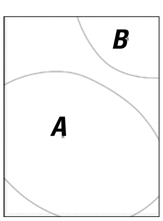
USGS
science for a changing world

Water-Budget Accounting for Tropical Regions Model (WATRMod) Documentation

Open-File Report 2022–1013

U.S. Department of the Interior
U.S. Geological Survey



Cover: *A, p*hotograph of localized rainfall over the Waiʻanae Range, viewed from Ford Island, Oʻahu, Hawaiʻi. *B*, photograph of fog at an altitude below 1,000 feet on the west slope of Mānoa Stream valley, Oʻahu, Hawaiʻi. U.S. Geological Survey photographs taken by Delwyn Oki on March 12, 2019 and January 2, 2022.

Water-Budget Accounting for Tropical Regions Model (WATRMod) Documentation

By Delwyn S. Oki

Open-File Report 2022–1013

U.S. Department of the Interior
U.S. Geological Survey

U.S. Geological Survey, Reston, Virginia: 2022

Suggested citation:
Oki, D.S., 2022, Water-budget accounting for tropical regions model (WATRMod) documentation: U.S. Geological Survey Open-File Report 2022–1013, 77 p., https://doi.org/10.3133/ofr20221013.

Associated data for this publication:
Oki, D.S., 2022, WATRMod, a Water-budget accounting for tropical regions model—source code, executable file, and example files: U.S. Geological Survey data release, https://doi.org/10.5066/P9VPAY41.

ISSN 2331-1258 (online)

Acknowledgments

The water-budget code that is described in this document is a modified version of the code that has evolved over time to estimate groundwater recharge for Pacific islands. The author of this report developed the original version of the code, which John A. Engott of the U.S. Geological Survey improved over time. John A. Engott's latest version of the code served as a starting point for the code described in this document. Adam G. Johnson and Alan Mair of the U.S. Geological Survey helped by suggesting conceptual improvements to the code and by testing the code.

Contents

Figures

Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
mile (mi)	1.609	kilometer (km)
	Volume	
million gallons (Mgal)	3,785	cubic meter (m^3)
	Flow rate	
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
inch per year (in/yr)	25.4	millimeter per year (mm/yr)

International System of Units to U.S. customary units

Multiply	By	To obtain
	Area	
square meter (m^2)	10.76	square foot (ft^2)

Datum

Vertical coordinate information is referenced to local mean sea level.

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Abbreviations

ET	evapotranspiration
FAO	Food and Agriculture Organization
GIS	geographic information system
WATRMod	Water-budget Accounting for Tropical Regions Model

List of Variables

Name	Description
$(EP)_i$	evaporation from built area for current day, *i*, in inches
$(ET_o)_d$	daily reference evapotranspiration from a hypothetical reference surface with particular height, albedo, and surface resistance for the prevailing climatic conditions, in inches
$(ET_o)_i$	reference-surface evapotranspiration rate for current day, *i*, in inches per day
$(ET_o)_m$	monthly reference evapotranspiration from a hypothetical reference surface with particular height, albedo, and surface resistance for the prevailing climatic conditions, in inches
$(ET_o)_{min}$	minimum ratio of daily-to-monthly ET_o, dimensionless value greater than or equal to zero and less than or equal to 1
$(NP)_i$	net precipitation for current day, *i*, expressed as an accumulated depth of water over day, in inches
$(PE)_i$	potential evapotranspiration rate for current day, *i*, in inches per day
$(RF)_d$	daily rainfall, in inches
$(RF)_m$	monthly rainfall, in inches
$(RI)_i$	rejected infiltration for current day, *i*, expressed as an accumulated depth of water over day, in inches
$(SP)_c$	water storage capacity of built area, in inches
$(SP)_i$	water storage of built area at end of current day, *i*, in inches
$(SP)_{i-1}$	water storage of built area at end of previous day, $i-1$, in inches
$(XP1)_i$	first interim water storage of built area for current day, *i*, in inches
$(XP2)_i$	second interim water storage of built area for current day, *i*, in inches

Name	Description
a	irrigation multiplier used in equation 1, dimensionless
A, B, C, D	constants used in equations 2 and 3
AE	actual evapotranspiration, expressed as an accumulated depth of water over a selected time interval, in inches
AR	constant (negative value) used in equations 4 and 5
BR	dimensionless maximum daily-to-monthly ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions, used in equations 4 and 5
C_i	threshold soil-moisture content for the current day, *i*, below which the actual-evapotranspiration rate is less than the potential-evapotranspiration rate, in inches
d	depletion fraction (see equation 25), a dimensionless value that ranges from 0 to 1
d_{rz}	vegetation root depth, in inches
E	instantaneous rate of actual evapotranspiration, in inches per day
ER_{mult}	dimensionless daily multiplier for the monthly ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions
ei	irrigation efficiency, a dimensionless value greater than 0 and less than or equal to 1
E_i	evapotranspiration from the soil and plant root zone for current day, *i*, expressed as an accumulated depth of water over day, in inches
ET_o	reference evapotranspiration from a hypothetical reference surface with particular height, albedo, and surface resistance for the prevailing climatic conditions, expressed as an accumulated depth of water over a selected time interval, in inches
F	fog interception, expressed as an accumulated depth of water over a selected time interval, in inches
I	irrigation (greater than or equal to zero), expressed as an accumulated depth of water over a selected time interval, in inches
i	subscript designating the current day
I_i	irrigation for current day, *i*, expressed as an accumulated depth of water over day, in inches
k_c	crop coefficient, dimensionless
K_s	infiltration capacity, expressed as a maximum depth of water that can be absorbed by the soil during a day, in inches
NP	net precipitation, expressed as an accumulated depth of water over a selected time interval, in inches
ϕ	available water capacity of the soil, dimensionless
P	precipitation (rainfall plus fog interception), expressed as an accumulated depth of water over a selected time interval, in inches
PE	potential evapotranspiration, expressed as an accumulated depth of water over a selected time interval, in inches
Q_i	recharge from the plant root zone, exclusive of direct recharge, for current day, *i*, expressed as an accumulated depth of water over day, in inches
RF	rainfall, expressed as an accumulated depth of water over a selected time interval, in inches
R_i	runoff for current day, *i*, expressed as an accumulated depth of water over day, in inches
RO	runoff, expressed as an accumulated depth of water over a selected time interval, in inches
S	instantaneous soil moisture, in inches

Name	Description
S_c	soil-moisture storage capacity, in inches
S_i	available moisture content of the soil at end of current day, *i*, in inches
S_{i-1}	available moisture content of the soil at end of previous day, $i-1$, in inches
t_i	fraction of current day *i* during which soil moisture is greater than C_i, in days (ranges from 0 to 1)
U_i	septic-system leachate for current day, *i*, expressed as an accumulated depth of water over day, in inches
W_i	water run on to unbuilt part of the subarea from the built part of the subarea for current day, *i*, in inches
X_i	interim soil moisture for current day, *i*, in inches
Y_i	interim water input for current day, *i*, in inches
z	fraction of subarea that is built, dimensionless
θ_{fc}	volumetric field-capacity moisture content of the soil, dimensionless
θ_i	volumetric moisture content of soil for day, *i*, dimensionless
θ_{wp}	volumetric wilting-point moisture content of the soil, dimensionless
$\bar{E}/\bar{R}$	ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions

Water-Budget Accounting for Tropical Regions Model (WATRMod) Documentation

By Delwyn S. Oki

Abstract

Regional groundwater recharge commonly is estimated using a threshold-type water-budget approach in which groundwater recharge is assumed to occur when water in the plant-root zone exceeds the soil's moisture storage capacity. A water budget of the plant-soil system accounts for water inputs (rainfall, fog interception, irrigation, septic-system leachate, and other inputs), water outputs (runoff, evaporation, transpiration, and recharge), and changes in stored water during a specified time interval. Water budgets can be computed on any desired interval, including annual, monthly, daily, and subdaily intervals. In general, uncertainty in recharge estimates is expected to be lower using daily or subdaily intervals relative to monthly and annual intervals. Average recharge rates computed over a period of a year or multiple years are commonly determined from water budgets computed using a daily computation interval capable of capturing rainfall and land-cover changes during the period.

This report documents the Water-budget Accounting for Tropical Regions Model, or WATRMod, code that can be used to estimate spatially variable, daily water-budget components in tropical-island and other appropriate settings. The purpose of this report is to provide descriptions of WATRMod's (1) approach to computing a daily water budget, (2) represented processes, (3) limitations, and (4) execution procedure, input requirements, output files, and example files. The model computes a daily water budget for each hydrologically independent subarea within the overall study area. A subarea is defined by its climatic, soil, land-cover, and human-related (for example, adding irrigation or other water) characteristics. The water-budget model can represent processes including rainfall, fog interception, irrigation, septic-system leachate, direct recharge that bypasses the plant-soil system, runoff, canopy evaporation in forested areas, evapotranspiration, and groundwater recharge. The water-budget model can represent either one of the following different accounting orders: (1) accounting for loss of water by evapotranspiration before accounting for recharge, and (2) accounting for recharge before accounting for evapotranspiration. WATRMod's limitations include: (1) uncharacterized, subdaily transient changes in water inputs and outputs from the plant-soil system, (2) unrepresented precipitation in the form of snow and sublimation, and (3) routing runoff from one subarea to an adjacent subarea that is not directly represented.

Introduction

Regional estimates of groundwater recharge are commonly needed to (1) evaluate water availability in an area, (2) develop numerical groundwater models, and (3) evaluate land-management actions that can affect water resources. A water-budget model of the plant-soil system can be used to estimate groundwater recharge (for example, Thornthwaite and Mather, 1955). Water-budget models generally use annual, monthly, weekly, daily, or subdaily computation procedures that account for water inputs to and outputs from the plant-soil system and changes in moisture within the plant-root zone, on built surfaces (for example, paved and rooftop surfaces, which are considered impermeable to water), and in plant canopies (fig. 1). For the purposes of the water-budget processes described in this report, the plant-soil system consists of the exposed vegetation (for example, the forest canopy and tree trunks), built surfaces, and soil and water within the plant-root zone. The choice of time interval used in a water-budget computation may be based on data availability and desired accuracy, with coarse time intervals generally corresponding to poor data availability and reduced accuracy. Daily water budgets are commonly used for regional estimates of groundwater recharge because (1) daily climatologic data are available or can be estimated, (2) transient processes that affect the water budget can be represented reasonably well using a daily time interval, and (3) computational demands are not excessive. Complex, data-intensive, and computationally less efficient methods, including physically based watershed models (Neitsch and others, 2011; Markstrom and others, 2015) or numerical models of the unsaturated zone (Lappala and others, 1987), may provide more accurate representations of the physical processes of water movement. However, these methods require substantially greater computational resources and may require model parameter values that are difficult or impossible to estimate with certainty owing to scarcity of available information.

Regional daily water budgets have been developed for many tropical areas, including the Hawaiian Islands of Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi, as well as other Pacific islands, including Guam, Tutuila, and Kwajalein (see for example, Izuka and others, 2007; Engott and others, 2017; Gingerich and others, 2017; Izuka and others, 2018; Johnson and others, 2018; Gingerich and others, 2019; Mair and others, 2019; Oki and others, 2020). The computational procedures and equations used in these studies were documented or referenced, although a computer code to implement the methods was not provided in these studies.

This report documents a water-budget model code (hereinafter referred to as WATRMod [Water-budget Accounting for Tropical Regions Model] code) that is a variant and updated version of the model code used in the listed tropical area studies. WATRMod can be used to estimate spatially variable daily water-budget components in tropical-island and other settings for which the model approach is appropriate. Results of water-budget studies generally have been used to estimate groundwater recharge and how changing land cover and climate affect recharge. Recharge estimates are commonly used as input for studies that evaluate groundwater availability using numerical groundwater models (Gingerich, 2008; Gingerich and Engott, 2012; Gingerich, 2013; Oki and others, 2020).

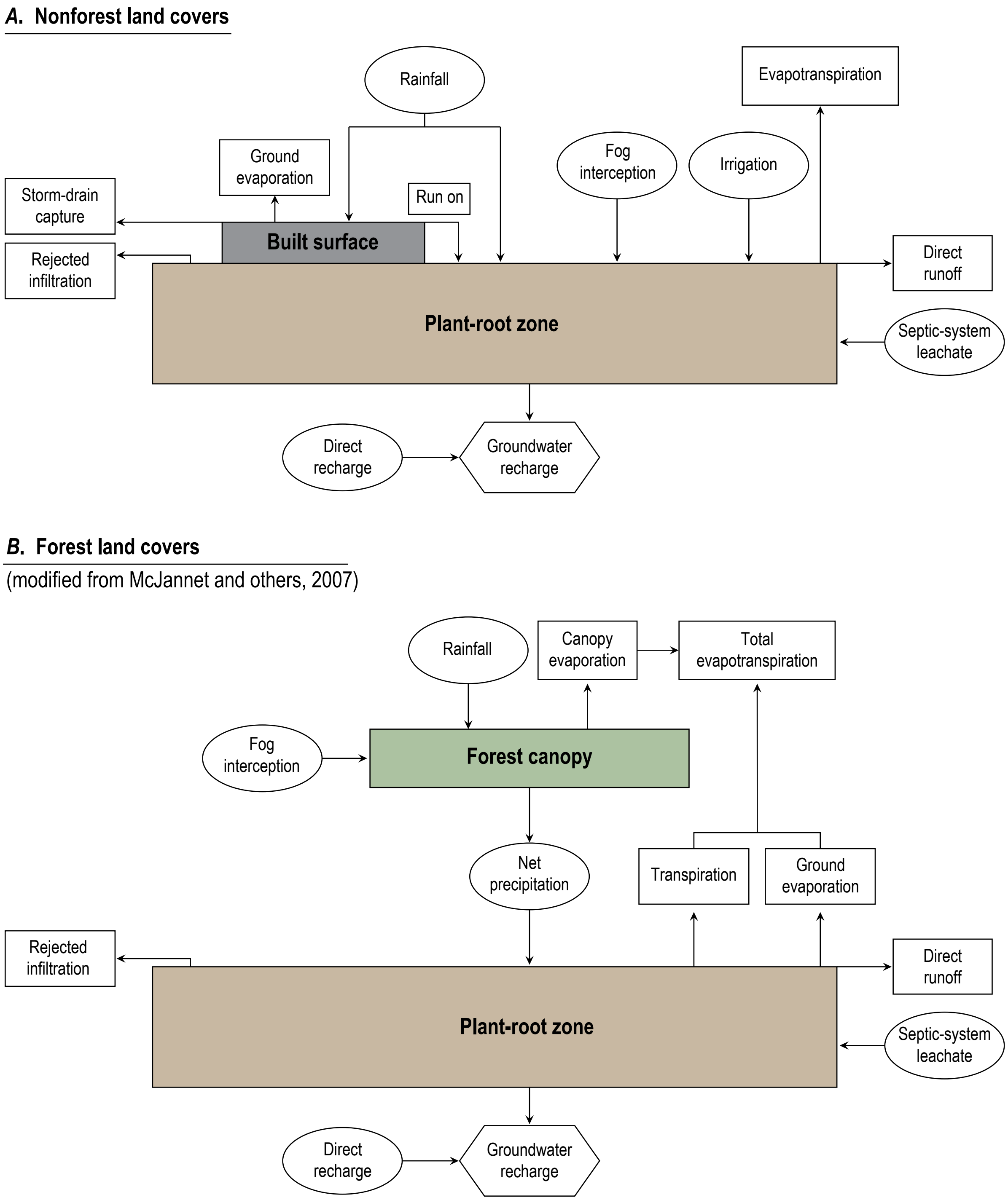


Figure 1. Conceptual water-budget flow diagrams for nonforest and forest land covers.

Purpose and Scope

The purpose of this report is to provide descriptions of WATRMod's (1) approach to computing a daily water budget; (2) represented processes; (3) limitations; and (4) execution procedure, input requirements, output files, and example files (appendixes 1–4). The model-code paradigm is based on monthly water-budget components that are disaggregated to daily values using either an observed, ordered daily pattern, a random daily pattern based on historical daily distributions for rainfall or other information, or a selected relation between rainfall and the water-budget component. The model code is written in the Fortran computer language. The model code and example files are available in a separate data release (Oki, 2022).

Overall Conceptual Approach

The water-budget model documented in this report, WATRMod, accounts for daily inputs of water to the plant-soil system (precipitation [which consists of rainfall and fog interception], irrigation, and septic-system leachate) and estimates daily outputs of water (runoff, evapotranspiration, and recharge) (fig. 1). WATRMod was developed mainly for tropical-island settings, although its use may be appropriate for other settings for which the model assumptions and limitations are acceptable. Water-budget components, soil properties, and land-cover characteristics are defined for model subareas, each defined by a unique identification number. Model subareas may be irregularly shaped polygon areas or uniformly gridded areas. For each subarea, sources of water that bypass the plant-soil system (cesspool and disposal-well discharge and watermain leakage) can be included. The model accounts for soil-moisture content at the beginning of each day and computes the daily water-budget component outputs and soil moisture at the ending of each day given the soil and land-cover characteristics of the subarea and prevailing weather conditions for the day.

For water-budget accounting, precipitation is conceptually assumed to occur instantaneously at the start of the day. In forested areas, precipitation can be intercepted by the canopy and evaporated, and therefore some or all of the precipitation may be unavailable to the plant-root zone. Direct runoff also is assumed to reduce the amount of water available to the plant-root zone. Remaining water that does not evaporate from the canopy or run off may either (1) infiltrate the soil surface if the remaining water for the day does not exceed the infiltration capacity of the soil, or (2) be characterized partly as rejected infiltration if the remaining water for the day exceeds the infiltration capacity of the soil. Water that infiltrates the soil contributes to the moisture of the plant-root zone and is assigned to evapotranspiration, recharge, or soil-moisture storage. The water-budget accounting order for evapotranspiration and recharge can be specified by the user. For areas where recharge is thought to occur as a rapid process, accounting for recharge before evapotranspiration in the water budget may be appropriate (see for example, Johnson, 2012). For each subarea, WATRMod sequentially computes a daily water budget for each day of the simulation period, independent of other subareas. This approach is computationally efficient, although a limitation of WATRMod is that runoff from one subarea is not routed to an adjacent subarea. A minimum simulation period of one year is required.

The spatial unit for the water budget is the model subarea, which can be an irregularly shaped area of nonuniform size or a regularly gridded area of uniform size. Water inputs, soil properties, runoff characteristics, reference-surface evapotranspiration (ET_o), and land-cover characteristics must be defined for each subarea. Subareas can be defined by overlaying (intersecting) geographic information system (GIS) layers, each containing required spatial input information (fig. 2).

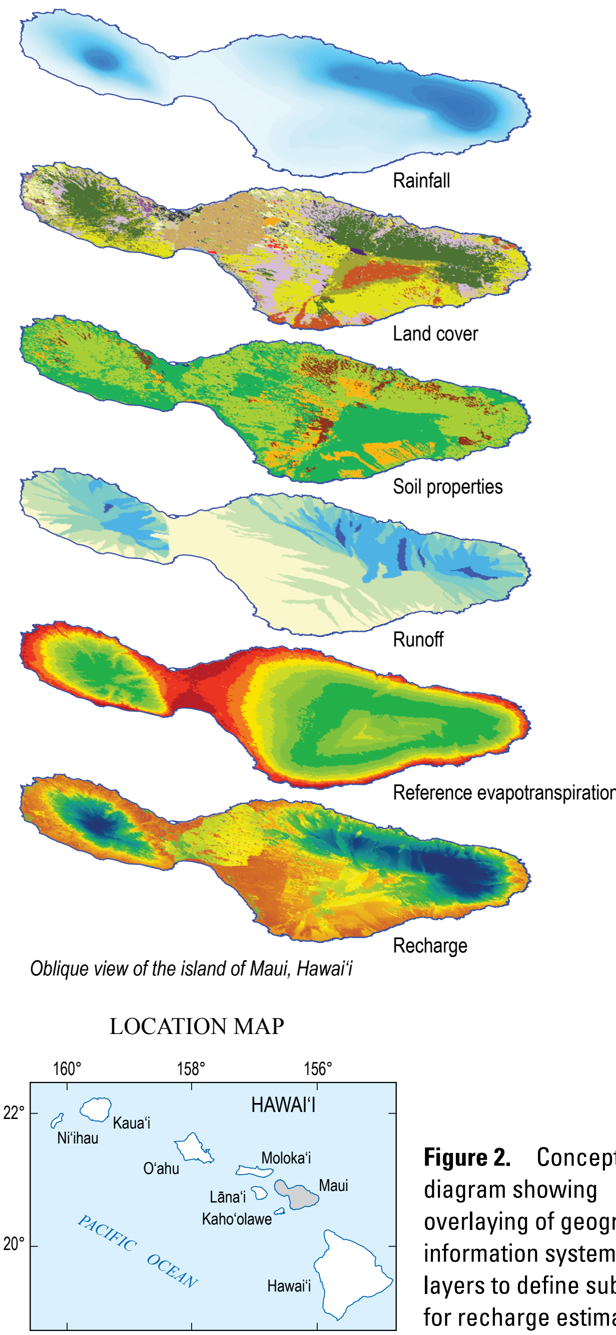


Figure 2. Conceptual diagram showing overlaying of geographic information system spatial layers to define subareas for recharge estimation.

WATRMod uses monthly water-budget-component input values and disaggregates the monthly values into daily values. Model users, however, can specify daily values for rainfall, fog interception, runoff, ET_o, and supply-based irrigation by preparing additional input files that contain observed or estimated, sequentially ordered ratios of daily-to-monthly values. The daily pattern for rainfall also can be determined using the method of fragments (see, for example, Oki, 2002), which assigns daily rainfall values according to observed or estimated ratios of daily-to-monthly rainfall through a random selection of sets of daily-to-monthly rainfall ratios. The code also accommodates simple relations (uniform, linear, or exponential) between rainfall and selected water-budget components. For example, monthly ET_o can be disaggregated into daily values using an inverse linear relation in which the ratio of daily-to-monthly ET_o increases as daily rainfall decreases.

Descriptions of the modeled processes and daily water-budget accounting procedure are provided in the "Modeled Processes" section. Descriptions of the input-file requirements, output files, and an example are provided in the appendixes.

Modeled Processes

This section briefly describes the hydrologic processes that can be represented by WATRMod. Also, methods that WATRMod uses to disaggregate monthly values into daily values are described for relevant processes.

Rainfall

WATRMod requires monthly rainfall values, in inches, for each subarea throughout the period of simulation. Because model subareas are defined by multiple spatial distributions of water-budget components, soil properties, and land-cover characteristics, adjacent subareas may have the same monthly rainfall values but differ in some other aspect related to the water budget. WATRMod also can adjust monthly rainfall values using mean monthly rainfall-adjustment factors, which may be appropriate for cases in which the monthly rainfall values do not produce a desired mean monthly value.

WATRMod can compute daily rainfall values from monthly rainfall values in one of two ways: (1) by randomly selecting user-defined monthly sets of daily-to-monthly rainfall ratios that are based on historical data or other information for each month of the year using the method of fragments (see, for example, Oki, 2002); or (2) by using an ordered sequence of daily-to-monthly rainfall ratios defined for each month of simulation. For a particular month, the daily rainfall is determined by multiplying each daily-to-monthly rainfall ratio for that month by the monthly rainfall. For each month, the sum of the daily-to-monthly rainfall ratios is equal to 1, which ensures that the monthly rainfall total is preserved. If monthly rainfall is disaggregated using the method of fragments, the user can opt to have WATRMod repeat the simulation period multiple times to generate multiple outcomes (realizations) of the water budget, each using randomly selected sets of fragments, and thereby develop a statistically representative average rainfall temporal distribution.

WATRMod routes rainfall over a subarea to the soil differently depending on the land cover of the subarea. For nonforested areas that are 100 percent unbuilt or undeveloped, the fraction of rainfall that does not run off contributes to the available water in the plant-root zone, provided the rate of water input to the plant-root zone during the day is less than the infiltration capacity of the soil (see the "Rejected Infiltration" section below). For nonforested areas that are partly built, rain that falls on the built area that exceeds the water-retention capacity of the built surface, expressed as a depth, is assumed to either (1) run on to the unbuilt fraction of the subarea and potentially contribute to the available water in the plant-root zone or (2) be removed from the subarea by storm-drain systems and assigned by the model to storm-drain capture. For forested areas, the forest canopy may intercept a fraction of the precipitation, resulting in a reduced depth of water that WATRMod assigns to net precipitation. Part or all of the net precipitation contributes to the available water in the plant-root zone depending on the infiltration capacity of the soil.

Fog Interception

In some areas, fog (cloud water) that is intercepted by vegetation and subsequently drips to the ground (fog drip) can contribute substantial amounts of water to the plant-soil system (see for example, Ekern, 1964; Juvik and Ekern, 1978; Delay and Giambelluca, 2010). In WATRMod, fog interception represents cloud water that is intercepted by vegetation (fig. 1). Fog interception that evaporates is assigned to canopy evaporation. Fog interception that does not evaporate is assumed to drip to the ground as the fog-drip component of net precipitation. Fog interception by vegetation may vary as a function of vegetation type, height, or location and can be characterized using a fog-catch efficiency value that ranges from 0 to 1 and that represents the fraction of cloud water that is intercepted by a given vegetation type. In WATRMod, monthly fog interception, in inches, can be either (1) computed from specified monthly fog-interception-to-rainfall ratios multiplied by the corresponding monthly rainfall for the subarea or (2) specified with monthly fog-interception values for each subarea throughout the period of simulation. The user may define the spatial distributions of monthly fog-interception-to-rainfall ratios or monthly fog interception independent of the spatial distributions of the other water-budget components.

If monthly fog-interception-to-rainfall ratios are specified, then daily fog-interception-to-rainfall ratios within a month are assumed to be equal to the monthly fog-interception-to-rainfall ratio for that month. Daily fog-interception values are determined by multiplying the daily fog-interception-to-rainfall ratio by the daily rainfall. If monthly fog-interception values are specified, then daily fog interception can be determined using one of three methods: (1) for each day of the month, the monthly fog-interception value is multiplied by the corresponding daily-to-monthly rainfall ratio (see previous “Rainfall” section); (2) the monthly fog-interception value is evenly distributed to each day of the month; or (3) the monthly fog-interception value is disaggregated using an ordered sequence of daily-to-monthly fog-interception ratios defined for each month of simulation.

Irrigation

Irrigation in WATRMod can be either (1) computed by the model using a demand-based approach that considers rainfall and potential evapotranspiration (*PE*) or (2) specified by the user as monthly irrigation depths, in inches, to represent supply-based irrigation rates. Irrigation is accounted for only in subareas with specified land cover that is designated as an irrigated land-cover type (for example, irrigated agricultural land covers). For each irrigated land-cover type, users specify the days on which irrigation is applied and whether irrigation will be determined using the demand- or supply-based approach.

For the demand-based approach, irrigation can be estimated based on either monthly or daily values of rainfall, runoff, and *PE*. The demand-based irrigation depth is determined from the general equation:

$$I = a\left[PE - \left(RF - RO\right)\right] / ei, \qquad (1)$$

where

- I is irrigation depth (greater than or equal to zero), in inches,
- PE is potential evapotranspiration, in inches,
- RF is rainfall, in inches,
- RO is runoff, in inches,
- a is the irrigation multiplier, dimensionless, and
- ei is irrigation efficiency, a dimensionless value greater than 0 and less than or equal to 1.

If the irrigation depth is determined on a monthly basis, the depth is evenly distributed on each of the user-specified irrigated days of the month.

For the supply-based approach, monthly irrigation depths provided by the user are disaggregated by WATRMod to daily values using one of three methods: (1) the depth is evenly distributed on each of the predefined, user-specified irrigated days of the month, regardless of the rainfall on the day; (2) the depth is evenly distributed on each of the relevant predefined, user-specified irrigated days of the month, excluding the user-specified irrigated days on which daily rainfall exceeds a specified threshold value; or (3) the depth is disaggregated using a user-specified, ordered sequence of daily-to-monthly irrigation ratios defined for each month of simulation.

Septic-System Leachate

Septic-system leachate, representing water discharged from septic wastewater-disposal systems, is assumed to be subject to the process of evapotranspiration. In WATRMod, the volume of water leached from septic systems is input as a depth over the unbuilt, pervious fraction of the subarea, and this depth of water is added to the available moisture content of the plant-root zone. For summary output purposes, the septic-system leachate is expressed as a depth over the entire subarea.

Direct Recharge

In WATRMod, water that is introduced below the plant-root zone, either within the unsaturated zone or saturated zone, contributes directly to recharge without reduction by evapotranspiration. The processes of leakage from watermains, discharge of wastewater from cesspools, and discharge of water from disposal wells are considered to bypass the plant-root zone and thereby contribute directly to recharge. Each of the processes of leakage from watermains (expressed as a depth of water, in inches, over the subarea), discharge of wastewater from cesspools (expressed as a depth of water, in inches, over the subarea), and discharge of water from disposal wells (expressed as a volumetric rate, in million gallons per day, within the subarea) can be represented separately in WATRMod.

Runoff

Runoff in WATRMod is modeled as an instantaneous response to rainfall and does not contribute to the available water in the plant-root zone. WATRMod computes a monthly runoff depth as a fraction of monthly rainfall by using monthly runoff-to-rainfall ratios provided by the model user for each subarea throughout the period of simulation. The spatial distributions of monthly runoff-to-rainfall ratios may be independently defined by zones relative to other water-budget components. The user may define monthly runoff-to-rainfall ratios using information from a streamgaging station or an appropriate statistical or deterministic rainfall-runoff model for ungaged areas.

WATRMod computes daily runoff using one of two methods: (1) for each day of the month, the monthly runoff is multiplied by the corresponding daily-to-monthly rainfall ratio (see “Rainfall” section above); or (2) for each day of the month, the monthly runoff is multiplied by a user-specified, daily-to-monthly runoff ratio. The latter method provides the user the ability to externally determine the sequence of daily runoff values for each subarea and specify runoff for each subarea and day of the simulation period.

Canopy Interception and Evaporation for Forests

In forested areas, the canopy and trunks of the vegetation may intercept some or all the precipitation (rainfall plus any fog interception) during a day. The properties of the canopy and trunk, including the fraction of canopy covering the area, the water-retention capacity of the canopy, and the water-retention capacity of the trunks, affect the amount of precipitation that can be intercepted. Canopy evaporation represents the fraction of intercepted precipitation that evaporates; net precipitation represents the remaining fraction of intercepted precipitation that contributes moisture to the plant-root zone (fig. 1). WATRMod can compute daily canopy evaporation and daily net precipitation using one of three methods. Method 1 uses the Gash (1995) model to compute daily canopy evaporation and then computes daily net precipitation from the difference between daily precipitation and daily canopy evaporation. Method 2 uses a linear relation between monthly fog interception and the monthly net-precipitation-to-rainfall ratio (equation 2) (modified from Engott, 2011) to compute the monthly net-precipitation-to-rainfall ratio; computes monthly net precipitation from the product of the monthly net-precipitation-to-rainfall ratio and monthly rainfall; computes daily net precipitation by disaggregating the monthly net-precipitation value using the daily-to-monthly rainfall ratios; and then computes daily canopy evaporation from the difference between daily precipitation and daily net precipitation. Method 3 uses an exponential relation between daily precipitation and the daily net-precipitation-to-precipitation ratio (*NP*/*P* in equation 3) to compute the daily net-precipitation-to-precipitation ratio; computes daily net precipitation from the product of the daily net-precipitation-to-precipitation ratio and the daily precipitation; and then computes daily canopy evaporation from the difference between daily precipitation and daily net precipitation.

$$NP / RF = A \times F + B, \tag{2}$$

and

$$NP / P = C \times e^{(D/P)}, \tag{3}$$

where

NP is net precipitation, in inches per month (equation 2) or inches per day (equation 3),
RF is rainfall, in inches per month (equation 2),
F is fog interception, in inches per month (equation 2),
P is precipitation (rainfall and fog), in inches per day (equation 3), and
A, B, C, and D are constants.

The Gash (1995) canopy-interception model requires a ratio of mean canopy evaporation rate during rainfall ($\overline{E}$) to mean precipitation rate ($\overline{R}$) for saturated canopy conditions. For WATRMod, monthly $\overline{E}/\overline{R}$ ratios are specified for each month of simulation. WATRMod has four different methods for disaggregating each monthly $\overline{E}/\overline{R}$ ratio into daily $\overline{E}/\overline{R}$ ratios: (1) constant daily $\overline{E}/\overline{R}$ ratio during the month equal to the monthly $\overline{E}/\overline{R}$ ratio; (2) daily multipliers of the monthly $\overline{E}/\overline{R}$ ratio determined using a linear relation between daily rainfall and daily multiplier of the monthly $\overline{E}/\overline{R}$ ratio (equation 4); (3) daily multipliers of the monthly $\overline{E}/\overline{R}$ ratio determined using an exponential relation between daily rainfall and daily multiplier of the monthly $\overline{E}/\overline{R}$ ratio (equation 5); and (4) a user-specified, ordered sequence of daily-to-monthly $\overline{E}/\overline{R}$ multipliers defined for each month of simulation.

$$ER_{mult} = AR \times \left(RF\right)_d + BR, \tag{4}$$

and

$$ER_{mult} = BR \times e^{\left[AR \times (RF)_d\right]}, \tag{5}$$

where

ER_{mult} is the dimensionless daily multiplier for the monthly $\overline{E}/\overline{R}$ ratio,
BR is the dimensionless maximum daily-to-monthly $\overline{E}/\overline{R}$ ratio,
$\left(RF\right)_d$ is daily rainfall, in inches, and
AR is a constant (negative value).

The canopy evaporation estimation methods available in WATRMod may not be appropriate for selected types of land cover, such as nonforest land-cover types. For these land-cover types, the canopy-evaporation process may be included in the specified crop coefficients (see “Crop Coefficient” section below) that represent all ET processes (ground evaporation, transpiration, and canopy evaporation combined) (fig.1) and are used to compute rates of *PE* and actual evapotranspiration (*AE*).

Evapotranspiration and Related Properties

In WATRMod, *AE* from the plant-root zone is a function of the *PE* rate and soil properties. *PE* is estimated from the product of ET_o and a coefficient that is dependent on the type of crop or vegetation, referred to as a crop coefficient. Soil properties that affect model *AE* estimates consist of the soil-moisture storage capacity of the root zone (a function of the available water capacity of the soil and the plant-root depth), the threshold soil-moisture content (the soil-moisture threshold below which the rate of evapotranspiration is less than the *PE* rate), and the available moisture content of the soil. Computation of *AE* in WATRMod is described below in the “Soil-Moisture Accounting” section.

Reference-Surface Evapotranspiration

ET_o is the evapotranspiration rate from a hypothetical reference surface with particular height, albedo, and surface resistance for the prevailing climatic conditions. Several reference surfaces have been used in different studies to generate ET_o estimates. For WATRMod, the reference surface selected resembles a green, well-watered grass surface of uniform height that completely shades the ground. The Food and Agriculture Organization (FAO) indicates that ET_o can be estimated for this reference surface with the FAO Penman-Monteith method (Allen and others, 1998). ET_o is sometimes estimated based on evaporation measured from an evaporation pan.

For WATRMod, the spatial distribution of monthly ET_o, in inches, is defined by the user. The spatial distribution of monthly ET_o may be independently defined or zoned relative to other water-budget components. Monthly ET_o can be disaggregated into daily values using one of four methods in WATRMod: (1) uniform distribution of daily ET_o in a month; (2) inverse linear relation between the daily-to-monthly rainfall ratio and the daily-to-monthly ET_o ratio (equation 6);

(3) exponential relation between the daily-to-monthly rainfall ratio and the daily-to-monthly ET_o ratio (equation 7); or (4) monthly ET_o disaggregated using an ordered sequence of daily-to-monthly ET_o ratios defined for each month of simulation.

$$\left(ET_o\right)_d / \left(ET_o\right)_m = \left[\left(ET_o\right)_{min} - 1\right] \times \left(RF\right)_d / \left(RF\right)_m + 1 , \quad (6)$$

and

$$\left(ET_o\right)_d / \left(ET_o\right)_m = e^{\left\{\ln\left[\left(ET_o\right)_{min}\right] \times \left(RF\right)_d / \left(RF\right)_m\right\}} , \quad (7)$$

where

$\left(ET_o\right)_d / \left(ET_o\right)_m$ is the dimensionless ratio of daily-to-monthly ET_o,

$\left(ET_o\right)_{min}$ is the minimum ratio of daily-to-monthly ET_o, dimensionless, $[0 < \left(ET_o\right)_{min} \leq 1]$, and

$\left(RF\right)_d / \left(RF\right)_m$ is the dimensionless ratio of daily-to-monthly rainfall $[0 \leq \left(RF\right)_d / \left(RF\right)_m \leq 1]$.

Within a month, the daily-to-monthly ET_o ratios computed using equations 6 and 7 are proportionately rescaled by WATRMod, if necessary, such that they sum to one.

Crop Coefficient

A crop coefficient is a multiplicative coefficient that is used to adjust ET_o to the existing vegetation on the land surface. Coefficients have been developed for numerous crops and vegetation types to estimate water demand (Allen and others, 1998). Johnson and others (2018) estimated crop coefficients, which exclude the process of canopy evaporation, for generalized native and nonnative forested areas in Hawai‘i.

Soil Properties

All other factors being equal, evapotranspiration from the plant-root zone increases with soil-moisture storage capacity, S_c. WATRMod estimates soil-moisture storage capacity as the product of the specified root depth and specified available water capacity (equation 8), the latter of which represents the difference between the volumetric field-capacity moisture content and the volumetric wilting-point moisture content (equation 9):

$$S_c = d_{rz} \times \phi , \quad (8)$$

and

$$\phi = \theta_{fc} - \theta_{wp} , \quad (9)$$

where

S_c is soil-moisture storage capacity, in inches,

d_{rz} is vegetation root depth, in inches,

ϕ is available water capacity of the soil, dimensionless,

θ_{fc} is volumetric field-capacity moisture content of the soil, dimensionless, and

θ_{wp} is volumetric wilting-point moisture content of the soil, dimensionless.

Different models are available to represent the threshold soil-moisture content, sometimes referred to as the root constant, below which the *AE* rate is depressed below the *PE* rate (fig. 3). Veihmeyer and Hendrickson (1955) proposed that evapotranspiration occurs at the *PE* rate when soil moisture is between field capacity and the wilting point, but that evapotranspiration is zero when soil moisture is at or below the wilting point. Thornthwaite and Mather (1955) proposed that the rate of evapotranspiration decreases linearly as soil moisture is reduced from field capacity to the wilting point. The models of Veihmeyer and Hendrickson (1955) and Thornthwaite and Mather (1955) are the extreme representations of threshold soil-moisture content. Allen and others (1998) proposed a threshold soil-moisture content that is between these extreme values. The models of Allen and others (1998), Veihmeyer and Hendrickson (1955), and Thornthwaite and Mather (1955) are implemented in WATRMod, with the model of Allen and others (1998) being the most general.

The available moisture content of the soil at a particular time limits evapotranspiration. Available moisture content of the soil is less than or equal to the soil-moisture storage capacity and is defined in WATRMod as:

$$S_i = d_{rz} \times \left(\theta_i - \theta_{wp}\right), \quad (10)$$

where

S_i is available moisture content of the soil for day *i*, in inches,

θ_i is volumetric moisture content of soil for day *i*, dimensionless, and,

i is a subscript designating the current day.

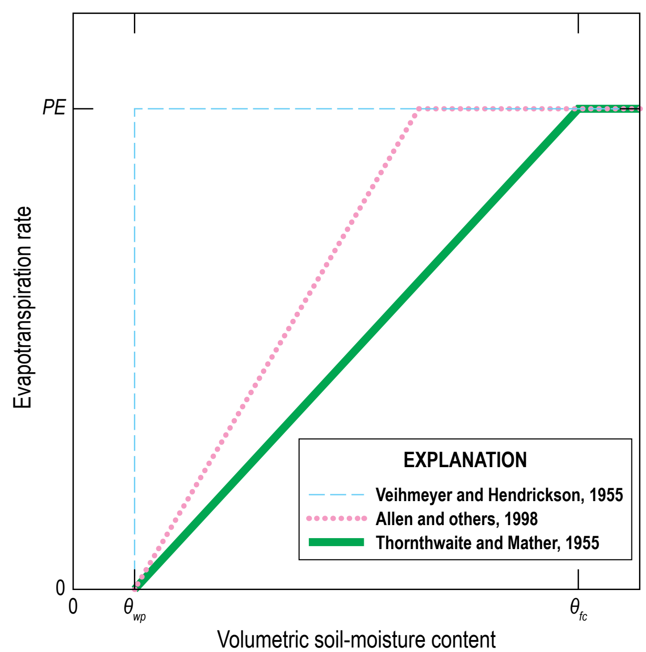


Figure 3. Conceptual diagram showing evapotranspiration rate as a function of soil moisture for selected models. *PE*, potential evapotranspiration; θ_{fc}, volumetric field-capacity moisture content of soil; θ_{wp}, volumetric wilting-point moisture content of soil.

Rejected Infiltration

Water applied to the soil surface through precipitation, irrigation, or other process can infiltrate the surface if the soil has sufficient permeability to accept the water. The infiltration capacity of a soil is the maximum rate at which a soil can absorb applied water. The infiltration capacity decreases as the moisture content of the soil increases and reaches a limiting rate at saturated soil conditions.

In WATRMod, the specified infiltration capacity of the soil is used to potentially limit the amount of water that contributes to the moisture content of the plant-root zone; water applied in excess of the specified infiltration capacity is considered as rejected infiltration and is not included as part of runoff, although the rejected infiltration conceptually would run off the area. Model users can force WATRMod to ignore the rejected-infiltration process by specifying an arbitrarily and sufficiently high infiltration capacity (for example, 999 inches per day) for the soil.

Soil-Moisture Accounting

WATRMod accounts for each of the modeled processes in a specific order on each day of the simulation. Model users, however, must specify the relative accounting order for ET and recharge that is most appropriate for soil conditions in their study area. Rainfall for the day is assumed to occur instantaneously at the start of a day (generally midnight) and is determined first in the water-budget accounting process in WATRMod. Direct recharge processes, such as discharge from cesspools, and septic-system leachate that contributes water directly to the plant-root zone are also considered simultaneously with rainfall. Runoff, fog interception, irrigation, and ET_o are commonly a function of rainfall and are computed next in WATRMod. In forested areas, the process of canopy interception controls the net precipitation that is potentially available to the plant-root zone and is computed next in WATRMod. In subareas that are partly built, net precipitation in excess of the water-retention capacity of the built area is next routed from the built part of the subarea to storm drains, where available, or to unbuilt parts of the subarea in subareas without storm drains. Water available at the soil surface that can be infiltrated is added to soil-moisture storage and the remaining water is considered as rejected infiltration in WATRMod. Water in soil-moisture storage is then assigned to evapotranspiration and recharge in the user-specified order. Finally, the moisture content of the soil at the end of the day is determined. The water-budget accounting equations presented in this report (equations 11–25) are consistent with equations documented previously (for example, Oki, 2008; Engott, 2011; Engott and others, 2017; Izuka and others, 2018; Johnson and others, 2018; Mair and others, 2019; Oki and others, 2020).

The water-budget method used in WATRMod is based on the Thornthwaite and Mather (1955) bookkeeping procedure. The daily water budget of the plant-soil system is computed by WATRMod in the following manner. At the start of day i, an interim water input, Y_i, is computed from the following equation:

$$Y_i = (NP)_i + I_i + U_i + W_i - R_i, \tag{11}$$

where

- Y_i is interim water input for current day i, in inches,
- $(NP)_i$ is net precipitation for current day i, in inches,
- I_i is irrigation for current day i, in inches,
- U_i is septic-system leachate for current day i, in inches,
- W_i is water run on to unbuilt part of the subarea from the built part of the subarea for current day i, in inches,
- R_i is runoff for current day i, in inches, and
- i is a subscript designating the current day.

All volumes of water are expressed as an equivalent depth of water corrected to the relevant (unbuilt) area. Not all processes may be relevant for a subarea. For example, net precipitation is the sum of rainfall and fog interception, which may be reduced by water losses related to canopy evaporation. Fog interception may not be present in all subareas and canopy evaporation may only be relevant in forested areas. Thus, in this context, net precipitation may represent combinations of rainfall, fog interception, and canopy evaporation losses, although canopy interception cannot occur in the absence of both rainfall and fog.

Interim water input to the plant-soil system is next compared in WATRMod to the specified infiltration capacity, K_s, of the soil, which potentially limits the amount of water that can infiltrate during the day. In WATRMod, interim water input for the day in excess of the infiltration capacity of the soil is considered rejected infiltration. An interim soil moisture, X_i, is computed using the following procedure:

$$\text{for } Y_i \le K_s,\ X_i = Y_i + S_{i-1},$$

and

$$(RI)_i = 0;$$

and

$$\text{for } Y_i > K_s,\ X_i = K_s + S_{i-1},$$

and

$$(RI) = Y_i - K_s, \tag{12}$$

where

- X_i is interim soil moisture for current day i, in inches,
- K_s is infiltration capacity, expressed as a maximum depth of water that can be absorbed by the soil during a day, in inches,
- $(RI)_i$ is rejected infiltration for current day i, in inches, and
- S_{i-1} is ending soil-moisture storage from previous day i-1, in inches.

Interim soil moisture is next apportioned to evapotranspiration, recharge, and soil moisture.

The rate of evapotranspiration is a function of the threshold soil-moisture content, C_i, which represents the soil-moisture content below which the *AE* rate is depressed below the *PE* rate. For soil moisture above C_i, the *AE* rate is assumed to occur at the *PE* rate. The instantaneous rate of evapotranspiration is thus defined by the following:

$$\text{for } S \geq C_i\,,\ E = \left(PE\right)_i\,,$$

and

$$\text{for } S < C_i \text{ and } C_i > 0\,,$$

$$E = S \times \left(PE\right)_i / C_i\,, \tag{13}$$

where

E is instantaneous rate of actual evapotranspiration, in inches per day,

S is instantaneous soil moisture, in inches,

$\left(PE\right)_i$ is potential-evapotranspiration rate for current day *i*, in inches per day, and

is threshold soil-moisture content for the current day *i*, below which the actual-evapotranspiration rate is less than the potential-evapotranspiration rate, in inches.

The value of C_i may be zero (Veihmeyer and Hendrickson, 1955), the soil-moisture storage capacity (Thornthwaite and Mather, 1955), or a value between zero and the soil-moisture storage capacity (Allen and others, 1998).

WATRMod users select one of two water-budget methods. One method accounts for ET before recharge on each simulated day and the other method accounts for recharge before ET on each simulated day. The method that accounts for ET before recharge is commonly used where soils effectively store water, whereas the method that accounts for recharge before evapotranspiration may be considered appropriate where soils are highly permeable or nonexistent, resulting in rapid recharge. The latter accounting method will result in larger recharge estimates than the former method. The accounting methods for each ordering approach are described below.

Accounting for Evapotranspiration before Recharge

For the water-budget method that accounts for evapotranspiration before recharge, WATRMod subtracts evapotranspiration from the interim soil-moisture storage, and all remaining soil moisture in excess of the soil-moisture storage capacity is assumed to be recharge. The evapotranspiration rate may be (1) equal to the *PE* rate for part of the day and less than the *PE* rate for the remainder of the day, (2) equal to the *PE* rate for the entire day, or (3) less than the *PE* rate for the entire day. The total evapotranspiration during a day is a function of the *PE* rate, $(PE)_i$, interim soil-moisture storage, X_i, and threshold soil-moisture content, C_i. By recognizing that $E = -dS/dt$, the total depth of water lost to evapotranspiration during a day, E_i, is determined by the following:

$$\text{for } X_i > C_i \text{ and } C_i > 0\,,$$

$$E_i = \left(PE\right)_i t_i + C_i\left\{1 - e^{\left[-\left(PE\right)_i\left(1-t_i\right)/C_i\right]}\right\},$$

$$\text{for } X_i > C_i \text{ and } C_i = 0\,,$$

$$E_i = \left(PE\right)_i t_i\,,$$

$$\text{for } X_i \leq C_i \text{ and } C_i > 0\,,$$

$$E_i = X_i\left\{1 - e^{\left[-\left(PE\right)_i/C_i\right]}\right\},$$

and

$$\text{for } X_i = C_i \text{ and } C_i = 0\,,\ E_i = 0, \tag{14}$$

where

E_i is actual evapotranspiration from the plant-root zone for current day *i*, in inches, and

t_i is fraction of current day *i* during which soil moisture is greater than C_i, in days.

The value for t_i is restricted from 0 to 1 day and determined by the following:

$$\text{for } (X_i - C_i) < \left(PE\right)_i \times \left(1\ day\right),\ t_i = (X_i - C_i)/\left(PE\right)_i\,,$$

and

$$\text{for } (X_i - C_i) \geq \left(PE\right)_i \times \left(1\ day\right),$$

$$t_i = 1, \tag{15}$$

where the term (1 *day*) converts the daily potential-evapotranspiration rate to an equivalent depth of water.

WATRMod subtracts *AE* from the interim soil moisture and assigns any remaining soil moisture to soil-moisture storage and to recharge if soil moisture is in excess of the soil-moisture storage capacity. Recharge from the plant-root zone and soil-moisture storage at the end of the current day are assigned according to the following:

$$\text{for } (X_i - E_i) \leq S_c\,,\ Q_i = 0\,,$$

and

$$S_i = (X_i - E_i)\,;$$

and

$$\text{for } (X_i - E_i) > S_c\,,\ Q_i = (X_i - E_i - S_c)\,,$$

and

$$S_i = S_c\,, \tag{16}$$

where

Q_i is recharge from the plant-root zone exclusive of direct recharge for current day *i*, in inches, and

S_i is ending soil-moisture storage for current day *i*, in inches.

Accounting for Recharge before Evapotranspiration

For the water-budget method that accounts for recharge before evapotranspiration, WATRMod assigns interim soil moisture in excess of the soil-moisture storage capacity to recharge, and evapotranspiration is then subtracted from the remaining soil-moisture storage. Recharge from the plant-soil system is determined from the following:

$$\text{for } X_i > S_c, Q_i = (X_i - S_c),$$

and

$$\text{for } X_i \le S_c,\ Q_i = 0. \tag{17}$$

Evapotranspiration is then assigned by WATRMod according to the following:

$$\text{for } (X_i - Q_i) > C_i \text{ and } C_i > 0,$$

$$E_i = (PE)_i\, t_i + C_i \left\{1 - e^{\left[-(PE)_i(1-t_i)/C_i\right]}\right\},$$

$$\text{for } (X_i - Q_i) > C_i \text{ and } C_i = 0,$$

$$E_i = (PE)_i\, t_i,$$

$$\text{for } (X_i - Q_i) \le C_i \text{ and } C_i > 0,$$

$$E_i = (X_i - Q_i)\left\{1 - e^{\left[-(PE)_i/C_i\right]}\right\},$$

and

$$\text{for } (X_i - Q_i) = C_i \text{ and } C_i = 0,$$

$$E_i = 0. \tag{18}$$

The value for t_i is restricted from 0 to 1 day and is determined by the following:

$$\text{for } (X_i - Q_i - C_i) < (PE)_i \times (1\ day),$$

$$t_i = (X_i - Q_i - C_i)/(PE)_i,$$

and

$$\text{for } (X_i - Q_i - C_i) \ge (PE)_i \times (1\ day),$$

$$t_i = 1. \tag{19}$$

The soil moisture storage at the end of the current day is given by:

$$S_i = X_i - Q_i - E_i. \tag{20}$$

Built Surfaces

In WATRMod, W_i for subareas without built surfaces is zero. For subareas with built surfaces, W_i is determined in WATRMod using the following procedure:

$$(XP1)_i = (NP)_i - R_i + (SP)_{i-1}, \tag{21}$$

$$\text{for } (XP1)_i \le (SP)_c, W_i = 0,$$

and

$$(XP2)_i = (XP1)_i,$$

$$\text{for } (XP1)_i > (SP)_c,$$

$$W_i = \left[(XP1)_i - (SP)_c\right] \times z/(1-z),$$

and

$$(XP2)_i = (SP)_c, \tag{22}$$

where

- $(XP1)_i$ is first interim water storage of built area for current day *i*, in inches,
- $(XP2)_i$ is second interim water storage of built area for current day *i*, in inches,
- $(SP)_{i-1}$ is water storage of built area at end of previous day *i*-1, in inches,
- $(SP)_c$ is water storage capacity of built area, in inches, and
- z is fraction of subarea that is built, dimensionless.

In subareas with storm drains, W_i is routed to the storm drains and does not contribute to soil-moisture storage. In subareas without storm drains, W_i is routed to the unbuilt part of the subarea and contributes to soil-moisture storage. The depth of water represented by W_i is adjusted to preserve mass. The water evaporated from and stored on the built surface at the end of the current day is determined in WATRMod from the following:

$$\text{for } (XP2)_i \le (ET_o)_i \times (1\ day), (SP)_i = 0,$$

and

$$(EP)_i = (XP2)_i;$$

and

$$\text{for } (XP2)_i > (ET_o)_i \times (1\ day),$$

$$(SP)_i = (XP2)_i - (ET_o)_i \times (1\ day),$$

and

$$(EP)_i = (ET_o)_i \times (1\ day), \tag{23}$$

where

- $(ET_o)_i$ is reference-surface evapotranspiration rate for current day *i*, in inches per day,
- $(SP)_i$ is water storage of built area at end of current day *i*, in inches, and
- $(EP)_i$ is evaporation from built area for current day *i*, in inches.

Potential Evapotranspiration

In WATRMod, the *PE* rate is a function of the ET_o rate and a crop coefficient that is dependent on vegetation type, stage of development, and possibly location.

$$(PE)_i = k_c \times (ET_o)_i, \tag{24}$$

where

- k_c is a crop coefficient, dimensionless.

For crops that are started from seeds or cuttings and receive different irrigation and fertilization depending on stage of development (Allen and others, 1998), the crop coefficient varies over time (fig. 4). Persistent fog in some locations may also affect the crop coefficient, although additional research would help to improve understanding of *PE* of vegetation inside and outside the fog zone. Allen and others (1998) provide crop

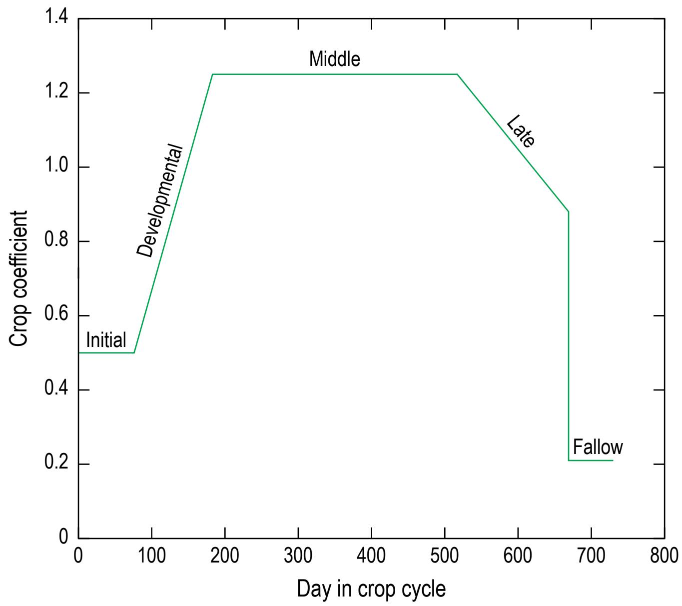


Figure 4. Conceptual diagram showing crop-coefficient variation with time for the initial, developmental, middle, late, and fallow stages of a crop.

coefficients for selected vegetation types and growth stages. These crop coefficients may need to be adjusted to reflect wetting frequency and local climate conditions.

Threshold Soil-Moisture Constant

The threshold soil-moisture content, C_i—below which the *AE* rate is depressed below the *PE* rate—may range from zero (Veihmeyer and Hendrickson, 1955) to the soil-moisture storage capacity value (Thornthwaite and Mather, 1955). WATRMod allows for the threshold soil-moisture content to range from zero to the soil-moisture storage capacity (S_c) value according to the following approach from Allen and others (1998):

$$C_i = (1 - d) \times S_c, \quad (25)$$

where

d is depletion fraction, a dimensionless value that ranges from 0 to 1.

The depletion fraction represents the fraction of available soil moisture that can be depleted from the plant-root zone before moisture stress occurs (when *AE* rate is depressed below the *PE* rate). In WATRMod, the depletion fraction is modeled as a function of the *PE* rate according to the method of Allen and others (1998).

Specified, Constant Recharge

WATRMod allows specification of a constant recharge rate for specified land-cover types. A constant recharge rate may be appropriate for subareas with a land-cover type for which recharge is not a function of precipitation. For example, for subareas representing water bodies with a steady water level, recharge may be controlled by the hydraulic properties of the soil and the water level rather than by precipitation. The source of water needed to maintain a constant recharge rate is assumed to be from an unspecified external source (for example, a nearby surface-water source). The quantity of external-source water required to maintain the water balance may be positive or negative depending on runoff, evaporative demand (assumed to be *PE*), net precipitation, and other specified sources of water such as irrigation, septic-system leachate, and direct recharge. For subareas with a specified, constant recharge rate, the value for infiltration capacity, K_s, of the soil is ignored by WATRMod. Thus, the user must ensure that the specified recharge rate does not exceed the infiltration capacity.

Subareas of Mixed Land Cover

The land-cover type assigned to each subarea by the user can represent one land-cover type, such as native forest, or a mixture of two land-cover types that cannot be effectively spatially separated. For example, some agricultural crops may occupy a fraction of a subarea in which information on the spatial distribution of cultivated and uncultivated areas may be proprietary or unavailable. For subareas with mixed land cover, WATRMod computes the water budget twice (once for each land-cover type) and estimates water-budget components using an area-weighted averaging procedure. The specified fractions of the subarea that are occupied by each land-cover type in the subarea are used to compute the area-weighted average value for the water-budget components. For example, Oki and others (2020) treated subareas mapped as seed corn on Molokaʻi as a mixed land-cover type, consisting of 25 percent cultivated corn and 75 percent bare soil. WATRMod allows specification of mixed land-cover types by defining the characteristics of each of the two land covers. Land-cover-specific characteristics are defined in appendix 2.

Model Limitations

WATRMod has numerous limitations that are briefly described in this section. In general, a major limitation of the water-budget approach is that the accuracy of the recharge estimate depends on the accuracy with which the other components in the water-budget computation are measured or estimated (Scanlon and others, 2002). Because WATRMod was mainly designed for tropical-island settings, cold-weather processes, such as frozen precipitation, snowpack sublimation, and snowmelt, are not represented. WATRMod uses a daily time step, which does not accurately represent transient intra-day changes in water inputs and outputs from the plant-soil system. Additionally, some processes, including precipitation, irrigation, septic-system leachate, and runoff, are considered to occur instantaneously at the start of each day. However, a water-budget model that uses a smaller time increment may require specification of additional spatially variable model parameter values, which are commonly not available, to represent the physical processes that occur at subdaily time scales. The daily time step used in WATRMod captures the daily and seasonal changes in hydrologic conditions that are important to represent on a regional scale and does not require quantification of numerous spatially variable model parameters.

WATRMod does not have the capability to internally route runoff from one subarea to an adjacent subarea. Watershed models that are parameter intensive and computationally less efficient could be used to estimate spatially distributed runoff. Watershed models can also consider interactions between groundwater and surface water, whereas the water-budget model cannot. WATRMod does, however, allow users to specify runoff-to-rainfall ratios that ensure model runoff estimates for a given area, such as the drainage basin of a streamgaging station, match runoff values determined from hydrologic data, such as the runoff component of streamflow measured at a streamgaging station.

WATRMod cannot check whether the irrigation volume is available or not. The source of irrigation water may be from stream base flow or groundwater and these sources are not addressed by WATRMod. Thus, the user is responsible for assuring that the estimated irrigation volumes are realistic.

Summary

Regional estimates of groundwater recharge commonly are needed to (1) evaluate water availability in an area, (2) develop numerical groundwater models, and (3) prioritize land-management actions designed to enhance water resources. Water-budget models of the plant-soil system can be used to estimate groundwater recharge on a regional basis such as on tropical islands. Daily water budgets are commonly used to quantify spatially distributed groundwater recharge for regions because (1) daily climatologic data are available or can be estimated, (2) transient processes that affect recharge can be represented reasonably well using a daily time interval, and (3) computational demands are not excessive in comparison to, for example, numerical groundwater models of the unsaturated zone.

This report documents the Water-budget Accounting for Tropical Regions Model, or WATRMod, code that can be used to estimate spatially variable daily water-budget components in tropical-island settings. This report provides descriptions of WATRMod's (1) approach to computing a daily water budget; (2) processes that are represented; (3) limitations; and (4) execution procedure, input requirements, output files, and example files (see appendixes 1–4). WATRMod can be used to simulate spatially variable daily water-budget components to determine mean recharge rates (monthly, mean monthly, annual, and mean annual) for periods of one year or more. Water-budget components represented in WATRMod include rainfall, fog interception, irrigation, septic-system leachate, cesspool and disposal-well discharge, watermain leakage, runoff, canopy evaporation, evapotranspiration from the plant-root zone, recharge, and soil-moisture storage.

Water-budget components, soil properties, and land-cover characteristics are defined for model subareas, each defined by a unique identification number. Model subareas may be irregularly shaped polygon areas or uniformly gridded areas. Precipitation, anthropogenic sources of water, reference-surface evapotranspiration, runoff, soil properties, and land-cover characteristics are all required WATRMod inputs for each subarea. The model-code paradigm is based on monthly water-budget components that are disaggregated to daily values using an observed, ordered daily pattern, a random daily pattern based on historical daily distributions for rainfall or other information, or selected relation between rainfall and the water-budget component. The model code is written in the Fortran computer language.

WATRMod has numerous limitations including (1) subdaily transient changes in water inputs and outputs from the plant-soil system that are not characterized, (2) precipitation in the form of snow and sublimation that are not represented, and (3) routing runoff from one subarea to an adjacent subarea that is not directly represented. For areas where these limitations are not relevant or substantive, WATRMod can be a useful tool for quantifying the water budget.

References Cited

Allen, R.G., Pereira, L.S., Raes, D., and Smith, M., 1998, Crop evapotranspiration—Guidelines for computing crop water requirements: Food and Agriculture Organization of the United Nations, FAO Irrigation and Drainage Paper 56, 300 p., accessed May 26, 2020, at http://www.fao.org/3/X0490E/x0490e00.htm.

DeLay, J.K., and Giambelluca, T.W., 2010, History of fog and cloud water interception research in Hawaiʻi, *in* Bruijnzeel, L.A., Scatena, F.N., and Hamilton, L.S., eds., Tropical montane cloud forests—Science for conservation and management: New York, Cambridge University Press, p. 332–341.

Ekern, P.C., 1964, Direct interception of cloud water on Lanaihale, Hawaii: Soil Science Society of America Proceedings, v. 28, no. 3, p. 419–421, accessed May 26, 2020, at https://doi.org/10.2136/sssaj1964.03615995002800030035x.

Engott, J.A., Johnson, A.G., Bassiouni, M., Izuka, S.K., and Rotzoll, K., 2017, Spatially distributed groundwater recharge for 2010 land cover estimated using a water-budget model for the Island of Oʻahu, Hawaiʻi (ver. 2.0, December 2017): U.S. Geological Survey Scientific Investigations Report 2015–5010, 49 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20155010.

Engott, J.A., 2011, A water-budget model and assessment of groundwater recharge for the Island of Hawaiʻi: U.S. Geological Survey Scientific Investigations Report 2011–5078, 53 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20115078.

Gash, J.H.C., Lloyd, C.R., and Lachaud, G., 1995, Estimating sparse forest rainfall interception with an analytical model: Journal of Hydrology, v. 170, p 79–86, accessed May 26, 2020, at https://doi.org/10.1016/0022-1694(95)02697-N.

Gingerich, S.B., 2008, Ground-water availability in the Wailuku area, Maui, Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2008–5236, 95 p., accessed May 26, 2020, at https://pubs.usgs.gov/sir/2008/5236/.

Gingerich, S.B., 2013, The effects of withdrawals and drought on groundwater availability in the Northern Guam Lens Aquifer, Guam: U.S. Geological Survey Scientific Investigations Report 2013–5216, 76 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20135216.

Gingerich, S.B., and Engott, J.A., 2012, Groundwater availability in the Lahaina District, West Maui, Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2012–5010, 90 p., accessed May 26, 2020, at https://pubs.usgs.gov/sir/2012/5010/.

Gingerich, S.B., Johnson, A.G., Rosa, S.N., Marineau, M.D., Wright, S.A., Hay, L.E., Widlansky, M.J., Jenson, J.W., Wong, C.I., Banner, J.L., Keener, V.W., and Finucane, M.L., 2019, Water resources on Guam—Potential impacts of and adaptive response to climate change: U.S. Geological Survey Scientific Investigations Report 2019–5095, 55 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20195095.

Gingerich, S.B., Voss, C.I., and Johnson, A.G., 2017, Seawater-flooding events and impact on freshwater lenses of low-lying islands—controlling factors, basic management and mitigation: Journal of Hydrology, v. 551, p. 676–688, accessed May 26, 2020, at https://doi.org/10.1016/j.jhydrol.2017.03.001.

Izuka, S.K., Engott, J.A., Rotzoll, K., Bassiouni, M., Johnson, A.G., Miller, L.D., and Mair, A., 2018, Volcanic aquifers of Hawai‘i—Hydrogeology, water budgets, and conceptual models (ver. 2.0, March 2018): U.S. Geological Survey Scientific Investigations Report 2015–5164, 158 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20155164.

Izuka, S.K., Perreault, J.A., and Presley, T.K., 2007, Areas contributing recharge to wells in the Tafuna-Leone Plain, Tutuila, American Samoa: U.S. Geological Survey Scientific Investigations Report 2007–5167, 51 p., accessed May 26, 2020, at https://pubs.usgs.gov/sir/2007/5167/.

Johnson, A.G., 2012, A water-budget model and estimates of groundwater recharge for Guam: U.S. Geological Survey Scientific Investigations Report 2012–5028, 53 p., accessed May 26, 2020, at https://pubs.usgs.gov/sir/2012/5028/.

Johnson, A.G., Engott, J.A., Bassiouni, M., and Rotzoll, K., 2018, Spatially distributed groundwater recharge estimated using a water-budget model for the Island of Maui, Hawai‘i, 1978–2007 (ver. 2.0, February 2018): U.S. Geological Survey Scientific Investigations Report 2014–5168, 53 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20145168.

Juvik, J.O., and Ekern, P.C., 1978, A climatology of mountain fog on Mauna Loa, Hawai‘i Island: University of Hawai‘i Water Resources Research Center Technical Report no. 118, 63 p., accessed May 26, 2020, at https://hdl.handle.net/10125/2006.

Lappala, E.G., Healy, R.W., and Weeks, E.P., 1987, Documentation of computer program VS2D to solve the equations of fluid flow in variably saturated porous media: U.S. Geological Survey Water-Resources Investigations Report 83–4099, 184 p., accessed April 12, 2021, at https://pubs.usgs.gov/wri/1983/4099/report.pdf.

Mair, A., Johnson A.G., Rotzoll, K., and Oki, D.S., 2019, Estimated groundwater recharge from a water-budget model incorporating selected climate projections, Island of Maui, Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2019–5064, 46 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20195064.

Markstrom, S.L., Regan, R.S., Hay, L.E., Viger, R.J., Webb, R.M.T., Payn, R.A., and LaFontaine, J.H., 2015, PRMS-IV, the precipitation-runoff modeling system, version 4: U.S. Geological Survey Techniques and Methods, book 6, chap. B7, 158 p, accessed April 12, 2021, at https://doi.org/10.3133/tm6B7.

McJannet, D., Wallace, J., Fitch, P., Disher, M., and Reddell, P., 2007, Water balance of tropical rainforest canopies in north Queensland, Australia: Hydrological Processes, v. 21, p. 3473–3484, accessed April 2, 2021, at https://doi.org/10.1002/hyp.6618.

Neitsch, S.L., Arnold, J.G., Kiniry, J.R., and Williams, J.R., 2011, Soil and water assessment tool theoretical documentation, version 2009: Texas Water Resources Institute Technical Report 406, 647 p., accessed April 12, 2021, at https://swat.tamu.edu/media/99192/swat2009-theory.pdf.

Oki, D.S., 2002, Reassessment of ground-water recharge and simulated ground-water availability for the Hawi area of North Kohala, Hawaii: U.S. Geological Survey Water-Resources Investigations Report 02–4006, 62 p., accessed May 26, 2020, at https://doi.org/10.3133/wri20024006.

Oki, D.S., 2008, The significance of accounting order for evapotranspiration and recharge in monthly and daily threshold-type water budgets: U.S. Geological Survey Scientific Investigations Report 2008–5163, 11 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20085163.

Oki, D.S., Engott, J.A., and Rotzoll, K., 2020, Numerical simulation of groundwater availability in central Moloka‘i, Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2019–5150, 95 p., accessed May 26, 2020, at https://doi.org/10.3133/sir20195150.

Oki, D.S., 2022, WATRMod, a Water-budget accounting for tropical regions model—source code, executable file, and example files: U.S. Geological Survey data release, https://doi.org/10.5066/P9VPAY41.

Scanlon, B.R., Healy, R.W., and Cook, P.G., 2002, Choosing appropriate techniques for quantifying groundwater recharge: Hydrogeology Journal, v. 10, p. 18–39, accessed March 29, 2021, at https://doi.org/10.1007/s10040-001-0176-2.

Thornthwaite, C.W., and Mather, J.R., 1955, The water balance: Publications in Climatology, v. 8, no. 1, p. 1–104, accessed May 26, 2020, at https://oregondigital.org/catalog/oregondigital:df70pr001#page/1/mode/1up.

Veihmeyer, F.J., and Hendrickson, A.H., 1955, Does transpiration decrease as soil moisture decreases?: Transactions of the American Geophysical Union, v. 36, p. 425–488, accessed May 26, 2020, at https://doi.org/10.1029/TR036i003p00425.

Appendixes 1–4

Appendix 1. Running WATRMod

The executable file for WATRMod (WATRMod1.exe) is available at https://doi.org/10.5066/P9VPAY41 (Oki, 2022). The model source code was compiled using Intel(R) Visual Fortran Intel(R) 64 for Windows, version 2021.2.0, Copyright 1985–2021. WATRMod can be executed (run) in a command window by typing the command WATRMod1 at the prompt. For WATRMod to run successfully, all input files must contain the required information (see appendix 2). One file with the required, immutable name WATRMOD.FIL must exist in the directory in which the command was initiated. This file (WATRMOD.FIL) contains a single line with the name of the main input file (100-character limit), which may be in another directory. Output files generated by WATRMod are described in appendix 3 and a simple circular-island example is provided in appendix 4.

Appendix 2. Input Files

WATRMod reads input files that contain the name of the main input file, time-invariant spatial information by subarea, land-cover information, soil characteristics, and time-varying spatial information related to the modeled processes (rainfall, fog interception, runoff, irrigation, and reference-surface evapotranspiration, ET_o). One file with the required name WATRMOD.FIL must exist in the directory in which the command to run the model was initiated. This required file contains the name and path of the main input file for WATRMod. The main input file lists the user-specified period of simulation, desired options for the simulation, and names of the remaining input files.

Many input files require monthly values. Input files with monthly values do not need to be limited by users to the period that will be simulated. The input files may contain monthly values for periods before and after the period that will be simulated. This capability allows the user to create common input files that can be used in separate simulations covering different periods. WATRMod will select the monthly values for the user-specified simulation years only. Input files with monthly values must contain values for complete calendar years (12 values per year): the first monthly value must be for January and the last monthly value must be for December.

WATRMOD.FIL, Required

The file with the required name WATRMOD.FIL must exist in the directory in which the command to run the model was initiated. This file contains only one line of information, the name of the main input file (100-character limit, no leading spaces) for the model. The main input file may reside in an arbitrary directory provided the full path of the directory is provided along with the main input file name.

Main Input File, Required

The main input file for the water-budget model contains information related to the simulation. The simulation-specific information includes the period of simulation, the accounting order for evapotranspiration and recharge in the water-budget computation, number and codes of land covers with specified constant recharge, number and codes of land covers made up of a mixture of two land covers, initial soil-moisture storage value (in fraction of soil-moisture storage capacity), built-surface interception capacity, and code values defining the methods for estimating daily canopy evaporation, rainfall, fog interception, irrigation, runoff, and ET_o. The main input file also contains the names of other input files (60-character limit, no leading spaces) required for the simulation and output file options. The following is an ordered list of information for each line of the main input file (each bullet in the list corresponds to one line in the main input file unless specified otherwise).

- Number of water-budget realizations desired (may be more than 1 if random process for monthly rainfall disaggregation desired and multiple realizations of the water budget are to be generated to develop a statistically representative, average rainfall temporal distribution) (integer, equal to or greater than 1)
- Number of years desired for each simulation realization (integer, equal to or greater than 1)
- Starting year of simulation (4-digit integer; must be 1901 or later)
- Accounting-order code for daily water-budget calculation (see “Accounting for Evapotranspiration before Recharge” and “Accounting for Recharge before Evapotranspiration” sections for descriptions) (integer code; 1=recharge before evapotranspiration; 2=evapotranspiration before recharge)
- Land-cover period code (desired integer code from 1 to 12, see description of subarea-specific input file that contains 12 land-cover period codes)
- Number of sugarcane land-cover codes (integer from 0 to 3; 0 if no sugarcane; maximum value is 3 codes)
- Land-cover codes for sugarcane (nonzero, positive integer land-cover codes with up to 3 codes separated by spaces on the line; enter a dummy value of 0 if no sugarcane represented)
- Number of land covers with constant recharge (integer; current maximum is 50,000); if the number of specified land covers with constant recharge is greater than zero, include that number of lines below, with each line corresponding to one of the land covers with constant recharge and containing the following four values per line (that is, include one line below for each land cover with constant recharge):
  - Land-cover code (nonzero, positive integer); constant recharge rate (inches per day); runoff multiplier (fractional value ranging from 0 to 1) to account for runoff from constant-recharge subarea (0=exclude runoff; 1=include 100 percent of runoff estimate); direct recharge multiplier (fractional value ranging from 0 to 1) to account for direct recharge in addition to constant recharge (0=exclude direct recharge; 1=include 100 percent of direct recharge)
- Number of land covers with mixed land-cover types (integer; maximum is 50,000); if the number of specified land covers with mixed land-cover types is greater than zero, include that number of lines below, with each line corresponding to one of the land covers with mixed land-cover types and containing the following five values per line (that is, include one line below for each land cover with mixed land-cover types):

- Land-cover code representing mixed land cover (nonzero, positive integer); land-cover code for first type of land cover (integer); fraction of subarea for first type of land cover (value ranging from 0 to 1); land-cover code for second type of land cover (integer); fraction of subarea for second type of land cover (value ranging from 0 to 1) (the sum of the two specified fractions must equal 1)
- Seed value for random number generator (integer)
- Common initial soil-moisture storage that is used for all subareas (in fraction of soil-moisture storage capacity; value ranging from 0 to 1)
- Depth of unvegetated or fallow areas for sugarcane land cover that contributes to evapotranspiration, in inches (a value must be entered even if no sugarcane land covers are specified, in which case an arbitrary value of 6 inches can be specified)
- Storm-drain code for built areas (integer code; 0=storm drains inactive, 1=storm drains active)
- Built surface interception capacity, in inches
- Canopy-interception method code (integer code; 1=Gash [1995] model; 2=linear relation between monthly fog interception and the monthly net-precipitation-to-rainfall ratio [equation 2]; 3=exponential relation between the inverse of daily precipitation and the daily net-precipitation-to-precipitation ratio [equation 3]; a value must be entered even if none of the land covers include a canopy, in which case an arbitrary value of 1 can be specified)
- Canopy-interception constant *A* or *C* (coefficient for canopy methods 2 and 3; **omit this line if canopy-interception method is 1**)
- Canopy-interception constant *B* or *D* (coefficient for canopy methods 2 and 3; **omit this line if canopy-interception method is 1**)
- Option code for limiting canopy evaporation plus root-zone evapotranspiration to potential evapotranspiration (*PE*) for the day (integer code; 0=no limit, which may be appropriate if *PE* excludes canopy evaporation; 1=limit, which may be appropriate if *PE* includes canopy evaporation)
- Total number of months represented in the monthly rainfall file (integer, greater than or equal to 12); value should be divisible by 12 corresponding to complete calendar years of monthly rainfall
- Starting year of monthly rainfall file (4-digit integer; must be 1901 or later)
- Selection method code for daily-to-monthly rainfall ratios (integer code; 0=random selection; 1=sequential, ordered selection)
- Total number of months represented in the monthly runoff-to-rainfall ratio file (integer, greater than or equal to 12); value should be divisible by 12 corresponding to complete calendar years of monthly runoff-to-rainfall ratios
- Starting year of monthly runoff-to-rainfall ratio file (4-digit integer; must be 1901 or later)
- Daily runoff estimation-method code (integer code; 0=monthly runoff is multiplied by the corresponding daily-to-monthly rainfall ratio, which is equivalent to assuming a uniform runoff-to-rainfall ratio during the month; 1=monthly runoff disaggregated using an ordered sequence of daily-to-monthly runoff-to-rainfall ratios defined for each month of simulation)
- Total number of months represented in the monthly ET_o files (integer, greater than or equal to 12); value should be divisible by 12 corresponding to complete calendar years of monthly ET_o
- Starting year of monthly ET_o file (4-digit integer; must be 1901 or later)
- Daily ET_o estimation-method code (integer code; 0=uniform distribution of daily ET_o in a month; 1=inverse linear relation between the daily-to-monthly rainfall ratio and the daily-to-monthly ET_o ratio [equation 6], with the daily-to-monthly ET_o ratios internally rescaled by WATRMod to sum to one for each month; 2=exponential relation between the daily-to-monthly rainfall ratio and the daily-to-monthly ET_o ratio [equation 7], with the daily-to-monthly ET_o ratios internally rescaled by WATRMod to sum to one for each month; 3=monthly ET_o disaggregated using an ordered sequence of daily-to-monthly ET_o ratios defined for each month of simulation)
- Minimum ratio of daily-to-monthly ET_o (value between 0 and 1) for daily ET_o estimation methods 1 or 2 (**omit this line if daily ET_o estimation method is 0 or 3**)
- Total number of months represented in the file containing monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions (integer, greater than or equal to 12); value should be divisible by 12 corresponding to complete calendar years of monthly data; **omit this line if canopy-interception method is 2 or 3**
- Starting year of file containing monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions (4-digit integer; must be 1901 or later; **omit this line if canopy-interception method is 2 or 3**)

- Estimation-method code for daily ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions for the Gash (1995) canopy-interception method (integer code; 0=constant daily ratio equal to the monthly ratio; 1=linear relation between daily rainfall and daily multiplier of the monthly ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions [equation 4]; 2=exponential relation between daily rainfall and daily multiplier of the monthly ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions [equation 5]; 3=sequential daily multipliers for each month of simulation; **omit this line if canopy-interception method is 2 or 3**)
- Coefficients *AR* and *BR* of relation used to estimate daily multipliers of the monthly ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions (coefficients *AR* and *BR*, separated by at least one space, of equations 4 and 5; **omit this line if the estimation method for daily ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions for the Gash [1995] canopy-interception method is 0 or 3**)
- Total number of months represented in the monthly fog-interception file (integer, greater than or equal to 12); value should be divisible by 12 corresponding to complete calendar years of monthly fog; if fog does not occur or is ignored, enter a dummy value equal to number of months represented in the monthly rainfall file. Note that a fog-interception file must be created even if no fog occurs, and the file should contain a single line of zeros (for a single fog zone) corresponding to zero monthly fog throughout the simulation period
- Starting year of monthly fog-interception file (4-digit integer; must be 1901 or later); if fog does not occur or is ignored, enter a dummy starting year equal to the starting year of the monthly rainfall file. Note that a fog-interception file must be created even if fog interception is ignored, and the fog-interception file should contain a single line of zeros (for single fog zone) corresponding to zero monthly fog throughout the simulation period
- Daily fog estimation-method code (integer code; 0=monthly fog-interception-to-rainfall ratios specified and used for each day of the month; 1=monthly fog-interception depth specified and disaggregated using daily-to-monthly rainfall ratios; 2=monthly fog-interception depth specified and disaggregated uniformly during the month (evenly apportioned to each day of the month); 3=monthly fog-interception depth specified and disaggregated using an ordered sequence of daily-to-monthly fog-interception ratios defined for each month of simulation)
- Total number of months represented in the monthly irrigation file (integer, greater than or equal to 12); value should be divisible by 12 corresponding to complete calendar years of monthly irrigation; if the irrigation process is ignored or all irrigation-estimation methods are demand based, enter a dummy value equal to number of months represented in the monthly rainfall file
- Starting year of monthly irrigation file (4-digit integer; must be 1901 or later); enter a dummy starting year equal to the starting year of the monthly rainfall file if the irrigation process is ignored or all irrigation-estimation methods are demand based
- Daily irrigation-estimation-method code for supply-based irrigation (0=ignore, no irrigation or demand based; 1=monthly supply evenly distributed on fixed days of the month, specified in the irrigation-parameter file, independent of rainfall; 2=monthly supply evenly distributed on those fixed days of the month, specified in the irrigation-parameter file, on which rainfall is less than a specified threshold; 3=monthly supply disaggregated using an ordered sequence of daily-to-monthly irrigation ratios defined for each month of simulation)
- Daily rainfall threshold above which irrigation is not applied, in inches (**include this line only if daily irrigation-estimation method 2 is used**)
- Printout interval for output file out04_WATRMod.sum4 (in terms of subarea frequency; for example, specifying 100 will result in output for every 100 subareas)
- Single printout code (0=no printout; 1= printout) for potentially large output files (out02_WATRMod.sum2, out03_WATRMod.sum3, and out08_WATRMod_FAO_subarea_mo_in.csv) containing average monthly water-budget-component values by subarea
- Sixteen space-delimited printout codes (0=no printout; 1= printout) on a single line for monthly output file out12_WATRMod_FAO_subarea_mo.sm; the 16 printout codes, in order, correspond to the following monthly components:

    1. average end-of-day soil moisture
    2. rainfall
    3. fog interception
    4. irrigation
    5. septic-system leachate

6. direct recharge
7. constant recharge
8. external-source water
9. runoff
10. canopy evaporation
11. storm-drain capture
12. reference-surface evapotranspiration
13. potential evapotranspiration
14. actual evapotranspiration
15. recharge
16. rejected infiltration

- Name of file containing subarea-specific information by numbered subarea (60-character limit)
- Name of file containing land-cover-specific information by land-cover code (60-character limit)
- Name of file containing available water capacity values by soil code (60-character limit)
- Name of file containing monthly rainfall by numbered zone, which could be a numbered grid cell (60-character limit)
- Name of file containing monthly rainfall adjustment factors by numbered zone, which could be a numbered grid cell (60-character limit)
- Name of file containing monthly runoff-to-rainfall ratios by numbered zone, which could be a numbered grid cell (60-character limit)
- Name of file containing monthly ET_o depth by numbered zone, which could be a numbered grid cell (60-character limit)
- Name of file containing monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions by numbered zone, which could be a numbered grid cell (60-character limit; **omit this line if canopy-interception method 2 or 3 is used**)
- Name of file containing monthly fog-interception data, in the form of monthly fog-interception-to-rainfall ratios or monthly fog-interception depth, by numbered zone, which could be a numbered grid cell (60-character limit)
- Name of file containing irrigation parameters by irrigated land-cover code (60-character limit); include a dummy file name if the irrigation process is ignored
- Name of file containing monthly supply-based irrigation depths by irrigated land-cover type (60-character limit; for all irrigated land covers using a demand-based irrigation-estimation method, monthly supply-based irrigation depths are set to zero for each month in this file; enter a dummy file name if the irrigation process is ignored)
- Name of file containing sugarcane crop-cycle information (60-character limit; **only include this line if the number of sugarcane land-cover codes is greater than zero**)
- Names of 13 files (one per line) containing daily-to-monthly rainfall ratios (fragments) for each month (60-character limit; **file 13 and month 13 correspond to leap-year February and are used if random selection of monthly sets of daily-to-monthly rainfall ratios is specified; if sequential selection of monthly sets of daily-to-monthly rainfall ratios is specified, file 13 can be a copy of the February file 2**)
- Names of 12 files (one per line) containing sequential daily-to-monthly ET_o ratios (fragments) (60-character limit; **only include these file names if daily ET_o estimation method code is 3**)
- Names of 12 files (one per line) containing sequential daily multipliers for the monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions by numbered zone, which could be a numbered grid cell, for each month of simulation (60-character limit; **only include these file names if the canopy-interception method code is 1 and the estimation method code for daily ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions is 3**)
- Names of 12 files (one per line) containing sequential daily-to-monthly runoff-to-rainfall-ratio ratios (fragments) (60-character limit; **only include these file names if daily runoff estimation-method code is 1**)
- Names of 12 files (one per line) containing sequential daily-to-monthly fog-interception ratios (fragments) (60-character limit; **only include these file names if daily fog estimation-method code is 3**)
- Names of 12 files (one per line) containing sequential daily-to-monthly irrigation ratios (fragments) (60-character limit; **only include these file names if daily irrigation-estimation-method code is 3**)

Subarea-Specific Input File, Required

The subarea-specific input file contains information for each subarea of the water budget. Each subarea of the water budget must be assigned a unique subarea-identification number. The file contains a separate line for each subarea, and each line of the file must contain the following space-delimited information (required information elements cannot be blank):

unique subarea-identification number; **area** (in square meters); **12 integer land-cover codes** (sequential) for 12 different land-cover scenarios (use zeros as place holders if less than 12 scenarios are specified); **nonzero, positive integer soil code**; **nonzero, positive integer zone number for monthly rainfall**; **nonzero, positive integer zone number for monthly runoff-to-rainfall ratios**; **nonzero, positive integer zone number for monthly ET_o**; **nonzero, positive integer zone number for monthly fog**; **nonzero, positive integer zone number for daily-to-monthly rainfall ratios (fragments)**; **nonzero, positive integer zone number for sequential daily multipliers of the monthly runoff-to-rainfall ratios** (enter 0 only if daily runoff estimation-method code is 0); **nonzero, positive integer zone number for sequential daily-to-monthly ET_o ratios** (enter 0 only if daily ET_o estimation method code is 0, 1, or 2); **nonzero, positive integer zone number for sequential daily-to-monthly fog ratios** (enter 0 only if daily fog estimation-method code is 0, 1, or 2); **nonzero, positive integer zone number for sequential daily-to-monthly irrigation ratios** (enter 0 only if daily irrigation-estimation-method code is 0, 1, or 2); **integer aquifer-system code** (integer identifier code for potential spatial grouping of subareas); **storm-drain code** (integer code; 0=no storm drains; 1=storm drains); **plantation code** (integer code; 0=nonsugarcane; 1 or higher sequential integer for sugarcane); **field number** (integer code; 0=nonsugarcane; 1 or higher sequential integer for each plantation for sugarcane); **direct-recharge rate for watermain leakage** (in inches per day, expressed as a depth over the entire subarea); **direct-recharge rate for disposal/injection wells** (in million gallons per day); **direct-recharge rate for cesspools** (in inches per day, expressed as a depth over the entire subarea); **septic-system leaching rate** (in inches per day expressed as a depth over the unbuilt, pervious fraction of the subarea); **fraction of subarea's area that is pervious (not built)** (value ranging from greater than 0 to 1); **soil infiltration capacity** (in inches per day); **fraction of canopy cover** (value ranging from 0 to 1, enter 0 if canopy-interception method code is 2 or 3); **fraction of precipitation diverted to stemflow** (value ranging from 0 to 1, enter 0 if canopy-interception method code is 2 or 3); **nonzero, positive integer zone number for monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions** (enter 0 only if the canopy-interception method code is 2 or 3); **nonzero, positive integer zone number for sequential daily multipliers for the monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions** (enter 0 only if the canopy-interception method code is 2 or 3 or if the estimation method code for daily ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions is 0, 1, or 2).

The subarea-specific input file contains user-assigned numbered values for different zones or codes. For example, monthly rainfall zones might include numbered zone values between 3 and 40,000 in the subarea-specific input. Information for each numbered value for each zone or code in the subarea-specific input file is obtained by WATRMod from one of the remaining input files.

WATRMod was designed to read input files in a way that may reduce the amount of effort users need to prepare model inputs files: information for numbered zones or codes not included in the subarea-specific input file can be included in the remaining input files. For example, the monthly rainfall input file can include monthly rainfall values for monthly rainfall zones that are outside the user's study area.

Land-Cover Input File, Required

The land-cover input file contains land-cover-specific information for each unique land-cover code. Mixed land-cover types must be assigned a land-cover code in this file, although the remaining land-cover-specific information associated with the assigned mixed land-cover code may be arbitrary because the land-cover-specific information will be defined by the component land covers that form the mixture. Each line of the land-cover input file must contain the following space-delimited information (required information elements cannot be blank):
land-cover code (integer code, must start with 1 and be sequentially ordered but not all codes need to be used in the water budget); **root depth** (in inches); **fog-catch efficiency** (value ranging from 0 to 1); **irrigation code** (integer code, 0=unirrigated; 1 or higher=irrigated); **storm-drain code** (integer code; 0=no storm drains; 1=storm drains); **canopy-interception capacity** (in inches; enter a nonzero value if the land cover contains a canopy from which evaporation is to be calculated by WATRMod (typically for tree or shrub land covers) or enter 0 if the land cover does not require canopy evaporation to be computed); **trunk-interception capacity** (in inches; enter 0 if canopy-interception method is 2 or 3, or land cover is not tree or shrub); **depletion fraction** for *PE* rate of 5 millimeters per day (see Allen and others, 1998, table 22); **12 monthly (Jan–Dec) crop coefficients** (enter 12 zeros for sugarcane land cover); **4 sugarcane crop coefficients for 4 growth periods** (crop coefficient 1 for initial growth stage, enter 0 for non-sugarcane land cover; crop coefficient 2 for middle growth stage, enter 0 for non-sugarcane land cover; crop coefficient 3 for ending growth stage, enter 0 for non-sugarcane land cover; crop coefficient 4 for fallow stage, enter 0 for non-sugarcane land cover); **number of days in initial sugarcane growth stage** (enter 0 for non-sugarcane land cover); **number of days in sugarcane developmental growth stage** (enter 0 for non-sugarcane land cover); **number of days in sugarcane middle growth stage** (enter 0 for non-sugarcane land cover); **number of days in late sugarcane growth stage** (enter 0 for non-sugarcane land cover); **number of fallow days following sugarcane harvest** (enter 0 for non-sugarcane land cover). The growth-stage-dependent crop coefficients for sugarcane are computed as follows (see fig. 4):

- stage 1, initial growth stage, constant crop coefficient 1

- stage 2, developmental growth stage, linearly interpolate between crop coefficients 1 and 2
- stage 3, middle growth stage, constant crop coefficient 2
- stage 4, late growth stage, linearly interpolate between crop coefficients 2 and 3
- stage 5, fallow stage, constant crop coefficient 4.

Available Water-Capacity Input File, Required

The available water-capacity input file contains soil-specific information for each unique soil code that identifies the soil type. Required soil information for WATRMod is available from the U.S. Department of Agriculture, Natural Resources Conservation Service Soil Survey Geographic database (https://websoilsurvey.nrcs.usda.gov/). Each line of the available water-capacity input file must contain the following space-delimited information (required information elements cannot be blank):
soil code (nonzero, positive integer code, must be sequentially ordered but not all codes need to be used in the water budget, and a soil code can be repeated for soil types with multiple components or horizons); **soil component number** (nonzero, positive integer code, sequential and can be repeated for soil components with multiple horizons); **fraction of area represented by the soil component** (0–1); **horizon or layer number** (nonzero, positive integer code, sequential); **depth for top of horizon** (in inches); **depth for bottom of horizon** (in inches); **available water capacity** (dimensionless).

For each soil component of a soil code, WATRMod computes a depth-weighted average available water capacity within the plant-root zone using the depth interval (defined by the top and bottom depths for the horizon) and available water capacity of each soil horizon within the plant-root zone. For each soil code, WATRMod then computes an area-weighted average available water capacity using the fractional area and depth-weighted average available water capacity of each soil component.

Monthly Rainfall Input File, Required

The monthly rainfall input file contains rainfall information for each unique rainfall zone or grid cell. Each line of the monthly rainfall input file must contain the following space-delimited information (required information elements cannot be blank):
monthly rainfall zone number (nonzero, positive integer code); **monthly rainfall values** (in inches, expressed as a depth over the entire area of the zone; the number of monthly rainfall values on each line should correspond to the total number of months specified in the main input file for the monthly rainfall input file and must include the months contained in the user-specified period of simulation). The monthly rainfall dataset should have complete calendar years of data.

Monthly Rainfall Adjustment-Factor Input File, Required

The monthly rainfall adjustment-factor input file contains information for each unique rainfall zone or grid cell. For each monthly rainfall zone, the model computes monthly rainfall as the product of (1) the monthly rainfall value specified in the monthly rainfall input file, and (2) the corresponding mean monthly rainfall adjustment factor. The mean monthly rainfall adjustment factors may be set to 1 if specified monthly rainfall values require no adjustments. Monthly rainfall adjustments may be desired for cases in which, for example, the average of the monthly rainfall values during a simulation period does not equal a desired average monthly value. Each line of the monthly rainfall adjustment-factor input file must contain the following space-delimited information (required information elements cannot be blank):
Monthly rainfall zone number (nonzero, positive integer code; must correspond to the same zones as in the monthly rainfall input file); **12 mean monthly rainfall-adjustment factors** (January to December rainfall-adjustment factors).

Monthly Runoff-to-Rainfall Ratio Input File, Required

The monthly runoff-to-rainfall ratio input file contains information for each unique runoff zone. Each line of the monthly runoff-to-rainfall ratio input file must contain the following space-delimited information (required information elements cannot be blank):
monthly runoff zone number (nonzero, positive integer code); **monthly runoff-rainfall ratio values** (the number of dimensionless monthly runoff-rainfall ratio values on each line should correspond to the total number of months specified in the main input file for the monthly runoff-rainfall ratio input file and must include the months contained in the user-specified period of simulation). The monthly runoff-rainfall ratio dataset should have complete calendar years of data.

Monthly Reference-Surface Evapotranspiration Input File, Required

The monthly reference-surface evapotranspiration (ET_o) input file contains information for each unique ET_o zone. Each line of the monthly ET_o input file must contain the following space-delimited information (required information elements cannot be blank):
monthly ET_o zone number (nonzero, positive integer code); **monthly ET_o values** (in inches, expressed as a depth over the entire area of the zone; the number of monthly ET_o values on each line should correspond to the total number of months specified in the main input file for the monthly ET_o input file and must include the months contained in the user-specified

period of simulation). The monthly ET_o dataset should have complete calendar years of data.

Monthly $\overline{E} / \overline{R}$ Input File

This input file is omitted if the canopy-interception method code is 2 or 3. The input file with monthly ratios of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions, $\overline{E} / \overline{R}$, contains information for each unique $\overline{E} / \overline{R}$ zone. Each line of the monthly $\overline{E} / \overline{R}$ input file must contain the following space-delimited information (required information elements cannot be blank):
monthly $\overline{E} / \overline{R}$ zone number (nonzero, positive integer code); **monthly $\overline{E} / \overline{R}$ values** (dimensionless) (the number of monthly $\overline{E} / \overline{R}$ values on each line should correspond to the total number of months specified in the main input file for the monthly $\overline{E} / \overline{R}$ input file and must include the months contained in the user-specified period of simulation). The monthly $\overline{E} / \overline{R}$ dataset should have complete calendar years of data.

Monthly Fog Input File

The monthly fog input file contains information for each unique fog zone. Monthly fog values in this input file may be in the form of either monthly fog-interception-to-rainfall ratios (for daily fog estimation-method code of 0) or monthly fog-interception depths (for daily fog estimation-method codes greater than 0). Each line of the monthly fog input file must contain the following space-delimited information (required information elements cannot be blank):
fog zone number (nonzero, positive integer code); **monthly fog values** (monthly fog values are either dimensionless fog-interception-to-rainfall ratios or fog-interception depths in inches, expressed as a depth over the entire area of the zone; the number of monthly fog values on each line should correspond to the total number of months specified in the main input file for the monthly fog input file and must include the months contained in the user-specified period of simulation). The monthly fog dataset should have complete calendar years of data.

Irrigation Parameter Input File

The irrigation parameter input file contains information for each irrigation code defined in the land-cover input file (one line per irrigation code). For model scenarios that ignore the irrigation process, the irrigation parameter input file may be omitted, but a dummy file name must be included in the main input file. For model scenarios that consider irrigation, each line of the irrigation parameter input file must contain the following space-delimited information (required information elements cannot be blank):
irrigation code (sequential nonzero, positive integer code corresponding to the irrigation code in the land-cover input file); **irrigation-estimation-method code** (integer code; 1=demand-based estimation method; 2=supply-based method); **irrigation-estimation interval code** (integer code; 0=monthly estimation interval; 1=daily estimation interval); **irrigation-estimation multiplier** (factor used to adjust irrigation volume); **irrigation method efficiency** (0–1); **31 irrigation application codes corresponding to each day of a generic month** (integer code; 0=no irrigation applied on the day; 1=irrigation applied on the day).

Monthly Irrigation Input File

For model scenarios that ignore the irrigation process, the monthly irrigation input file may be omitted, but a dummy file name must be included in the main input file. For model scenarios that consider irrigation, the monthly irrigation input file contains supply-based irrigation values for each irrigation-method code defined in the land-cover and irrigation parameter input files (one line per irrigation code), regardless of whether the irrigation-estimation-method code is 1 or 2 (demand- or supply-based method). For irrigation codes associated with a demand-based estimation method, the supply-based irrigation values may be arbitrarily assigned values of zero. Each line of the monthly irrigation input file must contain the following space-delimited information (required information elements cannot be blank):
irrigation code (sequential nonzero, positive integer code corresponding to the irrigation code in the land-cover input file and in the same order as in the irrigation parameter input file); **monthly supply-based irrigation values** (in inches, expressed as a depth over the unbuilt fraction of the subarea; the number of monthly irrigation values on each line should correspond to the total number of months specified in the main input file for the monthly irrigation input file and must include the months contained in the user-specified period of simulation; arbitrary supply-based irrigation values of 0 can be specified for irrigation codes that represent demand-based irrigation methods). The monthly irrigation dataset should have complete calendar years of data.

Sugarcane Parameter Input File

This file is omitted if sugarcane cultivation is not being simulated. The sugarcane parameter input file contains information for each sugarcane code defined in the main input file (one line per sugarcane code in the same order as in the main input file; maximum of 3 codes). Each line of the sugarcane parameter input file must contain the following space-delimited information (required information elements cannot be blank):

length of irrigation period (integer number of days); **length of non-irrigation period** (integer number of days); **length of fallow period** (integer number of days); **initial day of planting for field group 1** (integer day of the crop cycle); **initial day of planting for field group 2** (integer day of the crop cycle); **initial tolerance** (0–0.5; allowable error for randomly selecting fields in a plantation such that 50 percent of the sugarcane-field area is in field group 1). For each sugarcane code, the values for the required information elements currently must be the same, which is a limitation.

Daily-To-Monthly Rainfall Ratio (Fragment) Input Files, Required

The daily-to-monthly rainfall ratio input files (13 files) contain information for each daily-to-monthly rainfall ratio zone. A separate file is required for each of the 12 months of the year, and a 13th file is used to represent the daily-to-monthly rainfall ratios for leap-year February months, mainly needed if the method code for daily-to-monthly rainfall ratios is 0 (random selection of the monthly sets of daily-to-monthly rainfall ratios). The format of the files containing monthly sets of daily-to-monthly rainfall ratios for February months (for leap years and non-leap years) is as follows. If the method code for selection of daily-to-monthly rainfall ratios is 0 (corresponding to random selection of the monthly sets of daily-to-monthly rainfall ratios), then the non-leap-year February input file may have either 28 or 29 daily-to-monthly rainfall ratios for each month (WATRMod will read only the first 28 ratios and, if needed, adjust each set's ratios such that they sum to 1, although the user is responsible for verifying that the first 28 ratios contain at least one nonzero value), and the 13th input file for leap-year February must have 29 daily-to-monthly rainfall ratios for each month. If the method code for selection of daily-to-monthly rainfall ratios is 1 (corresponding to ordered, sequential selection of the monthly sets of daily-to-monthly rainfall ratios), then the February input file could have either 28 or 29 daily-to-monthly rainfall ratios for each month arranged in an ordered sequence of months and the 13th file must be present but is not used and can be identical to the non-leap-year February file. Each set of daily-to-monthly rainfall ratios for a zone and month must sum to 1 and therefore may not contain only zeros. This does not preclude simulating months with zero rainfall if the monthly rainfall input file contains zero values in the simulation period. Each line of a daily-to-monthly rainfall ratio input file must contain the following space-delimited information (required information elements cannot be blank):
month number (1–13, with month 13 representing leap-year February); **daily-to-monthly rainfall ratio (fragment) zone number** (nonzero, positive integer code); **sequential number of daily-to-monthly rainfall ratio set for the zone** (sequential nonzero, positive integer code; the sequential number is a 4-digit year (must be 1901 or later) if the method code for selection of daily-to-monthly rainfall ratios is 1); **31 daily-to-monthly rainfall ratios (fragments)** (pad with dummy "999" or "9999" values if the month has less than 31 days).

Daily-To-Monthly ET_o Ratio (Fragment) Input Files

These files are omitted if the daily ET_o estimation-method code from the main input file is 0, 1, or 2. The daily-to-monthly ET_o ratio input files (12 files) contain information for each daily-to-monthly ET_o ratio zone. A separate file is required for each of the 12 months of the year. Because this file is only required if the estimation-method code for the daily-to-monthly ET_o ratios is 3 (corresponding to ordered, sequential selection of the monthly sets of daily-to-monthly ET_o ratios), the February input file could have either 28 or 29 daily-to-monthly ET_o ratios for each month arranged in an ordered sequence of months. For each monthly set of daily-to-monthly ET_o ratios, the values must sum to 1. Thus, a monthly set with only zeros cannot be included. Each line of a daily-to-monthly ET_o ratio input file must contain the following space-delimited information (required information elements cannot be blank):
month number (1–12); **daily-to-monthly ET_o ratio (fragment) zone number** (nonzero, positive integer code); **sequential year of daily-to-monthly ET_o ratio set for the zone** (4-digit year; must be 1901 or later); **31 daily-to-monthly ET_o ratios (fragments)** (pad with dummy "999" or "9999" values if the month has less than 31 days).

Daily $\overline{E} / \overline{R}$ Multiplier Input Files

These files are omitted if the daily $\overline{E} / \overline{R}$ estimation-method code from the main input file is 0, 1, or 2. The daily $\overline{E} / \overline{R}$ multiplier input files (12 files) contain information for each daily $\overline{E} / \overline{R}$ multiplier zone. A separate file is required for each of the 12 months of the year. Because this file is only required if the estimation-method code for the daily $\overline{E} / \overline{R}$ multiplier values is 3 (corresponding to ordered, sequential selection of the monthly sets of daily $\overline{E} / \overline{R}$ multipliers), the February input file could have either 28 or 29 daily $\overline{E} / \overline{R}$ multipliers for each month arranged in an ordered sequence of months. Each line of a daily $\overline{E} / \overline{R}$ multiplier input file must contain the following space-delimited information (required information elements cannot be blank):
month number (1–12); **daily $\overline{E} / \overline{R}$ multiplier zone number** (nonzero, positive integer code); **sequential year of daily $\overline{E} / \overline{R}$ multiplier set for the zone** (4-digit year; must be 1901 or later); **31 daily $\overline{E} / \overline{R}$ multipliers** (pad with dummy "999" or "9999" values if the month has less than 31 days).

Daily-To-Monthly Runoff Ratio (Fragment) Input Files

These files are omitted if the daily runoff estimation-method code from the main input file is 0. The daily-to-monthly runoff ratio input files (12 files) contain information for each daily-to-monthly runoff ratio zone. A separate file is required for each of the 12 months of the year. Because this file is only required if the estimation-method code for the daily-to-monthly runoff ratios is 1 (corresponding to ordered, sequential selection of the monthly sets of daily-to-monthly runoff ratios), the February input file could have either 28 or 29 daily-to-monthly runoff ratios for each month arranged in an ordered sequence of months. For each monthly set of daily-to-monthly runoff ratios, the values must sum to 1. Thus, a monthly set with only zeros cannot be included. Each line of a daily-to-monthly runoff ratio input file must contain the following space-delimited information (required information elements cannot be blank):
month number (1–12); **daily-to-monthly runoff ratio (fragment) zone number** (nonzero, positive integer code); **sequential year of daily-to-monthly runoff ratio set for the zone** (4-digit year; must be 1901 or later); **31 daily-to-monthly runoff ratios (fragments)** (pad with dummy "999" or "9999" values if the month has less than 31 days).

Daily-To-Monthly Fog-Interception Ratio (Fragment) Input Files

These files are omitted if the daily fog estimation-method code from the main input file is 0, 1, or 2. The daily-to-monthly fog-interception ratio input files (12 files) contain information for each daily-to-monthly fog-interception ratio zone. A separate file is required for each of the 12 months of the year. Because this file is only required if the estimation-method code for the daily-to-monthly fog-interception ratios is 3 (corresponding to ordered, sequential selection of the monthly sets of daily-to-monthly fog-interception ratios), the February input file could have either 28 or 29 daily-to-monthly fog-interception ratios for each month arranged in an ordered sequence of months. For each monthly set of daily-to-monthly fog-interception ratios, the values must sum to 1. Thus, a monthly set with only zeros cannot be included. Each line of a daily-to-monthly fog-interception ratio input file must contain the following space-delimited information (required information elements cannot be blank):
month number (1–12); **daily-to-monthly fog-interception ratio (fragment) zone number** (nonzero, positive integer code); **sequential year of daily-to-monthly fog-interception ratio set for the zone** (4-digit year; must be 1901 or later); **31 daily-to-monthly fog-interception ratios (fragments)** (pad with dummy "999" or "9999" values if the month has less than 31 days).

Daily-To-Monthly Irrigation Ratio (Fragment) Input Files

These files are omitted if the daily irrigation-estimation-method code from the main input file is 0, 1, or 2. The daily-to-monthly irrigation ratio input files (12 files) contain information for each daily-to-monthly irrigation ratio zone. A separate file is required for each of the 12 months of the year. Because this file is only required if the estimation-method code for the daily-to-monthly irrigation ratios is 3 (corresponding to ordered, sequential selection of the monthly sets of daily-to-monthly irrigation ratios), the February input file could have either 28 or 29 daily-to-monthly irrigation ratios for each month arranged in an ordered sequence of months. For each monthly set of daily-to-monthly irrigation ratios, the values must sum to 1. Thus, a monthly set with only zeros cannot be included. Each line of a daily-to-monthly irrigation ratio input file must contain the following space-delimited information (required information elements cannot be blank):
month number (1–12); **daily-to-monthly irrigation ratio (fragment) zone number** (nonzero, positive integer code); **sequential year of daily-to-monthly irrigation ratio set for the zone** (4-digit year; must be 1901 or later); **31 daily-to-monthly irrigation ratios (fragments)** (pad with dummy "999" or "9999" values if the month has less than 31 days).

Appendix 3. Output Files

WATRMod generates up to 12 output files that contain different summaries of the water-budget results. Descriptions of each of the output files are provided in this appendix. The names of the output files are automatically assigned by WATRMod. The user may rename the files upon completion of the simulation. In the main input file, model users can specify whether the model should generate four optional and potentially large output files (out02_WATRMod.sum2, out03_WATRMod.sum3, out08_WATRMod_FAO_subarea_mo_in.csv, and out12_WATRMod_FAO_subarea_mo.sm).

out01_WATRMod.sum1

The main output file contains information that was provided in the main input file and also summarizes the water-budget components over the entire water-budget area for each simulation realization requested, expressed as a cumulative average computed after each simulation realization. The water-budget components summarized at the bottom of this output file (header labels used in the output file are shown here in parentheses; the label "Sim." indicates the simulation realization number), in terms of million gallons per day, are rainfall (Rainfall); fog interception (Fog); irrigation (Irrig.); septic-system leachate (Septic); direct recharge (Direct recharge); constant recharge (Constant recharge); sum of direct recharge and constant recharge (Direct recharge+); run on from built surfaces to unbuilt surfaces (Runon); external-source water needed to account for constant recharge (External source); runoff (Runoff); canopy evaporation (Canopy evap.); net precipitation (Net Precip.); storm-drain capture (Storm drain); reference-surface evapotranspiration (ETo); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Veihmeyer and Hendrickson (1955) model (Veihmeyer AE); total recharge for the Veihmeyer and Hendrickson (1955) model (Veihmeyer Recharge); rejected infiltration for the Veihmeyer and Hendrickson (1955) model (Veihmeyer Rejected); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Allen and others (1998) model (FAO 56 AE); total recharge for the Allen and others (1998) model (FAO 56 Recharge); rejected infiltration for the Allen and others (1998) model (FAO 56 Rejected); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Thornthwaite and Mather (1955) model (Thornthwaite AE); total recharge for the Thornthwaite and Mather (1955) model (Thornthwaite Recharge); rejected infiltration for the Thornthwaite and Mather (1955) model (Thornthwaite Rejected). The last three water-budget components (actual evapotranspiration, total recharge, and rejected infiltration) are determined for three different threshold soil-moisture content approaches (Veihmeyer and Hendrickson, 1955; Allen and others, 1998; Thornthwaite and Mather, 1955). The FAO 56 results in this file correspond to the output generated using the model of Allen and others (1998).

out02_WATRMod.sum2

This summary output file, which is optional, lists mean monthly water-budget components (in inches) for each subarea (polygon). The first three lines of this file are header lines. Each of the remaining lines lists the following information and monthly water-budget components, in inches (the header labels used in the output file are shown here in parentheses): month (Mo); unique subarea number (Poly-id); land-cover code (LC); monthly rainfall zone number (RF_zone); aquifer code (Aquifer); area in square meters (Area_m^2); rainfall (Rain); fog interception (Fog); irrigation (Irrig.); septic-system leachate (Septic); direct recharge from watermains, disposal wells, and cesspools (Dir_rc); user-specified constant recharge (Cnst_rc); sum of direct recharge and constant recharge (Dir_rc+); run on from built to unbuilt part of the subarea (Runon); external-source water input for balancing constant recharge (Ext_src); runoff (Runoff); canopy evaporation (Can_evp); net precipitation (Pnet); storm-drain capture (St_drn); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Veihmeyer and Hendrickson (1955) model (AE1); total recharge for the Veihmeyer and Hendrickson (1955) model (Tot_rc1); rejected infiltration for the Veihmeyer and Hendrickson (1955) model (Rej1); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Allen and others (1998) model (AE2); total recharge for the Allen and others (1998) model (Tot_rc2); rejected infiltration for the Allen and others (1998) model (Rej2); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Thornthwaite and Mather (1955) model (AE3); total recharge for the Thornthwaite and Mather (1955) model (Tot_rc3); rejected infiltration for the Thornthwaite and Mather (1955) model (Rej3).

out03_WATRMod.sum3

This summary output file, which is optional, lists mean monthly water-budget components (in inches) for each sugarcane subarea (polygon). The first three lines of this file are header lines. Each of the remaining lines lists the following information and monthly water-budget components (the header labels used in the output file are shown here in parentheses): month (Mo); unique subarea number (Poly-id); land-cover code (LC); field number (Field); planting stage (1 or 2) (Stage); area in square meters (Area_m^2); rainfall (Rain); fog interception (Fog); irrigation (Irrig.); septic-system leachate (Septic); direct recharge from watermains, disposal wells, and cesspools (Dir_rc); user-specified constant recharge (Cnst_rc); sum of direct recharge and constant recharge (Dir_rc+); run on from built to unbuilt part of the subarea (Runon); external-source water input for balancing constant recharge (Ext_src); runoff (Runoff); canopy evaporation (Can_evp); net precipitation (Pnet); storm-drain capture (St_drn); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Veihmeyer and Hendrickson (1955) model (AE1); total recharge for the Veihmeyer and Hendrickson (1955) model (Tot_rc1); rejected infiltration for the Veihmeyer and Hendrickson (1955) model (Rej1); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Allen and others (1998) model (AE2); total recharge for the Allen and others (1998) model (Tot_rc2); rejected infiltration for the Allen and others (1998) model (Rej2); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Thornthwaite and Mather (1955) model (AE3); total recharge for the Thornthwaite and Mather (1955) model (Tot_rc3); rejected infiltration for the Thornthwaite and Mather (1955) model (Rej3).

out04_WATRMod.sum4

This summary output file lists period-cumulative water-budget components for selected subareas (output at a user-specified subarea frequency) for each simulation realization, in inches. The first three lines of this file are header lines. Each of the next lines lists the following information and cumulative water-budget components (the header labels used in the output file are shown here in parentheses): simulation realization number (Sim); number of years in the simulation (Yrs); unique subarea number (Poly); area in square meters (Area_m^2); land-cover code (LC); soil code (Soil); soil-moisture storage capacity (SMC); fraction of subarea that is unbuilt (Perv); rainfall (Rain); Fog_interception (Fog); irrigation (Irrig.); septic-system leachate (Septic); direct recharge from watermains, disposal wells, and cesspools (Dir_rc); user-specified constant recharge (Cnst_rc); sum of direct recharge and constant recharge (Dir_rc+); run on from built to unbuilt part of the subarea (Runon); external-source water input for balancing constant recharge (Ext_src); runoff (Runoff); canopy evaporation (Can_evp); net precipitation (Pnet); storm-drain capture (St_drn); reference-surface evapotranspiration (ETo); ratio of potential evapotranspiration rate to reference-surface evapotranspiration rate (PE/ETo); initial soil-moisture storage for the Veihmeyer and Hendrickson (1955) model (SM1i); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Veihmeyer and Hendrickson (1955) model (AE1); total recharge for the Veihmeyer and Hendrickson (1955) model (Tot_rc1); rejected infiltration for the Veihmeyer and Hendrickson (1955) model (Rej1); final soil-moisture storage for the Veihmeyer and Hendrickson (1955) model (SM1f); water-budget closure error for the Veihmeyer and Hendrickson (1955) model (Err.1); initial soil-moisture storage for the Allen and others (1998) model (SM2i); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Allen and others (1998) model (AE2); total recharge for the Allen and others (1998) model (Tot_rc2); rejected infiltration for the Allen and others (1998) model (Rej2); final soil-moisture storage for the Allen and others (1998) model (SM2f); water-budget closure error for the Allen and others (1998) model (Err.2); initial soil-moisture storage for the Thornthwaite and Mather (1955) model (SM3i); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation, for the Thornthwaite and Mather (1955) model (AE3); total recharge for the Thornthwaite and Mather (1955) model (Tot_rc3); rejected infiltration for the Thornthwaite and Mather (1955) model (Rej3); final soil-moisture storage for the Thornthwaite and Mather (1955) model (SM3f); water-budget closure error for the Thornthwaite and Mather (1955) model (Err.3).

out05_WATRMod.fields

This diagnostic output file lists the planting stage for each plantation and field and is empty for model simulations with no sugarcane.

out06_WATRMod.smc

This output file lists the depth-weighted average soil moisture storage capacity for each subarea. This output file has no header lines. Each line of the output file contains the unique subarea number and the corresponding soil moisture storage capacity, in inches.

out07_WATRMod_FAO_annrech_in.csv

This comma-delimited output file lists the annual recharge, averaged over all the simulation realizations, by subarea. The first line is a header line. Each of the next lines contains the unique subarea number, the chronologically ordered annual recharge values, and the mean annual recharge value. All recharge values are in inches and are for the Allen and others (1998) model.

out08_WATRMod_FAO_subarea_mo_in.csv

This comma-delimited output file, which is optional, lists the mean monthly water-budget components, in inches, averaged over all the simulation realizations, by subarea. The first line is a header line (the header labels used in the output file are shown here in parentheses in the next sentence). Each of the next lines contains the unique subarea number (Poly_ID); January rainfall (1Rain); January fog interception (1Fog); January irrigation (1Irrig.); January septic-system leachate (1Septic); January direct recharge (1Dir_rc); January constant recharge (1Cnst_rc); January sum of direct recharge and constant recharge (1Dir_rc+); January run on from built to unbuilt part of the subarea (1Runon); January external-source water needed to balance the constant recharge (1Ext_src); January runoff (1Runoff); January canopy evaporation (1Can_evp); January net precipitation (1Pnet); January storm-drain capture (1St_drn); January actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation (1AE); January total recharge (1Tot_rc); January rejected infiltration (1Rej); February rainfall (2Rain); February fog interception (2Fog); February irrigation (2Irrig.); February septic-system leachate (2Septic); February direct recharge (2Dir_rc); February constant recharge (2Cnst_rc); February sum of direct recharge and constant recharge (2Dir_rc+); February run on from built to unbuilt part of the subarea (2Runon); February external-source water needed to balance the constant recharge (2Ext_src); February runoff (2Runoff); February canopy evaporation (2Can_evp); February net precipitation (2Pnet); February storm-drain capture (2St_drn); February actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation (2AE); February total recharge (2Tot_rc); February rejected infiltration (2Rej); and so on for the water-budget components for March to December. Water-budget components repeated for March to December have header labels reflecting the month number (3−12). All output values are for the Allen and others (1998) model.

out09_WATRMod_FAO_subarea_ann_in.csv

This comma-delimited output file lists the mean annual water-budget components, in inches, averaged over all the simulation realizations, by subarea. The first line is a header line (the header labels used in the output file are shown here in parentheses in the next sentence). Each of the next lines contains the unique subarea number (Poly_ID); rainfall (Rain); fog interception (Fog); irrigation (Irrig.); septic-system leachate (Septic); direct recharge (Dir_rc); constant recharge (Cnst_rc); sum of direct recharge and constant recharge (Dir_rc+); run on from built to unbuilt part of the subarea (Runon); external-source water needed to balance the constant recharge (Ext_src); runoff (Runoff); canopy evaporation (Can_evp); net precipitation (Pnet); storm-drain capture (St_drn); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation (AE); total recharge (Tot_rc); rejected infiltration (Rej). All output values are for the Allen and others (1998) model.

out10_WATRMod_FAO_totarea_mo_MGD.out

This space-delimited output file lists the mean monthly water-budget components, in million gallons per day, averaged over all simulation realizations over the entire study area. The first line is a header line (the header labels used in the output file are shown here in parentheses in the next sentence). Each of the next lines contains the month (Mo); rainfall (Rain); fog interception (Fog); irrigation (Irrig); septic-system leachate (Septic); direct recharge (Dir_rc); constant recharge (Cnst_rc); sum of direct recharge and constant recharge (Dir_rc+); run on from built part to unbuilt part of the subareas (Runon); external-source water needed to balance constant recharge (Ext_src); runoff (Runoff); canopy evaporation (Can_evp); net precipitation (Pnet); storm-drain capture (St_drn); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation (AE); total recharge (Tot_rc); rejected infiltration (Rej). All output values are for the Allen and others (1998) model.

out11_WATRMod_FAO_totarea_ann_MGD.out

This space-delimited output file lists the mean annual water-budget components, in million gallons per day, averaged over all simulation realizations over the entire study area. The first line is a header line (the header labels used in the output file are shown here in parentheses in the next sentence). The next line contains the rainfall (Rain); fog interception (Fog); irrigation (Irrig); septic-system leachate (Septic); direct recharge (Dir_rc); constant recharge (Cnst_rc); sum of direct recharge and constant recharge (Dir_rc+); run on from built part to unbuilt part of the subareas (Runon); external-source water needed to balance constant recharge (Ext_src); runoff (Runoff); canopy evaporation (Can_evp); net precipitation (Pnet); storm-drain capture (St_drn); actual evapotranspiration derived from the plant-root zone, exclusive of canopy evaporation (AE); total recharge (Tot_rc); rejected infiltration (Rej). All output values are for the Allen and others (1998) model.

out12_WATRMod_FAO_subarea_mo.sm

This space-delimited output file, which is optional, lists the monthly water-budget components specified by the user for each subarea and month of simulation. The 16 possible water-budget components that can be selected for output are (all values expressed as a depth, in inches, averaged over all simulation realizations):

1. average end-of-day soil moisture
2. rainfall
3. fog interception
4. irrigation
5. septic-system leachate
6. direct recharge
7. constant recharge
8. external-source water
9. runoff
10. canopy evaporation
11. storm-drain capture
12. reference-surface evapotranspiration
13. potential evapotranspiration
14. actual evapotranspiration (exclusive of canopy evaporation)
15. recharge
16. rejected infiltration

Only those water-budget components assigned a printout code of 1 in the main input file are included in this output file.

The output order of the water-budget components corresponds to the order of the numbered list above, skipping water-budget components with printout code of 0. The output file is structured to print out monthly water-budget components by subarea. For each subarea, the first line of the output lists the subarea identification number and the soil-moisture storage capacity for the subarea. The following lines contain the monthly water-budget component values, in inches, with each month of the simulation listed on a separate line in chronological order. Each line of monthly output lists the year, month, and desired output components in a space-delimited format.

Appendix 4. Example

This appendix contains a simple example problem (Oki, 2022) to help the user understand the input-file requirements. The example consists of a circular island with a diameter of 1 mile (mi) divided into 8 subareas (fig. 4.1). Subareas 1–4 form an interior circle of 0.5-mi diameter in the center of the island and subareas 5–8 form a coastal donut-shaped ring around the interior part of the island. Watermain leakage, injection wells, cesspools, septic-system leachate, and storm drains are not included in the example. All input files for the example are listed at the end of this appendix. The file WATRMOD.FIL contains a single line of information with the main input file name “in01_example.main.”

Input Files

The main input file (in01_example.main) for this example defines the overall simulation conditions and input files. For this example, a daily water budget is computed for a 5-year period (2001–05), and 3 simulation realizations are specified. The specified water-budget computation method in the main input file accounts for evapotranspiration before recharge. The land-cover period code is 1, which corresponds to the first of 12 land-cover codes specified for each subarea in the subarea-specific input file (in02_example_subarea.prn). One of the land covers is a mixed land-cover type consisting of an

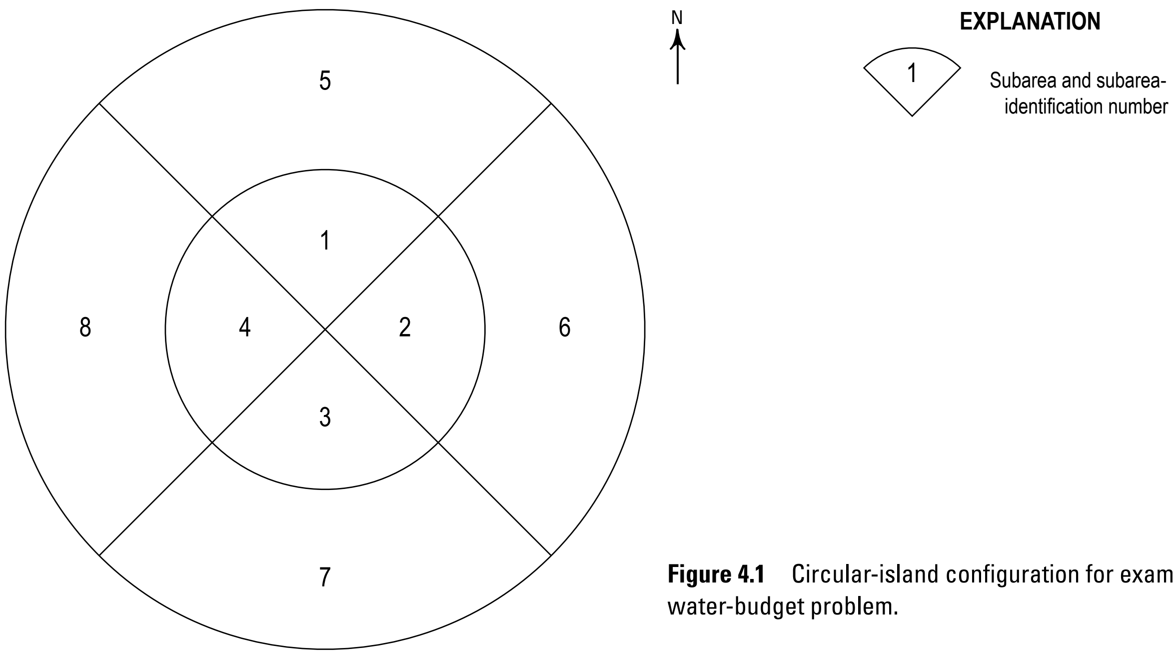


Figure 4.1 Circular-island configuration for example water-budget problem.

Selected zones and codes associated with subareas for example case.

Subarea	Code: Land cover	Code: Soil	Code: Storm drain	Zone: Rainfall	Zone: Runoff-rainfall ratio	Zone: ET_o[1]	Zone: Fog interception	Zone: Daily-to-monthly rainfall ratio	Zone: $\bar{E}/\bar{R}$[2]
1	17	1	0	11	2	1	1	2	1
2	16	1	0	11	2	1	1	2	1
3	15	2	0	12	2	1	2	3	2
4	14	2	0	12	2	1	2	3	2
5	13	3	0	13	4	2	3	5	3
6	12	3	0	13	4	2	3	5	3
7	11	4	0	14	4	3	3	5	3
8	10	4	0	14	4	3	3	5	3

[1]Reference-surface evapotranspiration.

[2]Ratio of mean canopy evaporation rate during rainfall to mean precipitation rate for saturated canopy conditions.

unirrigated fraction (75 percent of the area) and an irrigated fraction (25 percent of the area). The initial soil-moisture condition is 50 percent of the soil-moisture storage capacity for all subareas. The interception capacity of built surfaces is 0.25 in. The names of the required input files are listed at the bottom of the main input file.

The subarea-specific input file (in02_example_subarea.prn) is used to define the area (in square meters); land-cover and soil codes; rainfall, fog-interception, runoff, and ET_o zones; and other information for each subarea (fig. 4.1). For the example, each subarea has a different land cover. The study area is divided into four rainfall, three fog-interception, two runoff, and three ET_o zones. Subareas 6 and 7 have 90 and 50 percent pervious (unbuilt) surfaces, respectively, and all other subareas have 100 percent pervious surfaces. Subarea 7 is assigned a soil infiltration capacity of 1 inch per day, whereas all other subareas are assigned an infiltration capacity of 50 inches per day. Because of the limiting soil infiltration capacity of subarea 7, some of the infiltration is rejected in the example.

The example land-cover input file (in03_example_LC.prn) defines the root depth, irrigation code, crop coefficients, and other land-cover-related parameters for 17 land-cover types. Not all of the land-cover codes listed are used in the example problem. Land-cover codes 2 and 4–9 are not used. Land-cover codes 1 and 3 are needed and represent the components of mixed land-cover code 10 assigned to subarea 8. Land-cover codes 3 and 11 are used to include irrigation in subareas 7 and 8.

The example soil available water-capacity input file (in04_example_soils.prn) lists five soil codes, although the last soil code (5) is not used. Soil codes 1 and 2 each consist of a single component and a single soil horizon, whereas soil codes 3–5 consist of multiple components and soil horizons.

The example monthly rainfall input file (in05_example_monthly_RF.prn) has four lines corresponding to monthly rainfall zones 13, 14, 12, and 11. Note that the zones do not need to be sequentially numbered, although most users would likely opt to order the zones sequentially. Each line contains the zone number followed by 132 monthly rainfall values, in inches, corresponding to the 132 monthly rainfall values from 2000 through 2010. For this example, monthly rainfall values in a zone are computed from a single daily rate multiplied by the number of days in the month, which ignores seasonality. For monthly rainfall zone 11, the wettest zone representing subareas 1 and 2, each monthly rainfall value was based on a rate of 0.5 inches per day multiplied by the number of days in the month, accounting for leap-year February. For monthly rainfall zone 14, the driest zone representing subareas 7 and 8, each monthly rainfall value was based on a rate of 0.125 inches per day multiplied by the number of days in the month, accounting for leap-year February. For zones 11 and 14, average annual rainfall is about 183 and 46 inches, respectively. Average annual rainfall for zones 12 (representing subareas 3 and 4) and 13 (representing subareas 5 and 6) is about 114 and 68 inches, respectively. For this example, the monthly rainfall values were not adjusted, which is reflected in the multiplicative adjustment factors having values of 1 in the monthly rainfall adjustment-factor input file (in06_example_RF_adj.prn).

The example monthly runoff-to-rainfall ratio input file (in07_example_monthly_RF-RO_ratios.prn) has two lines corresponding to monthly runoff-to-rainfall zones 4 and 2. Note that the zones do not need to be sequentially numbered, although most users would likely opt to order the zones sequentially. Each line contains the zone number followed by 132 monthly runoff-to-rainfall ratios, corresponding to the 132 monthly values from 2000 through 2010. Constant monthly runoff-to-rainfall ratios are used for both zones; 0.1 for zone 4, representing the coastal subareas 5–8, and 0.2 for zone 2, representing the interior subareas 1–4.

The example monthly ET_o input file (in08_example_monthly_ETo.prn) has three lines corresponding to monthly ET_o zones 1–3. Note that the zones do not need to be sequentially numbered, although most users would likely opt to order the zones sequentially. Each line contains the zone number followed by 132 monthly ET_o values, in inches, corresponding to the 132 monthly values from 2000 through 2010. For this example, monthly ET_o values in a zone are computed from a single daily rate multiplied by the number of days in the month, which ignores seasonality. For zones 1, 2, and 3, the constant daily ET_o rates used to compute the monthly ET_o values are 0.05, 0.15, and 0.2 inches, respectively. Monthly ET_o zone 1 is used for interior subareas 1–4; monthly ET_o zone 2 is used for subareas 5 and 6; and monthly ET_o zone 3 is used for subareas 7 and 8.

The example monthly $\bar{E}/\bar{R}$ input file (in09_example_monthly_ER.prn) has three lines corresponding to monthly $\bar{E}/\bar{R}$ zones 1–3. Note that the zones do not need to be sequentially numbered, although most users would likely opt to order the zones sequentially. Each line contains the zone number followed by 132 monthly $\bar{E}/\bar{R}$ values, corresponding to the 132 monthly values from 2000 through 2010. Monthly $\bar{E}/\bar{R}$ zone 1 is used for interior subareas 1 and 2; monthly $\bar{E}/\bar{R}$ zone 2 is used for interior subareas 3 and 4; and monthly $\bar{E}/\bar{R}$ zone 3 is used for subareas 5–8.

The example monthly fog input file (in10_example_monthly_fog_ratios.prn) has three lines corresponding to monthly fog zones 1–3. Note that the zones do not need to be sequentially numbered, although most users would likely opt to order the zones sequentially. Each line contains the zone number followed by 132 monthly fog-interception-to-rainfall ratios, corresponding to the 132 monthly values from 2000 through 2010. Monthly fog zone 1 is used for interior subareas 1 and 2 where a constant monthly fog-interception-to-rainfall ratio of 0.2 is assigned; monthly fog zone 2 is used for interior subareas 3 and 4 where a constant monthly fog-interception-to-rainfall ratio of 0.1 is assigned; and monthly fog zone 3 is used for subareas 5–8 where a constant monthly fog-interception-to-rainfall ratio of 0 is assigned.

The example irrigation parameter input file (in11_example_irr_parameters.prn) defines irrigation parameters for six irrigation codes, although only irrigation codes 2 and 5 are used in the example. Irrigation in the example is estimated using a monthly demand-based approach and irrigation is applied on each day of the month. Irrigation method efficiency values for irrigation codes 2 and 5 are 0.70 and 0.85, respectively. Irrigation-estimation multiplier values for irrigation codes 2 and 5 are 0.37 and 0.41, respectively. The example monthly irrigation input file (in12_example_monthly_irr.prn) defines monthly supply-based irrigation depths for each of the six irrigation codes. Because all irrigation codes are for a demand-based irrigation-estimation method, the monthly supply-based irrigation depths are arbitrarily assigned values of 0 in the example input file.

The example daily-to-monthly rainfall ratio (fragment) input files for months 1–12 (including non-leap February; in_example_frag01.prn to in_example_frag12.prn) and 13 (leap-year February; in_example_frag13.prn) each contain five daily-to-monthly rainfall ratio zones. For each daily-to-monthly rainfall ratio zone, 4 sets of daily-to-monthly rainfall ratios are defined. The sum of the daily-to-monthly rainfall ratios in a set is 1.

Output Files

The information from the main input file (in01_example.main) is provided in the main output file out01_WATRMod.sum1, which can be used as an annotated input file. Water-budget results for each simulation realization (expressed as cumulative averages for each successive realization) indicate total island-wide rainfall of 2.986 Mgal/d and total recharge of 1.287 Mgal/d using the Allen and others (1998) model for estimating actual evapotranspiration (under the "FAO 56" header in the output file). The final average annual water-budget results (averaged over all simulation realizations) over the entire study area are also included in the output file out11_WATRMod_FAO_totarea_ann_MGD.out. Final average monthly water-budget results (averaged over all simulation realizations) over the entire study area are included in the output file out10_WATRMod_FAO_totarea_mo_MGD.out.

The main input file specifies a subarea printout interval of 1, which causes cumulative water-budget depths (in inches) over the simulation period for each subarea and simulation realization to be included in the output file out04_WATRMod.sum4. Annual recharge depths (in inches) for each year, averaged over all simulation realizations, and subarea are provided in the output file out07_WATRMod_FAO_annrech_in.csv. Simulated recharge is greatest in subareas 1 and 2 and least in subareas 7 and 8. Water-budget-component depths (in inches) averaged over all simulation realizations for each subarea are listed in the output file out09_WATRMod_FAO_subarea_ann_in.csv.

Input File Listings

Example file listing, main input file (in01_example.main) (each line may be annotated provided that the annotation appears after column 60):

3	Number of simulation realizations
5	Number of years in simulation
2001	Starting year of simulation
2	Water-budget accounting order (1=recharge before ET; 2=ET before recharge)
1	Land-cover period from subarea input file to use (1-12)
0	Number of land-cover codes for sugarcane
0	Land-cover code for sugarcane
0	Number of land covers with constant recharge
1	Number of land covers with mixed use
10 1 0.75000 3 0.25000	mixed land-cover code and components, no. 1
1	Initial seed (integer) for random number generator
0.5	Initial soil moisture (fraction of capacity, 0-1)
6	Pseudo root depth for unvegetated surfaces, in inches
0	Storm drain code (0=no storm drains)
0.25	Interception capacity of paved surfaces, in inches
1	Canopy-interception method (1=Gash; 2=linear; 3=event)
0	Limit canopy plus root-zone ET to PE (0=no limit; 1=limit)
132	Number of months represented in monthly rainfall file
2000	Starting year of monthly rainfall file
0	Selection method code for daily-to-monthly rainfall ratios (0=random; 1=sequential)
132	Number of months represented in monthly runoff-to-rainfall ratio file
2000	Starting year of monthly runoff-to-rainfall ratio file

0	Daily runoff estimation method (0=daily-to-monthly rainfall ratios; 1=sequential daily-to-monthly runoff-to-rainfall ratios
132	Number of months represented in monthly ETo file
2000	Starting year of monthly ETo file
0	Daily ETo estimation method (0=uniform; 1=inverse linear; 2=exponential; 3=sequential daily-to-monthly ETo ratios)
132	Number of months represented in monthly E/R file
2000	Starting year of monthly E/R file
0	Daily E/R estimation method (0=uniform; 1=linear; 2=exponential; 3=sequential daily multipliers)
132	Number of months represented in monthly fog-interception file
2000	Starting year of monthly fog-interception file
0	Daily fog estimation method (0=monthly fog-to-rainfall ratios; 1=daily-to-monthly rainfall ratios; 2=uniform; 3=sequential daily-to-monthly fog-interception ratios)
132	Number of months represented in monthly irrigation file
2000	Starting year of monthly irrigation file
0	Daily supply irrigation-estimation method (0=not applicable; 1=monthly irrigation uniformly applied on fixed days; 2=monthly irrigation uniformly applied on fixed days with rainfall below threshold; 3=sequential daily-to-monthly irrigation ratios)
1	Subarea print-out interval for out04_WATRMod.sum4
1	Monthly recharge print-out code (0=no print; 1=print) for files out02_WATRMod.sum2; out03_WATRMod.sum3; and out08_WATRMod_FAO_subarea_mo_in.csv
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Monthly parameter print-out codes (0=no print; 1=print)
in02_example_subarea.prn	File with subarea information
in03_example_LC.prn	File with land-cover information
in04_example_soils.prn	File with available water capacity data
in05_example_monthly_RF.prn	File with monthly rainfall
in06_example_RF_adj.prn	File with monthly rainfall adjustment factors
in07_example_monthly_RF-RO_ratios.prn	File with monthly runoff-to-rainfall ratios
in08_example_monthly_ETo.prn	File with monthly ET_o values
in09_example_monthly_ER.prn	File with monthly *E/R* values
in10_example_monthly_fog_ratios.prn	File with monthly fog-interception data
in11_example_irr_parameters.prn	File with irrigation parameters
in12_example_monthly_irr.prn	File with monthly irrigation depths
in_example_frag01.prn	File with daily-to-monthly rainfall ratios for month 1
in_example_frag02.prn	File with daily-to-monthly rainfall ratios for month 2
in_example_frag03.prn	File with daily-to-monthly rainfall ratios for month 3
in_example_frag04.prn	File with daily-to-monthly rainfall ratios for month 4
in_example_frag05.prn	File with daily-to-monthly rainfall ratios for month 5
in_example_frag06.prn	File with daily-to-monthly rainfall ratios for month 6
in_example_frag07.prn	File with daily-to-monthly rainfall ratios for month 7
in_example_frag08.prn	File with daily-to-monthly rainfall ratios for month 8
in_example_frag09.prn	File with daily-to-monthly rainfall ratios for month 9
in_example_frag10.prn	File with daily-to-monthly rainfall ratios for month 10
in_example_frag11.prn	File with daily-to-monthly rainfall ratios for month 11
in_example_frag12.prn	File with daily-to-monthly rainfall ratios for month 12
in_example_frag13.prn	File with daily-to-monthly rainfall ratios for month 13

Example file listing, subarea-specific input file (in02_example_subarea.prn):

```
1 127135.74407  17  0  0  0  0  0  0  0  0  0  0  0  0  1  11  2  1  1  2  0  0  0  0  11111  0  0  0  0  0  0  0  1.0  50  1.0  0.01  1  0

2 127135.74407  16  0  0  0  0  0  0  0  0  0  0  0  0  1  11  2  1  1  2  0  0  0  0  22222  0  0  0  0  0  0  0  1.0  50  1.0  0.01  1  0

3 127135.74407  15  0  0  0  0  0  0  0  0  0  0  0  0  2  12  2  1  2  3  0  0  0  0  33333  0  0  0  0  0  0  0  1.0  50  0.5  0.01  2  0

4 127135.74407  14  0  0  0  0  0  0  0  0  0  0  0  0  2  12  2  1  2  3  0  0  0  0  44444  0  0  0  0  0  0  0  1.0  50  0.5  0.01  2  0

5 381407.23220  13  0  0  0  0  0  0  0  0  0  0  0  0  3  13  4  2  3  5  0  0  0  0  55555  0  0  0  0  0  0  0  1.0  50  0.0  0.00  3  0

6 381407.23220  12  0  0  0  0  0  0  0  0  0  0  0  0  3  13  4  2  3  5  0  0  0  0  66666  0  0  0  0  0  0  0  0.9  50  0.0  0.00  3  0

7 381407.23220  11  0  0  0  0  0  0  0  0  0  0  0  0  4  14  4  3  3  5  0  0  0  0  77777  0  0  0  0  0  0  0  0.5   1  0.0  0.00  3  0

8 381407.23220  10  0  0  0  0  0  0  0  0  0  0  0  0  4  14  4  3  3  5  0  0  0  0  88888  0  0  0  0  0  0  0  1.0  50  0.0  0.00  3  0
```

Example file listing, land-cover input file (in03_example_LC.prn):

```
1  6 0 0 0 0.00 0.00 0.60 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0 0 0 0 0 0 0 0 0

2 12 0 0 0 0.00 0.00 0.60 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

3 18 0 5 0 0.00 0.00 0.60 0.85 0.50 0.29 0.40 0.80 1.20 0.85 0.50 0.29 0.40 0.80 1.20 0 0 0 0 0 0 0 0 0

4 24 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

5 36 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

6 42 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

7 48 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

8 54 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

9 60 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

10 12 0 0 0 0.00 0.00 0.50 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 0 0 0 0 0 0 0 0 0

11 12 0 2 1 0.00 0.00 0.50 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 0 0 0 0 0 0 0 0 0

12 12 0 0 0 0.00 0.00 0.50 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.18 0 0 0 0 0 0 0 0 0

13 39 0 0 0 0.00 0.00 0.60 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0 0 0 0 0 0 0 0 0

14 60 0 0 0 0.05 0.01 0.50 0.44 0.44 0.44 0.44 0.44 0.44 0.44 0.44 0.44 0.44 0.44 0.44 0 0 0 0 0 0 0 0 0

15 30 0 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0

16 60 1 0 0 0.05 0.01 0.50 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0 0 0 0 0 0 0 0 0

17 30 1 0 0 0.05 0.01 0.50 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0 0 0 0 0 0 0 0 0
```

Example file listing, soil available water-capacity input file (in04_example_soils.prn) (each row of the input file contains 7 values; the vertical lines separate batches of rows that appear below the rows to the left of the vertical line):

1	1	1.00	1	0	60	0.06
2	1	1.00	1	0	60	0.03
3	1	0.55	1	0	4	0.14
3	1	0.55	2	4	8	0.14
3	1	0.55	3	8	20	0.01
3	2	0.45	1	0	60	0.01
4	1	0.90	1	0	2	0.09
4	1	0.90	2	2	7	0.11
4	1	0.90	3	7	14	0.11
4	1	0.90	4	14	29	0.07
4	1	0.90	5	29	55	0.07
4	2	0.05	1	0	21	0.14
4	2	0.05	2	21	33	0.14
4	2	0.05	3	33	37	0.14
4	2	0.05	4	37	47	0.14
4	2	0.05	5	47	60	0.14
4	3	0.05	1	0	13	0.10
4	3	0.05	2	13	18	0.10
4	3	0.05	3	18	45	0.11
4	3	0.05	4	45	60	0.11
5	1	0.90	1	0	2	0.09
5	1	0.90	2	2	7	0.11
5	1	0.90	3	7	14	0.11
5	1	0.90	4	14	29	0.07
5	1	0.90	5	29	55	0.07
5	2	0.05	1	0	21	0.14
5	2	0.05	2	21	33	0.14
5	2	0.05	3	33	37	0.14
5	2	0.05	4	37	47	0.14
5	2	0.05	5	47	60	0.14
5	3	0.05	1	0	13	0.10
5	3	0.05	2	13	18	0.10
5	3	0.05	3	18	45	0.11
5	3	0.05	4	45	60	0.11

Example file listing, monthly rainfall input file (in05_example_monthly_RF.prn; each of the four lines of this example input file starts with a zone number, shown in bold font, and is wrapped to enable all monthly values to be visible):

13 5.81 5.44 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81
5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81 5.81 5.62
5.81 5.62 5.81 5.81 5.44 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81 5.81
5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81
5.81 5.62 5.81 5.62 5.81 5.81 5.44 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62
5.81 5.81 5.62 5.81 5.62 5.81 5.81 5.25 5.81 5.62 5.81 5.62 5.81 5.81 5.62 5.81 5.62 5.81

14 3.88 3.62 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88
3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88 3.88 3.75
3.88 3.75 3.88 3.88 3.62 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88 3.88
3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88
3.88 3.75 3.88 3.75 3.88 3.88 3.62 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75
3.88 3.88 3.75 3.88 3.75 3.88 3.88 3.50 3.88 3.75 3.88 3.75 3.88 3.88 3.75 3.88 3.75 3.88

12 9.69 9.06 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69
9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69 9.69 9.38
9.69 9.38 9.69 9.69 9.06 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69 9.69
9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69
9.69 9.38 9.69 9.38 9.69 9.69 9.06 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38
9.69 9.69 9.38 9.69 9.38 9.69 9.69 8.72 9.69 9.38 9.69 9.38 9.69 9.69 9.38 9.69 9.38 9.69

11 15.50 14.50 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50 15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50
15.00 15.50 15.00 15.50 15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50 15.50 14.00 15.50 15.00
15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50 15.50 14.50 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50
15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50 15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50
15.00 15.50 15.00 15.50 15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50 15.50 14.50 15.50 15.00
15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50 15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50
15.50 14.00 15.50 15.00 15.50 15.00 15.50 15.50 15.00 15.50 15.00 15.50

Example file listing, monthly rainfall adjustment-factor input file (in06_example_RF_adj.prn):

13 1 1 1 1 1 1 1 1 1 1 1 1

14 1 1 1 1 1 1 1 1 1 1 1 1

12 1 1 1 1 1 1 1 1 1 1 1 1

11 1 1 1 1 1 1 1 1 1 1 1 1

Example file listing, monthly runoff-to-rainfall ratio input file (in07_example_monthly_RF-RO_ratios.prn; each of the two lines of this example input file starts with a zone number, shown in bold font, and is wrapped to enable all monthly values to be visible):

4 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1

2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2

Example file listing, monthly ET_o input file (in08_example_monthly_ETo.prn; each of the three lines of this example input file starts with a zone number, shown in bold font, and is wrapped to enable all monthly values to be visible):

1 1.55 1.45 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55
1.40 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.45
1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55
1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.45 1.55 1.50
1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55 1.50 1.55 1.50 1.55 1.55 1.50 1.55 1.50 1.55 1.55 1.40 1.55 1.50 1.55
1.50 1.55 1.55 1.50 1.55 1.50 1.55

2 4.65 4.35 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65
4.20 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.35
4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65
4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.35 4.65 4.50
4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65 4.50 4.65 4.50 4.65 4.65 4.50 4.65 4.50 4.65 4.65 4.20 4.65 4.50 4.65
4.50 4.65 4.65 4.50 4.65 4.50 4.65

3 6.20 5.80 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20
5.60 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.80
6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20
6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.80 6.20 6.00
6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20 6.00 6.20 6.00 6.20 6.20 6.00 6.20 6.00 6.20 6.20 5.60 6.20 6.00 6.20
6.00 6.20 6.20 6.00 6.20 6.00 6.20

Example file listing, monthly $\overline{E}/\overline{R}$ input file (in09_example_monthly_ER.prn; each of the three lines of this example input file starts with a zone number, shown in bold font, and is wrapped to enable all monthly values to be visible):

1 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
0.25 0.25 0.25 0.25 0.25 0.25 0.25

2 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50
0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50
0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50
0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50
0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50
0.50 0.50 0.50 0.50 0.50 0.50 0.50

3 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75
0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75
0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75
0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75
0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75
0.75 0.75 0.75 0.75 0.75 0.75 0.75

Example file listing, monthly fog input file (in10_example_monthly_fog_ratios.prn; each of the three lines of this example input file starts with a zone number, shown in bold font, and is wrapped to enable all monthly values to be visible):

1 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2

2 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1

3 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

Example file listing, irrigation parameter input file (in11_example_irr_parameters.prn):

```
1 1 0 1.00 0.70 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2 1 0 0.37 0.70 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 1 0 1.00 0.85 1 1 1 0 0 0 0 1 1 1 0 0 0 0 1 1 1 0 0 0 0 1 1 1 0 0 0 1 0 0 0
4 1 0 1.00 0.85 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
5 1 0 0.41 0.85 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
6 1 0 1.00 0.80 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

Example file listing, monthly irrigation input file (in12_example_monthly_irr.prn; each of the six lines of this example input file starts with a zone number, shown in bold font, and is wrapped to enable all monthly values to be visible):

```
1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

Example file listings, daily-to-monthly rainfall ratio input files for January (in_example_frag01.prn), March (in_example_frag03.prn; identical to in_example_frag01.prn but replace first number on each line with 3), May (in_example_frag05.prn; identical to in_example_frag01.prn but replace first number on each line with 5), July (in_example_frag07.prn; identical to in_example_frag01.prn but replace first number on each line with 7), August (in_example_frag08.prn; identical to in_example_frag01.prn but replace first number on each line with 8), October (in_example_frag10.prn; identical to in_example_frag01.prn but replace first number on each line with 10), and December (in_example_frag12.prn; identical to in_example_frag01.prn but replace first number on each line with 12):

```
1 1  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 1  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0
1 1  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 0.0
1 1  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 2  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 2  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0
1 2  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 0.0
1 2  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 3  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 3  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0
1 3  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 0.0
1 3  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 4  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 4  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0
1 4  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 0.0
1 4  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 5  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1 5  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0
1 5  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 0.0
1 5  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
```

Example file listing, daily-to-monthly rainfall ratio input file for non-leap-year February (in_example_frag02.prn):

```
 2 1  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 1  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 999 999 999
 2 1  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 999 999 999
 2 1  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 2  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 2  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 999 999 999
 2 2  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 999 999 999
 2 2  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 3  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 3  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 999 999 999
 2 3  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 999 999 999
 2 3  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 4  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 4  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 999 999 999
 2 4  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 999 999 999
 2 4  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 5  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
 2 5  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 999 999 999
 2 5  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 999 999 999
 2 5  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999 999
```

Example file listings, daily-to-monthly rainfall ratio input files for April (in_example_frag04.prn), June (in_example_frag06.prn; identical to in_example_frag04.prn but replace first number on each line with 6), September (in_example_frag09.prn; identical to in_example_frag04.prn but replace first number on each line with 9), and November (in_example_frag11.prn; identical to in_example_frag04.prn but replace first number on each line with 11):

```
4 1  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 1  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 999
4 1  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 999
4 1  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 2  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 2  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 999
4 2  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 999
4 2  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 3  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 3  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 999
4 3  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 999
4 3  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 4  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 4  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 999
4 4  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 999
4 4  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 5  1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
4 5  2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 999
4 5  3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.0 999
4 5  4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999
```

Example file listing, daily-to-monthly rainfall ratio input file for leap-year February (in_example_frag13.prn):

13 1 1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 1 2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 999 999

13 1 3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 999 999

13 1 4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 2 1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 2 2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 999 999

13 2 3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 999 999

13 2 4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 3 1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 3 2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 999 999

13 3 3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 999 999

13 3 4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 4 1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 4 2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 999 999

13 4 3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 999 999

13 4 4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 5 1 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

13 5 2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 0.1 0.0 999 999

13 5 3 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.0 999 999

13 5 4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 999 999

Output File Listings

out01_WATRMod.sum1 (note that the lines in this output file are shown wrapped here to fit on the page):

3	Number of simulation realizations
5	Number of years in simulation
2001 2005	Starting and ending years of simulation
2	Water-budget accounting order (1=RC before ET; 2=ET before RC)
1	Land-cover period from subarea input file to use (1-12)
0	Number of land-cover codes for sugarcane
0	Land-cover code for sugarcane
0	Number of land covers with constant recharge
1	Number of land covers with mixed use
10 1 0.75000 3 0.25000	mixed land-cover code and components, no. 1
1	Initial seed (integer) for random number generator

0.5	Initial soil moisture (fraction of capacity, 0–1)
6	Pseudo root depth for unvegetated surfaces, in inches
0	Storm drain code (0=no storm drains)
0.25	Interception capacity of paved surfaces, in inches
1	Canopy-interception method (1=Gash; 2=linear; 3=event)
0	Limit canopy plus root-zone ET to PE (0=no limit; 1=limit)
132	Number of months represented in monthly rainfall file
2000	Starting year of monthly rainfall file
0	Selection method code for daily-to-monthly rainfall ratios (0=random; 1=sequential)
132	Number of months represented in monthly runoff-to-rainfall ratio file
2000	Starting year of monthly runoff-to-rainfall ratio file
0	Daily runoff estimation method (0=daily-to-monthly rainfall ratios; 1=sequential daily-to-monthly runoff-to-rainfall ratios
132	Number of months represented in monthly ETo file
2000	Starting year of monthly ETo file
0	Daily ETo estimation method (0=uniform; 1=inverse linear; 2=exponential; 3=sequential daily-to-monthly ETo ratios)
132	Number of months represented in monthly E/R file
2000	Starting year of monthly E/R file
0	Daily E/R estimation method (0=uniform; 1=linear; 2=exponential; 3=sequential daily multipliers)
132	Number of months represented in monthly fog-interception file
2000	Starting year of monthly fog-interception file
0	Daily fog estimation method (0=monthly fog-to-rainfall ratios; 1=daily-to-monthly rainfall ratios; 2=uniform; 3=sequential daily-to-monthly fog-interception ratios)
132	Number of months represented in monthly irrigation file
2000	Starting year of monthly irrigation file
0	Daily supply irrigation-estimation method (0=not applicable; 1=monthly irrigation uniformly applied on fixed days; 2=monthly irrigation uniformly applied on fixed days with rainfall below threshold; 3=sequential daily-to-monthly irrigation ratios)
1	Subarea print-out interval for out04_WATRMod.sum4
1	Monthly recharge print-out code (0=no print; 1=print) for files out02_WATRMod.sum2; out03_WATRMod.sum3; and out08_WATRMod_FAO_subarea_mo_in.csv
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Monthly parameter print-out codes (0=no print; 1=print)
in02_example_subarea.prn	File with subarea information
in03_example_LC.prn	File with land-cover information
in04_example_soils.prn	File with available water capacity data
in05_example_monthly_RF.prn	File with monthly rainfall
in06_example_RF_adj.prn	File with monthly rainfall adjustment factors
in07_example_monthly_RF-RO_ratios.prn	File with monthly runoff-to-rainfall ratios
in08_example_monthly_ETo.prn	File with monthly ETo values
in09_example_monthly_ER.prn	File with monthly E/R values
in10_example_monthly_fog_ratios.prn	File with monthly fog-interception data
in11_example_irr_parameters.prn	File with irrigation parameters
in12_example_monthly_irr.prn	File with monthly irrigation depths
in_example_frag01.prn	File with daily-to-monthly rainfall ratios for month 1
in_example_frag02.prn	File with daily-to-monthly rainfall ratios for month 2
in_example_frag03.prn	File with daily-to-monthly rainfall ratios for month 3

in_example_frag04.prn	File with daily-to-monthly rainfall ratios for month 4
in_example_frag05.prn	File with daily-to-monthly rainfall ratios for month 5
in_example_frag06.prn	File with daily-to-monthly rainfall ratios for month 6
in_example_frag07.prn	File with daily-to-monthly rainfall ratios for month 7
in_example_frag08.prn	File with daily-to-monthly rainfall ratios for month 8
in_example_frag09.prn	File with daily-to-monthly rainfall ratios for month 9
in_example_frag10.prn	File with daily-to-monthly rainfall ratios for month 10
in_example_frag11.prn	File with daily-to-monthly rainfall ratios for month 11
in_example_frag12.prn	File with daily-to-monthly rainfall ratios for month 12
in_example_frag13.prn	File with daily-to-monthly rainfall ratios for month 13

```
Output file generated by WATRMod version 1.0

Water-budget summary (Mgal/d) for 3 AE/PE models
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------

                                                Direct    Constant    Direct              External              Canopy     Net       Storm
----------Veihmeyer----------    -----------FAO 56------------    --------Thornthwaite---------

Sim.    Rainfall      Fog      Irrig.     Septic    recharge    recharge   recharge+      Runon      source     Runoff      evap.    Precip.
drain      ETo        AE      Recharge   Rejected      AE       Recharge    Rejected       AE       Recharge   Rejected

--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------------------------------

   1      2.986     0.171     0.095     0.000     0.000     0.000     0.000     0.109     0.000     0.437     0.427     2.729     0.000
9.810     1.072     1.290     0.027     1.045     1.310     0.032     0.942     1.405     0.039

   2      2.986     0.171     0.095     0.000     0.000     0.000     0.000     0.104     0.000     0.437     0.425     2.731     0.000
9.810     1.096     1.271     0.023     1.071     1.291     0.028     0.967     1.388     0.033

   3      2.986     0.171     0.095     0.000     0.000     0.000     0.000     0.104     0.000     0.437     0.425     2.731     0.000
9.810     1.102     1.266     0.022     1.076     1.287     0.026     0.971     1.386     0.032
```

out02_WATRMod.sum2 (note that the lines in this output file are shown wrapped here to fit on the page):

```
Output file generated by WATRMod version 1.0

Mo     Poly-id  LC RF_zone Aquifer    Area_m^2      Rain     Fog    Irrig.   Septic   Dir_rc Cnst_rc Dir_rc+   Runon Ext_src  Runoff
Can_evp    Pnet  St_drn    AE1  Tot_rc1    Rej1    AE2  Tot_rc2    Rej2    AE3  Tot_rc3    Rej3

 1         1  17     11   11111    127135.74    15.500   3.100   0.000   0.000   0.000   0.000   0.000   0.000   0.000   3.100   5.015
13.585   0.000   0.465   9.863   0.000   0.465   9.863   0.000   0.442   9.885   0.000

 2         1  17     11   11111    127135.74    14.100   2.820   0.000   0.000   0.000   0.000   0.000   0.000   0.000   2.820   4.570
12.350   0.000   0.423   9.075   0.000   0.423   9.075   0.000   0.411   9.089   0.000

 3         1  17     11   11111    127135.74    15.500   3.100   0.000   0.000   0.000   0.000   0.000   0.000   0.000   3.100   5.015
13.585   0.000   0.465  10.070   0.000   0.465  10.070   0.000   0.451  10.081   0.000
```

4 1 17 11 11111 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.904
13.096 0.000 0.450 9.636 0.000 0.450 9.636 0.000 0.438 9.648 0.000

5 1 17 11 11111 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 4.951
13.649 0.000 0.465 10.090 0.000 0.465 10.090 0.000 0.449 10.105 0.000

6 1 17 11 11111 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.861
13.139 0.000 0.450 9.694 0.000 0.450 9.694 0.000 0.434 9.709 0.000

7 1 17 11 11111 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 5.008
13.592 0.000 0.465 10.006 0.000 0.465 10.006 0.000 0.450 10.022 0.000

8 1 17 11 11111 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 4.980
13.620 0.000 0.465 10.063 0.000 0.465 10.063 0.000 0.450 10.078 0.000

9 1 17 11 11111 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.904
13.096 0.000 0.450 9.630 0.000 0.450 9.630 0.000 0.438 9.643 0.000

10 1 17 11 11111 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 5.111
13.489 0.000 0.465 9.941 0.000 0.465 9.941 0.000 0.455 9.950 0.000

11 1 17 11 11111 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.830
13.170 0.000 0.450 9.677 0.000 0.450 9.677 0.000 0.434 9.696 0.000

12 1 17 11 11111 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 4.969
13.631 0.000 0.465 10.113 0.000 0.465 10.113 0.000 0.451 10.124 0.000

1 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 5.015
13.585 0.000 0.512 9.639 0.000 0.512 9.639 0.000 0.493 9.656 0.000

2 2 16 11 22222 127135.74 14.100 2.820 0.000 0.000 0.000 0.000 0.000 0.000 0.000 2.820 4.570
12.350 0.000 0.465 9.029 0.000 0.465 9.029 0.000 0.458 9.038 0.000

3 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 5.015
13.585 0.000 0.512 10.029 0.000 0.512 10.029 0.000 0.503 10.035 0.000

4 2 16 11 22222 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.904
13.096 0.000 0.495 9.590 0.000 0.495 9.590 0.000 0.488 9.598 0.000

5 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 4.951
13.649 0.000 0.512 10.044 0.000 0.512 10.044 0.000 0.502 10.053 0.000

6 2 16 11 22222 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.861
13.139 0.000 0.495 9.649 0.000 0.495 9.649 0.000 0.485 9.659 0.000

7 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 5.008
13.592 0.000 0.512 9.958 0.000 0.512 9.958 0.000 0.502 9.967 0.000

8 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 4.980
13.620 0.000 0.512 10.018 0.000 0.512 10.018 0.000 0.502 10.027 0.000

9 2 16 11 22222 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.904
13.096 0.000 0.495 9.583 0.000 0.495 9.583 0.000 0.487 9.591 0.000

10 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 5.111
13.489 0.000 0.512 9.897 0.000 0.512 9.897 0.000 0.505 9.902 0.000

11 2 16 11 22222 127135.74 15.000 3.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.000 4.830

13.170 0.000 0.495 9.628 0.000 0.495 9.628 0.000 0.485 9.640 0.000

12 2 16 11 22222 127135.74 15.500 3.100 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.100 4.969
13.631 0.000 0.512 10.071 0.000 0.512 10.071 0.000 0.503 10.078 0.000

1 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.740
6.950 0.000 0.465 4.443 0.000 0.465 4.443 0.000 0.435 4.476 0.000

2 3 15 12 33333 127135.74 8.788 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.758 2.469
6.319 0.000 0.423 4.133 0.000 0.423 4.133 0.000 0.401 4.155 0.000

3 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.627
7.063 0.000 0.465 4.708 0.000 0.465 4.708 0.000 0.434 4.734 0.000

4 3 15 12 33333 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.645
6.735 0.000 0.450 4.380 0.000 0.450 4.380 0.000 0.417 4.416 0.000

5 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.719
6.971 0.000 0.465 4.590 0.000 0.465 4.590 0.000 0.434 4.619 0.000

6 3 15 12 33333 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.663
6.717 0.000 0.450 4.359 0.000 0.450 4.359 0.000 0.420 4.392 0.000

7 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.675
7.015 0.000 0.465 4.635 0.000 0.465 4.635 0.000 0.437 4.662 0.000

8 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.763
6.927 0.000 0.465 4.517 0.000 0.465 4.517 0.000 0.443 4.539 0.000

9 3 15 12 33333 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.639
6.741 0.000 0.450 4.425 0.000 0.450 4.425 0.000 0.422 4.452 0.000

10 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.651
7.039 0.000 0.465 4.632 0.000 0.465 4.632 0.000 0.432 4.666 0.000

11 3 15 12 33333 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.648
6.732 0.000 0.450 4.378 0.000 0.450 4.378 0.000 0.421 4.409 0.000

12 3 15 12 33333 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.645
7.045 0.000 0.465 4.677 0.000 0.465 4.677 0.000 0.436 4.703 0.000

1 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.740
6.950 0.000 0.682 4.130 0.000 0.682 4.130 0.000 0.647 4.168 0.000

2 4 14 12 44444 127135.74 8.788 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.758 2.469
6.319 0.000 0.620 3.932 0.000 0.620 3.932 0.000 0.596 3.957 0.000

3 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.627
7.063 0.000 0.682 4.513 0.000 0.682 4.513 0.000 0.648 4.542 0.000

4 4 14 12 44444 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.645
6.735 0.000 0.660 4.157 0.000 0.660 4.157 0.000 0.624 4.196 0.000

5 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.719
6.971 0.000 0.682 4.384 0.000 0.682 4.384 0.000 0.648 4.415 0.000

6 4 14 12 44444 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.663
6.717 0.000 0.660 4.134 0.000 0.660 4.134 0.000 0.627 4.171 0.000

7 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.675
7.015 0.000 0.682 4.429 0.000 0.682 4.429 0.000 0.651 4.458 0.000

8 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.763
6.927 0.000 0.682 4.297 0.000 0.682 4.297 0.000 0.658 4.321 0.000

9 4 14 12 44444 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.639
6.741 0.000 0.660 4.219 0.000 0.660 4.219 0.000 0.629 4.249 0.000

10 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.651
7.039 0.000 0.682 4.413 0.000 0.682 4.413 0.000 0.646 4.450 0.000

11 4 14 12 44444 127135.74 9.380 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.876 2.648
6.732 0.000 0.660 4.155 0.000 0.660 4.155 0.000 0.628 4.189 0.000

12 4 14 12 44444 127135.74 9.690 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.938 2.645
7.045 0.000 0.682 4.476 0.000 0.682 4.476 0.000 0.650 4.505 0.000

1 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.322 1.776 0.000 3.287 1.807 0.000 2.872 2.211 0.000

2 5 13 13 55555 381407.23 5.288 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.529 0.000
5.288 0.000 3.166 1.626 0.000 3.125 1.652 0.000 2.793 1.970 0.000

3 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.097 2.255 0.000 3.075 2.294 0.000 2.711 2.659 0.000

4 5 13 13 55555 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.562 0.000
5.620 0.000 2.891 2.165 0.000 2.855 2.199 0.000 2.506 2.538 0.000

5 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.385 1.904 0.000 3.344 1.939 0.000 2.911 2.367 0.000

6 5 13 13 55555 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.562 0.000
5.620 0.000 3.408 1.557 0.000 3.392 1.584 0.000 2.992 1.993 0.000

7 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.356 1.958 0.000 3.304 1.996 0.000 2.831 2.454 0.000

8 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.375 1.790 0.000 3.352 1.819 0.000 2.954 2.234 0.000

9 5 13 13 55555 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.562 0.000
5.620 0.000 3.199 1.764 0.000 3.175 1.798 0.000 2.806 2.182 0.000

10 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.560 1.692 0.000 3.522 1.723 0.000 3.078 2.162 0.000

11 5 13 13 55555 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.562 0.000
5.620 0.000 3.451 1.595 0.000 3.429 1.626 0.000 3.000 2.050 0.000

12 5 13 13 55555 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.581 0.000
5.810 0.000 3.368 2.015 0.000 3.318 2.052 0.000 2.874 2.479 0.000

1 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.346 0.000 0.581 0.000
5.810 0.000 3.486 1.750 0.000 3.338 1.880 0.000 3.003 2.168 0.000

2 6 12 13 66666 381407.23 5.288 0.000 0.000 0.000 0.000 0.000 0.000 0.296 0.000 0.529 0.000
5.288 0.000 3.203 1.499 0.000 3.132 1.580 0.000 2.908 1.835 0.000

3 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.383 0.000 0.581 0.000
5.810 0.000 2.947 2.378 0.000 2.867 2.460 0.000 2.650 2.676 0.000

4 6 12 13 66666 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.379 0.000 0.562 0.000
5.620 0.000 2.678 2.369 0.000 2.610 2.439 0.000 2.424 2.627 0.000

5 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.360 0.000 0.581 0.000
5.810 0.000 3.357 1.903 0.000 3.223 2.035 0.000 2.936 2.322 0.000

6 6 12 13 66666 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.316 0.000 0.562 0.000
5.620 0.000 3.591 1.437 0.000 3.452 1.570 0.000 3.140 1.875 0.000

7 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.381 0.000 0.581 0.000
5.810 0.000 3.214 2.046 0.000 3.063 2.199 0.000 2.779 2.486 0.000

8 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.346 0.000 0.581 0.000
5.810 0.000 3.459 1.750 0.000 3.329 1.879 0.000 3.034 2.169 0.000

9 6 12 13 66666 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.334 0.000 0.562 0.000
5.620 0.000 3.255 1.750 0.000 3.155 1.854 0.000 2.894 2.118 0.000

10 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.333 0.000 0.581 0.000
5.810 0.000 3.664 1.598 0.000 3.525 1.729 0.000 3.201 2.040 0.000

11 6 12 13 66666 381407.23 5.620 0.000 0.000 0.000 0.000 0.000 0.000 0.324 0.000 0.562 0.000
5.620 0.000 3.599 1.447 0.000 3.439 1.607 0.000 3.119 1.933 0.000

12 6 12 13 66666 381407.23 5.810 0.000 0.000 0.000 0.000 0.000 0.000 0.373 0.000 0.581 0.000
5.810 0.000 3.205 2.075 0.000 3.090 2.199 0.000 2.836 2.467 0.000

1 7 11 14 77777 381407.23 3.880 0.000 1.011 0.000 0.000 0.000 0.000 0.863 0.000 0.388 0.000
3.880 0.000 3.948 0.266 0.202 3.814 0.372 0.244 3.531 0.612 0.290

2 7 11 14 77777 381407.23 3.524 0.000 0.921 0.000 0.000 0.000 0.000 0.686 0.000 0.352 0.000
3.524 0.000 3.783 0.229 0.178 3.631 0.255 0.235 3.400 0.389 0.298

3 7 11 14 77777 381407.23 3.880 0.000 1.011 0.000 0.000 0.000 0.000 1.046 0.000 0.388 0.000
3.880 0.000 3.615 0.432 0.472 3.494 0.500 0.571 3.240 0.655 0.685

4 7 11 14 77777 381407.23 3.750 0.000 0.979 0.000 0.000 0.000 0.000 1.054 0.000 0.375 0.000
3.750 0.000 3.431 0.463 0.477 3.272 0.490 0.588 3.016 0.619 0.713

5 7 11 14 77777 381407.23 3.880 0.000 1.011 0.000 0.000 0.000 0.000 0.929 0.000 0.388 0.000
3.880 0.000 3.916 0.330 0.270 3.779 0.430 0.325 3.479 0.661 0.387

6 7 11 14 77777 381407.23 3.750 0.000 0.979 0.000 0.000 0.000 0.000 0.738 0.000 0.375 0.000
3.750 0.000 3.993 0.199 0.119 3.905 0.256 0.147 3.633 0.508 0.177

7 7 11 14 77777 381407.23 3.880 0.000 1.011 0.000 0.000 0.000 0.000 1.038 0.000 0.388 0.000
3.880 0.000 3.803 0.397 0.337 3.645 0.490 0.407 3.321 0.724 0.487

8 7 11 14 77777 381407.23 3.880 0.000 1.011 0.000 0.000 0.000 0.000 0.863 0.000 0.388 0.000
3.880 0.000 3.980 0.281 0.202 3.852 0.375 0.244 3.573 0.618 0.290

9 7 11 14 77777 381407.23 3.750 0.000 0.979 0.000 0.000 0.000 0.000 0.829 0.000 0.375 0.000
3.750 0.000 3.810 0.282 0.238 3.683 0.326 0.295 3.425 0.533 0.359

10 7 11 14 77777 381407.23 3.880 0.000 1.011 0.000 0.000 0.000 0.000 0.796 0.000 0.388 0.000
3.880 0.000 4.128 0.215 0.135 4.011 0.339 0.164 3.711 0.602 0.196

```
11      7  11    14  77777   381407.23   3.750  0.000  0.979  0.000  0.000  0.000  0.000  0.779  0.000  0.375  0.000
3.750  0.000  4.000  0.252  0.119  3.891  0.313  0.147  3.602  0.569  0.178

12      7  11    14  77777   381407.23   3.880  0.000  1.011  0.000  0.000  0.000  0.000  0.996  0.000  0.388  0.000
3.880  0.000  3.857  0.388  0.337  3.696  0.479  0.408  3.388  0.689  0.489

 1      8  10    14  88888   381407.23   3.880  0.000  0.214  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  2.083  1.496  0.000  2.057  1.515  0.000  1.802  1.736  0.000

 2      8  10    14  88888   381407.23   3.524  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.352  0.000
3.524  0.000  1.599  1.419  0.000  1.608  1.448  0.000  1.414  1.736  0.000

 3      8  10    14  88888   381407.23   3.880  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  1.521  1.964  0.000  1.501  2.011  0.000  1.243  2.289  0.000

 4      8  10    14  88888   381407.23   3.750  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.375  0.000
3.750  0.000  1.582  1.815  0.000  1.578  1.828  0.000  1.301  2.094  0.000

 5      8  10    14  88888   381407.23   3.880  0.000  0.177  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  2.305  1.608  0.000  2.240  1.627  0.000  1.879  1.889  0.000

 6      8  10    14  88888   381407.23   3.750  0.000  0.461  0.000  0.000  0.000  0.000  0.000  0.000  0.375  0.000
3.750  0.000  2.425  1.438  0.000  2.378  1.453  0.000  2.193  1.625  0.000

 7      8  10    14  88888   381407.23   3.880  0.000  0.214  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  2.139  1.578  0.000  2.130  1.601  0.000  1.847  1.867  0.000

 8      8  10    14  88888   381407.23   3.880  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  1.746  1.554  0.000  1.747  1.577  0.000  1.514  1.912  0.000

 9      8  10    14  88888   381407.23   3.750  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.375  0.000
3.750  0.000  1.446  1.724  0.000  1.437  1.772  0.000  1.232  2.043  0.000

10      8  10    14  88888   381407.23   3.880  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  1.728  1.811  0.000  1.709  1.824  0.000  1.477  2.049  0.000

11      8  10    14  88888   381407.23   3.750  0.000  0.172  0.000  0.000  0.000  0.000  0.000  0.000  0.375  0.000
3.750  0.000  2.239  1.503  0.000  2.193  1.519  0.000  1.873  1.721  0.000

12      8  10    14  88888   381407.23   3.880  0.000  0.476  0.000  0.000  0.000  0.000  0.000  0.000  0.388  0.000
3.880  0.000  2.573  1.591  0.000  2.506  1.615  0.000  2.236  1.857  0.000
```

out04_WATRMod.sum4 (note that the lines in this output file are shown wrapped here to fit on the page):
Output file generated by WATRMod version 1.0

```
  Sim Yrs    Poly   Area_m^2  LC  Soil   SMC  Perv        Rain         Fog       Irrig.       Septic       Dir_rc      Cnst_rc       Dir_rc+
Runon      Ext_src       Runoff      Can_evp         Pnet        St_drn         ETo       PE/ETo       SM1i         AE1       Tot_rc1        Rej1
SM1f    Err.1    SM2i          AE2       Tot_rc2         Rej2   SM2f    Err.2     SM3i          AE3       Tot_rc3         Rej3   SM3f    Err.3

   1   5       1   127135.74  17    1  1.800  1.00       913.00       182.60         0.00         0.00         0.00         0.00         0.00         0.00
0.00       182.60       298.24       797.36         0.00        91.30         0.30      0.90        27.39       586.65         0.00  1.62    0.000    0.90
27.39       586.65         0.00  1.62    0.000    0.90        26.59       587.44         0.00  1.63    0.000

   1   5       2   127135.74  16    1  3.600  1.00       913.00       182.60         0.00         0.00         0.00         0.00         0.00         0.00
0.00       182.60       298.24       797.36         0.00        91.30         0.33      1.80        30.13       583.03         0.00  3.40    0.000    1.80
30.13       583.03         0.00  3.40    0.000    1.80        29.60       583.55         0.00  3.41    0.000
```

1 5 3 127135.74 15 2 0.900 1.00 570.69 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 114.14 158.83 411.86 0.00 91.30 0.30 0.45 27.39 269.97 0.00 0.81 0.000 0.45
27.39 269.97 0.00 0.81 0.000 0.45 25.56 271.79 0.00 0.81 0.000

1 5 4 127135.74 14 2 1.800 1.00 570.69 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 114.14 158.83 411.86 0.00 91.30 0.44 0.90 40.17 256.78 0.00 1.67 0.000 0.90
40.17 256.78 0.00 1.67 0.000 0.90 38.15 258.80 0.00 1.67 0.000

1 5 5 381407.23 13 3 0.962 1.00 342.19 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 34.22 0.00 342.19 0.00 273.90 0.95 0.48 191.94 116.41 0.00 0.11 0.000 0.48
190.00 118.29 0.00 0.17 0.000 0.48 166.43 141.63 0.00 0.40 0.000

1 5 6 381407.23 12 3 0.692 0.90 342.19 0.00 0.00 0.00 0.00 0.00 0.00 21.55
0.00 34.22 0.00 342.19 0.00 273.90 1.18 0.32 189.61 118.69 0.00 0.00 0.000 0.32
182.73 125.52 0.00 0.04 0.000 0.32 167.18 140.98 0.00 0.13 0.000

1 5 7 381407.23 11 4 1.296 0.50 228.42 0.00 59.56 0.00 0.00 0.00 0.00 56.54
0.00 22.84 0.00 228.42 0.00 365.20 1.18 0.39 224.96 21.48 18.95 0.14 0.000 0.39
216.58 25.58 23.16 0.20 0.000 0.39 200.07 37.18 27.96 0.33 0.000

1 5 8 381407.23 10 4 1.296 1.00 228.42 0.00 8.58 0.00 0.00 0.00 0.00 0.00
0.00 22.84 0.00 228.42 0.00 365.20 0.36 0.46 116.34 98.02 0.00 0.25 0.000 0.46
114.72 99.57 0.00 0.32 0.000 0.46 98.64 115.43 0.00 0.54 0.000

2 5 1 127135.74 17 1 1.800 1.00 913.00 182.60 0.00 0.00 0.00 0.00 0.00 0.00
0.00 182.60 293.78 801.82 0.00 91.30 0.30 0.90 27.39 591.10 0.00 1.64 0.000 0.90
27.39 591.10 0.00 1.64 0.000 0.90 26.48 592.00 0.00 1.64 0.000

2 5 2 127135.74 16 1 3.600 1.00 913.00 182.60 0.00 0.00 0.00 0.00 0.00 0.00
0.00 182.60 293.78 801.82 0.00 91.30 0.33 1.80 30.13 587.47 0.00 3.42 0.000 1.80
30.13 587.47 0.00 3.42 0.000 1.80 29.55 588.05 0.00 3.42 0.000

2 5 3 127135.74 15 2 0.900 1.00 570.69 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 114.14 159.06 411.63 0.00 91.30 0.30 0.45 27.39 269.74 0.00 0.81 0.000 0.45
27.39 269.74 0.00 0.81 0.000 0.45 25.59 271.54 0.00 0.81 0.000

2 5 4 127135.74 14 2 1.800 1.00 570.69 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 114.14 159.06 411.63 0.00 91.30 0.44 0.90 40.17 256.55 0.00 1.67 0.000 0.90
40.17 256.55 0.00 1.67 0.000 0.90 38.18 258.54 0.00 1.67 0.000

2 5 5 381407.23 13 3 0.962 1.00 342.19 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 34.22 0.00 342.19 0.00 273.90 0.95 0.48 201.27 107.18 0.00 0.00 0.000 0.48
199.28 109.16 0.00 0.01 0.000 0.48 175.09 133.20 0.00 0.16 0.000

2 5 6 381407.23 12 3 0.692 0.90 342.19 0.00 0.00 0.00 0.00 0.00 0.00 20.22
0.00 34.22 0.00 342.19 0.00 273.90 1.18 0.32 203.63 104.66 0.00 0.00 0.000 0.32
196.86 111.44 0.00 0.00 0.000 0.32 180.12 128.15 0.00 0.03 0.000

2 5 7 381407.23 11 4 1.296 0.50 228.42 0.00 59.56 0.00 0.00 0.00 0.00 49.91
0.00 22.84 0.00 228.42 0.00 365.20 1.18 0.39 235.75 16.42 13.35 0.00 0.000 0.39
228.20 20.95 16.28 0.10 0.000 0.39 211.66 34.07 19.58 0.22 0.000

2 5 8 381407.23 10 4 1.296 1.00 228.42 0.00 8.58 0.00 0.00 0.00 0.00 0.00
0.00 22.84 0.00 228.42 0.00 365.20 0.36 0.46 117.54 97.05 0.00 0.02 0.000 0.46
116.10 98.41 0.00 0.10 0.000 0.46 101.10 113.16 0.00 0.36 0.000

3 5 1 127135.74 17 1 1.800 1.00 913.00 182.60 0.00 0.00 0.00 0.00 0.00 0.00
0.00 182.60 294.74 800.86 0.00 91.30 0.30 0.90 27.39 590.14 0.00 1.64 0.000 0.90

27.39 590.14 0.00 1.64 0.000 0.90 26.51 591.01 0.00 1.64 0.000

3 5 2 127135.74 16 1 3.600 1.00 913.00 182.60 0.00 0.00 0.00 0.00 0.00 0.00
0.00 182.60 294.74 800.86 0.00 91.30 0.33 1.80 30.13 586.52 0.00 3.42 0.000 1.80
30.13 586.52 0.00 3.42 0.000 1.80 29.57 587.07 0.00 3.42 0.000

3 5 3 127135.74 15 2 0.900 1.00 570.69 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 114.14 160.36 410.33 0.00 91.30 0.30 0.45 27.39 268.44 0.00 0.81 0.000 0.45
27.39 268.44 0.00 0.81 0.000 0.45 25.83 269.99 0.00 0.81 0.000

3 5 4 127135.74 14 2 1.800 1.00 570.69 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 114.14 160.36 410.33 0.00 91.30 0.44 0.90 40.17 255.25 0.00 1.67 0.000 0.90
40.17 255.25 0.00 1.67 0.000 0.90 38.45 256.97 0.00 1.67 0.000

3 5 5 381407.23 13 3 0.962 1.00 342.19 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 34.22 0.00 342.19 0.00 273.90 0.95 0.48 200.45 107.89 0.00 0.11 0.000 0.48
198.41 109.87 0.00 0.17 0.000 0.48 173.42 134.63 0.00 0.40 0.000

3 5 6 381407.23 12 3 0.692 0.90 342.19 0.00 0.00 0.00 0.00 0.00 0.00 20.80
0.00 34.22 0.00 342.19 0.00 273.90 1.18 0.32 201.61 106.68 0.00 0.00 0.000 0.32
193.76 114.50 0.00 0.04 0.000 0.32 176.58 131.58 0.00 0.13 0.000

3 5 7 381407.23 11 4 1.296 0.50 228.42 0.00 59.56 0.00 0.00 0.00 0.00 52.79
0.00 22.84 0.00 228.42 0.00 365.20 1.18 0.39 233.27 18.10 14.02 0.14 0.000 0.39
225.34 22.82 17.16 0.20 0.000 0.39 208.06 36.43 20.71 0.33 0.000

3 5 8 381407.23 10 4 1.296 1.00 228.42 0.00 8.58 0.00 0.00 0.00 0.00 0.00
0.00 22.84 0.00 228.42 0.00 365.20 0.36 0.46 116.94 97.43 0.00 0.25 0.000 0.46
115.43 98.86 0.00 0.32 0.000 0.46 100.40 113.67 0.00 0.54 0.000

out06_WATRMod.smc

1 1.800

2 3.600

3 0.900

4 1.800

5 0.962

6 0.692

7 1.296

8 1.296

out07_WATRMod_FAO_annrech_in.csv

Poly_ID,2001,2002,2003,2004,2005,Mean,
1, 117.117, 117.686, 117.701, 118.343, 118.447, 117.859,
2, 115.679, 117.139, 117.158, 117.789, 117.907, 117.134,
3, 53.941, 53.595, 53.824, 54.388, 53.636, 53.877,
4, 51.001, 51.042, 51.248, 51.847, 51.056, 51.239,
5, 21.490, 23.141, 23.928, 22.141, 21.737, 22.488,
6, 21.939, 23.337, 25.598, 23.200, 23.078, 23.430,
7, 4.133, 4.100, 5.027, 4.859, 4.999, 4.624,
8, 19.610, 19.889, 19.884, 19.829, 19.734, 19.789,

out08_WATRMod_FAO_subarea_mo_in.csv
(note that the lines in this output file are shown wrapped here to fit on the page):

Poly_ID,1Rain,1Fog,1Irrig.,1Septic,1Dir_rc,1Cnst_rc,1Dir_rc+,1Runon,1Ext_src,1Runoff,1Can_evp,1Pnet,1St_drn,1AE,1Tot_rc,1Rej,2Rain,2Fog,2Irrig.,2Septic,2Dir_rc,2Cnst_rc,2Dir_rc+,2Runon,2Ext_src,2Runoff,2Can_evp,2Pnet,2St_drn,2AE,2Tot_rc,2Rej,3Rain,3Fog,3Irrig.,3Septic,3Dir_rc,3Cnst_rc,3Dir_rc+,3Runon,3Ext_src,3Runoff,3Can_evp,3Pnet,3St_drn,3AE,3Tot_rc,3Rej,4Rain,4Fog,4Irrig.,4Septic,4Dir_rc,4Cnst_rc,4Dir_rc+,4Runon,4Ext_src,4Runoff,4Can_evp,4Pnet,4St_drn,4AE,4Tot_rc,4Rej,5Rain,5Fog,5Irrig.,5Septic,5Dir_rc,5Cnst_rc,5Dir_rc+,5Runon,5Ext_src,5Runoff,5Can_evp,5Pnet,5St_drn,5AE,5Tot_rc,5Rej,6Rain,6Fog,6Irrig.,6Septic,6Dir_rc,6Cnst_rc,6Dir_rc+,6Runon,6Ext_src,6Runoff,6Can_evp,6Pnet,6St_drn,6AE,6Tot_rc,6Rej,7Rain,7Fog,7Irrig.,7Septic,7Dir_rc,7Cnst_rc,7Dir_rc+,7Runon,7Ext_src,7Runoff,7Can_evp,7Pnet,7St_drn,7AE,7Tot_rc,7Rej,8Rain,8Fog,8Irrig.,8Septic,8Dir_rc,8Cnst_rc,8Dir_rc+,8Runon,8Ext_src,8Runoff,8Can_evp,8Pnet,8St_drn,8AE,8Tot_rc,8Rej,9Rain,9Fog,9Irrig.,9Septic,9Dir_rc,9Cnst_rc,9Dir_rc+,9Runon,9Ext_src,9Runoff,9Can_evp,9Pnet,9St_drn,9AE,9Tot_rc,9Rej,10Rain,10Fog,10Irrig.,10Septic,10Dir_rc,10Cnst_rc,10Dir_rc+,10Runon,10Ext_src,10Runoff,10Can_evp,10Pnet,10St_drn,10AE,10Tot_rc,10Rej,11Rain,11Fog,11Irrig.,11Septic,11Dir_rc,11Cnst_rc,11Dir_rc+,11Runon,11Ext_src,11Runoff,11Can_evp,11Pnet,11St_drn,11AE,11Tot_rc,11Rej,12Rain,12Fog,12Irrig.,12Septic,12Dir_rc,12Cnst_rc,12Dir_rc+,12Runon,12Ext_src,12Runoff,12Can_evp,12Pnet,12St_drn,12AE,12Tot_rc,12Rej

1, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.015, 13.585, 0.000, 0.465, 9.863, 0.000, 14.100, 2.820, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 2.820, 4.570, 12.350, 0.000, 0.423, 9.075, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.015, 13.585, 0.000, 0.465, 10.070, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.904, 13.096, 0.000, 0.450, 9.636, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 4.951, 13.649, 0.000, 0.465, 10.090, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.861, 13.139, 0.000, 0.450, 9.694, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.008, 13.592, 0.000, 0.465, 10.006, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 4.980, 13.620, 0.000, 0.465, 10.063, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.904, 13.096, 0.000, 0.450, 9.630, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.111, 13.489, 0.000, 0.465, 9.941, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.830, 13.170, 0.000, 0.450, 9.677, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 4.969, 13.631, 0.000, 0.465, 10.113, 0.000,

2, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.015, 13.585, 0.000, 0.512, 9.639, 0.000, 14.100, 2.820, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 2.820, 4.570, 12.350, 0.000, 0.465, 9.029, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.015, 13.585, 0.000, 0.512, 10.029, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.904, 13.096, 0.000, 0.495, 9.590, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 4.951, 13.649, 0.000, 0.512, 10.044, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.861, 13.139, 0.000, 0.495, 9.649, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.008, 13.592, 0.000, 0.512, 9.958, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 4.980, 13.620, 0.000, 0.512, 10.018, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.904, 13.096, 0.000, 0.495, 9.583, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 5.111, 13.489, 0.000, 0.512, 9.897, 0.000, 15.000, 3.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.000, 4.830, 13.170, 0.000, 0.495, 9.628, 0.000, 15.500, 3.100, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 3.100, 4.969, 13.631, 0.000, 0.512, 10.071, 0.000,

3, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.740, 6.950, 0.000, 0.465, 4.443, 0.000, 8.788, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.758, 2.469, 6.319, 0.000, 0.423, 4.133, 0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.627, 7.063, 0.000, 0.465, 4.708, 0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.645, 6.735, 0.000, 0.450, 4.380, 0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.719, 6.971, 0.000, 0.465, 4.590, 0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.663, 6.717, 0.000, 0.450, 4.359, 0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.675, 7.015, 0.000, 0.465, 4.635, 0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.763, 6.927, 0.000, 0.465, 4.517, 0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.639, 6.741, 0.000, 0.450, 4.425, 0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.651, 7.039, 0.000, 0.465, 4.632, 0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.648, 6.732, 0.000, 0.450, 4.378, 0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.645, 7.045, 0.000, 0.465, 4.677, 0.000,

4, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.740, 6.950, 0.000, 0.682, 4.130,
0.000, 8.788, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.758, 2.469, 6.319, 0.000, 0.620, 3.932,
0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.627, 7.063, 0.000, 0.682, 4.513,
0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.645, 6.735, 0.000, 0.660, 4.157,
0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.719, 6.971, 0.000, 0.682, 4.384,
0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.663, 6.717, 0.000, 0.660, 4.134,
0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.675, 7.015, 0.000, 0.682, 4.429,
0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.763, 6.927, 0.000, 0.682, 4.297,
0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.639, 6.741, 0.000, 0.660, 4.219,
0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.651, 7.039, 0.000, 0.682, 4.413,
0.000, 9.380, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.876, 2.648, 6.732, 0.000, 0.660, 4.155,
0.000, 9.690, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 1.938, 2.645, 7.045, 0.000, 0.682, 4.476,
0.000,

5, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.287, 1.807,
0.000, 5.288, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.529, 0.000, 5.288, 0.000, 3.125, 1.652,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.075, 2.294,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.562, 0.000, 5.620, 0.000, 2.855, 2.199,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.344, 1.939,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.562, 0.000, 5.620, 0.000, 3.392, 1.584,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.304, 1.996,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.352, 1.819,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.562, 0.000, 5.620, 0.000, 3.175, 1.798,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.522, 1.723,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.562, 0.000, 5.620, 0.000, 3.429, 1.626,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.581, 0.000, 5.810, 0.000, 3.318, 2.052,
0.000,

6, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.346, 0.000, 0.581, 0.000, 5.810, 0.000, 3.338, 1.880,
0.000, 5.288, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.296, 0.000, 0.529, 0.000, 5.288, 0.000, 3.132, 1.580,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.383, 0.000, 0.581, 0.000, 5.810, 0.000, 2.867, 2.460,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.379, 0.000, 0.562, 0.000, 5.620, 0.000, 2.610, 2.439,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.360, 0.000, 0.581, 0.000, 5.810, 0.000, 3.223, 2.035,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.316, 0.000, 0.562, 0.000, 5.620, 0.000, 3.452, 1.570,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.381, 0.000, 0.581, 0.000, 5.810, 0.000, 3.063, 2.199,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.346, 0.000, 0.581, 0.000, 5.810, 0.000, 3.329, 1.879,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.334, 0.000, 0.562, 0.000, 5.620, 0.000, 3.155, 1.854,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.333, 0.000, 0.581, 0.000, 5.810, 0.000, 3.525, 1.729,
0.000, 5.620, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.324, 0.000, 0.562, 0.000, 5.620, 0.000, 3.439, 1.607,
0.000, 5.810, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.373, 0.000, 0.581, 0.000, 5.810, 0.000, 3.090, 2.199,
0.000,

7, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 0.863, 0.000, 0.388, 0.000, 3.880, 0.000, 3.814, 0.372,
0.244, 3.524, 0.000, 0.921, 0.000, 0.000, 0.000, 0.000, 0.686, 0.000, 0.352, 0.000, 3.524, 0.000, 3.631, 0.255,
0.235, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 1.046, 0.000, 0.388, 0.000, 3.880, 0.000, 3.494, 0.500,
0.571, 3.750, 0.000, 0.979, 0.000, 0.000, 0.000, 0.000, 1.054, 0.000, 0.375, 0.000, 3.750, 0.000, 3.272, 0.490,
0.588, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 0.929, 0.000, 0.388, 0.000, 3.880, 0.000, 3.779, 0.430,
0.325, 3.750, 0.000, 0.979, 0.000, 0.000, 0.000, 0.000, 0.738, 0.000, 0.375, 0.000, 3.750, 0.000, 3.905, 0.256,
0.147, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 1.038, 0.000, 0.388, 0.000, 3.880, 0.000, 3.645, 0.490,
0.407, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 0.863, 0.000, 0.388, 0.000, 3.880, 0.000, 3.852, 0.375,
0.244, 3.750, 0.000, 0.979, 0.000, 0.000, 0.000, 0.000, 0.829, 0.000, 0.375, 0.000, 3.750, 0.000, 3.683, 0.326,
0.295, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 0.796, 0.000, 0.388, 0.000, 3.880, 0.000, 4.011, 0.339,
0.164, 3.750, 0.000, 0.979, 0.000, 0.000, 0.000, 0.000, 0.779, 0.000, 0.375, 0.000, 3.750, 0.000, 3.891, 0.313,
0.147, 3.880, 0.000, 1.011, 0.000, 0.000, 0.000, 0.000, 0.996, 0.000, 0.388, 0.000, 3.880, 0.000, 3.696, 0.479,
0.408,

```
    8,  3.880,  0.000,  0.214,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  2.057,  1.515,
0.000,  3.524,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.352,  0.000,  3.524,  0.000,  1.608,  1.448,
0.000,  3.880,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  1.501,  2.011,
0.000,  3.750,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.375,  0.000,  3.750,  0.000,  1.578,  1.828,
0.000,  3.880,  0.000,  0.177,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  2.240,  1.627,
0.000,  3.750,  0.000,  0.461,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.375,  0.000,  3.750,  0.000,  2.378,  1.453,
0.000,  3.880,  0.000,  0.214,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  2.130,  1.601,
0.000,  3.880,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  1.747,  1.577,
0.000,  3.750,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.375,  0.000,  3.750,  0.000,  1.437,  1.772,
0.000,  3.880,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  1.709,  1.824,
0.000,  3.750,  0.000,  0.172,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.375,  0.000,  3.750,  0.000,  2.193,  1.519,
0.000,  3.880,  0.000,  0.476,  0.000,  0.000,  0.000,  0.000,  0.000,  0.000,  0.388,  0.000,  3.880,  0.000,  2.506,  1.615,
0.000,
```

out09_WATRMod_FAO_subarea_ann_in.csv
(note that the lines in this output file are shown wrapped here to fit on the page)

```
Poly_ID,Rain,Fog,Irrig.,Septic,Dir_rc,Cnst_rc,Dir_rc+,Runon,Ext_src,Runoff,Can_evp,Pnet,St_drn,AE,Tot_rc,Rej

1,       182.600,36.520,  0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   36.520,  59.117,  160.003,0.000,
5.478,   117.859,0.000,

2,       182.600,36.520,  0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   36.520,  59.117,  160.003,0.000,
6.026,   117.134,0.000,

3,       114.138,0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   22.828,  31.884,  82.254,  0.000,
5.478,   53.877,  0.000,

4,       114.138,0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   22.828,  31.884,  82.254,  0.000,
8.034,   51.239,  0.000,

5,       68.438,  0.000,  0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   6.844,   0.000,   68.438,  0.000,
39.180,  22.488,  0.000,

6,       68.438,  0.000,  0.000,   0.000,   0.000,   0.000,   0.000,   4.171,   0.000,   6.844,   0.000,   68.438,  0.000,
38.224,  23.430,  0.000,

7,       45.684,  0.000,  11.912,  0.000,   0.000,   0.000,   0.000,   10.616,  0.000,   4.568,   0.000,   45.684,  0.000,
44.675,  4.624,   3.773,

8,       45.684,  0.000,  1.715,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   4.568,   0.000,   45.684,  0.000,
23.084,  19.789,  0.000,
```

out10_WATRMod_FAO_totarea_mo_MGD.out

Mo	Rain	Fog	Irrig.	Septic	Dir_rc	Cnst_rc	Dir_rc+	Runon	Ext_src	Runoff	Can_evp	Pnet	St_drn	AE	Tot_rc	Rej
1	2.986	0.171	0.101	0	0	0	0	0.100	0	0.437	0.427	2.730	0	1.090	1.233	0.020
2	2.984	0.171	0.084	0	0	0	0	0.089	0	0.437	0.426	2.729	0	1.102	1.240	0.021
3	2.986	0.171	0.083	0	0	0	0	0.118	0	0.437	0.421	2.736	0	0.961	1.407	0.047
4	2.985	0.171	0.084	0	0	0	0	0.122	0	0.437	0.429	2.726	0	0.938	1.383	0.050

5	2.986	0.171	0.098	0	0	0	0	0.106	0	0.437	0.422	2.735	0	1.097	1.299	0.027
6	2.985	0.171	0.123	0	0	0	0	0.090	0	0.437	0.428	2.728	0	1.178	1.206	0.013
7	2.986	0.171	0.101	0	0	0	0	0.117	0	0.437	0.423	2.734	0	1.061	1.318	0.034
8	2.986	0.171	0.083	0	0	0	0	0.100	0	0.437	0.426	2.731	0	1.072	1.262	0.020
9	2.985	0.171	0.084	0	0	0	0	0.099	0	0.437	0.429	2.727	0	1.035	1.283	0.025
10	2.986	0.171	0.083	0	0	0	0	0.093	0	0.437	0.427	2.730	0	1.112	1.258	0.014
11	2.985	0.171	0.098	0	0	0	0	0.094	0	0.437	0.425	2.731	0	1.163	1.224	0.013
12	2.986	0.171	0.123	0	0	0	0	0.113	0	0.437	0.419	2.738	0	1.099	1.331	0.034

out11_WATRMod_FAO_totarea_ann_MGD.out
(note that the lines in this output file are shown wrapped here to fit on the page)

Rain	Fog	Irrig.	Septic	Dir_rc	Cnst_rc	Dir_rc+	Runon	Ext_src	Runoff	Can_evp	Pnet	St_drn	AE	Tot_rc	Rej
2.99	0.17	0.1	0	0	0	0	0.1	0	0.44	0.43	2.73	0	1.08	1.29	0.03

out12_WATRMod_FAO_subarea_mo.sm

```
     1    1.80

2001  1   1.59  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.86   0.00   1.55   0.47   0.47   9.39   0.00

2001  2   1.74  14.00   2.80   0.00   0.00   0.00   0.00   0.00   2.80   4.41   0.00   1.40   0.42   0.42   9.12   0.00

2001  3   1.74  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.95   0.00   1.55   0.47   0.47  10.16   0.00

2001  4   1.75  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   4.94   0.00   1.50   0.45   0.45   9.55   0.00

2001  5   1.71  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.90   0.00   1.55   0.47   0.47  10.17   0.00

2001  6   1.76  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   5.03   0.00   1.50   0.45   0.45   9.56   0.00

2001  7   1.73  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.95   0.00   1.55   0.47   0.47  10.06   0.00

2001  8   1.75  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   5.09   0.00   1.55   0.47   0.47   9.95   0.00

2001  9   1.76  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   4.94   0.00   1.50   0.45   0.45   9.59   0.00

2001 10   1.76  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   5.18   0.00   1.55   0.47   0.47   9.90   0.00

2001 11   1.70  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   4.89   0.00   1.50   0.45   0.45   9.55   0.00

2001 12   1.74  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.95   0.00   1.55   0.47   0.47  10.11   0.00

2002  1   1.74  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   5.18   0.00   1.55   0.47   0.47   9.80   0.00

2002  2   1.77  14.00   2.80   0.00   0.00   0.00   0.00   0.00   2.80   4.73   0.00   1.40   0.42   0.42   8.94   0.00

2002  3   1.72  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.95   0.00   1.55   0.47   0.47  10.05   0.00

2002  4   1.74  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   4.89   0.00   1.50   0.45   0.45   9.72   0.00

2002  5   1.73  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.95   0.00   1.55   0.47   0.47  10.07   0.00

2002  6   1.71  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   4.89   0.00   1.50   0.45   0.45   9.59   0.00

2002  7   1.76  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   5.00   0.00   1.55   0.47   0.47  10.04   0.00

2002  8   1.74  15.50   3.10   0.00   0.00   0.00   0.00   0.00   3.10   4.86   0.00   1.55   0.47   0.47  10.21   0.00

2002  9   1.75  15.00   3.00   0.00   0.00   0.00   0.00   0.00   3.00   4.94   0.00   1.50   0.45   0.45   9.58   0.00
```

2002	10	1.75	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.47	0.47	9.96	0.00
2002	11	1.73	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.45	0.45	9.63	0.00
2002	12	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.47	0.47	10.11	0.00
2003	1	1.75	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.47	0.47	9.89	0.00
2003	2	1.74	14.00	2.80	0.00	0.00	0.00	0.00	0.00	2.80	4.50	0.00	1.40	0.42	0.42	9.04	0.00
2003	3	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.04	0.00	1.55	0.47	0.47	10.03	0.00
2003	4	1.74	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.80	0.00	1.50	0.45	0.45	9.75	0.00
2003	5	1.73	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.04	0.00	1.55	0.47	0.47	10.04	0.00
2003	6	1.72	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.45	0.45	9.60	0.00
2003	7	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.47	0.47	10.11	0.00
2003	8	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.47	0.47	9.86	0.00
2003	9	1.74	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.45	0.45	9.72	0.00
2003	10	1.75	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.47	0.47	9.93	0.00
2003	11	1.73	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.80	0.00	1.50	0.45	0.45	9.73	0.00
2003	12	1.76	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.47	0.47	10.01	0.00
2004	1	1.71	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.90	0.00	1.55	0.47	0.47	10.16	0.00
2004	2	1.71	14.50	2.90	0.00	0.00	0.00	0.00	0.00	2.90	4.65	0.00	1.45	0.44	0.44	9.31	0.00
2004	3	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.47	0.47	10.16	0.00
2004	4	1.74	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.85	0.00	1.50	0.45	0.45	9.61	0.00
2004	5	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.47	0.47	10.12	0.00
2004	6	1.74	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.45	0.45	9.72	0.00
2004	7	1.72	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.47	0.47	9.74	0.00
2004	8	1.74	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.47	0.47	10.18	0.00

2004 9 1.75 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.94 0.00 1.50 0.45 0.45 9.55 0.00

2004 10 1.76 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 5.09 0.00 1.55 0.47 0.47 9.96 0.00

2004 11 1.73 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.80 0.00 1.50 0.45 0.45 9.73 0.00

2004 12 1.74 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.95 0.00 1.55 0.47 0.47 10.10 0.00

2005 1 1.73 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.95 0.00 1.55 0.47 0.47 10.08 0.00

2005 2 1.75 14.00 2.80 0.00 0.00 0.00 0.00 0.00 2.80 4.55 0.00 1.40 0.42 0.42 8.96 0.00

2005 3 1.76 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 5.18 0.00 1.55 0.47 0.47 9.96 0.00

2005 4 1.76 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 5.03 0.00 1.50 0.45 0.45 9.55 0.00

2005 5 1.74 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.92 0.00 1.55 0.47 0.47 10.04 0.00

2005 6 1.70 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.61 0.00 1.50 0.45 0.45 10.00 0.00

2005 7 1.73 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.95 0.00 1.55 0.47 0.47 10.08 0.00

2005 8 1.70 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.90 0.00 1.55 0.47 0.47 10.12 0.00

2005 9 1.72 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.80 0.00 1.50 0.45 0.45 9.71 0.00

2005 10 1.76 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 5.09 0.00 1.55 0.47 0.47 9.96 0.00

2005 11 1.75 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.77 0.00 1.50 0.45 0.45 9.75 0.00

2005 12 1.72 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.90 0.00 1.55 0.47 0.47 10.23 0.00

2 3.60

2001 1 3.22 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.86 0.00 1.55 0.51 0.51 8.45 0.00

2001 2 3.53 14.00 2.80 0.00 0.00 0.00 0.00 0.00 2.80 4.41 0.00 1.40 0.46 0.46 9.08 0.00

2001 3 3.53 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.95 0.00 1.55 0.51 0.51 10.12 0.00

2001 4 3.54 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.94 0.00 1.50 0.50 0.50 9.50 0.00

2001 5 3.51 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.90 0.00 1.55 0.51 0.51 10.13 0.00

2001 6 3.56 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 5.03 0.00 1.50 0.50 0.50 9.52 0.00

2001	7	3.52	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.02	0.00
2001	8	3.55	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.51	0.51	9.90	0.00
2001	9	3.56	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.94	0.00	1.50	0.50	0.50	9.55	0.00
2001	10	3.55	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.51	0.51	9.86	0.00
2001	11	3.49	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.49	0.00
2001	12	3.54	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.07	0.00
2002	1	3.54	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.51	0.51	9.75	0.00
2002	2	3.57	14.00	2.80	0.00	0.00	0.00	0.00	0.00	2.80	4.73	0.00	1.40	0.46	0.46	8.91	0.00
2002	3	3.51	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.00	0.00
2002	4	3.54	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.68	0.00
2002	5	3.52	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.02	0.00
2002	6	3.50	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.53	0.00
2002	7	3.55	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.00	0.00	1.55	0.51	0.51	9.99	0.00
2002	8	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.86	0.00	1.55	0.51	0.51	10.17	0.00
2002	9	3.55	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.94	0.00	1.50	0.50	0.50	9.53	0.00
2002	10	3.55	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.51	0.51	9.91	0.00
2002	11	3.52	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.58	0.00
2002	12	3.54	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.07	0.00
2003	1	3.54	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.51	0.51	9.85	0.00
2003	2	3.54	14.00	2.80	0.00	0.00	0.00	0.00	0.00	2.80	4.50	0.00	1.40	0.46	0.46	9.00	0.00
2003	3	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.04	0.00	1.55	0.51	0.51	9.98	0.00
2003	4	3.53	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.80	0.00	1.50	0.50	0.50	9.70	0.00
2003	5	3.52	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.04	0.00	1.55	0.51	0.51	10.00	0.00

2003	6	3.51	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.55	0.00
2003	7	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.07	0.00
2003	8	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.51	0.51	9.80	0.00
2003	9	3.53	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.68	0.00
2003	10	3.54	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.51	0.51	9.88	0.00
2003	11	3.52	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.80	0.00	1.50	0.50	0.50	9.68	0.00
2003	12	3.55	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.51	0.51	9.97	0.00
2004	1	3.50	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.90	0.00	1.55	0.51	0.51	10.11	0.00
2004	2	3.50	14.50	2.90	0.00	0.00	0.00	0.00	0.00	2.90	4.65	0.00	1.45	0.48	0.48	9.26	0.00
2004	3	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.12	0.00
2004	4	3.53	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.85	0.00	1.50	0.50	0.50	9.56	0.00
2004	5	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.08	0.00
2004	6	3.54	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.89	0.00	1.50	0.50	0.50	9.68	0.00
2004	7	3.52	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.51	0.51	9.68	0.00
2004	8	3.54	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.15	0.00
2004	9	3.54	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.94	0.00	1.50	0.50	0.50	9.50	0.00
2004	10	3.55	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.09	0.00	1.55	0.51	0.51	9.91	0.00
2004	11	3.52	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	4.80	0.00	1.50	0.50	0.50	9.68	0.00
2004	12	3.53	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.05	0.00
2005	1	3.52	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	4.95	0.00	1.55	0.51	0.51	10.04	0.00
2005	2	3.54	14.00	2.80	0.00	0.00	0.00	0.00	0.00	2.80	4.55	0.00	1.40	0.46	0.46	8.91	0.00
2005	3	3.56	15.50	3.10	0.00	0.00	0.00	0.00	0.00	3.10	5.18	0.00	1.55	0.51	0.51	9.92	0.00
2005	4	3.56	15.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	5.03	0.00	1.50	0.50	0.50	9.51	0.00

2005 5 3.54 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.92 0.00 1.55 0.51 0.51 9.99 0.00

2005 6 3.49 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.61 0.00 1.50 0.50 0.50 9.96 0.00

2005 7 3.52 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.95 0.00 1.55 0.51 0.51 10.03 0.00

2005 8 3.49 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.90 0.00 1.55 0.51 0.51 10.07 0.00

2005 9 3.51 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.80 0.00 1.50 0.50 0.50 9.66 0.00

2005 10 3.55 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 5.09 0.00 1.55 0.51 0.51 9.92 0.00

2005 11 3.55 15.00 3.00 0.00 0.00 0.00 0.00 0.00 3.00 4.77 0.00 1.50 0.50 0.50 9.71 0.00

2005 12 3.51 15.50 3.10 0.00 0.00 0.00 0.00 0.00 3.10 4.90 0.00 1.55 0.51 0.51 10.19 0.00

3 0.90

2001 1 0.81 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.65 0.00 1.55 0.47 0.47 4.28 0.00

2001 2 0.86 8.72 0.00 0.00 0.00 0.00 0.00 0.00 1.74 2.54 0.00 1.40 0.42 0.42 3.98 0.00

2001 3 0.81 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.51 0.00 1.55 0.47 0.47 4.88 0.00

2001 4 0.83 9.38 0.00 0.00 0.00 0.00 0.00 0.00 1.88 2.67 0.00 1.50 0.45 0.45 4.38 0.00

2001 5 0.82 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.75 0.00 1.55 0.47 0.47 4.51 0.00

2001 6 0.82 9.38 0.00 0.00 0.00 0.00 0.00 0.00 1.88 2.60 0.00 1.50 0.45 0.45 4.41 0.00

2001 7 0.84 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.67 0.00 1.55 0.47 0.47 4.63 0.00

2001 8 0.85 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.72 0.00 1.55 0.47 0.47 4.59 0.00

2001 9 0.85 9.38 0.00 0.00 0.00 0.00 0.00 0.00 1.88 2.71 0.00 1.50 0.45 0.45 4.31 0.00

2001 10 0.83 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.67 0.00 1.55 0.47 0.47 4.62 0.00

2001 11 0.82 9.38 0.00 0.00 0.00 0.00 0.00 0.00 1.88 2.48 0.00 1.50 0.45 0.45 4.60 0.00

2001 12 0.81 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.56 0.00 1.55 0.47 0.47 4.75 0.00

2002 1 0.85 9.69 0.00 0.00 0.00 0.00 0.00 0.00 1.94 2.79 0.00 1.55 0.47 0.47 4.46 0.00

2002 2 0.82 8.72 0.00 0.00 0.00 0.00 0.00 0.00 1.74 2.38 0.00 1.40 0.42 0.42 4.19 0.00

2002	3	0.81	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.63	0.00	1.55	0.47	0.47	4.70	0.00
2002	4	0.78	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.43	0.00	1.50	0.45	0.45	4.60	0.00
2002	5	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.75	0.00	1.55	0.47	0.47	4.52	0.00
2002	6	0.85	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.45	0.45	4.21	0.00
2002	7	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.68	0.00
2002	8	0.84	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.87	0.00	1.55	0.47	0.47	4.37	0.00
2002	9	0.84	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.45	0.45	4.41	0.00
2002	10	0.83	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.75	0.00	1.55	0.47	0.47	4.55	0.00
2002	11	0.83	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.45	0.45	4.17	0.00
2002	12	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.73	0.00
2003	1	0.83	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.87	0.00	1.55	0.47	0.47	4.32	0.00
2003	2	0.85	8.72	0.00	0.00	0.00	0.00	0.00	0.00	1.74	2.43	0.00	1.40	0.42	0.42	4.18	0.00
2003	3	0.83	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.60	0.00	1.55	0.47	0.47	4.70	0.00
2003	4	0.84	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.45	0.45	4.18	0.00
2003	5	0.83	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.63	0.00	1.55	0.47	0.47	4.80	0.00
2003	6	0.81	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.45	0.45	4.29	0.00
2003	7	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.56	0.00	1.55	0.47	0.47	4.80	0.00
2003	8	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.47	0.47	4.55	0.00
2003	9	0.85	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.71	0.00	1.50	0.45	0.45	4.31	0.00
2003	10	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.56	0.00	1.55	0.47	0.47	4.78	0.00
2003	11	0.84	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.71	0.00	1.50	0.45	0.45	4.29	0.00
2003	12	0.83	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.62	0.00
2004	1	0.84	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.66	0.00

2004	2	0.85	9.06	0.00	0.00	0.00	0.00	0.00	0.00	1.81	2.49	0.00	1.45	0.44	0.44	4.24	0.00
2004	3	0.84	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.70	0.00
2004	4	0.81	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.55	0.00	1.50	0.45	0.45	4.51	0.00
2004	5	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.56	0.00
2004	6	0.83	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.45	0.45	4.40	0.00
2004	7	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.47	0.47	4.48	0.00
2004	8	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.47	0.47	4.58	0.00
2004	9	0.79	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.43	0.00	1.50	0.45	0.45	4.65	0.00
2004	10	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.56	0.00
2004	11	0.83	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.45	0.45	4.40	0.00
2004	12	0.83	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.64	0.00
2005	1	0.84	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.47	0.47	4.50	0.00
2005	2	0.84	8.72	0.00	0.00	0.00	0.00	0.00	0.00	1.74	2.50	0.00	1.40	0.42	0.42	4.07	0.00
2005	3	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.47	0.47	4.56	0.00
2005	4	0.85	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.45	0.45	4.22	0.00
2005	5	0.86	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.47	0.47	4.57	0.00
2005	6	0.84	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.60	0.00	1.50	0.45	0.45	4.48	0.00
2005	7	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.47	0.47	4.58	0.00
2005	8	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.47	0.47	4.50	0.00
2005	9	0.83	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.45	0.45	4.44	0.00
2005	10	0.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.60	0.00	1.55	0.47	0.47	4.64	0.00
2005	11	0.83	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.60	0.00	1.50	0.45	0.45	4.43	0.00
2005	12	0.85	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.65	0.00	1.55	0.47	0.47	4.65	0.00

4 1.80

2001	1	1.63	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.65	0.00	1.55	0.68	0.68	3.66	0.00
2001	2	1.74	8.72	0.00	0.00	0.00	0.00	0.00	0.00	1.74	2.54	0.00	1.40	0.62	0.62	3.77	0.00
2001	3	1.66	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.51	0.00	1.55	0.68	0.68	4.71	0.00
2001	4	1.70	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.66	0.66	4.17	0.00
2001	5	1.68	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.75	0.00	1.55	0.68	0.68	4.28	0.00
2001	6	1.68	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.60	0.00	1.50	0.66	0.66	4.18	0.00
2001	7	1.71	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.42	0.00
2001	8	1.73	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.68	0.68	4.38	0.00
2001	9	1.73	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.71	0.00	1.50	0.66	0.66	4.09	0.00
2001	10	1.70	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.41	0.00
2001	11	1.68	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.48	0.00	1.50	0.66	0.66	4.40	0.00
2001	12	1.67	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.56	0.00	1.55	0.68	0.68	4.54	0.00
2002	1	1.72	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.68	0.68	4.23	0.00
2002	2	1.68	8.72	0.00	0.00	0.00	0.00	0.00	0.00	1.74	2.38	0.00	1.40	0.62	0.62	4.01	0.00
2002	3	1.67	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.63	0.00	1.55	0.68	0.68	4.51	0.00
2002	4	1.62	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.43	0.00	1.50	0.66	0.66	4.38	0.00
2002	5	1.69	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.75	0.00	1.55	0.68	0.68	4.29	0.00
2002	6	1.72	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.66	0.66	3.98	0.00
2002	7	1.72	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.50	0.00
2002	8	1.71	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.87	0.00	1.55	0.68	0.68	4.12	0.00
2002	9	1.72	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.66	0.66	4.21	0.00
2002	10	1.70	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.75	0.00	1.55	0.68	0.68	4.34	0.00

2002	11	1.70	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.66	0.66	3.91	0.00
2002	12	1.72	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.56	0.00
2003	1	1.70	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.87	0.00	1.55	0.68	0.68	4.06	0.00
2003	2	1.73	8.72	0.00	0.00	0.00	0.00	0.00	0.00	1.74	2.43	0.00	1.40	0.62	0.62	4.01	0.00
2003	3	1.70	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.60	0.00	1.55	0.68	0.68	4.49	0.00
2003	4	1.71	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.66	0.66	3.93	0.00
2003	5	1.70	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.63	0.00	1.55	0.68	0.68	4.65	0.00
2003	6	1.66	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.66	0.66	4.03	0.00
2003	7	1.68	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.56	0.00	1.55	0.68	0.68	4.62	0.00
2003	8	1.73	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.68	0.68	4.32	0.00
2003	9	1.72	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.71	0.00	1.50	0.66	0.66	4.09	0.00
2003	10	1.68	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.56	0.00	1.55	0.68	0.68	4.59	0.00
2003	11	1.72	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.71	0.00	1.50	0.66	0.66	4.06	0.00
2003	12	1.70	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.41	0.00
2004	1	1.71	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.46	0.00
2004	2	1.73	9.06	0.00	0.00	0.00	0.00	0.00	0.00	1.81	2.49	0.00	1.45	0.64	0.64	4.00	0.00
2004	3	1.71	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.52	0.00
2004	4	1.67	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.55	0.00	1.50	0.66	0.66	4.31	0.00
2004	5	1.68	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.31	0.00
2004	6	1.70	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.66	0.66	4.20	0.00
2004	7	1.72	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.68	0.68	4.26	0.00
2004	8	1.73	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.68	0.68	4.37	0.00
2004	9	1.64	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.43	0.00	1.50	0.66	0.66	4.45	0.00

2004	10	1.68	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.32	0.00
2004	11	1.69	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.66	0.66	4.20	0.00
2004	12	1.69	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.44	0.00
2005	1	1.72	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.68	0.68	4.25	0.00
2005	2	1.71	8.72	0.00	0.00	0.00	0.00	0.00	0.00	1.74	2.50	0.00	1.40	0.62	0.62	3.88	0.00
2005	3	1.73	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.72	0.00	1.55	0.68	0.68	4.34	0.00
2005	4	1.73	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.79	0.00	1.50	0.66	0.66	3.99	0.00
2005	5	1.74	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.68	0.68	4.39	0.00
2005	6	1.71	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.60	0.00	1.50	0.66	0.66	4.28	0.00
2005	7	1.69	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.67	0.00	1.55	0.68	0.68	4.35	0.00
2005	8	1.73	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.79	0.00	1.55	0.68	0.68	4.28	0.00
2005	9	1.70	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.67	0.00	1.50	0.66	0.66	4.26	0.00
2005	10	1.69	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.60	0.00	1.55	0.68	0.68	4.40	0.00
2005	11	1.70	9.38	0.00	0.00	0.00	0.00	0.00	0.00	1.88	2.60	0.00	1.50	0.66	0.66	4.20	0.00
2005	12	1.73	9.69	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.65	0.00	1.55	0.68	0.68	4.43	0.00

5 0.96

2001	1	0.58	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.98	1.44	0.00
2001	2	0.50	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	3.99	3.03	1.63	0.00
2001	3	0.52	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.46	2.12	0.00
2001	4	0.46	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	2.95	1.80	0.00
2001	5	0.49	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.45	2.04	0.00
2001	6	0.58	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.45	1.36	0.00
2001	7	0.48	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.28	2.03	0.00

2001	8	0.60	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.65	1.63	0.00
2001	9	0.62	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.64	1.58	0.00
2001	10	0.47	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.20	1.98	0.00
2001	11	0.49	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.19	1.91	0.00
2001	12	0.47	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.21	1.98	0.00
2002	1	0.55	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.19	1.57	0.00
2002	2	0.71	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	3.99	3.62	1.59	0.00
2002	3	0.26	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	2.19	3.07	0.00
2002	4	0.49	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.14	1.91	0.00
2002	5	0.46	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.26	1.87	0.00
2002	6	0.48	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	2.98	1.95	0.00
2002	7	0.50	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.37	2.09	0.00
2002	8	0.47	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.20	1.98	0.00
2002	9	0.55	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.04	1.41	0.00
2002	10	0.51	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.80	1.99	0.00
2002	11	0.55	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.09	1.41	0.00
2002	12	0.52	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.41	2.30	0.00
2003	1	0.48	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.15	2.08	0.00
2003	2	0.52	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	3.99	3.05	1.65	0.00
2003	3	0.37	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	2.68	2.57	0.00
2003	4	0.28	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	2.32	2.90	0.00
2003	5	0.59	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.65	1.60	0.00
2003	6	0.49	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.14	1.91	0.00

2003	7	0.37	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	2.66	2.58	0.00
2003	8	0.56	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.75	1.38	0.00
2003	9	0.37	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	2.53	2.40	0.00
2003	10	0.58	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.75	1.49	0.00
2003	11	0.60	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.73	1.39	0.00
2003	12	0.48	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.35	1.99	0.00
2004	1	0.46	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.08	1.97	0.00
2004	2	0.60	5.44	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	4.35	4.13	3.40	1.32	0.00
2004	3	0.61	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.80	1.61	0.00
2004	4	0.38	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	2.65	2.40	0.00
2004	5	0.47	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.21	2.03	0.00
2004	6	0.61	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.71	1.49	0.00
2004	7	0.56	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.87	1.29	0.00
2004	8	0.48	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.30	2.03	0.00
2004	9	0.49	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.17	1.85	0.00
2004	10	0.58	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.56	1.59	0.00
2004	11	0.50	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.17	1.98	0.00
2004	12	0.38	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	2.74	2.58	0.00
2005	1	0.46	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.03	1.97	0.00
2005	2	0.38	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	3.99	2.52	2.07	0.00
2005	3	0.49	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.25	2.10	0.00
2005	4	0.50	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.22	1.98	0.00
2005	5	0.49	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.16	2.16	0.00

2005	6	0.57	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.68	1.21	0.00
2005	7	0.48	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.35	1.99	0.00
2005	8	0.46	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	2.86	2.07	0.00
2005	9	0.49	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.50	1.74	0.00
2005	10	0.56	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.30	1.57	0.00
2005	11	0.62	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	4.27	3.96	1.45	0.00
2005	12	0.58	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	4.42	3.88	1.41	0.00
	6	0.69															
2001	1	0.34	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.92	1.55	0.00
2001	2	0.32	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	4.96	2.97	1.62	0.00
2001	3	0.32	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.33	2.11	0.00
2001	4	0.28	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	2.91	2.03	0.00
2001	5	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.13	2.21	0.00
2001	6	0.37	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.67	1.28	0.00
2001	7	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.07	2.21	0.00
2001	8	0.39	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.88	1.36	0.00
2001	9	0.41	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.88	1.24	0.00
2001	10	0.27	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.02	2.20	0.00
2001	11	0.31	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.13	1.94	0.00
2001	12	0.27	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.02	2.20	0.00
2002	1	0.38	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.71	1.35	0.00
2002	2	0.45	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	4.96	3.89	1.00	0.00
2002	3	0.13	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	1.61	3.62	0.00

2002	4	0.31	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.12	1.94	0.00
2002	5	0.25	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	2.92	2.28	0.00
2002	6	0.31	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.03	1.95	0.00
2002	7	0.31	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.22	2.11	0.00
2002	8	0.27	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.02	2.20	0.00
2002	9	0.38	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.58	1.19	0.00
2002	10	0.26	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.20	2.31	0.00
2002	11	0.39	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.59	1.19	0.00
2002	12	0.32	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.27	2.20	0.00
2003	1	0.30	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.12	2.11	0.00
2003	2	0.31	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	4.96	2.98	1.74	0.00
2003	3	0.22	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	2.37	2.87	0.00
2003	4	0.14	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	1.66	3.45	0.00
2003	5	0.39	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.88	1.35	0.00
2003	6	0.31	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.12	1.94	0.00
2003	7	0.22	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	2.36	2.87	0.00
2003	8	0.33	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.68	1.53	0.00
2003	9	0.22	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	2.28	2.70	0.00
2003	10	0.36	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.82	1.44	0.00
2003	11	0.35	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.68	1.41	0.00
2003	12	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.06	2.20	0.00
2004	1	0.27	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	2.97	2.20	0.00
2004	2	0.38	5.44	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	4.35	5.13	3.62	1.16	0.00

2004	3	0.37	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.88	1.47	0.00
2004	4	0.22	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	2.33	2.70	0.00
2004	5	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.05	2.21	0.00
2004	6	0.38	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.78	1.32	0.00
2004	7	0.30	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.60	1.62	0.00
2004	8	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.05	2.21	0.00
2004	9	0.28	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.01	2.03	0.00
2004	10	0.39	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.84	1.35	0.00
2004	11	0.29	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.02	2.08	0.00
2004	12	0.22	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	2.38	2.87	0.00
2005	1	0.27	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	2.96	2.20	0.00
2005	2	0.22	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	4.20	4.96	2.21	2.37	0.00
2005	3	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.15	2.23	0.00
2005	4	0.29	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.03	2.08	0.00
2005	5	0.31	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.13	2.12	0.00
2005	6	0.34	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.66	1.36	0.00
2005	7	0.28	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.06	2.20	0.00
2005	8	0.30	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.01	2.11	0.00
2005	9	0.26	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.02	2.12	0.00
2005	10	0.38	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.74	1.35	0.00
2005	11	0.35	5.62	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	4.50	5.31	3.77	1.42	0.00
2005	12	0.33	5.81	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	4.65	5.49	3.72	1.53	0.00

7 1.30

2001	1	0.81	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.19	0.43	0.00
2001	2	0.59	3.50	0.00	0.91	0.00	0.00	0.00	0.00	0.35	0.00	0.00	5.60	6.61	3.52	0.25	0.29
2001	3	0.70	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.90	0.35	0.41
2001	4	0.65	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.40	0.41	0.37
2001	5	0.71	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.73	0.51	0.41
2001	6	0.75	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	4.04	0.18	0.00
2001	7	0.70	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.63	0.51	0.41
2001	8	0.78	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.39	0.15	0.00
2001	9	0.80	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	4.34	0.10	0.00
2001	10	0.68	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.59	0.48	0.41
2001	11	0.66	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.74	0.28	0.37
2001	12	0.68	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.59	0.48	0.41
2002	1	0.71	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.11	0.13	0.00
2002	2	0.91	3.50	0.00	0.91	0.00	0.00	0.00	0.00	0.35	0.00	0.00	5.60	6.61	4.31	0.02	0.00
2002	3	0.49	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	2.54	0.76	1.22
2002	4	0.66	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.71	0.28	0.37
2002	5	0.70	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.42	0.61	0.41
2002	6	0.65	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.63	0.29	0.37
2002	7	0.69	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.88	0.35	0.41
2002	8	0.68	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.58	0.48	0.41
2002	9	0.67	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.98	0.03	0.00
2002	10	0.76	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.72	0.68	0.41
2002	11	0.68	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	4.01	0.03	0.00

2002	12	0.75	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.92	0.45	0.41
2003	1	0.67	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.75	0.34	0.41
2003	2	0.74	3.50	0.00	0.91	0.00	0.00	0.00	0.00	0.35	0.00	0.00	5.60	6.61	3.41	0.34	0.29
2003	3	0.58	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.15	0.55	0.82
2003	4	0.51	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	2.57	0.76	1.10
2003	5	0.77	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.38	0.14	0.00
2003	6	0.66	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.70	0.28	0.37
2003	7	0.58	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.14	0.56	0.81
2003	8	0.79	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.04	0.40	0.00
2003	9	0.56	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.03	0.52	0.74
2003	10	0.78	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.24	0.27	0.00
2003	11	0.85	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	4.01	0.37	0.00
2003	12	0.70	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.67	0.49	0.41
2004	1	0.67	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.52	0.48	0.41
2004	2	0.78	3.62	0.00	0.95	0.00	0.00	0.00	0.00	0.36	0.00	0.00	5.80	6.84	3.98	0.15	0.00
2004	3	0.82	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.26	0.32	0.00
2004	4	0.57	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.09	0.52	0.73
2004	5	0.69	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.59	0.51	0.41
2004	6	0.83	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	4.19	0.24	0.00
2004	7	0.81	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.91	0.55	0.00
2004	8	0.71	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	3.66	0.50	0.41
2004	9	0.70	3.75	0.00	0.98	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	7.08	3.54	0.42	0.37
2004	10	0.75	3.88	0.00	1.01	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	7.32	4.32	0.14	0.00

2004 11 0.74 3.75 0.00 0.98 0.00 0.00 0.00 0.00 0.38 0.00 0.00 6.00 7.08 3.55 0.48 0.37

2004 12 0.58 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 3.19 0.55 0.81

2005 1 0.66 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 3.49 0.48 0.41

2005 2 0.54 3.50 0.00 0.91 0.00 0.00 0.00 0.00 0.35 0.00 0.00 5.60 6.61 2.93 0.51 0.59

2005 3 0.69 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 3.62 0.51 0.41

2005 4 0.75 3.75 0.00 0.98 0.00 0.00 0.00 0.00 0.38 0.00 0.00 6.00 7.08 3.58 0.48 0.37

2005 5 0.69 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 3.78 0.37 0.41

2005 6 0.78 3.75 0.00 0.98 0.00 0.00 0.00 0.00 0.38 0.00 0.00 6.00 7.08 3.96 0.30 0.00

2005 7 0.70 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 3.67 0.49 0.41

2005 8 0.64 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 3.59 0.34 0.41

2005 9 0.74 3.75 0.00 0.98 0.00 0.00 0.00 0.00 0.38 0.00 0.00 6.00 7.08 3.52 0.56 0.37

2005 10 0.73 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 4.18 0.13 0.00

2005 11 0.89 3.75 0.00 0.98 0.00 0.00 0.00 0.00 0.38 0.00 0.00 6.00 7.08 4.14 0.41 0.00

2005 12 0.81 3.88 0.00 1.01 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 7.32 4.11 0.42 0.00

8 0.93

2001 1 0.52 3.88 0.00 0.21 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 2.48 2.32 1.45 0.00

2001 2 0.55 3.50 0.00 0.00 0.00 0.00 0.00 0.00 0.35 0.00 0.00 5.60 1.75 1.62 1.41 0.00

2001 3 0.72 3.88 0.00 0.00 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 1.61 1.59 2.09 0.00

2001 4 0.61 3.75 0.00 0.00 0.00 0.00 0.00 0.00 0.38 0.00 0.00 6.00 1.72 1.50 1.62 0.00

2001 5 0.63 3.88 0.00 0.18 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 2.40 2.33 1.68 0.00

2001 6 0.49 3.75 0.00 0.46 0.00 0.00 0.00 0.00 0.37 0.00 0.00 6.00 2.93 2.35 1.41 0.00

2001 7 0.47 3.88 0.00 0.21 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 2.48 2.08 1.62 0.00

2001 8 0.63 3.88 0.00 0.00 0.00 0.00 0.00 0.00 0.39 0.00 0.00 6.20 1.94 1.87 1.58 0.00

2001	9	0.76	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	1.56	1.55	1.84	0.00
2001	10	0.66	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.78	1.65	1.83	0.00
2001	11	0.60	3.75	0.00	0.17	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.32	2.23	1.52	0.00
2001	12	0.46	3.88	0.00	0.48	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	3.02	2.40	1.56	0.00
2002	1	0.46	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	1.92	1.44	0.00
2002	2	0.73	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	5.60	1.75	1.75	1.57	0.00
2002	3	0.53	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.61	1.39	2.10	0.00
2002	4	0.68	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	1.72	1.63	1.79	0.00
2002	5	0.50	3.88	0.00	0.18	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.40	2.17	1.53	0.00
2002	6	0.45	3.75	0.00	0.46	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.93	2.30	1.54	0.00
2002	7	0.51	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	2.23	1.64	0.00
2002	8	0.54	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.94	1.71	1.59	0.00
2002	9	0.59	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	1.56	1.32	1.54	0.00
2002	10	0.72	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.78	1.77	2.05	0.00
2002	11	0.50	3.75	0.00	0.17	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.32	2.06	1.36	0.00
2002	12	0.50	3.88	0.00	0.48	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	3.02	2.62	1.73	0.00
2003	1	0.48	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	2.08	1.60	0.00
2003	2	0.56	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	5.60	1.75	1.54	1.41	0.00
2003	3	0.58	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.61	1.46	1.99	0.00
2003	4	0.55	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	1.72	1.53	1.99	0.00
2003	5	0.68	3.88	0.00	0.18	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.40	2.33	1.55	0.00
2003	6	0.46	3.75	0.00	0.46	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.93	2.34	1.49	0.00
2003	7	0.45	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	2.00	1.71	0.00

2003	8	0.59	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.94	1.81	1.43	0.00
2003	9	0.56	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	1.56	1.38	1.84	0.00
2003	10	0.74	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.78	1.74	1.76	0.00
2003	11	0.63	3.75	0.00	0.17	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.32	2.25	1.50	0.00
2003	12	0.47	3.88	0.00	0.48	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	3.02	2.51	1.60	0.00
2004	1	0.45	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	2.01	1.54	0.00
2004	2	0.59	3.62	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	5.80	1.81	1.66	1.39	0.00
2004	3	0.74	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.61	1.58	1.90	0.00
2004	4	0.60	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	1.72	1.58	1.86	0.00
2004	5	0.55	3.88	0.00	0.18	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.40	2.15	1.63	0.00
2004	6	0.52	3.75	0.00	0.46	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	2.93	2.53	1.50	0.00
2004	7	0.49	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	2.16	1.42	0.00
2004	8	0.57	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.94	1.81	1.69	0.00
2004	9	0.66	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	1.56	1.42	1.79	0.00
2004	10	0.73	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.78	1.74	1.81	0.00
2004	11	0.57	3.75	0.00	0.17	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.32	2.10	1.61	0.00
2004	12	0.44	3.88	0.00	0.48	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	3.02	2.40	1.69	0.00
2005	1	0.45	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	1.96	1.54	0.00
2005	2	0.47	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	5.60	1.75	1.47	1.46	0.00
2005	3	0.66	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.61	1.49	1.98	0.00
2005	4	0.69	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	6.00	1.72	1.65	1.88	0.00
2005	5	0.61	3.88	0.00	0.18	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.40	2.21	1.74	0.00
2005	6	0.48	3.75	0.00	0.46	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.93	2.37	1.33	0.00

2005	7	0.49	3.88	0.00	0.21	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	2.48	2.19	1.61	0.00
2005	8	0.49	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.94	1.53	1.59	0.00
2005	9	0.70	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	1.56	1.52	1.84	0.00
2005	10	0.68	3.88	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	1.78	1.65	1.67	0.00
2005	11	0.71	3.75	0.00	0.17	0.00	0.00	0.00	0.00	0.37	0.00	0.00	6.00	2.32	2.31	1.60	0.00
2005	12	0.51	3.88	0.00	0.48	0.00	0.00	0.00	0.00	0.39	0.00	0.00	6.20	3.02	2.61	1.50	0.00

Moffett Field Publishing Service Center, California
Manuscript approved for publication January 4, 2022
Edited by Mitchell Phillips
Illustrative support by Katie Sullivan
Layout by Kimber Petersen

USGS

Oki—**Water-Budget Accounting for Tropical Regions Model (WATRMod) Documentation**—Open-File Report 2022–1013

ISSN 2331-1258 (online)
https://doi.org/10.3133/ofr20221013