	5.7	7.1	3.6	7.1	10.2
	562.5	33.35	19.4	0.64	99.9	6.1	7.6	4.0	7.6	10.6
	587.5	35.11	18.4	0.66	99.8	6.5	8.0	4.4	8.0	11.0
	600.0	35.90	18.0	0.67	99.8	6.7	8.1	4.6	8.1	11.2

Table 3i Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.20	**112.5**	4.55	90.3	0.54	66.8	0.1	1.1	0.1	1.0	7.9
	137.5	5.87	72.5	0.45	69.2	0.3	1.4	0.1	1.4	8.2
	162.5	7.26	65.0	0.40	76.7	0.6	1.7	0.3	1.7	8.4
	187.5	8.69	57.2	0.36	80.8	0.9	2.1	0.5	2.0	8.6
	212.5	9.96	56.6	0.32	91.7	1.1	2.4	0.5	2.3	8.8
	237.5	11.47	46.1	0.28	86.0	1.4	2.7	0.5	2.7	9.0
	262.5	13.01	42.0	0.27	88.8	1.8	3.1	0.6	3.1	9.1
	287.5	14.54	38.7	0.28	91.5	2.1	3.4	0.6	3.4	9.2
	312.5	16.12	36.0	0.32	94.4	2.4	3.8	0.7	3.8	9.4
	337.5	17.73	33.6	0.37	96.9	2.8	4.2	0.7	4.2	9.5
	362.5	19.11	31.8	0.41	98.8	3.1	4.5	1.0	4.5	9.5
	387.5	20.76	29.5	0.46	99.6	3.5	4.9	1.4	4.9	9.6
	412.5	22.43	27.4	0.50	99.9	3.9	5.3	1.8	5.3	9.7
	437.5	24.08	25.5	0.53	99.8	4.3	5.7	2.2	5.7	9.8
	462.5	25.78	23.8	0.56	99.8	4.7	6.1	2.6	6.1	9.9
	487.5	27.48	22.3	0.59	99.6	5.1	6.5	3.0	6.5	9.9
	512.5	28.96	21.2	0.61	99.8	5.4	6.9	3.3	6.9	10.0
	537.5	30.70	20.0	0.63	99.8	5.8	7.3	3.7	7.3	10.4
	562.5	32.45	18.9	0.65	99.7	6.3	7.7	4.2	7.7	10.8
	587.5	34.18	17.9	0.67	99.5	6.7	8.2	4.6	8.2	11.2
	600.0	34.93	17.6	0.68	100	6.9	8.3	4.8	8.3	1.4
0.21	**112.5**	4.43	89.4	0.56	67.6	0.1	1.1	0.2	1.1	8.1
	137.5	5.71	74.3	0.44	72.4	0.3	1.4	0.2	1.4	8.4
	162.5	7.07	63.5	0.38	76.6	0.6	1.7	0.2	1.7	8.6
	187.5	8.46	54.6	0.30	78.8	0.9	2.1	0.2	2.1	8.9
	212.5	9.70	50.8	0.32	84.6	1.2	2.4	0.6	2.4	9.0
	237.5	11.17	45.4	0.28	86.6	1.5	2.8	0.6	2.8	9.2
	262.5	12.66	41.3	0.27	91.4	1.8	3.1	0.6	3.1	9.4
	287.5	14.16	37.8	0.28	94.6	2.2	3.5	0.4	3.5	9.5
	312.5	15.70	35.3	0.32	97.5	2.5	3.9	0.5	3.9	9.6
	337.5	17.26	33.1	0.38	99.2	2.9	4.3	0.7	4.3	9.7
	362.5	18.63	31.2	0.42	99.4	3.2	4.6	1.1	4.6	9.8
	387.5	20.23	28.9	0.47	99.6	3.6	5.0	1.5	5.0	9.9
	412.5	21.86	26.7	0.51	99.7	4.0	5.5	1.9	5.5	10.0
	437.5	23.46	24.9	0.54	99.8	4.4	5.9	2.3	5.9	10.0
	462.5	25.11	23.3	0.57	99.9	4.8	6.3	2.7	6.3	10.1
	487.5	26.78	21.8	0.60	99.7	5.2	6.7	3.1	6.7	10.2
	512.5	28.21	20.7	0.62	99.7	5.6	7.1	3.5	7.1	10.2
	537.5	29.91	19.5	0.64	99.6	6.0	7.5	3.9	7.5	10.6
	562.5	31.61	18.5	0.66	99.8	6.4	7.9	4.3	7.9	11.0
	587.5	33.30	17.5	0.68	99.5	6.9	8.3	4.8	8.3	11.4
	600.0	34.05	17.2	0.68	100	7.1	8.5	4.9	8.5	11.6

Table 3j Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.22	**112.5**	4.32	87.3	0.50	67.5	0.1	1.1	0.1	1.1	8.2
	137.5	5.57	73.6	0.44	73.3	0.4	1.4	0.2	1.4	8.6
	162.5	6.89	62.2	0.36	76.7	0.7	1.8	0.2	1.8	8.8
	187.5	8.25	55.5	0.35	81.9	0.9	2.2	0.5	2.1	9.1
	212.5	9.45	48.8	0.28	82.1	1.2	2.4	0.3	2.4	9.2
	237.5	10.89	44.2	0.26	86.1	1.5	2.8	0.4	2.8	9.4
	262.5	12.35	40.4	0.26	89.2	1.9	3.2	0.4	3.2	9.6
	287.5	13.80	37.3	0.28	92.1	2.2	3.6	0.5	3.6	9.7
	312.5	15.31	34.8	0.33	95.3	2.6	4.0	0.5	4.0	9.8
	337.5	16.83	32.6	0.39	98.1	2.9	4.4	0.8	4.4	9.9
	362.5	18.16	30.6	0.44	88.4	3.3	4.7	1.2	4.7	10.0
	387.5	19.73	28.3	0.48	99.9	3.7	5.2	1.6	5.2	10.1
	412.5	20.31	26.2	0.52	95.2	4.1	5.6	2.0	5.6	10.2
	437.5	22.88	24.3	0.55	99.4	4.5	6.0	2.4	6.0	10.3
	462.5	24.50	22.7	0.58	99.5	4.9	6.4	2.8	6.4	10.4
	487.5	26.11	21.3	0.61	99.5	5.4	6.8	3.3	6.8	10.4
	512.5	27.51	20.2	0.63	99.4	5.7	7.2	3.6	7.2	10.5
	537.5	29.18	19.0	0.65	99.2	6.2	7.7	4.1	7.7	10.7
	562.5	30.85	18.0	0.67	99.3	6.6	8.1	4.5	8.1	11.2
	587.5	32.48	17.1	0.68	99.3	7.1	8.5	4.9	8.5	11.6
	600.0	33.21	16.7	0.69	99.2	7.2	8.7	5.1	8.7	11.8
0.23	**112.5**	4.21	85.5	0.49	67.3	0.1	1.1	0.1	1.1	8.4
	137.5	5.43	71.0	0.40	72.1	0.4	1.5	0.1	1.4	8.8
	162.5	6.72	61.5	0.37	77.3	0.7	1.8	0.2	1.8	9.0
	187.5	8.05	53.2	0.31	80.1	1.0	2.2	0.3	2.2	9.3
	212.5	9.23	48.1	0.28	83.0	1.3	2.5	0.3	2.5	9.4
	237.5	10.62	44.2	0.29	87.8	1.6	2.9	0.7	2.9	9.6
	262.5	12.05	39.8	0.26	89.7	1.9	3.3	0.5	3.3	9.8
	287.5	13.47	36.7	0.29	92.4	2.3	3.7	0.5	3.7	9.9
	312.5	14.94	34.2	0.35	95.5	2.7	4.1	0.6	4.1	10.1
	337.5	16.43	31.9	0.40	98.0	3.0	4.5	0.9	4.5	10.2
	362.5	17.73	29.9	0.45	99.1	3.4	4.8	1.3	4.8	10.3
	387.5	19.26	27.6	0.49	99.4	3.8	5.3	1.7	5.3	10.4
	412.5	20.81	25.5	0.53	99.2	4.2	5.7	2.1	5.7	10.5
	437.5	22.35	23.8	0.56	99.5	4.6	6.1	2.5	6.1	10.5
	462.5	23.91	22.2	0.59	99.3	5.1	6.6	3.0	6.6	10.6
	487.5	25.50	20.8	0.61	99.2	5.5	7.0	3.4	7.0	10.7
	512.5	26.86	19.8	0.63	99.4	5.9	7.4	3.8	7.4	10.8
	537.5	28.50	18.6	0.65	99.1	6.3	7.8	4.2	7.8	10.9
	562.5	30.11	17.6	0.67	99.1	6.8	8.3	4.7	8.3	11.4
	587.5	31.73	16.7	0.69	99.1	7.2	8.7	5.1	8.7	11.8
	600.0	32.43	16.4	0.70	99.5	7.4	8.9	5.3	8.9	12.0

Table 3k Lookup table, basin with a 0.1 % bed slope

Q_o	L_{co}	t_{co}	E_a	Du_{lq}	E_r	D_p	D_{av}	D_{min}	D_{app}	Y_{max}
Cfs/ft	**ft**	**min**	**%**	**%**	**%**	**in**	**in**	**in**	**in**	**in**
0.24	**112.5**	4.11	85.4	0.49	68.5	0.2	1.2	0.1	1.1	8.6
	137.5	5.30	70.3	0.40	72.7	0.4	1.5	0.1	1.5	8.9
	162.5	6.56	60.5	0.37	77.4	0.7	1.9	0.2	1.8	9.2
	187.5	7.86	52.5	0.31	80.5	1.0	2.2	0.3	2.2	9.5
	212.5	9.01	49.0	0.32	86.1	1.3	2.6	0.7	2.5	9.7
	237.5	10.38	43.0	0.26	87.1	1.6	2.9	0.5	2.9	9.8
	262.5	11.77	39.3	0.27	90.0	2.0	3.3	0.5	3.3	10.0
	287.5	13.16	36.2	0.30	93.0	2.4	3.7	0.6	3.7	10.2
	312.5	14.60	33.8	0.36	96.3	2.7	4.2	0.7	4.2	10.3
	337.5	16.05	31.4	0.41	98.3	3.1	4.6	1.0	4.6	10.4
	362.5	17.33	29.4	0.46	99.4	3.5	4.9	1.4	4.9	10.5
	387.5	18.83	27.1	0.50	99.6	3.9	5.4	1.8	5.4	10.6
	412.5	20.33	25.0	0.54	99.2	4.3	5.8	2.2	4.3	10.7
	437.5	21.83	23.3	0.57	99.2	4.8	6.2	2.7	6.2	10.8
	462.5	23.38	21.8	0.60	99.5	5.2	6.7	3.1	6.7	10.9
	487.5	24.93	20.4	0.62	99.2	5.7	7.1	3.5	7.1	10.9
	512.5	26.26	19.4	0.64	99.4	6.0	7.5	3.9	7.5	11.0
	537.5	27.85	18.3	0.66	99.4	6.5	8.0	4.4	8.0	11.1
	562.5	29.45	17.3	0.68	99.4	7.0	8.4	4.8	8.4	11.5
	587.5	31.01	16.4	0.69	99.2	7.4	8.9	5.3	8.9	12.0
	600.0	31.71	16.0	0.70	99.0	7.6	9.1	5.5	9.1	12.2
0.25	**112.5**	4.02	85.0	0.51	69.5	0.2	1.2	0.2	1.2	8.8
	137.5	5.18	69.4	0.40	73.1	0.4	1.5	0.1	1.5	9.1
	162.5	6.42	60.0	0.37	78.3	0.7	1.9	0.3	1.9	9.4
	187.5	7.69	52.6	0.32	82.2	1.1	2.3	0.4	2.3	9.7
	212.5	8.81	47.5	0.29	85.1	1.4	2.6	0.5	2.6	9.9
	237.5	10.15	2.6	0.26	87.9	1.7	3.0	0.5	3.0	10.0
	262.5	11.51	38.8	0.27	90.7	2.1	3.4	0.6	3.4	10.2
	287.5	12.87	35.9	0.32	93.9	2.4	3.8	0.7	3.8	10.4
	312.5	14.28	33.3	0.37	96.7	2.8	4.2	0.7	4.2	10.5
	337.5	15.70	31.0	0.43	98.9	3.2	4.7	1.1	4.7	10.6
	362.5	16.95	28.9	0.47	99.6	3.6	5.0	15	5.0	10.7
	387.5	18.41	26.6	0.51	99.5	4.0	5.5	1.9	4.0	10.8
	412.5	19.90	24.6	0.55	99.5	4.4	5.9	2.3	5.9	10.9
	437.5	21.36	22.9	0.58	99.4	4.9	6.4	2.8	6.4	11.0
	462.5	22.86	21.4	0.60	99.4	5.3	6.8	3.2	6.8	11.1
	487.5	24.38	20.0	0.63	99.1	5.8	7.3	3.7	7.3	11.2
	512.5	25.70	19.0	0.65	99.2	6.2	7.7	4.1	7.7	11.2
	537.5	27.25	17.9	0.67	99.1	6.7	8.1	4.5	8.1	11.3
	562.5	28.81	17.0	0.68	99.5	7.1	8.6	5.0	8.3	11.7
	587.5	30.35	16.1	0.70	99.3	7.6	9.1	5.5	9.1	12.2
	600.0	31.03	15.7	0.71	99.0	7.8	9.3	5.7	9.3	12.4

Table 4. Power-law advance parameters

Unit inlet flow rate (cfs/ft)	Level basin		1 % bed slope	
	∀ (min/ft$^{(}$)[6]	((-)	∀ (min/ft$^{(}$)	((-)
0.04	0.03289	1.2533	0.04787	1.1675
0.05	0.02858	1.2539	0.04003	1.1763
0.06	0.02580	1.2526	0.03393	1.1862
0.07	0.02330	1.2541	0.03180	1.1836
0.08	0.02139	1.2551	0.02835	1.1904
0.09	0.02047	1.2511	0.02618	1.1929
0.10	0.01921	1.2512	0.02443	1.1949
0.11	0.01920	1.2406	0.02289	1.1971
0.12	0.01735	1.2504	0.02163	1.1986
0.13	0.01652	1.2508	0.02051	1.2002
0.14	0.01589	1.2501	0.01953	1.2017
0.15	0.01526	1.2503	0.01811	1.2080
0.16	0.01476	1.2497	0.01739	1.2089
0.17	0.01423	1.2499	0.01673	1.2099
0.18	0.01379	1.2497	0.01610	1.2112
0.19	0.01334	1.2500	0.01557	1.2118
0.20	0.01298	1.2498	0.01503	1.2131
0.21	0.01261	1.2499	0.01458	1.2139
0.22	0.01228	1.2499	0.01435	1.2119
0.23	0.01198	1.2498	0.01376	1.2153
0.24	0.01172	1.2495	0.01337	1.2163
0.25	0.01142	1.2499	0.01305	1.2166

[6] $t_a=\forall x^{(}$, where t_a = advance time (min), x = advance distance (ft), ∀ and (= coefficient and exponent of the power function, respectively.

LIST OF FIGURES

Figure 26. Application efficiency expressed as a function of inlet flow rate and cutoff distance, basin with 0.1 % bed slope

Figure 27. Water requirement efficiency, 0.1 % slope

Figure 28. Low quarter distribution uniformity, 0.1 % slope

Figure 29. Application efficiency expressed as a function cutoff time, 0.1 % slope