SPOKANE RIVER BASIN MODEL PROJECT

Volume VI - User's Manual for Stratified Reservoir Model

by

John L. Shepherd

E. John Finnemore, Ph.D.

Systems Control, Inc., Palo Alto, California

for the

ENVIRONMENTAL PROTECTION AGENCY

Contract No. 68-01-0756

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EPA Review Notice

ABSTRACT

Three existing mathematical models, capable of representing water quality in rivers and lakes, have been modified and adapted to the Spokane River Basin in Washington and Idaho. The resulting models were named the Steady-state Stream Model, the Dynamic Stream Model, and the Stratified Reservoir Model. They are capable of predicting water quality levels resulting from alternative basinwide wastewater management schemes, and are designed to assist EPA, State, and local planning organizations to evaluate water quality management strategies and to establish priorities and schedules for investments in abatement facilities in the basin.

Physical data and historical hydrologic, water quality and meteorologic data were collected, assessed and used for the model calibrations and verifications.

The modified models are all capable of simulating the behavior of various subsets of up to sixteen different water quality constituents. Sensitivity analyses were conducted with all three models to determine the relative importance of a number of individual model parameters.

The models were provided to the EPA as computer source card decks in FORTRAN IV language, with accompanying data decks. All development work on, and applications made with, these models were fully documented so as to permit their easy utilization and duplication of historical simulations by other potential users. A user's manual with a complete program listing was prepared for each model.

This report was submitted in fulfillment of Contract No. 68-01-0756 under the sponsorship of the Environmental Protection Agency.

The titles and identifying numbers of the final report volumes are:

Title	EPA Report No.
SPOKANE RIVER BASIN MODEL PROJECT Volume I - Final Report	_____ DOC __/74
SPOKANE RIVER BASIN MODEL PROJECT Volume II - Data Report	_____ DOC __/74
SPOKANE RIVER BASIN MODEL PROJECT Volume III - Verification Report	_____ DOC __/74
SPOKANE RIVER BASIN MODEL PROJECT Volume IV - User's Manual for Steady-state Stream Model	_____ DOC __/74
SPOKANE RIVER BASIN MODEL PROJECT Volume V - User's Manual for Dynamic Stream Model	_____ DOC __/74
SPOKANE RIVER BASIN MODEL PROJECT Volume VI - User's Manual for Stratified Reservoir Model	_____ DOC __/74

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SECTION I

INTRODUCTION

This document is a supplement to Reference [3]. The Stratefied Model (LAKSCI), documented herein, is an extensive modification of the Deep Reservoir Model (DRM) described in References [1-5], and is one of three water quality simulation programs developed by Systems Control, Inc. (SCI) for use on the Spokane River Basin in the States of Washington and Idaho.

The three original separate programs comprising DRM (BAL, CEMIFP, and CETSIP) have been combined into a single program named LAKSCI and generalized. Subroutines which are unchanged or only slightly modified include BETA, CURVE, PINE, PPLOT, SCALE, SUBA, SUBB, SUBB2, (formerly SUBB of CEMIFP), SUBD, SUBE, SUBG, and SUBH. Subroutines BAL, QPRINT and SUBC have been extensively modified. Seven newly added subroutines are named FILL, GETAVI, GETCON, LAKCON, NEWIN, SETOPT, and SUN. The resulting modifications have given LAKSCI the capability of simultaneously modeling the concentrations of as many as sixteen inter-related water quality constituents in a stratified reservoir. All capabilities of DRM have been retained.

The mathematical procedures used in the thermal and hydrodynamic simulation are described in References [1] and [3]. The algorithms used to model the quality constituents are explained in detail in Volume I (Part III) of this report. The changes to DRM as described on pages 51-53 of Reference [5] are included in LAKSCI.

The format of this users manual is generally consistent with the format of Reference [3], subject to the constraints imposed by EPA documentation specifications.

LAKSCI has been applied to Coeur d'Alene Lake and Long Lake (and to the Spokane River Arm of FDR lake in modified form) and has been executed on both the UNIVAC 1108 and the IBM 370/155 systems.

SECTION II

MODE OF OPERATION

The new Stratified Reservoir Model (LAKSCI) described herein may be divided into three logical parts. These parts are:

Part I - Water Balance Program (Subroutine BAL)

This subroutine (previously referred to as the BAL program) calculates a time history of the lake surface elevation as a function of lake inflow and outflow. It outputs the surface elevation, lake inflow, lake outflow, and lake inflow temperature for use by Part III. Input to BAL is lake inflow, lake inflow temperature, lake outflow, and lake coefficients. It is described in more detail in Section III.

Part II - Meteorologic Data Processing (Subroutines SUBA, SUBB2)

These subroutines (previously referred to as the CEMIF program) accept up to seven meteorologic parameters as input, convert them to appropriate units, and output them for use by Part III. They are referenced in Section IV.

PART III - Reservoir Simulation (Subroutine SUBB, NEWIN, and SUBC)

These subroutines, and the routines which they call, (together previously referred to as the CETSIP program) read in all required input from cards and from the data files written by Parts I and II and simulate both the hydrodynamic and quality behavior of the lake or reservoir over the time period of interest. Detailed descriptions of the numerous subroutines are provided in Section V.

An execution of LAKSCI consists of successive calls to BAL, SUBA, SUBB2, SUBB, NEWIN, and SUBC.

SECTION III

WATER BALANCE PROGRAM

DESCRIPTION OF SUBROUTINE BAL

Subroutine BAL calculates the daily variation in the lake surface elevation as a function of lake inflow, lake outflow, and the lake coefficients C_1, C_2, and C_3. Previously this was a separate program, but in this project is has been combined into the new overall LAKSCI program. The required input is described in Table 9.

Subroutine BAL is called from the main program and makes a standard return. It calls subroutine FILL to interpolate input values if required and is entered only once during program execution. The daily lake surface elevation is calculated in the following manner.

The lake coefficients C_1, C_2, and C_3 are defined by

$$V(d) = C_1 d + \frac{C_2 d^2}{2} + \frac{C_3 d^3}{3}$$

$$A(d) = C_1 + C_2 d + C_3 d^2$$

where

V(d) = volume of lake in acre feet (d is depth in feet)

A(d) = surface area of lake in acres

For each day being simulated Q_{IN}, Q_{OUT}, and T are read in where Q_{IN} is lake inflow in CFS, Q_{OUT} is lake outflow in CFS, and T is the inflow temperature in centrigrade degrees. Q_{IN} is adjusted by

$$Q_I = Q_{IN} \cdot f + Q_g$$

where

f and Q_g = input

The lake volume on day J + 1 is calculated from the volume on day J by

$$V_{J+1} = V_j + (Q_I - Q_{OUT}) fac$$

where

V_i = volume on day i (acre feet)

fac = 86400/43560 and changes CFS to daily volume in acre feet

The surface elevation on day J + 1 is calculated from the elevation on day J by the following iterative technique.

$$X_i = Z_j$$

$$Z_{j+1} = X_1 + (V_{j+1} - V(X_1))/A_j$$

where

Z_i = surface elevation on day i (feet)

A_i = surface area on day i (acres)

If Z_{j+1} differs from Z_j by more than .005 feet, X_1 is set equal to Z_{j+1} and the process is repeated. A maximum of ten iterations is allowed. When Z_{j+1} has been determined the "error" term $V_{j+1} - V(Z_{j+1})$ is calculated and stored for output. The number of iterations required is also stored for output. When all days in the simulation period have been considered, BAL writes the surface elevation (referenced to sea level), Q_I, Q_{OUT}, and T out on tape or disk for use by LAKSCI. A summary is also output on the printer (see Table 16).

The local program variables in subroutine BAL are defined in Table 1. They are all undimensioned.

TABLE 1.

LOCAL PROGRAM VARIABLES OF SUBROUTINE BAL

Variable Name	Description
BOTEL	Lake bottom elevation above sea level (feet)
FACIN	Factor applied to inflow
GWFLOW	Bias added to inflow (cfs)
RSELI	Initial surface elevation above lake bottom (feet)
TA	Conversion factor

SECTION IV

METEOROLOGIC DATA PROCESSING

INTRODUCTION

Previously the subroutines described in this section comprised a separate program, CEMIFP. In this project they have been combined together to form Part II of the new overall LAKSCI program.

DESCRIPTION OF SUBROUTINE SUBA

A description of subroutine SUBA may be found on pages 13-14 of Reference [3]. This subroutine reads in the basic meteorologic input data and makes the required unit conversions. See Tables 10 and 11 for a description of the required input parameters and units.

DESCRIPTION OF SUBROUTINE SUBB2

This subroutine is described on pages 15-21 of Reference [3] under the title of subroutine SUBB. The subroutine was renamed SUBB2 in LAKSCI since the reservoir simulation portion of LAKSCI has a different subroutine named SUBB. Subroutine SUBB2 calculates the various meteorological parameters needed by the reservoir simulation portion of LAKSCI and also calculates the equilibrium temperature at the water surface. A summary of the meteorological parameters employed is output on the printer (see Table 16).

SECTION V

RESERVOIR SIMULATION PROGRAM

INTRODUCTION

This third part of the new overall LAKSCI program previously comprised a separate program, CETSIP (Corps of Engineers Thermally Stratified Impoundment Program). In its new modified form, it simulates the thermal conditions and the quality constituent conditions in a lake or reservoir. Hydrologic and meteorologic data, as prepared by subroutines BAL, SUBA, and SUBB2, is used together with card input to model the conditions over the required simulation period. The maximum period which may be simulated is 365 days. The minimum time step allowed is one hour. A maximum of one lake inflow is allowed, and the lake must be conceptualized into 100 or less horizontal layers or elements.

This part of LAKSCI simulates the thermal behavior of an impoundment using a forward stepping integration scheme on a set of differential equations. Time is the independent variable and the accuracy of the results is dependent on the length of the time step employed. With all other parameters held constant, it can be stated that the shorter the time step the more accurate the results. This statement is always true, but many factors other than the length of the time step are important to the overall accuracy of the simulation. Some information on the selection of the time step and other items of importance are given below. The sensitivity of LAKSCI to time step size and other parameters is described in Volume I (Part V) of this report.

The following statements concerning the operation of LAKSCI can be made at the outset. First, LAKSCI should never be run using time steps of longer than a day's duration. A great deal of trouble will be avoided if this suggestion is followed, even though technically the model will work on longer periods. Secondly, LAKSCI cannot be expected to produce temporal response characteristics which have more detail than the observation interval for input data. What this means, of course, is that if one wishes to investigate a particular aspect of a reservoir's response, the input data pertinent to that investigation will need to be supplied in at least as much detail as the shortest time period of interest. Daily values for daily response, hourly values for hourly response, etc. Finally, LAKSCI should never be run using more than 24 intervals per day. Again, the model is technically capable of doing this, but such a practice is strongly discouraged.

Within the limits suggested above, the maximum time step allowed is largely determined by the ratio of the volume of an element to the volume of flow which is advected into or out of any element during any time step. This ratio is defined as the advection ratio (R_a), and is critical to the model's operation. In no case should the R_a exceed unity and values on the order of 0.5 and less are most satisfactory. The magnitude of the error in the model's results will be proportional to the amount and frequency of the violation of this criteria, and no simulation should be accepted for which violations occur with regularity. Experience has shown that an occasional violation is often not critical to the model's output, but one must remain alert to advection's role in the simulation.

The advection ratios for vertical advection (VAR) and horizontal advection (HAR) are shown on LAKSCI's printed output, and the sum of these components indicates the total, R_a.

If violations in the R_a criteria occur, two courses of action are open, both of which can be accomplished by card input to LAKSCI. First, more execution intervals per day can be specified. This results in a shorter time step, but will increase the program's running time on the computer. Secondly, the volume of segment elements can be enlarged by an increase in vertical element size. This will result in larger elements, with a corresponding decrease in computer time; this also results in a decrease in vertical detail. The user's experience and requirements will dictate the optimum selection of time step and element size.

Description of the subroutines which comprise the reservoir simulation portion of LAKSCI follow. The group of subroutines which produces the plots of temperature versus depth is not documented in this report. This group consists of the following subroutines: CURVE, PINE, PPLOT, and SCALE.

DESCRIPTION OF SUBROUTINE SUBB

Subroutine SUBB flowcharted in Figure 1 is called by the main program to initialize variables and to read in the data necessary for the hydrologic and thermal simulation of the reservoir. The data files written by subroutines BAL and SUBB2 are read in and stored and the inputs described on cards 1-11 of the Lake Data input (see Table 12) are read and processed. The area and volume profiles of the reservoir are generated and stored as is the initial temperature profile. When the input processing is finished, subroutine SUBB prints out a summary and returns control to the main program which then calls subroutine NEWIN to read in all relevant quality data. Subroutine SUBB has a second entry point, namely PRNT. This portion of the code prints out the hydrologic and thermal summary for a given day and calls QPRINT to print out the quality conditions and CURVE to plot the temperature profile for that day.

SUBB is called once from the main program and calls subroutine SUBG if interpolation is required to generate the initial temperature profile. PRNT is called as needed by subroutine SUBC and calls QPRINT and CURVE to assist it in printing out the daily summary. The volume and area profiles are generated from

$$V_j = C_1 Z + (C_2/2)Z^2 + (C_3/3)Z^3$$

$$A_j = C_1 + C_2 Z + C_3 Z^2$$

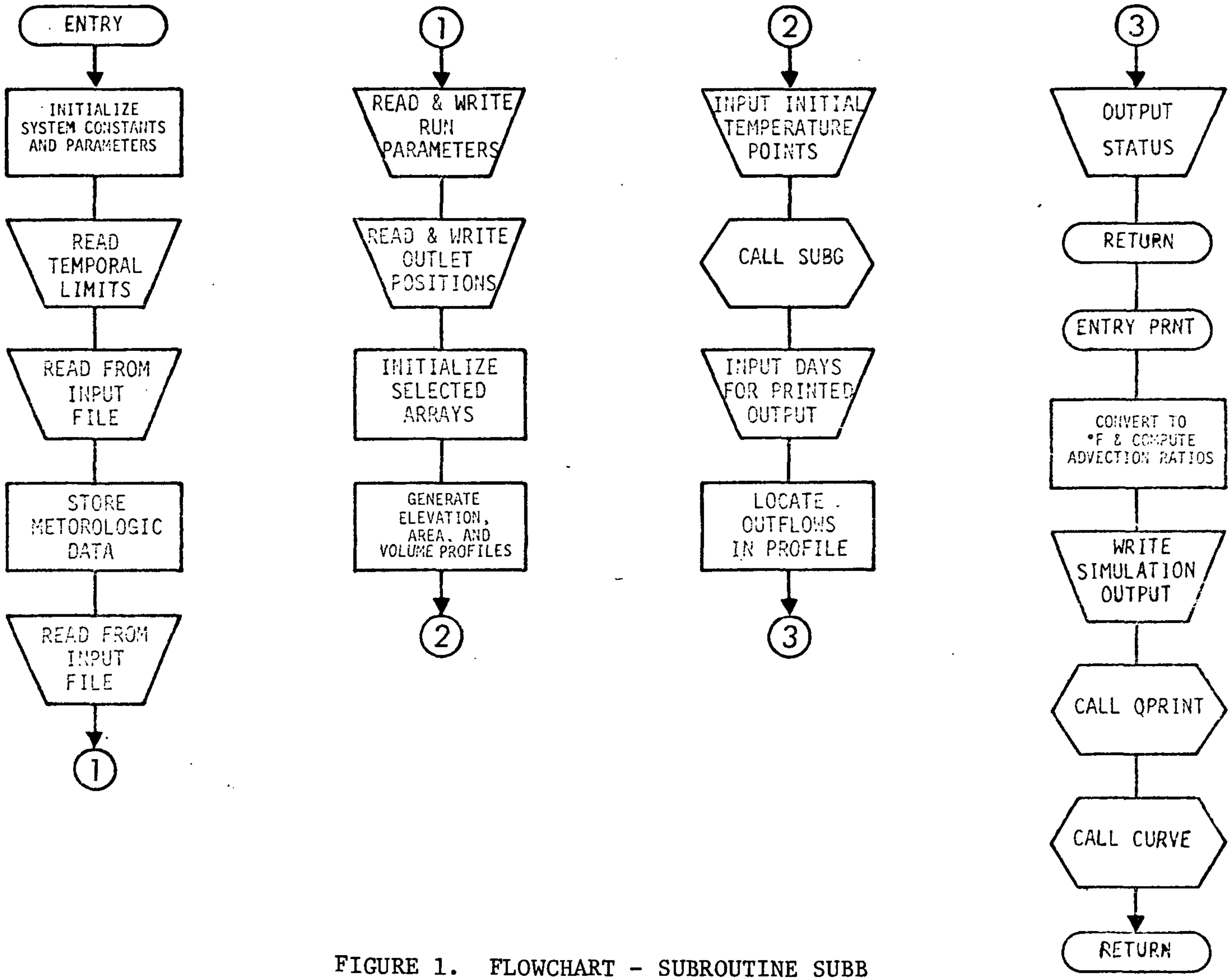


FIGURE 1. FLOWCHART - SUBROUTINE SUBB

where

V_j = volume of lake below and including element j (m^3)

A_j = lower surface area of element j (m^2)

C_1, C_2, C_3 are input coefficients

The local program variables in subroutine SUBB are defined in Table 2. They are all undimensioned.

TABLE 2.

LOCAL PROGRAM VARIABLES OF SUBROUTINE SUBB

Variable Name	Description
ELMAX	Maximum possible lake surface elevation (meters above bottom)
IQ	Temporary loop limit
IB	Temporary Loop limit
IC	Temporary loop limit
IEND	Upper value of print loop limit
IGO	Lower value of print loop limit
IYR	Meteorologic data year
MAX	Temporary loop limit

Other local variables may be found on page 36 of Reference [3].

DESCRIPTION OF SUBROUTINE QPRINT

Subroutine QPRINT is called to print out the current concentrations of the constituents being modeled. The concentrations of all constituents in each layer of the lake are output. QPRINT is called by PRNT and calls no subroutines.

DESCRIPTION OF SUBROUTINE NEWIN

Subroutine NEWIN flowcharted in Figure 2, reads in the various quality related parameters defined on cards 12-27 of the Lake Input Data (see Table 12). SETOPT is called to set various internal logic flags based on the input values of various options. A summary of the input quality data is printed out and a check is made to insure that the BOD nitrogen exceeds the algal nitrogen in each lake element.

Subroutine NEWIN is called once from the main program and calls subroutine SETOPT to set internal flags. Subroutine FILL is called to fill in quantities which are not input by interpolation between values which are input. The BOD nitrogen and algal nitrogen in a lake layer are calculated as follows.

BOD weight

$$BODWT = BODC \cdot 12/BODPC$$

where

BODC = carbon to phosphorus ratio in BOD material

BODPC= dry weight fraction of carbon in BOD material

BOD nitrogen weight ratio

$$BODNWR = BODN \cdot 14/BODWT$$

where

BODN = nitrogen to phosphorus ratio in BOD material

BOD phosphorus weight ratio

$$BODPWR = 32./BODWT$$

BOD nitrogen

$$BODNX = C_{BOD} \cdot BODNWR/BODOQ$$

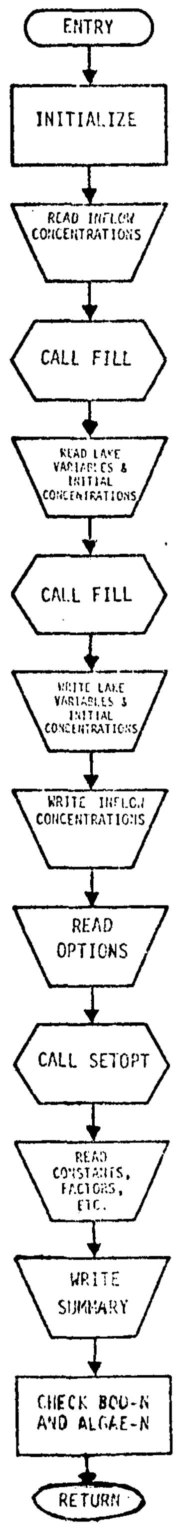


FIGURE 2. FLOWCHART - SUBROUTINE NEWIN

where

C_{BOD} = BOD concentration

BODOQ= BOD oxygen quotient

Algae Nitrogen

$$ALGN = C_A \cdot BODNWR/(APR \cdot BODPWR)$$

where

C_A = algae concentration

APR = algae to phosphorus ratio

The local program variables in Subroutine NEWIN are defined in Table 3. They are all undimensioned.

DESCRIPTION OF SUBROUTINE SETOPT

Subroutine SETOPT is called to set various internal logic flags based on the input values of various options. A summary of the constituents being modeled is output. SETOPT is called by subroutine NEWIN and calls no subroutines.

DESCRIPTION OF SUBROUTINE FILL

Subroutine FILL, flowcharted in Figure 3, is called by subroutines BAL and NEWIN and fills in the values of specified entries in an array by interpolation between adjacent array values. The parameters passed to FILL are the array to be filled, the length of the array, and a check value. Subroutine FILL replaces any array location which contains the check value in the following manner.

$$\Delta = (d_K - d_M)/(K - M)$$

where

d_j = the j^{th} entry of the data array and the values between d_M and d_K are to be filled in

$$d_{\ell + 1} = d_\ell + \Delta$$

where

$M \leq \ell \leq K - 2$

The local program variables in subroutine FILL are defined in Table 4. They are all undimensioned.

TABLE 3.

LOCAL PROGRAM VARIABLES OF SUBROUTINE NEWIN

Variable Name	Description
ALGN	Algal nitrogen in a lake layer (mg)
BODNWR	BOD nitrogen weight ratio
BODNX	BOD nitrogen in a lake layer (mg)
BODPWR	BOD phosphorus weight ratio
CFSQ	Inflow in CFS
CMSCFS	M^3/sec to CFS conversion factor
E1106	Diffusion coefficient E1 for printout
E2106	Diffusion coefficient E2 for printout
XLATD	Latitude in degrees for printout

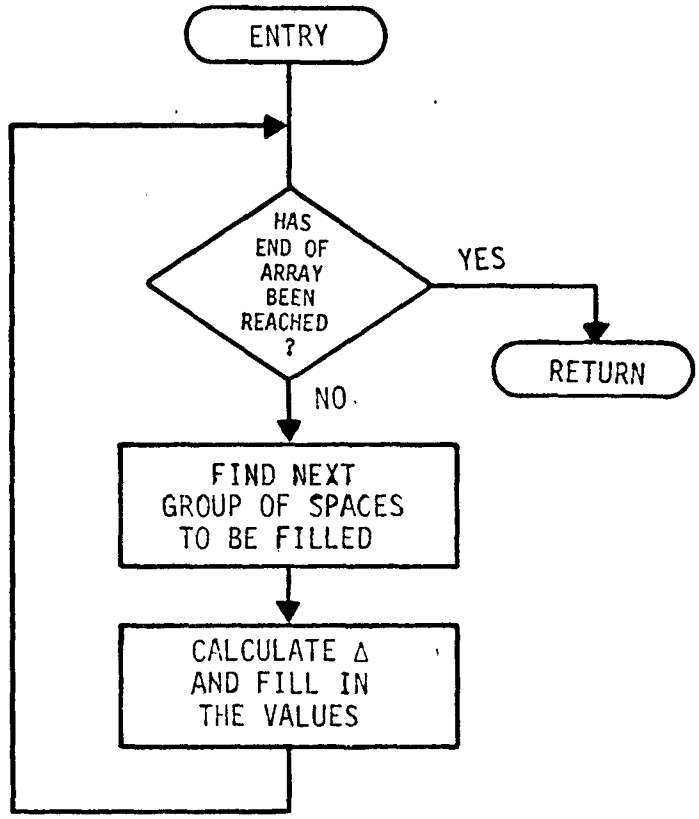


FIGURE 3. FLOWCHART - SUBROUTINE FILL

TABLE 4.

LOCAL PROGRAM VARIABLES OF SUBROUTINE FILL

Variable Name	Description
DEL	Data increment
MM1	Upper loop limit for filling in values
N	Array length
NLO	Lower loop limit for filling in values
WORD	Check word

DESCRIPTION OF SUBROUTINE SUBC

Subroutine SUBC, flowcharted in Figure 4, is the heart of the thermal calculation procedures for LAKSCI. It also calls subroutine LAKCON, which is the driver for the calculations involving the quality constituents. In the course of execution, SUBC simulates the thermal behavior of a reservoir by forming and solving a set of simultaneous, linear equations. These equations provide a forward, stepwise, integration of the differential equations which have been derived to describe the thermal processes within the system. The steps associated with the formulation and solution of these equations are presented in Reference [1] and will not be covered in detail here. In brief, however, the procedure forms a set of equations which provide a heat balance for each horizontal element within the reservoir. A linear rate of change of the rate of temperature change is assumed, and the temperature of each element is projected forward to the end of a simulation time step by a solution for the equations. The forward projection always takes place from some known condition and the most recently determined temperature automatically becomes the starting point for the next projection.

In the simulation scheme employed, all heat transfer is considered to be some component of one of the five following transfer mechanisms:

(a) eddy diffusion;
(b) horizontally advected flow;
(c) vertically advected flow;
(d) short wave solar radiation;
(e) air-water interface heat transfer

The contribution of each of these processes is calculated for each element, and the procedure moved forward in time using constantly updated values for inflow, outflow and meteorological conditions. In the simulation process one day is considered the basic time unit for hydrologic input. Meteorological data may be input to represent periods as short as one hour or as long as one day. The number of simulation intervals per day, which determines the length of the time step, is specified on input and need not correspond to the interval of meteorologic data observation. Changes in reservoir water surface are accounted for only once per day, and data on reservoir inflow and outflow are assumed to be available as average daily values.

Finally, if the solution to the basic heat equations results in a temperature (density) profile which is considered to be physically unstable, the code will commence a reservoir mixing process until a stable profile is achieved. The value of the temperature (density) gradient which will be considered as stable is an input variable.

When the stable thermal profile has been achieved for a given time step, i.e., when the mixed zone of the reservoir has been determined, the concentrations of the quality constituents being modeled are adjusted appropriately in the mixed zone and subroutine LAKCON is called to calculate the concentration changes occuring during the time step. If

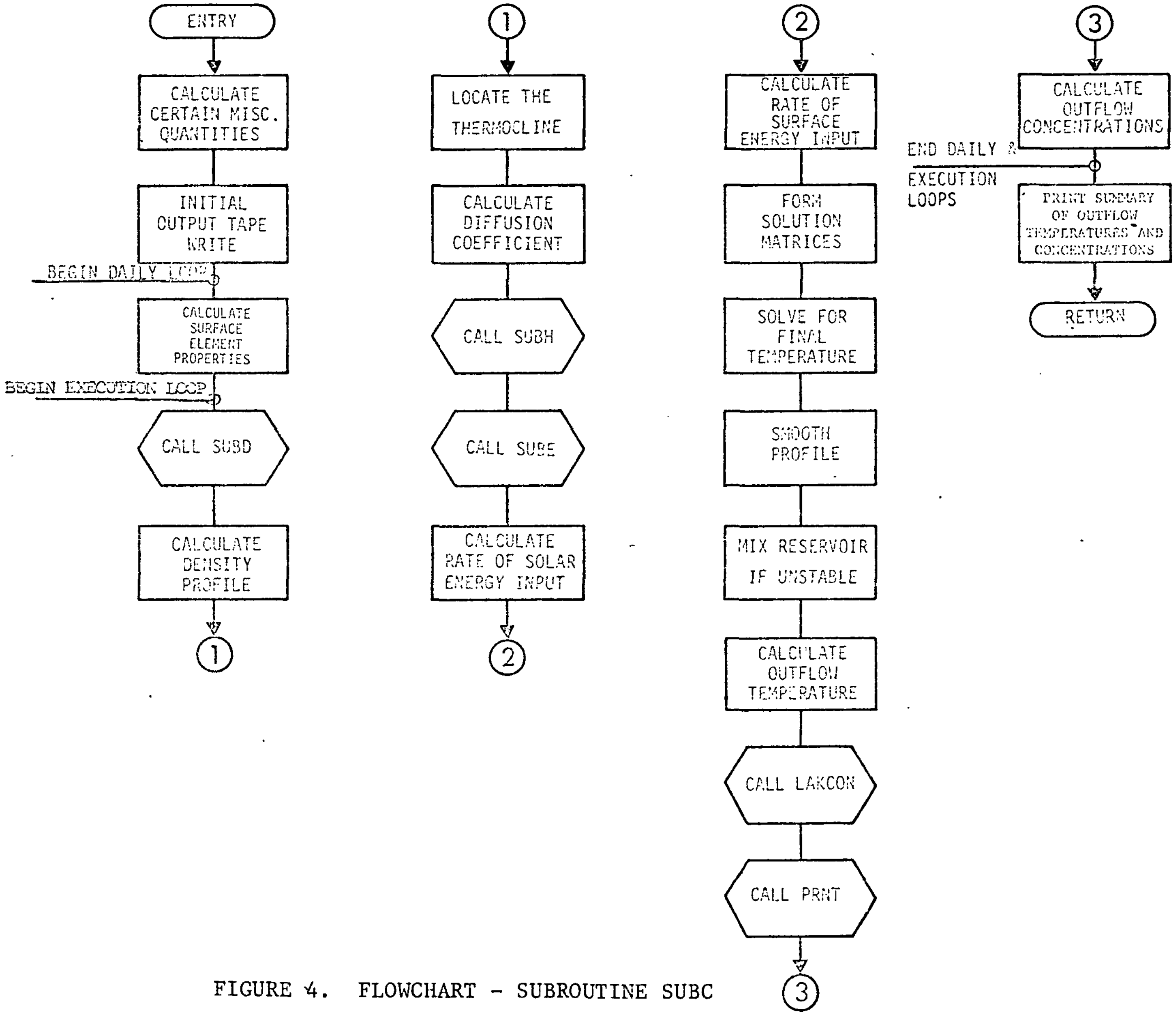


FIGURE 4. FLOWCHART - SUBROUTINE SUBC

the end of the time step corresponds to the end of a day, the concentrations of the constituents in the reservoir outflow are calculated and stored.

Subroutine SUBC is called from subroutine SUBB once. In the course of execution, SUBC calls SUBD, SUBH, SUBE and LAKCON at least once per simulation day. More than one call may be made depending on the length of the time step and the number of meteorologic observations; SUBC calls ENTRY PRNT in SUBB under the control of program input variables to print the simulation output at requested intervals. All program variables employed by SUBC are passed through labeled COMMON.

Important formulae and local variables used by SUBC may be found on pages 40-43 of Reference [3].

DESCRIPTION OF SUBROUTINE LAKCON

Subroutine LAKCON, flowcharted in Figure 5, with the help of subroutine GETCON, calculates the changes in constituent concentrations which occur in the elements of a reservoir during a time interval Δt. The inputs to LAKCON include the horizontal flows into and out of each element during Δt and the concentrations of the constituents in each element at the beginning of Δt. Also input are the temperature profile during Δt, diffusion coefficients for both above and below the thermocline, concentrations of the horizontal inflows (i.e., the reservoir inflow), reservoir volume and area profiles, and the reservoir extinction coefficient.

LAKCON first calculates the vertical flows into and out of each element as a function of the horizontal flows into and out of each element. The thermocline is then located by examination of the temperature profile and the changes in concentration between the elements due to diffusion are calculated. LAKCON next calculates the concentration changes due to mass transfer into and out of each element. These mass transfers are the result of the vertical and horizontal flows into and out of each element. The concentrations of all elements are updated with the above changes and if algae or NO_3-N is being modeled, subroutine GETAVI is called to calculate light intensity at the reservoir surface and the percent of Δt during which it is daylight. The following procedure is then followed for each element, starting with the top element and working down.

The area of the lake bottom for the element is calculated. If algae is being specifically modeled the light intensity for the element is calculated from the element depth and the light intensity on the reservoir surface. If algae is not being modeled specifically and NO_3-N is being modeled and also the element being considered is the surface element, then the extinction depth, i.e., the depth where 99% of the surface light has been absorbed, is calculated. The average NO_3-N concentration, the average NO_3-N reaction rate, and the average temperature are then determined for this euphotic zone. The light intensity for each euphotic element is also calculated and saved and the total NO_3-N concentration

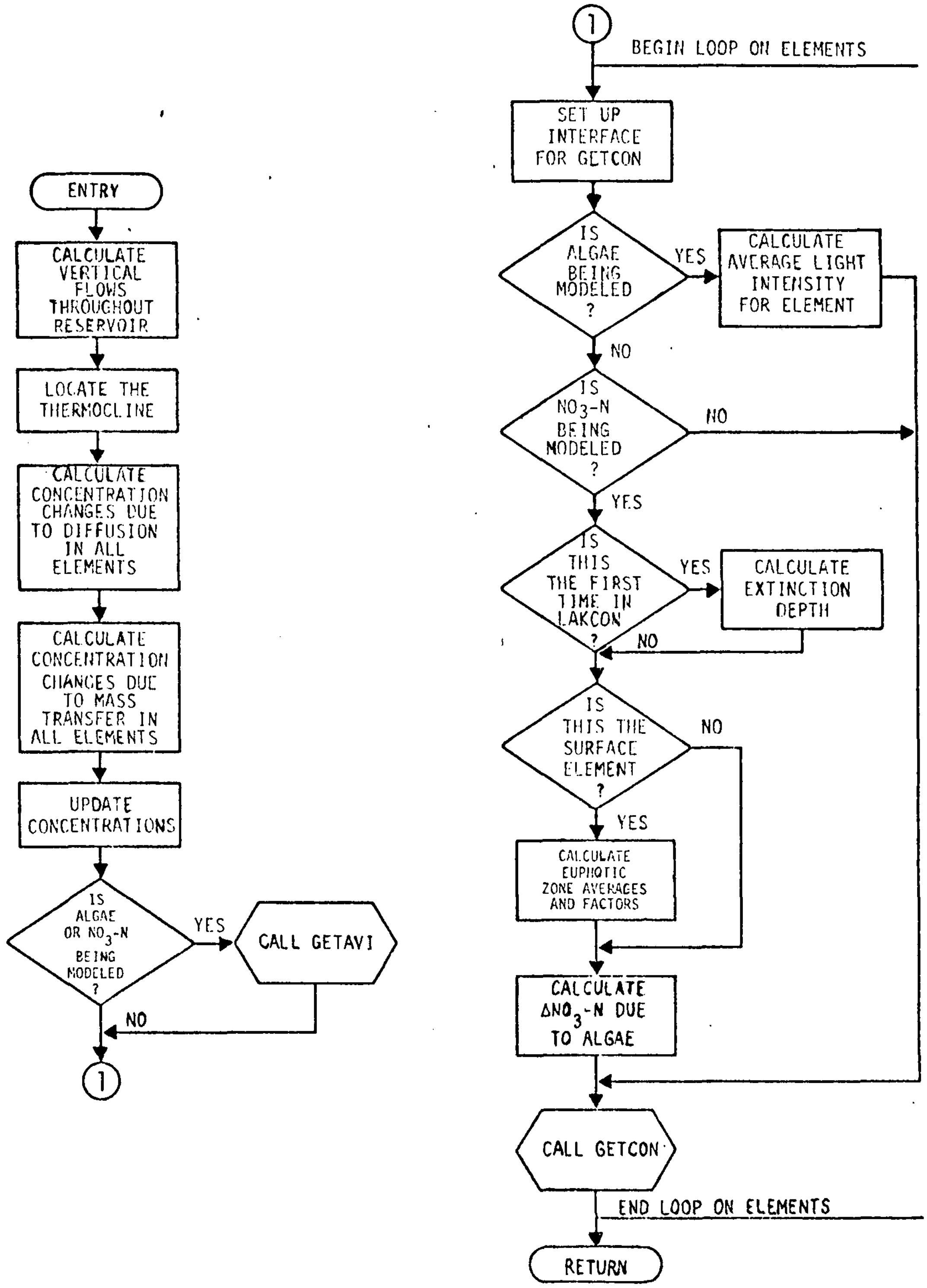


FIGURE 5. FLOWCHART - SUBROUTINE LAKCON

change for the euphotic zone is determined and stored. From these quantities the change in NO_3-N concentration for each element in the euphotic zone may be determined. These changes represent NO_3-N consumption by algae which is why they are calculated only if algae is not being modeled specifically. Having thus determined the NO_3-N concentration change due to algal consumption, LAKCON then calls subroutine GETCON to calculate concentration changes due to growth, decay, settling, reaeration, benthal releases and absorptions, and volitization during Δt (reaeration and volitization occur only in the surface element). The concentrations are then updated with these changes and when all elements have been processed, control is returned to subroutine SUBC.

LAKCON is called once per integration step by subroutine SUBC. LAKCON calls subroutine GETAVI if algae or NO_3-N is being modeled. Subroutine GETCON is always called. The following quantities are calculated by LAKCON.

Flow Balance For Each Element Except the Surface Element

$$H_I + V_I = H_o + V_o$$

where

H_I = horizontal flow in (cms)

V_I = vertical flow in (cms)

H_o = horizontal flow out (cms)

V_o = vertical flow out (cms)

Thermocline Element

$$TE = \max_i \left((T_{i+1}) - T_i \right)/Z$$

where

T_i = temperature of element i (°C)

Z = thickness of element (m)

Diffusion Between Element n and Element n+1 for a Constituent

$$\Delta m_D = 2 E A_n \frac{C_n - C_{n+1}}{d_n + d_{n+1}} \Delta t$$

where

Δm_D = mass rising from element n to element n+1 (m^3 mg/L)

E = diffusion coefficient (depends on location of element n with respect to the thermocline) (m^2/sec)

A_n = interface area between elements (m^2)

C_j = concentration of constituent in element j (mg/L)

d_j = thickness of element i (m)

$$\Delta C_n = - \Delta m_D / V_n$$

$$\Delta C_{n+1} = \Delta m_D / V_{n+1}$$

where

ΔC_j = concentration change in element j (mg/L)

V_j = volume of element j (m^3)

Concentration Change Due to Mass Transfer

$$\Delta m_T = M_{VI} + M_{HI} - M_{VO} - M_{HO}$$

where

Δm_T = mass change in the element during Δt (m^3mg/L)

M_{VI} = mass brought into the element vertically during Δt (m^3mg/L)

M_{HI} = mass brought into the element horizontally during Δt (m^3mg/L)

M_{VO} = mass transported from the element vertically during Δt(m^3mg/L)

M_{HO} = mass transported from the element horizontally during Δt(m^3mg/L)

$$\Delta C = \Delta m_T / V$$

where

ΔC = concentration change of the constituent in the element (mg/L)

V = element volume (m^3)

Bottom Area of Element n

$$B_n = A_{n+1} - A_n$$

where

A_i = surface area of element i-1 (m^2)

Light Intensity Relationship

$$I_d = I_s e^{Kd}$$

where

I_d = intensity at depth d (Langleys/min)

I_s = intensity at the surface (Langleys/min)

K = extinction coefficient (m^{-1})

Average Light Intensity in an Element

$$\bar{I} = \frac{I_T - I_B}{KZ}$$

where

I_T = intensity at element top (Langleys/min)

I_B = intensity at element bottom (Langleys/min)

Z = element thickness (m)

K = extinction coefficient (m^{-1})

Extinction Depth

$$D_{ex} = 4.6052/K$$

where

K = extinction coefficient (m^{-1})

NO_3-N Concentration Change in Euphotic Zone During Δt (if NO_3-N is being modeled by a first order reaction)

$$\Delta NO_3\text{-}N = (NO_3\text{-}N)\ (e^{-K_1 \Delta t} - 1)$$

where

NO_3-N = average NO_3-N concentration in euphotic zone (mg/L)

$$K_1 = K_1^{20} \theta^{(T-20)}$$

where

K_1^{20} = the average NO_3-N reaction coefficient in euphotic zone at 20 degrees centigrade (hr^{-1})

T = average temperature of euphotic zone (°C)

θ = correction constant

If NO_3-N is being modeled by a second order reaction

$$\Delta NO_3\text{-}N = \frac{-K_1 \Delta t \, (NO_3\text{-}N)^2}{1. + K_1 \Delta t \, (NO_3\text{-}N)}$$

NO_3-N Concentration Change in Euphotic Element i

$$(\Delta NO_3\text{-}N)_i = B \, \bar{I}_i$$

where

$\bar{I}_i = I_o \, e^{-KZ_i} (1 - e^{-Kd_i})/Kd_i$

I_o = light intensity at reservoir surface (Langleys/min)

K = extinction coefficient (m^{-1})

Z_i = depth below surface of top of element i (m)

d_i = thickness of element i (m)

and B is determined from

$$(\Delta NO_3\text{-}N) \sum_{\text{euphotic } i} V_i = B \sum_{\text{euphotic } i} (V_i \, \bar{I}_i)$$

where

V_i = volume of element i (m^3)

ΔNO_3-N is defined above

The local program variables in subroutine LAKCOM are defined in Table 5. They are all undimensioned with the exception of IBRSAV.

TABLE 5.

LOCAL PROGRAM VARIABLES OF SUBROUTINE LAKCON

Variable Name	Description
AVINT	Average surface light intensity (Langleys/min)
AVNO3	Average NO_3-N concentration in euphotic zone (mg/L)
AVTEM	Average temperature in euphotic zone (°C)
BFAC	B factor (see formulae)
BGDNO3	(ΔNO_3-N), see formulae
BOT	Bottom area of element (m^2)
DELMAS	Change in mass due to diffusion (m^3mg/L)
DEX	Extinction depth (m)
DTDDM	Thermal gradient
E	Diffusion coefficient (m^2sec)
FLOIN	Flow into an element (cms)
FLOUT	Flow out of an element (cms)
HMSIN	Horizontal mass in (m^3mg/L)
HMSOUT	Horizontal mass out (m^3mg/L)
IBARI	$\overline{I}_i$ (see formulae)
IBRSAV	Saved values of $\overline{I}_i$ (dimensioned)
JBAC	Loop index
NDU	Extinction depth element
NTHERM	Thermocline element
THK	Element thickness (m)
VMSIN	Vertical mass in (m^3mg/L)
VMSOUT	Vertical mass out (m^3mg/L)
XMADD	Change in mass due to mass transfer (m^3mg/L)
XNH3K	Average NO_3 reaction rate in euphotic zone (hr^{-1})
ZIT	Z_i (see formulae)

DESCRIPTION OF SUBROUTINE GETAVI

Subroutine GETAVI, flowcharted in Figure 6, calculates the average light intensity in Langleys per minute during a time interval $[t_1, t_2]$ on Julian day n. Subroutine SUN is called to calculate sunrise and sunset on day n. The total radiation for day n is an input quantity.

Subroutine GETAVI is called by subroutine LAKCON and calls subroutine SUN.

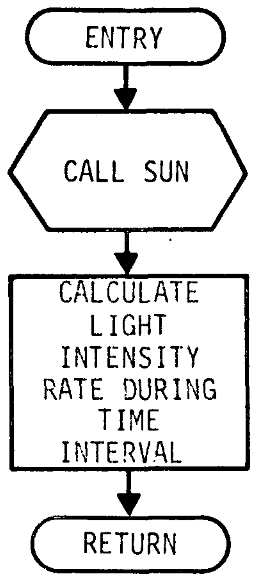


FIGURE 6. FLOWCHART - SUBROUTINE GETAVI

The average light intensity over $[t_1, t_2]$ is calculated from sunrise, sunset, and the daily total radiation by assuming that the total is distributed between sunrise and sunset according to the distribution illustrated in Figure 7.

The local program variables in subroutine GETAVI are defined in Table 6. They are all undimensioned.

DESCRIPTION OF SUBROUTINE SUN

Subroutine SUN, flowcharted in Figure 8, is called by subroutine GETAVI to calculate sunrise and sunset on Julian day n. The following equations are used.

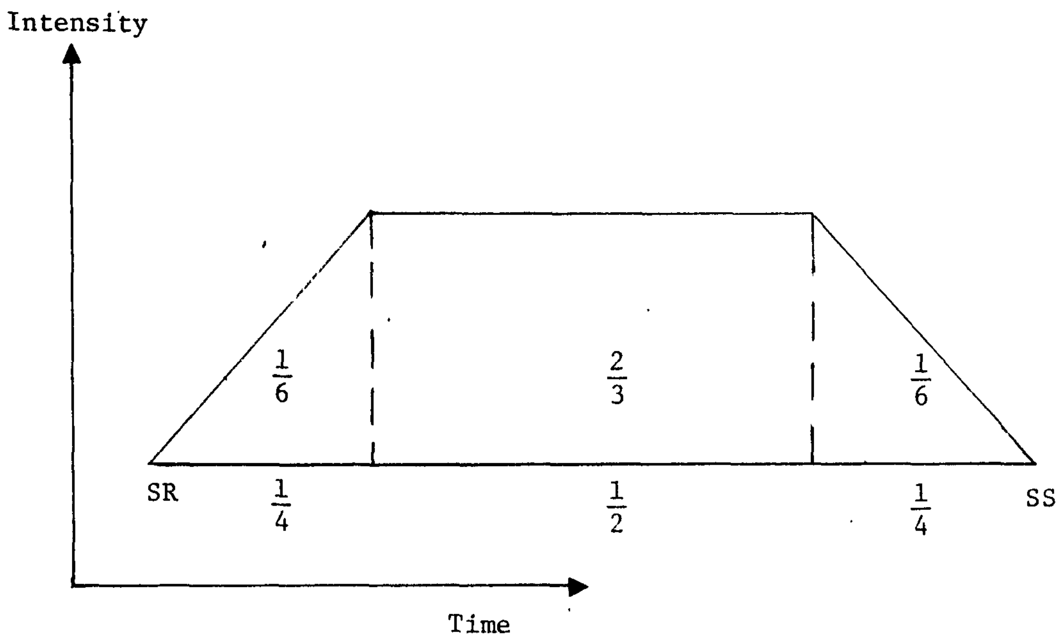


FIGURE 7. ASSUMED DAYLIGHT INTENSITY DISTRIBUTION

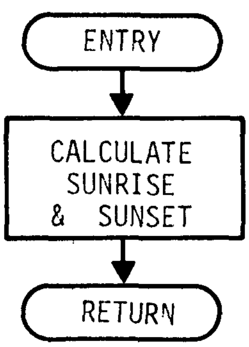


FIGURE 8. FLOWCHART - SUBROUTINE SUN

TABLE 6.

LOCAL PROGRAM VARIABLES OF SUBROUTINE GETAVI

Variable Name	Description
AREA	Area under a portion of the curve in Figure 6
DAY	Hours of daylight
D4	One fourth of daylight hours
PDL	Percent of interval $[t_1, t_2]$ in daylight
T_1	t_1 (see formulae)
T_2	t_2 (see formulae)

Sunset Time

$$SS = 3.81972 \cos^{-1}(-\tan(d) \tan(lat)) + 12. \quad \text{(hours after midnight)}$$

where

lat = latitude of reservoir (radians)
d = .409279 Cos(.0172142 (172 - n))

where

n = Julian day number

Sunrise Time

$$SR = 24 - SS \qquad \text{(hours after midnight)}$$

The local program variables in subroutine SUN are defined in Table 7. They are all undimensioned.

TABLE 7

LOCAL PROGRAM VARIABLES OF SUBROUTINE SUN

Variables Name	Description
D	d (see formulae)
DAY	n, Julian day number
SS	sunset (hours after midnight)
SR	sunrise (hours after midnight)

DESCRIPTION OF SUBROUTINE GETCON

Subroutine GETCON, flowcharted in Figure 9, is called by subroutine LAKCON to calculate the changes in the constituent concentrations in a lake or reservoir element over a time interval Δt, where Δt is the integration step size. The algorithms used are explained in detail in Volume I, Part III. The inputs to GETCON include the average light intensity in the element, the element location with respect to the surface and the bottom of the reservoir, the bottom area of the element (i.e., the area available for benthal releases and demands), the volume and thickness of the element, the percent of Δt which is daylight, appropriate constants and variables, and the concentration of all constituents at the beginning of Δt.

All formulae used by GETCON are described in detail in Part III of Volume I. Equations references as A.NN in the flowchart of GETCON may also be found in Part III of Volume I.

The local program variables in subroutine GETCON are defined in Table 8. They are all undimensioned.

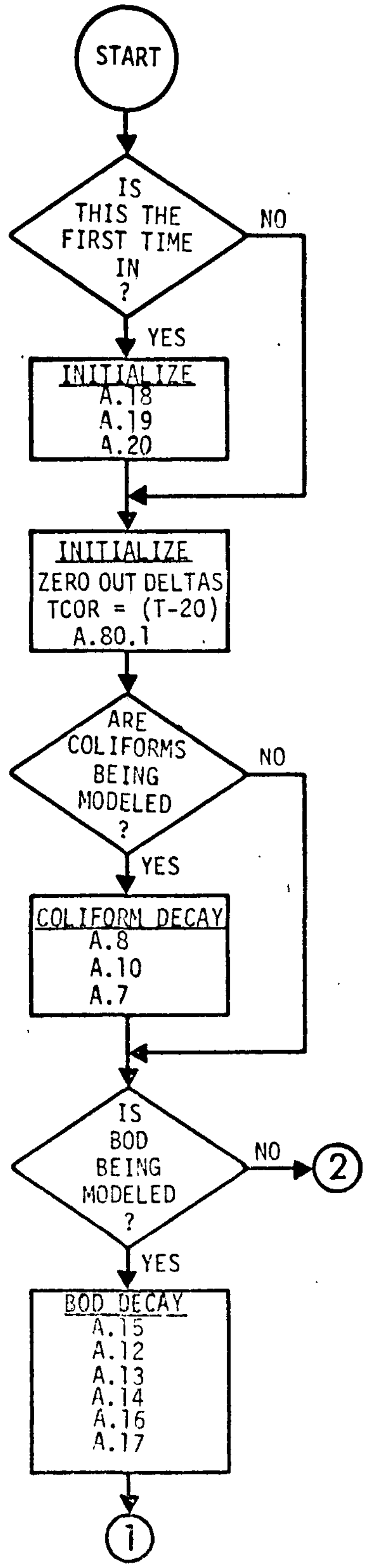


FIGURE 9. FLOWCHART - SUBROUTINE GETCON

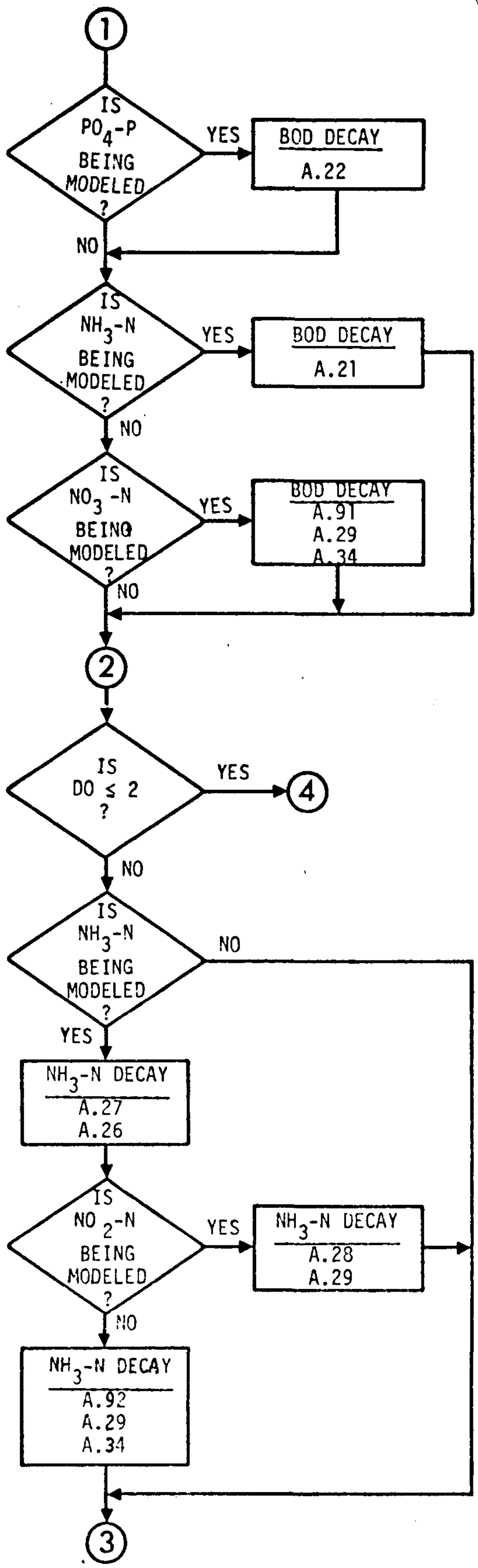


FIGURE 9. (cont'd)

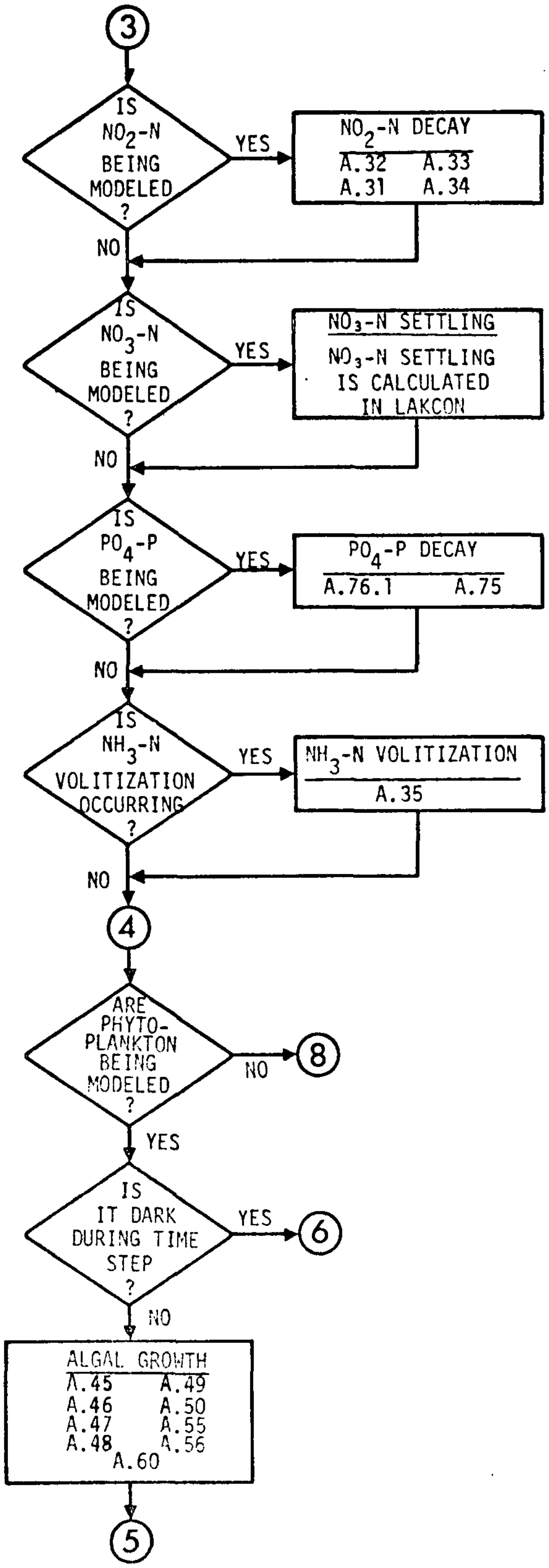


FIGURE 9. (Cont'd)

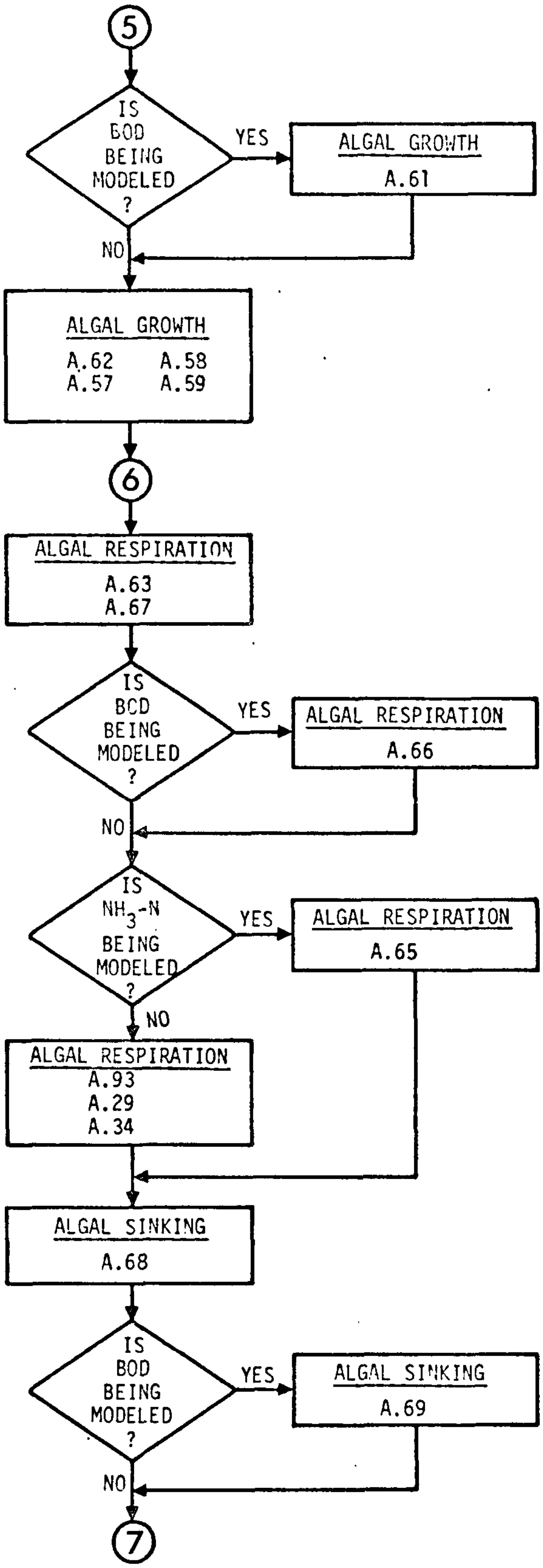


FIGURE 9. (Cont'd)

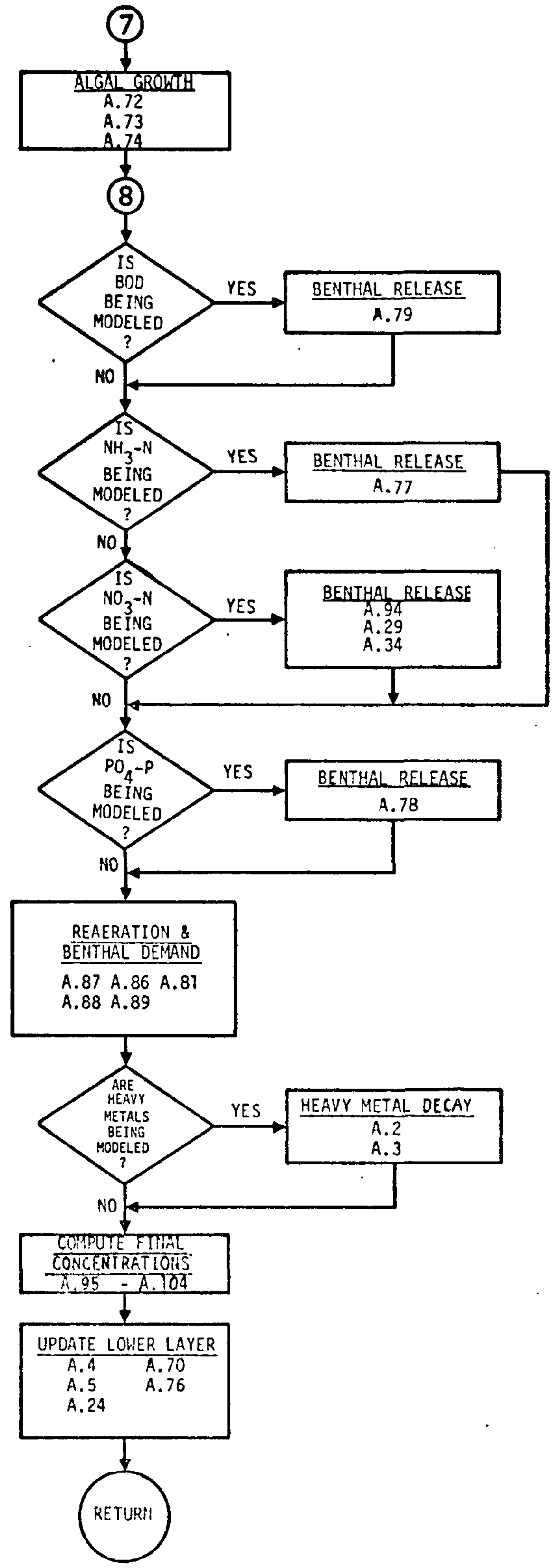


FIGURE 9. (Cont'd)

TABLE 8.

LOCAL PROGRAM VARIABLES OF SUBROUTINE GETCON

Variable Name	Description
AO	Reservoir surface area at start of time step (m^2)
ARR	Algal respiration rate (hr^{-1})
ASLOP	Rate of change of reservoir surface area (m^2/hr)
AT	Reservoir surface area at end of time step (m^2)
BODMC	BOD convertible to inorganic forms
BODMTL	BOD material in BOD decay
BODNWR	BOD nitrogen weight ratio
BODWT	BOD weight
DALND	Algae change due to natural death (mg/L)
DALTOX	Algae change due to toxicity (mg/L)
DN	Nitrogen demand due to algal growth (mg/L)
DOBEN	Benthal DO demand (mg/L)
DOD	DO reaeration change (mg/L)
FACHM1	Heavy metal factor on coliforms and algae reactions
FACHM2	Heavy metal factor on coliforms and algae reactions
FACHM3	Heavy metal factor on coliforms and algae reactions
FL	Algal growth limitation function due to light
FLIM	Minimum of FL, FN, FP
FN	Algal growth limitation function due to nitrogen
FNH3	Algal growth limitation function due to NH_3-N
FNO3	Algal growth limitation function due to NO_3-N
FP	Algal growth limitation function due to PO_4-P
GRLIM	Total algal growth limiting function
IBAR	Maximum light intensity (Langleys/min)
NOUT	Output unit
OSAT	DO saturation level (mg/L)
RAT	Ratio used in settling calculations
TCOR	Temperature correction term (°C)
TT	Temperature (°C)
VO	Volume of surface element at start of time step (m^3)
VSLOP	Rate of change of volume of surface element (m^3/hr)
VT	Volume of surface element at end of time step (m^3)

DESCRIPTION OF SUBROUTINE SUBD

A description of subroutine SUBD may be found on pages 45-49 of Reference [3].

DESCRIPTION OF SUBROUTINE SUBE

A description of subroutine SUBE may be found on pages 50-53 of Reference [3].

DESCRIPTION OF FUNCTION BETA

A description of function BETA may be found on pages 54-56 of Reference [3].

DESCRIPTION OF SUBROUTINE SUBG

A description of subroutine SUBG may be found on pages 57-58 of Reference [3].

DESCRIPTION OF SUBROUTINE SUBH

A description of subroutine SUBH may be found on pages 59-61 of Reference [3].

SECTION VI

INPUT REQUIREMENTS

The input to LAKSCI falls into three categories. They are:

1. Input to define the hydrodynamic behavior of the lake surface elevation during the time period being simulated and to define the lake outflow, lake inflow, and the temperature of the lake inflow. (This is read and processed by subroutine BAL.)

2. Meteorologic data for the period being simulated. (This is read and processed by subroutines SUBA and SUBB2.)

3. Input to define lake initial conditions, outflow geometry, inflow concentrations, and various lake dependent variables such as diffusion coefficients, extinction depth, etc. (This is read and processed by SUBB, NEWIN, and SUBC.)

The input required is described in detail in this section. All equations referenced as (A.NN) may be found in Part III of Volume I. A listing of a sample input deck is provided in Section IX.

The following constraints govern the use of LAKSCI.

1. No more than 365 days may be simulated.

2. No more than 2920 values may be input for any meteorological parameter.

3. The lake may be divided into a maximum of 100 layers.

4. No more than one initial temperature per layer may be input.

5. Special output may be requested on no more than 50 days.

6. A minimum of one and a maximum of three outlets are allowed.

7. Minimum of one and a maximum of twenty-four integration steps per day are allowed.

TABLE 9.

SURFACE ELEVATION AND INFLOW TEMPERATURE INPUT CARD DATA

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
1	1-10	I10	ITAPE			Interface unit
	11-20	I10	IDAY			First day of run (1 is January 1)
	21-30	I10	LDAY			Last day of run (365 is December 31) LDAY must be $\leq$ 365
	31-40	F10.2	C1			For depth d in feet $V(d) = C1 \cdot d + (1/2) \cdot C2 \cdot d^2 + (1/3) \cdot C3 \cdot d^2$
	41-50	F10.2	C2			$A(d) = C1 + C2 \cdot d + C3 \cdot d^2$ where V is volume in acre feet and A is area in acres
	51-60	F10.2	C3			
2	1-10	F10.0	RSELI	(FEET)		Initial surface elevation referenced to lake bottom
	11-20	F10.0	BOTEL	(FEET)		Elevation of lake bottom above sea level
	21-30	F10.0	GWFLOW	(CFS)	0.	Flow added to inflow (may be positive or negative)
	31-40	F10.0	FACIN		1.	Factor by which inflow is multiplied

TABLE 9. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
3	1-6	F6.0	FLOW (IDAY,1)	(CFS)		Inflow rate for day IDAY
	7-12	F6.0	FLOW (IDAY,2)	(CFS)		Outflow rate for day IDAY
	13-18	F6.0	FLOW (IDAY,3)	(°C)		Temperature of inflow for day
	19-24	F6.0	FLOW (IDAY + 1,1)	(CFS)		Inflow rate for day IDAY + 1
	25-30	F6.0	FLOW (IDAY + 1,2)	(CFS)		Outflow rate for day IDAY + 1
	31-36	F6.0	FLOW (IDAY + 1,3)	(°C)		Temperature of inflow for day
	37-42	F6.0	FLOW (IDAY + 2,1)	(°C)		Inflow rate for day IDAY + 2
	43-48	F6.0	FLOW (IDAY + 2,2)	(CFS)		Outflow rate for day IDAY + 2
	49-54	F6.0	FLOW (IDAY + 2,3)	(°C)		Temperature of inflow for day IDAY + 2
	55-60	F6.0	FLOW (IDAY + 3,1)	(CFS)		Inflow rate for day IDAY + 3

TABLE 9. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
3	61-66	F6.0	FLOW (IDAY + 3,2)	(CFS)		Outflow rate for day IDAY + 3
	67-72	F6.0	FLOW (IDAY + 3,3)	(CFS)		Temperature of inflow for day IDAY + 3

There are as many cards as necessary to define FLOW for days IDAY through LDAY. Any value read in as zero will be replaced with a value interpolated linearly from other data. The inflow, outflow, and inflow temperature MUST be defined for IDAY and LDAY, i.e., no interpolation is done for IDAY and LDAY.

TABLE 10.

METEOROLOGIC DATA INPUT CARD

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
1	1-80	20A4	ALPHA			Output heading
2	1-10	I10	IYR			Year of observations
	11-20	I10	IDAY			First Julian day of observation (1 is January 1)
	21-30	I10	LDAY			Last Julian day of observation (365 is December 31) LDAY must be ≤ 365
	31-40	I10	NOBS			Number of observations per day (Total number of observations of a parameter must be ≤ 2920)
	41-50	I10	ITAPE			Interface unit (must be same as ITAPE on card #1 of Table 9)
3	1-10	E10.0	A	$(M\ SEC^{-1}\ MB^{-1})$		Evaporation coefficient } used in calculation of equilibrium temperature
	11-20	E10.0	B	(MB^{-1})		Evaporation coefficient } used in calculation of equilibrium temperature
	21-30	E10.0	LAT	(DEG)		Lake latitude
	31-40	E10.0	LOG	(DEG)		Lake longitude

TABLE 10. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
	41-50	E10.0	RESEL	(M)		Lake elevation above sea level

The following reules govern the input of the meteorologic parameters. Sky cover, dry bulb air temperature, wind speed and either wet bulb air temperature or dew point MUST be input (dew point is preferable). Atmospheric pressure will be calculated from the lake elevation if it is not input. Solar radiation input is also optional but should be input if algae is being modeled. Each of the seven meteorologic parameters which is being input (see Parameter Identification Codes in Table 11, and previous note) requires the following group of cards:

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
4	1-10	I10	ID			Parameter identification code (see Table 11) ID = 100 means there is no more meteorologic input
	11-20	E10.0	CV			Data conversion factor A (see below)
	21-30	E10.0	CVA			Data conversion factor B (see below)
	31-40	E10.0	CVB			Data conversion factor C (see below)

TABLE 10. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	DESCRIPTION
5	1-80	(5X, F5.0, 7F10.0)	(DATA(J,ID),J=IDAY, IDAY + 7)	Parameter values for first 8 days
6	1-80	(5X, F5.0, 7F10.0)	(DATA(J,ID),J=IDAY + 8,IDAY + 15)	Parameter values for 2nd 8 days
7	1-80	(5X, F5.0, 7F10.0)	(DATA(J,ID),J=IDAY + 16,IDAY + 23)	Parameter values for 3rd 8 days
8	1-80	(5X, F5.0, 7F10.0)	(DATA(J,ID),J=IDAY + 24, end of first month of run)	Parameter values for remainder of first month
9	1-80	(5X, F5.0, 7F10.0)	(DATA(J,ID), J=first day of second month, 8th day of second month)	Parameter values for first 8 days of second month

As many cards are input (blocked by month) as are required to define the parameter for the entire simulation period IDAY through LDAY. After the last of the seven parameters has been input, an ID = 100 card MUST be input to signify that there is no more data.

TABLE 11.

PARAMETER IDENTIFICATION CODES FOR METEOROLOGIC INPUT DATA

PARAMETER CODE	METEOROLOGIC PARAMETER	UNITS

Use the following parameter identification codes and prescribe suitable conversion factors to enable input data conversion to the specified units.

(ID on card 4)

1	atmospheric pressure	MB
2	sky cover	DECIMAL FRACTION
3	wind speed	M SEC^{-1}
4	dry bulb air temperature	°C
5	wet bulb air temperature	°C
6	dew point temperature	°C
7	short wave solar radiation	KCAL M^{-2} SEC^{-1}

TABLE 11. (Continued)

DATA CONVERSION
Conversion of the input data is done in accordance with the following expression: $$X_c = A(X_R + B) + C$$ where X_c = converted data value, having the specified units; X_R = input data value; A = first input conversion factor; B = second input conversion factor; C = third input conversion factor.

TABLE 12.

LAKE INPUT CARD DATA

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
1	1-10	I10	INT			Interface unit (samè as ITAPE on card #1 of Table 9)
2	1-5	I5	IDAY			First day of run (January 1 is day 1)
	6-10	I5	LDAY			Last day of run (December 31 is day 365 (LDAY must be $\leq$ 365)
3	1-80	20A4	(CMENT(I), I=1,20)			Run title
4	1-80	20A4	(CMENT(I), I=21,40)			Run title
5	1-10	E10.0	SDZ	(M)		Vertical element thickness
	11-20	E10.0	ELMAX	(M)		Maximum allowable surface elevation referenced to lake bottom (ELMAX/SDZ < 100)
	21-30	E10.0	EDMAX	(M)		Short wave extinction depth
	31-40	E10.0	A	$(M\ SEC^{-1}MB^{-1})$		Evaporation coefficient
	41-50	E10.0	BB	(MB^{-1})		Evaporation coefficient
	51-60	E10.0	GMIN	$(°CM^{-1})$		Minimum vertical thermal gradient considered stable

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
6	1-5	I5	NSEG			1 means all outflow is through lowest outlet 2 means outflow will be adjusted to meet downstream temperature ojective (use only if two or more outlets)
	6-10	I5	NTP			Number of points in the reservoir's initial temperature profile (maximum of one point per layer)
	11-15	I5	NSD			Number of special days for which output is desired ($\leq$ 50)
	16-20	I5	IPRT			Daily frequency of output
	21-25	I5	INTP			Vertical output frequency (every INTP'th vertical element is out-put)
	26-30	I5	ITAPE			Output tape (not equal to INT) 0 means no output tape desired
	31-35	I5	NOUTS			Number of outlets (minimum of one, maximum of three)
	36-40	I5	NXEQ			Number of integration steps per day

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
6	41-45	I5	IVAL			Output after the IVAL'th time step each day
7	1-10	E10.0	GSWH	(M^{-1})		Critical diffusion stability
	11-20	E10.0	A1			Diffusion parameters for temperature calculations
	21-30	E10.0	A2			
	31-40	E10.0	A3			
	41-50	E10.0	RLEN	(M)		Length of lake
8	1-10	E10.0	C1			For depth d in meters $V(d) = C1 \cdot d + 1/2\, C2 \cdot d^2 + 1/3\, C3 \cdot d^3$ $A(d) = C1 + C2 \cdot d + C3 \cdot d^2$ where V is volume in cubic meters and A is area in square meters
	11-20	E10.0	C2			
	21-30	E10.0	C3			
9	1-10	I10	N			Outlet (turbine intake) numbers (1, 2 or 3)
	11-20	E10.0	ELOUT(N)	(M)		Outlet elevation (referenced to lake bottom)
	21-30	E10.0	WOT(N)	(M)		Dam width at outlet elevation

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
9	31-40	I10	ISRNOU(N)	(M)		1 means outlet is always at lake surface (spillway)
						NOTE: Repeat card 9 for each outlet
10	1-10	E10.0	TA	(M)		Elevation of initial temperature point TB (referenced to lake bottom)
	11-20	E10.0	TB	(°C)		Initial temperature at elevation TA
						NOTE: Repeat card 10 NTP times
11	1-80	16I5	(IDOUT(I), I=1,NSD)			Special days for which output is desired
						NOTE: Repeat card 11 until NSD days have been input
12	1-5	I5	NDAY			Day for which inflow concentrations are specified (NDAY > 400 means no more inflow data)
13	1-10	F10.4	CINFLO (NDAY,1)	(MG/L)		Concentration of DO in inflow on day NDAY
	11-20	F10.4	(NDAY,2) (NDAY,2)	(MG/L)		Concentration of BOD in inflow on day NDAY

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
13	21-30	F10.4	CINFLO (NDAY,3)	(MG/L)		Concentration of NH_3-N in inflow on day NDAY
	31-40	F10.4	CINFLO (NDAY,4)	(MG/L)		Concentration of NO_2-N in inflow on day NDAY
	41-50	F10.4	CINFLO (NDAY,5)	(MG/L)		Concentration of NO_3-N in inflow on day NDAY
	51-60	F10.4	CINFLO (NDAY,6)	(MG/L)		Concentration of PO_4-P in inflow on day NDAY
	61-70	F10.4	CINFLO (NDAY,7)	(MG/L)		Concentration of algae in inflow on day NDAY
	71-80	F10.4	CINFLO (NDAY,8)	(MPN/100)		Concentration of coliforms in inflow on day NDAY
14	1-10	F10.4	CINFLO (NDAY,9)	(MG/L)		Concentration of HM1 in inflow on day NDAY
	11-20	F10.4	CINFLO (NDAY,10)	(MG/L)		Concentration of HM2 in inflow on day NDAY
	21-30	F10.4	CINFLO (NDAY,11)	(MG/L)		Concentration of HM3 in inflow on day NDAY
	31-40	F10.4	CINFLO (NDAY,12)	(MG/L)		Concentration of N in inflow on day NDAY

TABLE 12 (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
14	41-50	F10.4	CINFLO (NDAY,13)	(MG/L)		Concentration of CL_2 in inflow on day NDAY
	51-60	F10.4	CINFLO (NDAY,14)	(MG/L)		Concentration of HM1 ions in inflow on day NDAY
	61-70	F10.4	CINFLO (NDAY,15)	(MG/L)		Concentration of HM2 ions in inflow on day NDAY
	71-80	F10.4	CINFLO (NDAY,16)	(MG/L)		Concentration of HM3 ions in inflow on day NDAY

Repeat cards 12, 13, and 14 until all inflow concentrations have been defined. Inflow concentrations MUST be defined for IDAY and LDAY. The inflow concentrations for any day which is not specifically input are linearly interpolated from input concentrations. Card 12 with NDAY greater than 400 must be input to signal the end of the inflow concentration input.

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
15	1-10	F10.4	ELEV	(FEET)		Lake elevation above sea level
	11-20	F10.4	TEMPAV	(°C)		Average lake temperature on IDAY
	21-30	F10.4	XLAT	(DEGREES)		Lake latitude
	31-40	E10.0	E1	(M^2/SEC)		Diffusion coefficient above thermocline

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
15	41-50	E10.0	E2	(M^2/SEC)		Diffusion coefficient below thermocline
16	1-5	I5	I			Lake element number (I > 200 means no more element data)
17	1-6	F6.0	BODK(I)	($HOUR^{-1}$)	.008	BOD decay coefficient for element I (A.13)
	7-12	F6.0	BODKS(I)	($HOUR^{-1}$)	.0009	BOD settling coefficient for element I (A.12)
	13-18	F6.0				
	19-24	F6.0	COLK(I)	($HOUR^{-1}$)	.004	Coliform decay coefficient for element I (A.7)
	25-30	F6.0	NH3K(I)	($HOUR^{-1}$)	.004	NH_3 decay coefficient for element I (A.26)
	31-36	F6.0	NO2K(I)	($HOUR^{-1}$)	.015	NO_2 decay coefficient for element I (A.31)
	37-42	F6.0	NO3K(I)	($HOUR^{-1}$)	.004	NO_3 settling coefficient for element I (A.37)
	43-48	F6.0	PO4K(I)	($HOUR^{-1}$)	.0009	PO_4 settling coefficient for element I (A.75)

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
17	49-54	Blank				
	55-60	F6.0	HM1K(I)	$(HOUR^{-1})$	.004	HM1 settling coefficient for element I (A.2)
	61-66	F6.0	HM2K(I)	$(HOUR^{-1})$	0	HM2 settling coefficient for element I (A.2)
	67-72	F6.0	HM3K(I)	$(HOUR^{-1})$	0	HM3 settling coefficient for element 1 (A.2)
18	1-10	F10.4	C(I,1)	(MG/L)		Initial DO concentration in element I
	11-20	F10.4	C(I,2)	(MG/L)		Initial BOD concentration in element I
	21-30	F10.4	C(I,3)	(MG/L)		Initial NH_3-N concentration in element I
	31-40	F10.4	C(I,4)	(MG/L)		Initial NO_2-N concentration in element I
	41-50	F10.4	C(I,5)	(MG/L)		Initial NO_3-N concentration in element I
	51-60	F10.4	C(I,6)	(MG/L)		Initial PO_4-P concentration in element I

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
18	61-70	F10.4	C(I,7)	(MG/L)		Initial algae concentration in element I
	71-80	F10.4	C(I,8)	(MPN/100Ml)		Initial coliform concentration in element I
19	1-10	F10.4	C(I,9)	(MG/L)		Initial HM1 concentration in element I
	11-20	F10.4	C(I,10)	(MG/L)		Initial HM2 concentration in element I
	21-30	F10.4	C(I,11)	(MG/L)		Initial HM3 concentration in element I
	31-40	F10.4	C(I,12)	(MG/L)		Initial N concentration in element I
	41-50	F10.4	C(I,13)	(MG/L)		Initial CL_2 concentration in element I
	51-60	F10.4	C(I,14)	(MG/L)		Initial HM1 ions concentration in element I
	61-70	F10.4	C(I,15)	(MG/L)		Initial HM2 ions concentration in element I
	71-80	F10.4	C(I,16)	(MG/L)		Initial HM3 ions concentration in element I

TABLE 12. (Continued)

Cards 16-19 are repeated until all initial conditions have been input. Card 16 with I > 200 signals the end of the initial condition input. Card 17 must be input even if the default values are satisfactory (i.e., include a blank card 17 if the default values are desired). Cards 16-19 <u>MUST</u> be input for both the bottom and top elements of the lake. The bottom element is I = 1, the top element is I = ELMAX/SDZ. The initial concentrations for an element which is not specifically input are linearly interpolated from input concentrations. The card 17 variables assume their default values for an element which is not input.

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
20	1-5	I5	IFN			PHYTOPLANKTON growth function option 0 = growth limited by NO_3-N concentration 1 = growth limited by NH_3-N concentration 2 = growth limited by maximum of NH_3-N and NO_3-N
	6-10	I5	ICOL			COLIFORM option 0 = don't model COLIFORMS 1 = model COLIFORMS

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
20	11-15	I5	ICOMB			Constituent selection option (see Table 13 below)
	16-20	I5	IHEAVY			Heavy metal option 0 = model no heavy metals or ions N = model N heavy metals and their associated ions (N=1,2,3)
	21-25	I5	ITOTN			TOTAL NITROGEN option 0 = don't model TOTAL NITROGEN 1 = model TOTAL NITROGEN
	26-30	I5	ICHLOR			CHLORIDE option 0 = don't model CHLORIDES 1 = model CHLORIDES
	31-35	I5	INH		1	NH_3 reaction order 1 = 1st order 2 = 2nd order
	36-40	I5	IN2		1	NO_2 reaction order 1 = 1st order 2 = 2nd order
	41-45	I5	IN3		1	NO_3 reaction order 1 = 1st order 2 = 2nd order

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
20	46-50	I5	IP		2	PO_4 reaction order 1 = 1st order 2 = 2nd order
21	1-10	blank				
	11-20	F10.4	THKCOL		1.07	Temperature correction constant for coliform (COL) reaction coefficient (A.8)
	21-30	F10.4	ABOD		0.	Coefficient on BOD in COL calculation (A.10)
	31-40	F10.4	AHM		0.	Coefficient on HEAVY METAL 1 (HM1) in COL calculation (A.10)
	41-50	F10.4	CHMOC	(MG/L)	20.	HM1 concentration limit in COL calculation (A.10)
	51-60	F10.4	THKNH3		1.10	Temperature correction constant for NH_3-N decay coefficient (A.27)
	61-70	F10.4	VOLITK		.01	Exponent for NH_3-N volitization (A.35)
	71-80	F10.4	THVOLK		.17	Temperature correction constant for NH_3-N volitization (A.35)

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
22	1-10	blank				
	11-20	F10.4	BODC		106.	Carbon to phosphorus ratio in BOD (A.18)
	21-30	F10.4	BODN		16.	Nitrogen to phosphorus ratio in BOD (A.19)
	31-40	F10.4	BODPC		.5	Dry weight fraction of carbon in BOD (A.18)
	41-50	F10.4	BODOQ	(MG 0_2/MG BOD)	1.5	BOD - oxygen quotient (A.16)
	51-60	F10.4	NOREFR		.5	Non-refractory part of BOD (A.17)
	61-70	F10.4	GRMAX	(HOUR^{-1})	.1	Maximum fractional growth rate for phytoplankton at 20° centigrade (A.45)
	71-80	F10.4	THGRMX		1.07	Temperature correction constant GRMAX (A.45)
23	1-10	blank				
	11-20	F10.4	CHMOA	(MG/L)	20.	HM1 limit for phytoplankton growth (A.46)

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
23	21-30	F10.4	HMKA		.01	HM1 coefficient for phytoplankton growth calculation (A.46)
	31-40	F10.4	MPO4	(MG PO_4-P/L)	.03	Michaelis-Menton constant (A.47)
	41-50	F10.4	MINO3	(MG N/L)	.028	Michaelis-Menton constant (A.47)
	51-60	F10.4	M2NO3	(MG NO_3-N/L)	.045	Michaelis-Menton constant (A.48)
	61-70	F10.4	MNH3	(MG NH_3-N/L)	.045	Michaelis-Menton constant (A.49)
	71-80	F10.4	ML	(LANGLEYS/MIN)	.03	Light intensity calculation factor (A.50)
24	1-10	blank				
	11-20	F10.4	APR		.6	Chlorophyll-A to phosphorus ratio in phytoplankton (A.57)
	21-30	F10.4	NR	($HOUR^{-1}$ $DEG.C^{-1}$)	.0001	Phytoplankton respiration factor (A.63)
	31-40	F10.4	ASR	(FT/HOUR)	.05	Phytoplankton sinking rate (A.68)
	41-50	F10.4	AND	($HOUR^{-1}$)	.001	Fractional death for phytoplankton (A.72)

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
24	51-60	F10.4	ATD		.001	Phytoplankton toxic death coefficient for HM1 (A.73)
	61-70	F10.4	BRRBOD	(MG/M^2-HR)	61.	BOD benthal release rate (A.79)
	71-80	F10.4	BRRPO4	(MG/M^2-HR)	.125	PO_4-P benthal release rate (A.78)
25	1-10	blank				
	11-20	F10.4	BRRNH3	(MG/M^2-HR)	.108	Nitrogen benthal release rate (A.77)
	21-30	F10.4	BENOD	(MG/M^2-HR)	15.	Benthal oxygen demand (A.81)
	31-40	F10.4	AHM2		0.	Coefficient on HEAVY METAL 2 (HM2) in COL calculation (A.10)
	41-50	F10.4	AHM3		0.	Coefficient on HEAVY METAL 3 (HM3) in COL calculation (A.10)
	51-60	F10.4	ATD2		0.	Phytoplankton toxic death coefficient for HM2 (A.73)
	61-70	F10.4	ATD3		0.	Phytoplankton toxic death coefficient for HM3 (A.73)
	71-80	F10.4	PIHM1		0.	Fraction of HM1 in ion form (A.3)

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
26	1-10	blank				
	11-20	F10.4	PIHM2		0.	Fraction of HM2 in ion form (A.3)
	21-30	F10.4	PIHM3		0.	Fraction of HM3 in ion form (A.3)
	31-40	F10.4	CHMO2C	(MG/L)	0.	HM2 concentration limit in COL calculation (A.10)
	41-50	F10.4	CHMO3C	(MG/L)	0.	HM3 concentration limit in COL calculation (A.10)
	51-60	F10.4	CHMOA2	(MG/L)	0.	HM2 limit for phytoplankton growth (A.46)
	61-70	F10.4	CHMOA3	(MG/L)	0.	HM3 limit for phytoplankton growth (A.46)
	71-80	F10.4	HMKA2		0.	HM2 coefficient for phytoplankton growth calculation (A.46)

TABLE 12. (Continued)

CARD #	CARD COLUMN	FORMAT	VARIABLE NAME	UNITS	DEFAULT VALUE	DESCRIPTION
27	1-10	blank				
	11-20	F10.4	HMKA3		0.	HM3 coefficient for phytoplankton growth calculation (A.46)
	21-30	F10.4	THNO3K		1.12	Temperature correction constant for NO_3-N decay coefficient (A.38)
	31-40	F10.4	THPO4K		1.084	Temperature correction constant for PO_4-P settling coefficient (A.76.1)

Although no values need be specified (in which case the default values apply), cards 21-27 must be included.

TABLE 13.

DEFINITION OF CONSTITUENT SELECTION OPTION, ICOMB (FOR CARD 20 OF TABLE 12)

ICOMB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
DO	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
BOD	X	X	X	X	X	X	X	X	X	X	X												
NH_3-N	X	X	X	X	X	X						X	X	X	X				X	X			
NO_2-N	X	X		X								X	X						X				
NO_3-N	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X		X	X	X		
PO_4-P	X	X	X		X		X	X		X		X	X	X	X	X	X					X	
PHYTO-PLANKTON	X		X				X					X		X		X							

X indicates that the constituent will be modeled under the indicated ICOMB option.

SECTION VII

OUTPUT DESCRIPTION

Magnetic Tape Output

If tape output is requested, the format of the tape is as follows:

1. First logical record
   (a) first Julian day simulated
   (b) last Julian day simulated
   (c) standard element thickness
   (d) number of outlets

2. Second logical record
   The inflow temperature for each day simulated.

3. Third logical record
   Outflows for each outlet for each day simulated.

4. Fourth logical record
   Outflow temperature for each outlet for each day simulated.

5. Fifth logical record
   Concentrations of lake outflow for each day simulated.

Printed Output

The printed output from LAKSCI consists of a summary of the hydrologic conditions of the reservoir over the simulation period, which is written by BAL, a summary of the meteorologic conditions, which is written by SUBB2, and output from the reservoir simulation portion of LAKSCI. This latter printout consists of a summary of initial conditions written by SUBB and NEWIN and a summary of lake conditions written by PRNT, CURVE, and QPRINT when requested. The summary consists of the following quantities and describes the lake conditions valid at the time of the summary.

(a) reservoir elevation, m;

(b) thickness of the surface element, m;

(c) total flowrate entering lake, $m^3 sec^{-1}$;

(d) total flowrate leaving lake $m^3 sec^{-1}$;

(e) elevation of the thermocline, m;

(f) average downstream temperature, °C;

(g) average retention time under existing conditions, days;

(h) dry bulb air temperature, °C;

(i) reservoir surface temperature, °C;

(j) total evaporation rate, $m^3 sec^{-1}$;

(k) cumulative evaporation to date, m;

(l) inflow temperature, °C;

(m) the lowest depth of convective mixing, m;

(n) downstream objective temperature °C; (same as inflow temperature)

(o) the net rate of short wave solar radition, kcal $m^{-2} sec^{-1}$;

(p) the net rate of long wave atmospheric radiation, kcal $m^{-2} sec^{-1}$;

(q) the net rate of long wave back radiation, kcal $m^{-2} sec^{-1}$;

(r) net rate of long wave evaporative heat loss, kcal $m^{-2} sec^{-1}$;

(s) net rate of long wave sensible heat loss, kcal $m^{2} sec^{-1}$;

(t) flow for each system outlet, $m^3 sec^{-1}$;

(u) temperature for each system outlet, °C;

Under suitable headings, for each element the following information is also printed:

(a) the element number, j;

(b) the elevation of element j;

(c) the temperature of element j, °C;

(d) the temperature of element j, °F;

(e) the horizontal inflow to element j, $m^3 sec^{-1}$;

(f) the horizontal outflow from element j, $m^3 sec^{-1}$;

(g) the time rate of change of temperature in element j, °C sec^{-1};

(h) the diffusion coefficient at element j, kcal $m^{-1} sec^{-1} {}^{\circ}C^{-1}$;

(i) the ratio of vertical advection in the time step to the volume of element j;

(j) the ratio of horizontal advection in the time step to the volume of element j;

(k) the concentrations in element j of all quality constituents being modeled

A plot of water temperature versus depth is also output. At the conclusion of the simulation period the daily temperature, flow, and constituent concentrations of the outlet are printed out. An example of LAKSCI output is probided in Section X.

SECTION VIII

DEFINITION OF COMMON VARIABLES

Common variables employed in the Stratified Reservoir Model are described in Table 14 under their respective common blocks.

TABLE 14.

DESCRIPTION OF COMMON VARIABLES

FORTRAN Name	Description
COMMON/CONBEG/	
DO	Initial DO concentration for GETCON
BOD	Initial BOD concentration for GETCON
NH3	Initial NH_3-N concentration for GETCON
NO2	Initial NO_2-N concentration for GETCON
NO3	Initial NO_3-N concentration for GETCON
PO4	Initial PO_4-P concentration for GETCON
ALG	Initial algae concentration for GETCON
COL	Initial coliform concentration for GETCON
HM1	Initial HM1 concentration for GETCON
HM2	Initial HM2 concentration for GETCON
HM3	Initial HM3 concentration for GETCON
HM	Initial HM concentration for GETCON
TOTN	Initial N concentration for GETCON

TABLE 14. (Continued)

FORTRAN Name	Description
COMMON/CONEND/	
DOE	Final DO concentration from GETCON
BODE	Final BOD concentration from GETCON
NH3E	Final NH_3-N concentration from GETCON
NO2E	Final NO_2-N concentration from GETCON
NO3E	Final NO_3-N concentration from GETCON
PO4E	Final PO_4-P concentration from GETCON
ALGE	Final algae concentration from GETCON
COLE	Final coliform concentration from GETCON
HM1E	Final HM1 concentration from GETCON
HM2E	Final HM2 concentration from GETCON
HM3E	Final HM3 concentration from GETCON
HME	Final HM concentration from GETCON
TOTNE	Final N concentration from GETCON
COMMON/CONST/	
	The variables in common CONST are defined on cards 21-27 of LAKSCI input (see Table 12)

All concentrations have units of mg/L except coliform concentrations which have units of MPN/00 ml.

TABLE 14. (Continued)

FORTRAN Name	Description
COMMON/LAK/	
KCON	Maximum number of constituents
DU	Euphotic depth (m)
E1	Diffusion coefficient above thermocline (m^2/sec)
E2	Diffusion coefficient below thermocline (m^2/sec)
NOWDAY	Current Julian date
SDZ	Standard element thickness (m)
DZTOP	Surface element thickness at start of time step (m)
ATOP	Surface area at start of time step (m^2)
VTOP	Surface element volume at start of time step (m^3)
NHOUR	Hour of day of time step
PDL	Percent of time step during which sun shines
DNO3DS	Change in NO_3-N concentration due to algae (mg/L)
COMMON/LAK2/	
DZTOP2	Surface element thickness at end of time step (m)
ATOP2	Surface area at end of time step (m^2)
VTOP2	Surface element volume at end of time step (m^3)
ELEV	Reservoir elevation above sea level (m)

TABLE 14. (Continued)

FORTRAN Name	Description
COMMON/OPTION/	
IFN	Algae (phytoplankton) growth function option 0 = growth limited by NO_3-N concentration 1 = growth limited by NH_3-N concentration 2 = growth limited by maximum of NH_3-N and NO_3-N
IK2	(not used)
ICOL	0 = don't model coliforms; 1 = model coliforms
ICOMB	Constituent selection option (see Table 13)
INH3	0 = don't model NH_3-N; 1 = model NH_3-N
INO_2	0 = don't model NO_2-N; 1 = model NO_2-N
INO_3	0 = don't model NO_3-N; 1 = model NO_3-N
IPO_4	0 = don't model PO_4-P; 1 = model PO_4-P
IALG	0 = don't model algae; 1 = model algae
IFIRST	Logic flag for GETCON
COMMON/OPT2/	
IHEAVY	Number of heavy metals to be modeled
ITOTN	0 = don't model total nitrogen; 1 = model N
ICHLOR	0 = don't model CL_2; 1 = model Cl_2
COMMON/OPT3/	
IP	Order of PO_4-N reaction (IP = 1 or 2)
INH	Order of NH_3-N reaction (INH = 1 or 2)

TABLE 14. (Continued)

FORTRAN Name	Description
IN2	Order of NO_2-N reaction (IN2 = 1 or 2)
IN3	Order of NO_3-N reaction (IN3 = 1 or 2)
COMMON/PASS/	
TOTL	Total Langleys for the day being considered
DAWN	Sunrise for the day being considered
DUSK	Sunset for the day being considered
COMMON/RCHVAR/	
Variables in RCHVAR are defined on card 16 of LAKSCI inputs (see Table 12).	
COMMON/TEMPER/	
TEMPAV	Average water temperature for reservoir (°C)
TEMREA(J)	Temperature for element J (°C)
SATREA(J)	DO saturation level for element J (mg/L)
BLANK COMMON	
ZF(J)	Reservoir surface elevation for day j (feet above sea level)
V(J)	Reservoir volume for day j (acre feet)
FLOW(J,K)	K = 1 flow into reservoir on day j (cfs) K = 2 flow out of reservoir on day j (cfs) K = 3 inflow temperature on day j (°F)

TABLE 14. (Continued)

FORTRAN Name	Description
ERR(J)	BAL error on day j
OUT(J,K)	Same as flow but different units (cms)
IF(J)	BAL iteration counter for day j
ZM(J)	Reservoir surface elevation for day j (meters above bottom)
DATA	Meteorologic data
ALPHA	Heading for meteorologic data
INDEX	Meteorologic parameters
CINFLO	Inflow concentrations
CLAK	Lake element concentrations
COTFLO	Outflow concentrations
QVI	Vertical inflows for elements (cms)
QVO	Vertical outflows for elements (cms)
DCON	Concentration changes

Variables in common blocks ABLK, BBLK, CBLK, DBLK, and NDV are defined on pages 62-66 of Reference [3].

SECTION IX

SAMPLE INPUT DECK

A listing of a sample input deck for LAKSCI is provided in Table 15. The deck is for a simulation of Long Lake from June 1 (day 152) to November 30 (day 334), 1971. The missing inflow temperatures are filled in by the program. Daily values of barometric pressure, cloud cover, wind speed, dry bulb temperature, dew point temperature, and solar radiation are input. Inflow concentrations are specified on days 152, 164, 192, 206, 213, 227, 249, 262 and 334. Output is requested every 20 days and on 28 special days (when observed data was available). Two integration steps per day are taken. The initial concentrations in layer 32, i.e., the top layer, are input. Nominal values for reaction rates are used except for the benthal oxygen demand rate, which is set to 75 mg/m^2-hr. The constituent selection option is set equal to 2 (see Table 13). Total nitrogen is modeled as a conservative. There is one turbine outlet at an elevation of 21 meters.

TABLE 15. SAMPLE INPUT

```
        18        152        334 -2752.95  149.969    -.7252
  103.       1432.     620.          1.
 25100 25400  12.0 24800 25100        24400 25000        24100 24600         JUNE 1
 23700 24600       23000 24000        22300 22500        21700 22300
 21200 21400       20700 22000        20300 20800        19500 20100
 19100 20000  13.7 18800 19600        18700 19200        18500 19600
 17800 18800       17200 18400        16600 18000        16000 16600
 15200 16300       14600 15000  17.1  14100 14500        13500 14800
 13100 13800       12800 13700        12500 13800        12300 13000
 11900 12500       11600 12100         9000 10400         5400  6270         JUNE 29
  4800  5360        4800  4900         4800  5450         4800  5680
  4800  5700        4800  5700  14.8   4800  5620         5200  5210
  5400  6220  15.8  4800  6090         4400  5200         4600  5180
  5200  5230        5000  5770         4600  6160         4100  4610
  3700  5010        3700  4880         3800  4000         3800  4060
  3800  4310        3800  3920         3400  4340  20.2   3000  3930
  2900  3800        2900  3640         2800  3240         2500  3250
  2500  2450        2500  2730  21.0   2500  2180         1900  2310         JULY 31
  2300  2680        2300  2690         2300  2700         2400  2490
  2400  3310        1900  3110         2200  2620         1700  2420
  1900  2700        2100  2700         2000  2700         2100  1430  19.5
  2000  2680        1600  2680         1400  2810         1800  2360
  1800  1990        1400   830         1200  1140         1200  2010
  1400  1540  20.6  1500  2330         1700  2620         1700  2310
  1800  1920        1800  2130         1800  2640         1900  3010
  2000  2680        1800  2670         2200  2850         2300  2560         SEPT 1
  2300  2030        2300  2750  16.8   2300  3170         2300  2690
  2300  3240        2300  3810         2300  2040         2300  1830
  2400  3870        2500  3370         2400  3360         2300  2490
  2200  2720        2200  2320         2400  1450  14.4   2200  3310
  2300  3500        2300  2720         2300  2970         2300  2970
  2300  2970        2300  3040         2300  3320         2400  2910
  2400  2950        2400  2920         2400  3020         2400  2860         SEPT 29
  2400  2850        2400  2830         1800  2960  14.1   2400  3380
  2400  2550        2300  3060         2400  2820         2400  2870
  2400  2730        2400  2870         1800  2750         2500  3810
  2700  2790        2400  2860         2400  2760         2400  3260
  2400  2940  10.0  2400  2810         2400  2950         2400  3340
  2400  2700        2500  2750         2500  2990         2400  3370
  2400  3260   8.6  2400  3280         2300  3040         2400  2690
  2400  2650        2600  2940         2600  2960         2700  3030  7.5 OCT 31
  2500  3130        2600  3300         2500  2710         2600  3300
  2600  3330        2700  3260         2500  3300         2600  3040
  2600  3640        2600  3190         2600  2810         2700  3500
  2900  3480        2900  3280         3000  3610         2900  3720
  2800  3310        2900  3380         2900  3510         2900  3630
  2900  3470        3000  3470         3200  4190         3400  4600
  3400  3860        3600  4610         4000  5090  7.2                       NOV 28
 LONG LAKE METEOROLOGIC DATA---JUNE THRU NOV,1971--DEEP RES MODEL-PHASE 3
      1971       152        334         1          18
                      48.         118.        468.
         1    25.4     0.0          0.0
JUNE 27.43   27.45    27.50       27.56       27.55       27.52       27.47       27.49
     27.34   27.34    27.53       27.47       27.43       27.62       27.57       27.50
     27.44   27.39    27.55       27.64       27.58       27.42       27.47       27.42
     27.38   27.40    27.41       27.51       27.64       27.60
JULY 27.50   27.55    27.61       27.53       27.50       27.49       27.63       27.49
     27.51   27.59    27.64       27.66       27.68       27.67       27.53       27.48
     27.60   27.61    27.53       27.48       27.48       27.52       27.45       27.44
     27.52   27.54    27.50       27.47       27.57       27.53       27.54
```

AUG	27.46	27.44	27.35	27.45	27.48	27.49	27.45	27.51
	27.59	27.58	27.46	27.37	27.37	27.46	27.48	27.53
	27.58	27.54	27.40	27.37	27.45	27.48	27.73	27.62
	27.54	27.50	27.49	27.54	27.46	27.31	27.34	
SEPT	27.29	27.32	27.58	27.52	27.32	27.45	27.72	27.51
	27.51	27.43	27.59	27.67	27.66	27.73	27.71	27.91
	27.95	27.80	27.54	27.73	27.74	27.68	27.51	27.36
	27.22	27.30	27.39	27.27	27.21	27.40		
OCT	27.56	27.70	27.68	27.72	27.76	27.66	27.77	27.76
	27.72	27.67	27.61	27.65	27.37	27.46	27.45	27.43
	27.33	27.34	27.26	27.60	27.74	27.52	27.30	27.42
	27.38	27.19	27.49	27.90	27.81	27.49	27.52	
NOV	27.39	27.78	27.57	27.46	27.85	27.75	27.48	27.52
	27.35	27.54	27.42	27.31	27.28	27.56	27.75	27.78
	27.80	27.81	27.72	27.70	27.52	27.65	27.54	27.45
	27.58	27.39	27.41	27.13	27.29	27.66		
	2	.1	0.0	0.0				
JUNE	9	10	10	9	4	3	10	7
	4	10	7	10	7	5	2	4
	8	10	3	9	6	7	8	9
	7	6	10	10	2	6		
JULY	6	1	1	7	9	7	4	9
	9	9	5	3	0	0	1	0
	0	0	2	6	2	0	0	0
	1	0	2	2	0	1	0	
AUG	2	3	4	0	2	7	1	0
	0	0	0	0	0	1	0	1
	3	0	0	5	2	10	3	0
	0	4	9	3	3	7	9	
SEPT	10	10	9	0	0	8	2	2
	5	1	1	2	1	0	1	0
	1	8	5	3	2	4	1	9
	8	9	10	10	8	4		
OCT	3	2	10	8	1	9	3	0
	0	4	5	9	6	10	3	0
	2	9	10	9	4	10	10	8
	10	4	6	0	8	10	10	
NOV	2	9	10	6	0	10	9	10
	9	10	10	10	10	8	10	8
	8	10	8	10	10	4	10	9
	10	10	10	10	10	10		
	3	.447	0.0	0.0				
JUNE	8.9	8.2	6.0	11.1	8.9	5.9	10.8	11.2
	7.9	6.5	9.2	9.1	11.4	15.1	10.1	10.9
	6.0	5.2	8.8	5.9	8.5	6.6	10.8	8.1
	12.8	6.5	8.8	5.9	8.8	6.5		
JULY	10.2	7.1	6.2	8.9	13.4	12.7	5.9	6.5
	7.5	12.2	9.5	4.6	4.8	4.6	4.9	4.3
	4.8	7.8	6.3	5.5	7.5	7.8	9.6	6.3
	5.9	6.0	6.5	10.9	8.5	5.2	7.5	
AUG	5.6	8.8	9.5	6.5	6.0	7.5	6.9	8.2
	7.9	3.7	8.6	10.1	9.4	10.1	6.2	12.9
	8.1	8.9	4.6	13.2	8.9	9.9	5.6	5.2
	4.8	5.8	6.8	5.9	6.3	8.2	14.4	
SEPT	10.2	13.5	7.2	7.6	10.5	10.2	5.9	8.3
	6.8	9.9	13.5	12.2	6.3	7.6	7.5	11.5
	6.8	4.8	5.6	13.1	2.7	3.5	9.4	12.8
	10.6	5.3	10.9	11.4	8.9	7.1		
OCT	6.5	7.2	6.9	8.1	8.2	6.0	2.6	5.0
	4.8	4.0	9.2	7.6	16.0	5.9	12.8	11.8

	5.8	8.8	17.3	12.8	6.9	8.1	5.9	9.4
	15.0	16.0	11.1	6.0	7.2	5.0	8.5	
NOV	18.4	11.1	15.2	19.4	8.2	7.1	5.0	5.3
	9.6	6.9	6.2	6.0	6.3	5.6	3.7	7.9
	6.2	7.1	12.1	5.5	6.9	9.4	6.3	6.9
	10.8	9.4	8.6	7.1	5.2	3.3		
	4	.5555	-32.	0.0				
JUNE	53	49	52	56	58	61	58	53
	57	54	56	63	57	54	56	56
	58	60	64	65	72	75	63	60
	57	56	56	51	58	64		
JULY	65	60	60	66	56	53	55	67
	64	56	57	60	65	67	72	75
	76	78	80	82	82	80	78	74
	73	74	80	78	75	78	81	
AUG	84	83	79	77	80	76	80	83
	82	81	83	80	79	70	70	70
	68	71	76	75	70	58	58	67
	70	74	74	76	74	74	60	
SEPT	49	53	58	61	69	56	54	64
	66	69	62	61	56	54	51	54
	51	52	55	52	50	54	62	57
	55	51	50	50	43	43		
OCT	47	49	53	62	63	61	54	57
	57	56	54	51	46	38	40	40
	34	43	44	42	41	48	44	41
	41	37	28	24	23	29	27	
NOV	37	36	43	34	27	27	30	33
	43	43	42	41	39	35	37	37
	31	31	40	40	40	34	29	37
	35	35	36	35	33	28		
	6	.5555	-32.	0.0				
JUNE	45	43	45	46	42	44	45	36
	39	46	45	47	48	38	36	34
	36	48	45	50	53	53	44	39
	40	32	34	39	38	41		
JULY	37	32	31	35	38	34	33	41
	51	43	40	41	40	39	44	43
	40	46	48	53	50	46	43	42
	45	46	47	50	43	48	51	
AUG	51	44	41	45	50	55	52	47
	33	37	33	29	31	36	33	33
	33	36	40	40	41	42	42	39
	41	42	41	47	49	54	46	
SEPT	44	48	49	45	47	48	41	41
	45	46	39	37	33	29	26	26
	26	29	29	33	32	34	34	36
	37	43	39	36	36	32		
OCT	32	35	38	44	49	46	40	42
	43	42	36	35	31	26	21	14
	17	25	39	32	29	37	38	33
	30	25	12	3	9	18	21	
NOV	27	26	27	22	10	14	20	28
	32	41	38	38	35	30	32	31
	27	27	35	38	34	23	25	33
	30	31	32	31	33	27		
	7	.000115	0.0	0.0				
JUNE	476	115	219	286	684	694	359	585
	706	130	589	547	463	695	737	744
	669	293	693	412	677	660	538	587

```
         627      734      447      204      721      644
JULY     568      748      737      627      247      525      715      535
         500      463      663      665      750      726      696      695
         712      706      678      570      653      674      693      685
         647      678      652      619      676      616      645
AUG      626      642      633      640      584      302      623      610
         639      623      629      641      617      617      629      611
         614      599      591      459      570      124      604      588
         575      565      475      501      523      480      333
SEPT     137      127      333      535      526      233      528      521
         428      485      501      497      489      503      499      489
         475      438      399      457      454      415      433      338
         294      211      178      244      278      360
OCT      402      388      256      361      362      266      321      346
         341      318      248      260      187      173      287      332
         319      256       74      241      283      156       56      177
         105      239      194      290      228       99      122
NOV      255      213      .96      157      248      178       70      147
         146       67      118       24       48      116       39      119
         145       35      128       72       95      167       45       62
          45       37       56       52       48       36
         999
          18   INPUT UNIT CONTAINING BAL AND MIFP OUTPUT
    152  334
     DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
                            SYSTEMS CONTROL INC
        1.0       32.       15.       0.        1.5E-9    -7.E-2
     1    1    28   20    1    0    1    2    2
      9.0E-7    2.5E-1     1.4E-5    -7.E-1     3.65E4
   .195361E6 .611446E6      0.0E6
          1      21.      552.
     32.        12.
    152  164  173  189  192  202  206  208  213  222  227  230  235  236  244  249
    258  262  264  265  278  292  300  307  313  320  326  333
    152
     11.7      .2        .01       .00       .72       .02                 1100.
     .27                           .02
    164
     11.5      .274      .00       .00       .86       .01                 4000.
     .18                           .02
    192
      9.3      .9        .02       .02       1.2       .03                 3000.
     .17                           .06
    206
      7.4      1.35      .02       .01       1.3       .04                 2500.
     .14                           .06
    213
      7.7      1.74      .02       .03       1.2       .04                  800.
     .11                           .07
    227
      7.4      3.        .03       .01       1.3       .02                 5500.
     .11                           .08
    249
      8.8      3.        .02       .02       2.1       .02                 3000.
     .13                           .13
    262
     10.0      1.8       .01       .00       2.0       .02                 2000.
     .11                           .15
    334
     10.0      1.18      .01       .00       2.0       .02                 2000.
```

```
 .11                          .15
500
 1534.    12.      49.         1.E+6   1.E-10
 1


 32

 11.7     1.       .01         .00      .26      .006             1100.
                              .02
200
  0   1   2   1   1   0   1   1   1   2


                 75.

**
```

SECTION X

SAMPLE OUTPUT

A listing of a sample LAKSCI output is provided in Table 16. The output is the result of the input deck listed in Table 15 except that output is requested on only 4 days. The output is self explanatory for the most part. The first five pages are output by the water balance part of LAKSCI and show the history of lake surface elevation, lake volume and depth, lake inflow and outflow, and lake inflow temperature for the simulation period. The next section lists the meteorologic parameters for the 183 day simulation period. Summaries of the lake volume and area profiles, reaction rates for each lake layer, initial concentrations for each lake layer, and inflow concentrations follow. A summary of the constituents being modeled is output and lake conditions on days 152, 200, 240 and 333 are listed. Histories of the calculated outflow temperatures and concentrations are also output.

TABLE 16. SAMPLE OUTPUT

```
INITIAL SURFACE ELEVATION, REFERENCED TO LAKE BOTTOM =          103.(FT)
   ELEVATION OF LAKE BOTTOM, REFERENCED TO SEA LEVEL =         1432.(FT)
                TOTAL INFLOW FOR SIMULATION PERIOD =   83410550000.(FT**3)
               TOTAL OUTFLOW FOR SIMULATION PERIOD =   93206551000.(FT**3)
                                        DIFFERENCE =       -224885.(ACRE FEET)
                                        DIFFERENCE =          -620.(CFS)

   INFLOW FACTOR =    1.0000
GROUNDWATER FLOW =  620.0000(CFS)

VOLUME = C1*D + (C2/2)*D**2 + (C3/3)*D**3
  AREA = C1 + C2*D + C3*D**2
WITH VOLUME IN ACRE FEET AND D IN FEET ABOVE LAKE BOTTOM

         C1 =   -.27529500+04
         C2 =    .14996900+03
         C3 =   -.72520000-00
```

DAY	ELEV(FT)	V(ACFT)	ERR	ITER	IN(CFS)	OUT(CFS)	TEMP(F)	IN(CMS)	OUT(CMS)	TEMP(C)	DEPTH(M)
152	1535.13	2.484+05	-1.953-03	2	25720.0	25400.0	53.60	728.3	719.3	12.00	31.41
153	1535.25	2.491+05	3.906-03	2	25420.0	25100.0	53.86	719.8	710.8	12.14	31.45
154	1535.26	2.491+05	3.906-03	2	25020.0	25000.0	54.11	708.5	707.9	12.28	31.47
155	1535.31	2.494+05	-3.906-03	2	24720.0	24600.0	54.37	700.0	696.6	12.42	31.48
156	1535.20	2.488+05	-0.000	2	24320.0	24600.0	54.62	688.7	696.6	12.57	31.47
157	1535.05	2.480+05	3.906-03	2	23620.0	24000.0	54.88	668.8	679.6	12.71	31.43
158	1535.21	2.489+05	-9.766-03	2	22920.0	22500.0	55.13	649.0	637.1	12.85	31.43
159	1535.22	2.489+05	1.953-03	2	22320.0	22300.0	55.39	632.0	631.5	12.99	31.46
160	1535.39	2.496+05	-3.906-03	2	21820.0	21400.0	55.64	617.9	606.0	13.13	31.49
161	1535.12	2.484+05	-9.766-03	2	21320.0	22000.0	55.90	603.7	623.0	13.27	31.47
162	1535.17	2.486+05	9.766-03	2	20920.0	20800.0	56.15	592.4	589.0	13.42	31.44
163	1535.17	2.487+05	1.953-03	2	20120.0	20100.0	56.41	569.7	569.2	13.56	31.45
164	1535.06	2.481+05	-1.953-03	2	19720.0	20000.0	56.66	558.4	566.3	13.70	31.43
165	1534.99	2.476+05	5.859-03	2	19420.0	19600.0	57.34	549.9	555.0	14.08	31.40
166	1535.04	2.480+05	-1.953-03	2	19320.0	19200.0	58.02	547.1	543.7	14.46	31.40
167	1534.85	2.471+05	-3.906-03	2	19120.0	19600.0	58.70	541.4	555.0	14.83	31.38
168	1534.70	2.463+05	-7.813-03	2	18420.0	18800.0	59.38	521.6	532.4	15.21	31.33
169	1534.47	2.452+05	5.859-03	2	17820.0	18400.0	60.06	504.6	521.0	15.59	31.27
170	1534.16	2.436+05	-0.000	2	17220.0	18000.0	60.74	487.6	509.7	15.97	31.19
171	1534.17	2.436+05	-3.906-03	2	16620.0	16600.0	61.42	470.6	470.1	16.34	31.14
172	1533.98	2.427+05	-1.367-02	2	15820.0	16300.0	62.10	448.0	461.6	16.72	31.11
173	1534.06	2.431+05	5.859-03	2	15220.0	15000.0	62.78	431.0	424.8	17.10	31.10
174	1534.15	2.436+05	9.766-03	2	14720.0	14500.0	62.52	416.8	410.6	16.96	31.12
175	1533.88	2.422+05	-3.906-03	2	14120.0	14800.0	62.26	399.8	419.1	16.81	31.09
176	1533.85	2.421+05	7.813-03	2	13720.0	13800.0	62.00	388.5	390.8	16.67	31.05
177	1533.74	2.415+05	3.906-03	2	13420.0	13700.0	61.75	380.0	387.9	16.53	31.03
178	1533.47	2.402+05	-1.953-03	2	13120.0	13800.0	61.49	371.5	390.8	16.38	30.97
179	1533.44	2.400+05	-5.859-03	2	12920.0	13000.0	61.23	365.9	368.1	16.24	30.92
180	1533.44	2.400+05	-1.953-03	2	12520.0	12500.0	60.97	354.5	354.0	16.09	30.92
181	1533.49	2.403+05	1.953-03	2	12220.0	12100.0	60.71	346.0	342.6	15.95	30.93
182	1533.18	2.387+05	-1.172-02	2	9620.0	10400.0	60.45	272.4	294.5	15.81	30.89
183	1533.08	2.382+05	-1.172-02	2	6020.0	6270.0	60.19	170.5	177.5	15.66	30.83
184	1533.11	2.383+05	3.906-03	2	5420.0	5360.0	59.93	153.5	151.8	15.52	30.81
185	1533.31	2.394+05	-1.953-03	2	5420.0	4900.0	59.68	153.5	138.8	15.38	30.85
186	1533.30	2.393+05	1.953-03	2	5420.0	5450.0	59.42	153.5	154.3	15.23	30.88
187	1533.20	2.388+05	-1.172-02	2	5420.0	5680.0	59.16	153.5	160.8	15.09	30.86
188	1533.09	2.382+05	-0.000	2	5420.0	5700.0	58.90	153.5	161.4	14.94	30.83
189	1532.98	2.377+05	-3.906-03	2	5420.0	5700.0	58.64	153.5	161.4	14.80	30.79
190	1532.90	2.373+05	9.766-03	2	5420.0	5620.0	59.24	153.5	159.1	15.13	30.77
191	1533.14	2.385+05	-3.906-03	2	5820.0	5210.0	59.84	164.8	147.5	15.47	30.79
192	1533.06	2.381+05	-1.953-03	2	6020.0	6220.0	60.44	170.5	176.1	15.80	30.82
193	1532.79	2.368+05	-1.172-02	2	5420.0	6090.0	61.01	153.5	172.5	16.11	30.76
194	1532.72	2.364+05	-0.000	2	5020.0	5200.0	61.57	142.2	147.2	16.43	30.71
195	1532.74	2.365+05	1.953-03	2	5220.0	5180.0	62.14	147.8	146.7	16.74	30.70
196	1532.97	2.377+05	1.953-03	2	5820.0	5230.0	62.70	164.8	148.1	17.06	30.74
197	1532.91	2.374+05	-5.859-03	2	5620.0	5770.0	63.27	159.1	163.4	17.37	30.77
198	1532.54	2.355+05	-9.766-03	2	5220.0	6160.0	63.83	147.8	174.4	17.69	30.70
199	1532.58	2.357+05	3.906-03	2	4720.0	4610.0	64.40	133.7	130.5	18.00	30.65
200	1532.31	2.344+05	-1.172-02	2	4320.0	5010.0	64.97	122.3	141.9	18.31	30.62
201	1532.09	2.332+05	-0.000	2	4320.0	4880.0	65.53	122.3	138.2	18.63	30.54
202	1532.25	2.341+05	1.953-03	2	4420.0	4000.0	66.10	125.2	113.3	18.94	30.53
203	1532.40	2.348+05	3.906-03	2	4420.0	4060.0	66.66	125.2	115.0	19.26	30.58
204	1532.44	2.350+05	-9.766-03	2	4420.0	4310.0	67.23	125.2	122.0	19.57	30.61
205	1532.64	2.360+05	-1.953-03	2	4420.0	3920.0	67.79	125.2	111.0	19.89	30.64
206	1532.51	2.354+05	-3.906-03	2	4020.0	4340.0	68.36	113.8	122.9	20.20	30.66
207	1532.39	2.348+05	3.906-03	2	3620.0	3930.0	68.57	102.5	111.3	20.31	30.62
208	1532.28	2.342+05	3.906-03	2	3520.0	3800.0	68.77	99.7	107.6	20.43	30.58
209	1532.23	2.340+05	-0.000	2	3520.0	3640.0	68.98	99.7	103.1	20.54	30.56

210	1532.30	2.343+05	-0.000	2	3420.0	3240.0	69.18	96.8	91.7	20.66	30.56
211	1532.25	2.341+05	-1.953-03	2	3120.0	3250.0	69.39	88.3	92.0	20.77	30.56
212	1532.52	2.354+05	-0.000	2	3120.0	2450.0	69.59	88.3	69.4	20.89	30.60
213	1532.67	2.362+05	-5.859-03	2	3120.0	2730.0	69.80	88.3	77.3	21.00	30.66
214	1533.04	2.380+05	-9.766-03	2	3120.0	2180.0	69.61	88.3	61.7	20.89	30.74
215	1533.13	2.384+05	-1.953-03	2	2520.0	2310.0	69.41	71.4	65.4	20.79	30.81
216	1533.22	2.389+05	1.367-02	2	2920.0	2680.0	69.22	82.7	75.9	20.68	30.84
217	1533.31	2.394+05	-0.000	2	2920.0	2690.0	69.03	82.7	76.2	20.57	30.87
218	1533.40	2.398+05	3.906-03	2	2920.0	2700.0	68.84	82.7	76.5	20.46	30.89
219	1533.61	2.409+05	3.906-03	2	3020.0	2490.0	68.64	85.5	70.5	20.36	30.94
220	1533.50	2.403+05	-5.859-03	2	3020.0	3310.0	68.45	85.5	93.7	20.25	30.95
221	1533.26	2.391+05	-5.859-03	2	2520.0	3110.0	68.26	71.4	88.1	20.14	30.90
222	1533.34	2.395+05	3.906-03	2	2820.0	2620.0	68.06	79.9	74.2	20.04	30.88
223	1533.30	2.393+05	1.953-03	2	2320.0	2420.0	67.87	65.7	68.5	19.93	30.88
224	1533.23	2.390+05	-5.859-03	2	2520.0	2700.0	67.68	71.4	76.5	19.82	30.87
225	1533.24	2.390+05	1.953-03	2	2720.0	2700.0	67.49	77.0	76.5	19.71	30.86
226	1533.21	2.388+05	5.859-03	2	2620.0	2700.0	67.29	74.2	76.5	19.61	30.85
227	1533.72	2.414+05	1.953-03	2	2720.0	1430.0	67.10	77.0	40.5	19.50	30.93
228	1533.69	2.413+05	-1.953-03	2	2620.0	2680.0	67.32	74.2	75.9	19.62	31.00
229	1533.51	2.404+05	-0.000	2	2220.0	2680.0	67.54	62.9	75.9	19.74	30.97
230	1533.20	2.388+05	7.813-03	2	2020.0	2810.0	67.76	57.2	79.6	19.87	30.89
231	1533.22	2.389+05	-3.906-03	2	2420.0	2360.0	67.98	68.5	66.8	19.99	30.85
232	1533.39	2.398+05	-0.000	2	2420.0	1990.0	68.20	68.5	56.4	20.11	30.58
233	1533.87	2.421+05	-1.367-02	2	2020.0	830.0	68.42	57.2	23.5	20.23	30.98
234	1534.14	2.435+05	7.813-03	2	1820.0	1140.0	68.64	51.5	32.3	20.36	31.09
235	1534.06	2.431+05	-7.813-03	2	1820.0	2010.0	68.86	51.5	56.9	20.48	31.12
236	1534.25	2.441+05	-9.766-03	2	2020.0	1540.0	69.08	57.2	43.6	20.60	31.14
237	1534.17	2.436+05	-1.953-03	2	2120.0	2330.0	68.55	60.0	66.0	20.31	31.15
238	1534.05	2.430+05	-7.813-03	2	2320.0	2620.0	68.03	65.7	74.2	20.02	31.12
239	1534.05	2.431+05	-1.953-03	1	2320.0	2310.0	67.50	65.7	65.4	19.72	31.10
240	1534.25	2.441+05	-9.766-03	2	2420.0	1920.0	66.98	68.5	54.4	19.43	31.14
241	1534.37	2.446+05	7.813-03	2	2420.0	2130.0	66.45	68.5	60.3	19.14	31.18
242	1534.28	2.442+05	-7.813-03	2	2420.0	2640.0	65.92	68.5	74.8	18.85	31.19
243	1534.08	2.432+05	-1.367-02	2	2520.0	3010.0	65.40	71.4	85.2	18.55	31.14
244	1534.06	2.431+05	-1.953-03	2	2620.0	2680.0	64.87	74.2	75.9	18.26	31.11
245	1533.96	2.426+05	1.953-03	2	2420.0	2670.0	64.34	68.5	75.6	17.97	31.09
246	1533.95	2.426+05	1.953-03	2	2820.0	2850.0	63.82	79.9	80.7	17.68	31.08
247	1534.09	2.433+05	-0.000	2	2920.0	2560.0	63.29	82.7	72.5	17.38	31.10
248	1534.44	2.450+05	7.813-03	2	2920.0	2030.0	62.77	82.7	57.5	17.09	31.17
249	1534.51	2.454+05	-1.953-03	2	2920.0	2750.0	62.24	82.7	77.9	16.80	31.24
250	1534.41	2.449+05	-1.953-03	2	2920.0	3170.0	61.91	82.7	89.8	16.62	31.23
251	1534.50	2.453+05	-0.000	2	2920.0	2690.0	61.58	82.7	76.2	16.43	31.23
252	1534.38	2.447+05	5.859-03	2	2920.0	3240.0	61.24	82.7	91.7	16.25	31.22
253	1534.02	2.429+05	-9.766-03	2	2920.0	3810.0	60.91	82.7	107.9	16.06	31.15
254	1534.37	2.447+05	1.367-02	2	2920.0	2040.0	60.58	82.7	57.8	15.88	31.15
255	1534.81	2.468+05	-1.172-02	2	2920.0	1830.0	60.25	82.7	51.8	15.69	31.27
256	1534.47	2.452+05	-3.906-03	2	3020.0	3870.0	59.91	85.5	109.6	15.51	31.28
257	1534.37	2.447+05	-1.172-02	2	3120.0	3370.0	59.58	88.3	95.4	15.32	31.22
258	1534.23	2.440+05	-7.813-03	2	3020.0	3360.0	59.25	85.5	95.1	15.14	31.18
259	1534.40	2.448+05	-0.000	2	2920.0	2490.0	58.92	82.7	70.5	14.95	31.19
260	1534.44	2.450+05	-1.953-03	2	2820.0	2720.0	58.58	79.9	77.0	14.77	31.22
261	1534.64	2.460+05	-1.367-02	2	2820.0	2320.0	58.25	79.9	65.7	14.58	31.26
262	1535.27	2.491+05	-7.813-03	2	3020.0	1450.0	57.92	85.5	41.1	14.40	31.38
263	1535.07	2.482+05	9.766-03	2	2820.0	3310.0	57.89	79.9	93.7	14.38	31.45
264	1534.84	2.470+05	-1.172-02	2	2920.0	3500.0	57.85	82.7	99.1	14.36	31.38
265	1534.92	2.474+05	1.953-03	2	2920.0	2720.0	57.82	82.7	77.0	14.34	31.36
266	1534.90	2.473+05	-1.953-03	2	2920.0	2970.0	57.79	82.7	84.1	14.33	31.37
267	1534.88	2.472+05	-5.859-03	2	2920.0	2970.0	57.75	82.7	84.1	14.31	31.36
268	1534.86	2.471+05	-1.953-03	2	2920.0	2970.0	57.72	82.7	84.1	14.29	31.36
269	1534.91	2.469+05	-9.766-03	2	2920.0	3040.0	57.68	82.7	86.1	14.27	31.34

270	1534.65	2.461+05	1.367-02	2	2920.0	3320.0	57.65	82.7	94.0	14.25	31.31
271	1534.70	2.463+05	-0.000	2	3020.0	2910.0	57.62	85.5	82.4	14.23	31.30
272	1534.73	2.464+05	5.859-03	2	3020.0	2950.0	57.58	85.5	83.5	14.21	31.31
273	1534.77	2.466+05	-0.000	2	3020.0	2920.0	57.55	85.5	82.7	14.19	31.32
274	1534.77	2.466+05	-0.000	1	3020.0	3020.0	57.52	85.5	85.5	14.18	31.32
275	1534.83	2.470+05	-1.953-03	2	3020.0	2860.0	57.48	85.5	81.0	14.16	31.33
276	1534.90	2.473+05	7.813-03	2	3020.0	2850.0	57.45	85.5	80.7	14.14	31.35
277	1534.97	2.477+05	-3.906-03	2	3020.0	2830.0	57.41	85.5	80.1	14.12	31.37
278	1534.76	2.466+05	3.906-03	2	2420.0	2960.0	57.38	68.5	83.8	14.10	31.35
279	1534.62	2.459+05	-1.953-03	2	3020.0	3380.0	56.85	85.5	95.7	13.81	31.30
280	1534.80	2.468+05	1.953-03	2	3020.0	2550.0	56.33	85.5	72.2	13.51	31.31
281	1534.75	2.465+05	7.813-03	2	2920.0	3060.0	55.80	82.7	86.7	13.22	31.33
282	1534.83	2.469+05	-1.953-03	2	3020.0	2820.0	55.27	85.5	79.9	12.93	31.33
283	1534.88	2.472+05	1.953-03	2	3020.0	2870.0	54.74	85.5	81.3	12.64	31.35
284	1535.00	2.478+05	-3.906-03	2	3020.0	2730.0	54.22	85.5	77.3	12.34	31.38
285	1535.06	2.481+05	3.906-03	2	3020.0	2870.0	53.69	85.5	81.3	12.05	31.40
286	1534.93	2.475+05	1.953-03	2	2420.0	2750.0	53.16	68.5	77.9	11.76	31.39
287	1534.65	2.461+05	5.859-03	2	3120.0	3810.0	52.64	88.3	107.9	11.46	31.33
288	1534.87	2.471+05	1.953-03	2	3320.0	2790.0	52.11	94.0	79.0	11.17	31.32
289	1534.93	2.475+05	-3.906-03	2	3020.0	2860.0	51.58	85.5	81.0	10.88	31.36
290	1535.03	2.480+05	-1.367-02	2	3020.0	2760.0	51.05	85.5	78.2	10.59	31.39
291	1534.94	2.475+05	1.953-03	2	3020.0	3200.0	50.53	85.5	92.3	10.29	31.39
292	1534.97	2.476+05	-9.766-03	2	3020.0	2940.0	50.00	85.5	83.3	10.00	31.38
293	1535.05	2.481+05	1.953-03	2	3020.0	2810.0	49.69	85.5	79.6	9.83	31.40
294	1535.08	2.482+05	-3.906-03	2	3020.0	2950.0	49.37	85.5	83.5	9.65	31.41
295	1534.95	2.476+05	1.953-03	2	3020.0	3340.0	49.06	85.5	94.6	9.48	31.40
296	1535.08	2.482+05	-3.906-03	2	3020.0	2700.0	48.74	85.5	76.5	9.30	31.40
297	1535.23	2.489+05	-0.000	2	3120.0	2750.0	48.43	88.3	77.9	9.13	31.44
298	1535.28	2.492+05	1.953-03	2	3120.0	2990.0	48.11	88.3	84.7	8.95	31.47
299	1535.14	2.485+05	1.953-03	2	3020.0	3370.0	47.80	85.5	95.4	8.78	31.46
300	1535.04	2.480+05	-1.953-03	2	3020.0	3260.0	47.48	85.5	92.3	8.60	31.42
301	1534.94	2.475+05	-0.000	2	3020.0	3280.0	47.20	85.5	92.9	8.44	31.39
302	1534.89	2.473+05	-0.000	2	2920.0	3040.0	46.91	82.7	86.1	8.29	31.37
303	1535.02	2.479+05	-5.859-03	2	3020.0	2690.0	46.63	85.5	76.2	8.13	31.38
304	1535.17	2.487+05	-1.953-03	2	3020.0	2650.0	46.35	85.5	75.0	7.97	31.42
305	1535.28	2.492+05	1.953-03	2	3220.0	2940.0	46.07	91.2	83.3	7.81	31.46
306	1535.38	2.497+05	3.906-03	2	3220.0	2960.0	45.78	91.2	83.8	7.66	31.50
307	1535.50	2.503+05	-9.766-03	2	3320.0	3030.0	45.50	94.0	85.8	7.50	31.53
308	1535.50	2.503+05	3.906-03	1	3120.0	3130.0	45.48	88.3	88.6	7.49	31.55
309	1535.46	2.501+05	-0.000	2	3220.0	3300.0	45.46	91.2	93.4	7.48	31.54
310	1535.63	2.509+05	3.906-03	2	3120.0	2710.0	45.44	88.3	76.7	7.47	31.56
311	1535.59	2.508+05	-3.906-03	2	3220.0	3300.0	45.42	91.2	93.4	7.46	31.58
312	1535.55	2.506+05	9.766-03	2	3220.0	3330.0	45.40	91.2	94.3	7.44	31.57
313	1535.58	2.507+05	-1.953-03	2	3320.0	3260.0	45.38	94.0	92.3	7.43	31.57
314	1535.50	2.503+05	1.953-03	2	3120.0	3300.0	45.36	88.3	93.4	7.42	31.56
315	1535.58	2.507+05	1.953-03	2	3220.0	3040.0	45.34	91.2	86.1	7.41	31.56
316	1535.41	2.499+05	3.906-03	2	3220.0	3640.0	45.32	91.2	103.1	7.40	31.54
317	1535.42	2.499+05	3.906-03	2	3220.0	3190.0	45.30	91.2	90.3	7.39	31.52
318	1535.58	2.507+05	-0.000	2	3220.0	2810.0	45.28	91.2	79.6	7.38	31.55
319	1535.51	2.504+05	7.813-03	2	3320.0	3500.0	45.26	94.0	99.1	7.37	31.56
320	1535.53	2.504+05	1.953-03	2	3520.0	3480.0	45.24	99.7	98.5	7.36	31.55
321	1535.62	2.509+05	-1.953-03	2	3520.0	3280.0	45.22	99.7	92.9	7.34	31.57
322	1535.63	2.509+05	3.906-03	1	3620.0	3610.0	45.20	102.5	102.2	7.33	31.58
323	1535.55	2.505+05	-1.953-03	2	3520.0	3720.0	45.18	99.7	105.3	7.32	31.57
324	1535.59	2.508+05	-3.906-03	2	3420.0	3310.0	45.16	96.8	93.7	7.31	31.57
325	1535.65	2.510+05	1.953-03	2	3520.0	3380.0	45.14	99.7	95.7	7.30	31.58
326	1535.65	2.511+05	-0.000	1	3520.0	3510.0	45.12	99.7	99.4	7.29	31.59
327	1535.61	2.508+05	-1.953-03	2	3520.0	3630.0	45.10	99.7	102.8	7.28	31.59
328	1535.63	2.509+05	1.953-03	2	3520.0	3470.0	45.08	99.7	98.3	7.27	31.58
329	1535.69	2.512+05	1.953-03	2	3620.0	3470.0	45.06	102.5	98.3	7.26	31.59

330	1535.54	2.505+05	-1.953-03	2	3820.0	4190.0	45.04	108.2	118.6	7.24	31.58
331	1535.31	2.494+05	-7.813-03	2	4020.0	4600.0	45.02	113.8	130.3	7.23	31.52
332	1535.37	2.497+05	-5.859-03	2	4020.0	3860.0	45.00	113.8	109.3	7.22	31.50
333	1535.22	2.489+05	-7.813-03	2	4220.0	4610.0	44.98	119.5	130.5	7.21	31.48
334	1535.03	2.480+05	-3.906-03	2	4620.0	5090.0	44.96	130.8	144.1	7.20	31.43

LONG LAKE METEOROLOGIC DATA---JUNE THRU NOV,1971--DEEP RES MODEL-PHASE 3

YEAR	1971
FIRST DAY	152
LAST DAY	334
OBS	1
TAPE OUT	18

A	-0.00
B	-0.00
LATITUDE	48.0
LONGITUDE	118.0
ELEVATION	468.0

ATMOSPHERIC PRESSURE INPUT	CONVERSIONS	2.540+01	0.000	0.000
CLOUDINESS INPUT	CONVERSIONS	1.000-01	0.000	0.000
WIND SPEED INPUT	CONVERSIONS	4.470-01	0.000	0.000
DRY BULB TEMPERATURE INPUT	CONVERSIONS	5.555-01	-3.200+01	0.000
DEW POINT TEMPERATURE INPUT	CONVERSIONS	5.555-01	-3.200+01	0.000
SHORT WAVE SOLAR RADIATION INPUT	CONVERSIONS	1.150-04	0.000	0.000

END DATA INPUT

METEOROLOGIC DATA

NO	NET SOLAR	NET ATMOS	AT PRESS	DRY BLUB	EA	WIND	EQ TEMP
1	.05156	.07464	696.72199	11.66550	10.16788	3.97830	27.33251
2	.01237	.07324	697.22999	9.44550	9.41933	3.66540	6.03548
3	.02356	.07587	698.49999	11.11000	10.16788	2.68200	14.02301
4	.03099	.07731	700.02399	13.33200	10.56145	4.96170	19.05766
5	.07391	.07144	699.76999	14.44300	9.06362	3.97830	36.05499
6	.07500	.07310	699.00799	16.10950	9.78730	2.63730	38.03676
7	.03863	.08137	697.73798	14.44300	10.16788	4.82760	26.45194
8	.06340	.07108	698.24599	11.66550	7.16764	5.00640	30.35486
9	.07605	.07061	694.43599	13.88750	8.06655	3.53130	36.44860
10	.01398	.07767	694.43599	12.22100	10.56145	2.90550	10.64367
11	.06371	.07361	699.26199	13.33200	10.16783	4.11240	32.68097
12	.05881	.08620	697.73798	17.22050	10.56833	4.06770	40.93120
13	.05009	.07447	696.72199	13.88750	11.38905	5.09580	26.43028
14	.07490	.06920	701.54799	12.22100	7.75645	6.74970	34.65023
15	.07942	.06841	700.27799	13.33200	7.16764	4.51470	36.29547
16	.08018	.06980	698.49999	13.33200	6.61869	4.87230	37.86840
17	.07238	.07711	696.97599	14.44300	7.16764	2.68200	40.12001
18	.03151	.08327	695.70599	15.55400	11.38906	2.32440	24.42592
19	.07470	.07567	699.76999	17.77600	10.16783	3.93360	40.07328
20	.04458	.08577	702.05599	18.33150	12.27326	2.63730	33.25973
21	.07326	.08662	700.53199	22.22000	13.71288	3.79950	48.69803
22	.07142	.09146	696.46799	23.88650	13.71288	2.95020	51.89267
23	.05821	.08169	697.73798	17.22050	9.78730	4.82760	36.76859
24	.06351	.08098	696.46799	15.55400	8.06656	3.62070	38.87286
25	.06784	.07447	695.45199	13.88750	8.38758	5.72160	35.53155
26	.07941	.07211	695.95999	13.33200	6.10726	2.90550	39.44662
27	.04806	.07950	696.21599	13.33200	6.61869	3.93360	29.69020
28	.02193	.07498	698.75399	10.55450	8.06656	2.63730	12.43117
29	.07769	.07002	702.05599	14.44300	7.75645	3.93360	36.78180
30	.06966	.07909	701.03999	17.77600	8.71982	2.90550	40.41599
31	.06144	.08000	698.49999	18.33150	7.45691	4.55940	36.97634
32	.08058	.07130	699.76999	15.55400	6.10726	3.17370	39.35405
33	.07937	.07130	701.29399	15.55400	5.86492	2.77140	38.73557
34	.06794	.08260	699.26199	18.88700	6.88833	3.97830	42.53892
35	.02676	.07731	698.49999	13.33200	7.75645	5.98980	16.89236
36	.05688	.07108	698.24599	11.66550	6.61869	5.67690	27.01311
37	.07725	.06899	701.80199	12.77650	6.35843	2.63730	35.67237
38	.05796	.08775	698.24599	19.44250	8.71982	2.90550	41.81368
39	.05416	.08479	698.75399	17.77600	12.73760	3.35250	37.34004
40	.05015	.07731	700.78599	13.33200	9.41933	5.45340	28.88439
41	.07159	.07167	702.05599	13.88750	8.38758	4.24650	35.06021
42	.07180	.07226	702.56399	15.55400	8.71982	2.05620	35.67682
43	.08042	.07539	703.07199	18.33150	8.38758	2.14560	42.76950
44	.07784	.07713	702.81798	19.44250	8.06656	2.05620	42.93219
45	.07511	.08177	699.26199	22.22000	9.78730	2.19030	45.49592
46	.07449	.08443	697.99199	23.88650	9.41933	1.92210	47.46008
47	.07630	.08538	701.03999	24.44200	8.38758	2.14560	49.20146
48	.07565	.08732	701.29399	25.55300	10.56145	3.48660	50.51714
49	.07311	.08989	699.26199	26.66400	11.38906	2.81610	51.41401
50	.06166	.09687	697.99199	27.77500	13.71280	2.45850	51.51485

METEOROLOGIC DATA

NO	NET SOLAR	NET ATMOS	AT PRESS	DRY BLUB	EA	WIND	EQ TEMP
51	.07038	.09191	697.99199	27.77500	12.27326	3.35250	51.74064
52	.07217	.08928	699.00799	26.66400	10.56145	3.48660	50.41260
53	.07418	.08732	697.22999	25.55300	9.41933	4.29120	49.76544
54	.07331	.08349	696.97599	23.33100	9.06362	2.81610	46.04682
55	.06966	.08269	699.00799	22.77550	10.16788	2.63730	43.49482
56	.07253	.08349	699.51599	23.33100	10.56145	2.68200	45.64668
57	.07016	.08989	698.49999	26.66400	10.96858	2.90550	49.90159
58	.06659	.08791	697.73798	25.55300	12.27326	4.87230	46.37786
59	.07226	.08443	700.27799	23.88650	9.41933	3.79950	46.31540
60	.06622	.08746	699.26199	25.55300	11.38906	2.32440	45.80943
61	.06892	.09028	699.51599	27.21950	12.73760	3.35250	49.59853
62	.06725	.09396	697.48399	28.88600	12.73760	2.50320	51.89402
63	.06894	.09372	696.97599	28.33050	9.78730	3.93360	52.54658
64	.06795	.09070	694.68999	26.10850	8.71982	4.24650	49.45797
65	.06830	.08635	697.22999	24.99750	10.16788	2.90550	45.91830
66	.06264	.08989	697.99199	26.66400	12.27326	2.68200	46.04808
67	.03255	.09250	698.24599	24.44200	14.75322	3.35250	32.84494
68	.06677	.08944	697.22999	26.66400	13.21733	3.08430	47.77452
69	.06501	.09230	698.75399	28.33050	10.96838	3.66540	49.32505
70	.06807	.09129	700.78599	27.77500	6.35843	3.53130	50.02630
71	.06634	.09028	700.53199	27.21950	7.45691	1.65390	48.27837
72	.06695	.09230	697.48399	28.33050	6.35843	3.84420	50.31989
73	.06820	.08928	695.19799	26.66400	5.40562	4.51470	48.37897
74	.06562	.08829	695.19799	26.10850	5.86492	4.20180	46.21305
75	.06594	.07994	697.48399	21.10900	7.16764	4.51470	39.23067
76	.06713	.07980	697.99199	21.10900	6.35843	2.77140	39.72769
77	.06534	.07994	699.26199	21.10900	6.35843	5.76630	38.92654
78	.06576	.07920	700.53199	19.99800	6.35843	3.62070	38.51063
79	.06376	.08071	699.51599	21.66450	7.16764	3.97830	38.77583
80	.06288	.08538	695.95999	24.44200	8.38758	2.05620	42.31997
81	.04908	.08802	695.19799	23.88650	8.38758	5.90040	37.49327
82	.06091	.08034	697.22999	21.10900	8.71932	3.97830	37.00179
83	.01329	.08137	697.99199	14.44300	9.06362	4.42530	13.45511
84	.06475	.07061	704.34199	14.44300	9.06362	2.50320	30.65189
85	.06262	.07713	701.54799	19.44250	8.06656	2.32440	35.12787
86	.06121	.07980	699.51599	21.10900	8.71982	2.14560	36.68926
87	.06047	.08576	698.49999	23.33100	9.06362	2.59260	41.40287
88	.05107	.09498	698.24599	23.33100	8.71982	3.03960	44.46971
89	.05356	.08669	699.51599	24.44200	10.96838	2.63730	38.65318
90	.05587	.08477	697.48399	23.33100	11.82388	2.81610	38.19624
91	.05155	.09044	693.67599	23.33100	14.22459	3.66540	40.83063
92	.03574	.08098	694.43599	15.55400	10.56145	6.43680	24.63396
93	.01464	.07324	693.16600	9.44350	9.78730	4.55940	7.20088
94	.01357	.07676	693.92800	11.66550	11.38906	6.03450	9.66424
95	.03569	.07912	700.53199	14.44300	11.82388	3.21840	23.02461
96	.05664	.07200	699.00799	16.10950	10.16788	3.39720	27.68103
97	.05566	.07890	693.92800	20.55350	10.96838	4.69350	33.07346
98	.02494	.07534	697.22999	13.33200	11.38906	4.55940	14.27670
99	.05604	.06683	704.08799	12.22100	8.71982	2.63730	22.95378
100	.05525	.07503	698.75399	17.77600	8.71982	3.71010	29.55805

METEOROLOGIC DATA

NO	NET SOLAR	NET ATMOS	AT PRESS	DRY BLUB	EA	WIND	EQ TEMP
101	.04535	.07949	698.75399	18.88700	10.16788	3.03960	28.29228
102	.05134	.07904	696.72199	20.55350	10.56145	4.42530	30.97579
103	.05299	.07296	700.78599	16.66500	8.06656	6.03450	26.62424
104	.05251	.07249	702.81798	16.10950	7.45691	5.45340	25.98106
105	.05162	.06806	702.56399	15.33200	6.35843	2.81610	21.74190
106	.05289	.06658	704.34199	12.22100	5.40562	3.39720	20.95303
107	.05219	.06420	703.83398	10.55450	4.77634	3.35250	18.72656
108	.05132	.06658	708.91398	12.22100	4.77634	5.14050	20.15122
109	.05000	.06420	709.92998	10.55450	4.77634	3.03960	17.60397
110	.04650	.07190	706.11998	11.11000	5.40562	2.14560	22.39158
111	.04206	.07002	699.51599	12.77650	5.40562	2.50320	18.50790
112	.04805	.06584	704.34199	11.11000	6.35843	5.85570	18.00643
113	.04781	.06377	704.59598	9.99900	6.10726	1.20690	16.11483
114	.04365	.06819	703.07199	12.22100	6.61869	1.56450	17.76107
115	.04550	.07296	698.75399	16.66500	6.61869	4.20180	22.76414
116	.03587	.07821	694.94399	13.88750	7.16764	5.72160	22.33573
117	.03129	.07447	691.38798	12.77650	7.45691	4.73820	16.78926
118	.02244	.07291	693.41999	10.55450	9.41933	2.36910	10.92198
119	.01891	.07411	695.70599	9.99900	8.06656	4.87230	10.13081
120	.02591	.07411	692.65798	9.99900	7.16764	5.09580	13.72081
121	.02950	.06464	691.13398	6.11050	7.16764	3.97830	7.46744
122	.03776	.05988	695.95999	6.11050	6.10726	3.17370	7.63669
123	.04212	.06207	700.02399	8.33250	6.10726	2.90550	11.74228
124	.04060	.06302	703.57998	9.44350	6.85833	3.21840	11.77987
125	.02712	.07676	703.07199	11.66550	7.75645	3.08430	16.61392
126	.03816	.08076	704.08799	16.66500	9.73730	3.62070	25.66702
127	.03774	.07380	705.10399	17.22050	11.82388	3.66540	19.52426
128	.02807	.08192	702.56399	16.10950	10.56145	2.68200	21.50144
129	.03337	.06740	705.35799	12.22100	8.38758	1.16220	11.81201
130	.03589	.06874	705.10399	13.88750	9.06362	2.23500	14.25573
131	.03534	.06874	704.08799	13.88750	9.41933	2.14560	13.97001
132	.03292	.06980	702.81798	13.33200	9.06362	1.78800	13.63075
133	.02563	.06920	701.29399	12.22100	7.16764	4.11240	9.38748
134	.02729	.07291	702.30999	10.55450	6.88833	3.39720	13.40667
135	.01961	.06411	695.19799	7.77700	5.85492	7.15200	1.94384
136	.01823	.06423	697.48399	3.33300	4.77634	2.63730	1.34118
137	.02947	.05710	697.22999	4.44400	3.87082	5.72160	1.00858
138	.03412	.05624	690.72199	4.44400	2.85939	5.27460	2.65474
139	.03266	.05266	694.18199	1.11100	3.25976	2.59260	-1.15103
140	.02670	.06632	694.43599	6.11050	4.58152	3.93360	7.47123
141	.00778	.06902	692.40399	6.66600	8.06656	7.73510	.07509
142	.02508	.06553	701.03999	5.55500	6.10726	5.72160	5.96388
143	.02882	.05846	704.59598	4.99950	5.40562	3.08430	1.83958
144	.01636	.07238	699.00799	8.88800	7.45691	3.62070	7.34448
145	.00598	.06902	693.41999	6.66600	7.75645	2.63730	-.84647
146	.01839	.06311	696.46799	4.99950	6.35843	4.20180	.46355
147	.01102	.06659	695.45199	4.99950	5.63113	6.70500	-.34088
148	.02429	.05571	690.62598	2.77750	4.58152	7.15200	-2.82991
149	.02013	.05158	698.24599	-2.22200	2.61740	4.96170	-8.50191
150	.02949	.04626	708.65998	-4.44400	1.73907	2.68200	-8.24530

METEOROLOGIC DATA

NO	NET SOLAR	NET ATMOS	AT PRESS	DRY BLUB	EA	WIND	EQ TEMP
151	.02360	.05066	706.37399	-4.99950	2.28853	3.21840	-7.50633
152	.01038	.05757	698.24599	-1.66650	3.40388	2.23500	-8.37904
153	.01279	.05617	699.00799	-2.77750	3.87082	3.79950	-8.34217
154	.02588	.05461	695.70599	2.77750	4.97848	8.22480	-2.96159
155	.02207	.06097	705.61199	2.22200	4.77634	4.96170	.52135
156	.01005	.06820	700.27799	6.11050	4.97848	6.79440	.53916
157	.01623	.05550	697.48399	1.11100	4.03864	8.67180	-7.14230
158	.02512	.04801	707.38999	-2.77750	2.39381	3.66540	-8.99514
159	.01859	.05617	704.84999	-2.77750	2.85939	3.17370	-5.36496
160	.00721	.05667	697.99199	-1.11100	3.70922	2.23500	-10.77222
161	.01534	.06045	699.00799	.55550	5.18816	2.36910	-3.37065
162	.01501	.06632	694.68999	6.11050	6.10726	4.29120	1.47639
163	.00698	.06820	699.51599	6.11050	8.71982	3.08430	-1.03157
164	.01229	.06739	696.46799	5.55500	7.75645	2.77140	.99790
165	.00250	.06659	693.67399	4.99950	7.75645	2.68200	-4.70969
166	.00499	.06501	692.91200	3.88850	6.88633	2.81610	-4.78109
167	.01186	.05870	700.02399	1.66650	5.63113	2.50320	-6.65217
168	.00405	.06346	704.84999	2.77750	6.10726	1.65390	-6.58796
169	.01214	.06014	705.61199	2.77750	5.66492	3.53130	-5.27906
170	.01477	.05591	706.11998	-.55550	4.97848	2.77140	-7.54435
171	.00363	.05900	706.37399	-.55550	4.97848	3.17370	-10.62047
172	.01301	.06235	704.08799	4.44400	6.88833	5.40870	-2.93887
173	.00746	.06580	703.57998	4.44400	7.75645	2.45850	-2.84318
174	.00984	.06580	699.00799	4.44400	6.61869	3.08430	-1.62343
175	.01628	.05373	702.30999	1.11100	4.21289	4.20180	-8.63970
176	.00466	.05757	699.51599	-1.66650	4.58152	2.81610	-11.31593
177	.00627	.06171	697.22999	2.77750	6.35843	3.08430	-6.94955
178	.00465	.06194	700.53199	1.66650	5.63113	4.82760	-7.57878
179	.00382	.06194	695.70599	1.66650	5.86492	4.20180	-8.00383
180	.00578	.06270	696.21399	2.22200	6.10726	3.84420	-6.35279
181	.00537	.06194	689.10199	1.66650	5.86492	3.17370	-7.21160
182	.00495	.06045	693.16600	.55550	6.35843	2.32440	-8.69643
183	.00371	.05686	702.56399	-2.22200	4.97848	1.47510	-12.40111

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

FIRST DAY	152
FINAL DAY	334
NORMAL DZ	1.000
MAXIMUM EL	32.0
EX DEPTH	1.500+01
EVAP COEFF A	0.000
EVAP COEFF B	1.500-09
MIN STAB	-.070
SW EX COEF	.461-00
SEG NUMBER	1
TEMP PTS	1
DAYS OUT	3
OUTPUT FREQ	500
VERT PRT FREQ	1
TAPE OUT	0
NUM OUTLETS	1
REPEAT XEQ	2
XEQ OUTPUT INT	2
OBS PER DAY	1
CRITICAL STAB	9.000-07
LOW GRAD COEF	2.500-01
INTERCEPT	1.400-05
EXPONENT	-7.000-01
REACH LENGTH	3.650+04
AREA COEFF C1	1.954+05
AREA COEFF C2	6.114+05
AREA COEFF C3	0.000

OUTLET	ELEVATION	EFF WIDTH
1	2.100+01	5.520+02

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

NO	ELEVATION	SEC AREA	CULM VOL	DELTA VOL	TEMP(C)
1	.0	1.954+05	0.000	5.011+05	1.200+01
2	1.0	8.068+05	5.011+05	1.113+06	1.200+01
3	2.0	1.418+06	1.614+06	1.724+06	1.200+01
4	3.0	2.030+06	3.338+06	2.335+06	1.200+01
5	4.0	2.641+06	5.673+06	2.947+06	1.200+01
6	5.0	3.253+06	8.620+06	3.558+06	1.200+01
7	6.0	3.864+06	1.218+07	4.170+06	1.200+01
8	7.0	4.475+06	1.635+07	4.781+06	1.200+01
9	8.0	5.087+06	2.113+07	5.393+06	1.200+01
10	9.0	5.698+06	2.652+07	6.004+06	1.200+01
11	10.0	6.310+06	3.253+07	6.616+06	1.200+01
12	11.0	6.921+06	3.914+07	7.227+06	1.200+01
13	12.0	7.533+06	4.637+07	7.838+06	1.200+01
14	13.0	8.144+06	5.421+07	8.450+06	1.200+01
15	14.0	8.756+06	6.266+07	9.061+06	1.200+01
16	15.0	9.367+06	7.172+07	9.673+06	1.200+01
17	16.0	9.978+06	8.139+07	1.028+07	1.200+01
18	17.0	1.059+07	9.168+07	1.090+07	1.200+01
19	18.0	1.120+07	1.026+08	1.151+07	1.200+01
20	19.0	1.181+07	1.141+08	1.212+07	1.200+01
21	20.0	1.242+07	1.262+08	1.273+07	1.200+01
22	21.0	1.304+07	1.389+08	1.334+07	1.200+01
23	22.0	1.365+07	1.523+08	1.395+07	1.200+01
24	23.0	1.426+07	1.662+08	1.456+07	1.200+01
25	24.0	1.487+07	1.808+08	1.518+07	1.200+01
26	25.0	1.548+07	1.960+08	1.579+07	1.200+01
27	26.0	1.609+07	2.117+08	1.640+07	1.200+01
28	27.0	1.670+07	2.281+08	1.701+07	1.200+01
29	28.0	1.732+07	2.452+08	1.762+07	1.200+01
30	29.0	1.793+07	2.628+08	1.823+07	1.200+01
31	30.0	1.854+07	2.810+08	1.884+07	1.200+01
32	31.0	1.915+07	2.999+08	1.946+07	1.200+01
33	32.0	1.976+07	3.193+08	0.000	1.200+01

LAKE ELEMENT VARIABLES

ELEM NUM	BOD REACTION COEF	BOD SETTLING COEF	COLIFORM REACTION COEF	NH3 REACTION COEF	NO2 REACTION COEF	NO3 REACTION COEF	PO4 SETTLING COEF	HEAVY MET 1 COEF	HEAVY MET 2 COEF	HEAVY MET 3 COEF	TEMP (DEG-CEN)
1	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	-.0000	-.0000	12.00
2	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
3	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
4	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
5	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
6	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
7	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
8	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
9	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
10	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
11	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
12	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
13	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
14	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
15	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
16	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
17	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
18	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
19	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
20	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
21	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
22	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
23	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
24	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
25	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
26	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
27	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
28	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
29	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
30	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
31	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	.0000	.0000	12.00
32	.008	.000900	.0040	.0040	.0150	.0014	.0009	.0040	-.0000	-.0000	12.00

INITIAL CONCENTRATIONS

ELEMENT NUMBER	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
1	-.00	-.00	-.0000	-.0000	-.0000	-.0000	-.0000	-.0	-.00	-.00	-.00	-.00	-.00	-.00	-.00	-.00
2	.38	.03	.0003	.0000	.0084	.0002	.0000	35.5	.00	.00	.00	.00	.00	.00	.00	.00
3	.75	.06	.0006	.0000	.0168	.0004	.0000	71.0	.00	.00	.00	.00	.00	.00	.00	.00
4	1.13	.10	.0010	.0000	.0252	.0006	.0000	106.5	.00	.00	.00	.00	.00	.00	.00	.00
5	1.51	.13	.0013	.0000	.0335	.0008	.0000	141.9	.00	.00	.00	.00	.00	.00	.00	.00
6	1.89	.16	.0016	.0000	.0419	.0010	.0000	177.4	.00	.00	.00	.00	.00	.00	.00	.00
7	2.26	.19	.0019	.0000	.0503	.0012	.0000	212.9	.00	.00	.00	.00	.00	.00	.00	.00
8	2.64	.23	.0023	.0000	.0587	.0014	.0000	248.4	.00	.00	.00	.00	.00	.00	.00	.00
9	3.02	.26	.0026	.0000	.0671	.0015	.0000	283.9	.00	.00	.00	.01	.00	.00	.00	.00
10	3.40	.29	.0029	.0000	.0755	.0017	.0000	319.4	.00	.00	.00	.01	.00	.00	.00	.00
11	3.77	.32	.0032	.0000	.0839	.0019	.0000	354.8	.00	.00	.00	.01	.00	.00	.00	.00
12	4.15	.35	.0035	.0000	.0923	.0021	.0000	390.3	.00	.00	.00	.01	.00	.00	.00	.00
13	4.53	.39	.0039	.0000	.1006	.0023	.0000	425.8	.00	.00	.00	.01	.00	.00	.00	.00
14	4.91	.42	.0042	.0000	.1090	.0025	.0000	461.3	.00	.00	.00	.01	.00	.00	.00	.00
15	5.28	.45	.0045	.0000	.1174	.0027	.0000	496.8	.00	.00	.00	.01	.00	.00	.00	.00
16	5.66	.48	.0048	.0000	.1258	.0029	.0000	532.3	.00	.00	.00	.01	.00	.00	.00	.00
17	6.04	.52	.0052	.0000	.1342	.0031	.0000	567.7	.00	.00	.00	.01	.00	.00	.00	.00
18	6.42	.55	.0055	.0000	.1426	.0033	.0000	603.2	.00	.00	.00	.01	.00	.00	.00	.00
19	6.79	.58	.0058	.0000	.1510	.0035	.0000	638.7	.00	.00	.00	.01	.00	.00	.00	.00
20	7.17	.61	.0061	.0000	.1594	.0037	.0000	674.2	.00	.00	.00	.01	.00	.00	.00	.00
21	7.55	.65	.0065	.0000	.1677	.0039	.0000	709.7	.00	.00	.00	.01	.00	.00	.00	.00
22	7.93	.68	.0068	.0000	.1761	.0041	.0000	745.2	.00	.00	.00	.01	.00	.00	.00	.00
23	8.30	.71	.0071	.0000	.1845	.0043	.0000	780.6	.00	.00	.00	.01	.00	.00	.00	.00
24	8.68	.74	.0074	.0000	.1929	.0045	.0000	816.1	.00	.00	.00	.01	.00	.00	.00	.00
25	9.06	.77	.0077	.0000	.2013	.0046	.0000	851.6	.00	.00	.00	.02	.00	.00	.00	.00
26	9.44	.81	.0081	.0000	.2097	.0048	.0000	887.1	.00	.00	.00	.02	.00	.00	.00	.00
27	9.81	.84	.0084	.0000	.2181	.0050	.0000	922.6	.00	.00	.00	.02	.00	.00	.00	.00
28	10.19	.87	.0087	.0000	.2265	.0052	.0000	958.1	.00	.00	.00	.02	.00	.00	.00	.00
29	10.57	.90	.0090	.0000	.2348	.0054	.0000	993.5	.00	.00	.00	.02	.00	.00	.00	.00
30	10.95	.94	.0094	.0000	.2432	.0056	.0000	1029.0	.00	.00	.00	.02	.00	.00	.00	.00
31	11.32	.97	.0097	.0000	.2516	.0058	.0000	1064.5	.00	.00	.00	.02	.00	.00	.00	.00
32	11.70	1.00	.0100	.0000	.2600	.0060	-.0000	1100.0	-.00	-.00	-.00	.02	-.00	-.00	-.00	-.00

LAKE INFLOW CONCENTRATIONS

DAY NUMBER	FLOW (CFS)	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
152	25720.	11.70	.20	.0100	.0000	.7200	.0200	-.0000	1100.0	.27	-.00	-.00	.02	-.00	-.00	-.00	-.00
153	25420.	11.68	.21	.0092	.0000	.7317	.0192	.0000	1341.7	.26	.00	.00	.02	.00	.00	.00	.00
154	25020.	11.67	.21	.0083	.0000	.7433	.0183	.0000	1583.3	.26	.00	.00	.02	.00	.00	.00	.00
155	24720.	11.65	.22	.0075	.0000	.7550	.0175	.0000	1825.0	.25	.00	.00	.02	.00	.00	.00	.00
156	24320.	11.63	.22	.0067	.0000	.7667	.0167	.0000	2066.7	.24	.00	.00	.02	.00	.00	.00	.00
157	23620.	11.62	.23	.0058	.0000	.7783	.0158	.0000	2308.3	.23	.00	.00	.02	.00	.00	.00	.00
158	22920.	11.60	.24	.0050	.0000	.7900	.0150	.0000	2550.0	.23	.00	.00	.02	.00	.00	.00	.00
159	22320.	11.58	.24	.0042	.0000	.8017	.0142	.0000	2791.7	.22	.00	.00	.02	.00	.00	.00	.00
160	21820.	11.57	.25	.0033	.0000	.8133	.0133	.0000	3033.3	.21	.00	.00	.02	.00	.00	.00	.00
161	21320.	11.55	.26	.0025	.0000	.8250	.0125	.0000	3275.0	.20	.00	.00	.02	.00	.00	.00	.00
162	20920.	11.53	.26	.0017	.0000	.8367	.0117	.0000	3516.7	.20	.00	.00	.02	.00	.00	.00	.00
163	20120.	11.52	.27	.0008	.0000	.8483	.0108	.0000	3758.3	.19	.00	.00	.02	.00	.00	.00	.00
164	19720.	11.50	.27	.0000	.0000	.8600	.0100	-.0000	4000.0	.18	-.00	-.00	.02	-.00	-.00	-.00	-.00
165	19420.	11.42	.30	.0007	.0007	.8721	.0107	.0000	3964.3	.18	.00	.00	.02	.00	.00	.00	.00
166	19320.	11.34	.32	.0014	.0014	.8843	.0114	.0000	3928.6	.18	.00	.00	.02	.00	.00	.00	.00
167	19120.	11.26	.34	.0021	.0021	.8964	.0121	.0000	3892.9	.18	.00	.00	.02	.00	.00	.00	.00
168	18420.	11.19	.36	.0029	.0029	.9086	.0129	.0000	3857.1	.18	.00	.00	.03	.00	.00	.00	.00
169	17820.	11.11	.39	.0036	.0036	.9207	.0136	.0000	3821.4	.18	.00	.00	.03	.00	.00	.00	.00
170	17220.	11.03	.41	.0043	.0043	.9329	.0143	.0000	3785.7	.18	.00	.00	.03	.00	.00	.00	.00
171	16620.	10.95	.43	.0050	.0050	.9450	.0150	.0000	3750.0	.18	.00	.00	.03	.00	.00	.00	.00
172	15820.	10.87	.45	.0057	.0057	.9571	.0157	.0000	3714.3	.18	.00	.00	.03	.00	.00	.00	.00
173	15220.	10.79	.48	.0064	.0064	.9693	.0164	.0000	3678.6	.18	.00	.00	.03	.00	.00	.00	.00
174	14720.	10.71	.50	.0071	.0071	.9814	.0171	.0000	3642.9	.18	.00	.00	.03	.00	.00	.00	.00
175	14120.	10.64	.52	.0079	.0079	.9936	.0179	.0000	3607.1	.18	.00	.00	.04	.00	.00	.00	.00
176	13720.	10.56	.54	.0086	.0086	1.0057	.0186	.0000	3571.4	.18	.00	.00	.04	.00	.00	.00	.00
177	13420.	10.48	.56	.0093	.0093	1.0179	.0193	.0000	3535.7	.18	.00	.00	.04	.00	.00	.00	.00
178	13120.	10.40	.59	.0100	.0100	1.0300	.0200	.0000	3500.0	.18	.00	.00	.04	.00	.00	.00	.00
179	12920.	10.32	.61	.0107	.0107	1.0421	.0207	.0000	3464.3	.17	.00	.00	.04	.00	.00	.00	.00
180	12520.	10.24	.63	.0114	.0114	1.0543	.0214	.0000	3428.6	.17	.00	.00	.04	.00	.00	.00	.00
181	12220.	10.16	.65	.0121	.0121	1.0664	.0221	.0000	3392.9	.17	.00	.00	.04	.00	.00	.00	.00
182	9620.	10.09	.68	.0129	.0129	1.0786	.0229	.0000	3357.1	.17	.00	.00	.05	.00	.00	.00	.00
183	6020.	10.01	.70	.0136	.0136	1.0907	.0236	.0000	3321.4	.17	.00	.00	.05	.00	.00	.00	.00
184	5420.	9.93	.72	.0143	.0143	1.1029	.0243	.0000	3285.7	.17	.00	.00	.05	.00	.00	.00	.00
185	5420.	9.85	.74	.0150	.0150	1.1150	.0250	.0000	3250.0	.17	.00	.00	.05	.00	.00	.00	.00
186	5420.	9.77	.77	.0157	.0157	1.1271	.0257	.0000	3214.3	.17	.00	.00	.05	.00	.00	.00	.00
187	5420.	9.69	.79	.0164	.0164	1.1393	.0264	.0000	3178.6	.17	.00	.00	.05	.00	.00	.00	.00
188	5420.	9.61	.81	.0171	.0171	1.1514	.0271	.0000	3142.9	.17	.00	.00	.05	.00	.00	.00	.00
189	5420.	9.54	.83	.0179	.0179	1.1636	.0279	.0000	3107.1	.17	.00	.00	.06	.00	.00	.00	.00
190	5420.	9.46	.86	.0186	.0186	1.1757	.0286	.0000	3071.4	.17	.00	.00	.06	.00	.00	.00	.00
191	5820.	9.38	.88	.0193	.0193	1.1879	.0293	.0000	3035.7	.17	.00	.00	.06	.00	.00	.00	.00
192	6020.	9.30	.90	.0200	.0200	1.2000	.0300	-.0000	3000.0	.17	-.00	-.00	.06	-.00	-.00	-.00	-.00
193	5420.	9.16	.93	.0200	.0193	1.2071	.0307	.0000	2964.3	.17	.00	.00	.06	.00	.00	.00	.00
194	5020.	9.03	.96	.0200	.0186	1.2143	.0314	.0000	2928.6	.17	.00	.00	.06	.00	.00	.00	.00
195	5220.	8.89	1.00	.0200	.0179	1.2214	.0321	.0000	2892.9	.16	.00	.00	.06	.00	.00	.00	.00
196	5820.	8.76	1.03	.0200	.0171	1.2286	.0329	.0000	2857.1	.16	.00	.00	.06	.00	.00	.00	.00
197	5620.	8.62	1.06	.0200	.0164	1.2357	.0336	.0000	2821.4	.16	.00	.00	.06	.00	.00	.00	.00
198	5220.	8.49	1.09	.0200	.0157	1.2429	.0343	.0000	2785.7	.16	.00	.00	.06	.00	.00	.00	.00
199	4720.	8.35	1.12	.0200	.0150	1.2500	.0350	.0000	2750.0	.16	.00	.00	.06	.00	.00	.00	.00
200	4320.	8.21	1.16	.0200	.0143	1.2571	.0357	.0000	2714.3	.15	.00	.00	.06	.00	.00	.00	.00
201	4320.	8.08	1.19	.0200	.0136	1.2643	.0364	.0000	2678.6	.15	.00	.00	.06	.00	.00	.00	.00
202	4420.	7.94	1.22	.0200	.0129	1.2714	.0371	.0000	2642.9	.15	.00	.00	.06	.00	.00	.00	.00
203	4420.	7.81	1.25	.0200	.0121	1.2786	.0379	.0000	2607.1	.15	.00	.00	.06	.00	.00	.00	.00

204	4420.	7.67	1.29	.0200	.0114	1.2857	.0386	.0000	2571.4	.14	.00	.00	.06	.00	.00	.00	.00
205	4420.	7.54	1.32	.0200	.0107	1.2929	.0393	.0000	2535.7	.14	.00	.00	.06	.00	.00	.00	.00
206	4020.	7.40	1.35	.0200	.0100	1.3000	.0400	-.0000	2500.0	.14	-.00	-.00	.06	-.00	-.00	-.00	-.00
207	3620.	7.44	1.41	.0200	.0129	1.2857	.0400	.0000	2257.1	.14	.00	.00	.06	.00	.00	.00	.00
208	3520.	7.49	1.46	.0200	.0157	1.2714	.0400	.0000	2014.3	.13	.00	.00	.06	.00	.00	.00	.00
209	3520.	7.53	1.52	.0200	.0186	1.2571	.0400	.0000	1771.4	.13	.00	.00	.06	.00	.00	.00	.00
210	3420.	7.57	1.57	.0200	.0214	1.2429	.0400	.0000	1528.6	.12	.00	.00	.07	.00	.00	.00	.00
211	3120.	7.61	1.63	.0200	.0243	1.2286	.0400	.0000	1285.7	.12	.00	.00	.07	.00	.00	.00	.00
212	3120.	7.66	1.68	.0200	.0271	1.2143	.0400	.0000	1042.9	.11	.00	.00	.07	.00	.00	.00	.00
213	3120.	7.70	1.74	.0200	.0300	1.2000	.0400	-.0000	800.0	.11	-.00	-.00	.07	-.00	-.00	-.00	-.00
214	3120.	7.68	1.83	.0207	.0286	1.2071	.0386	.0000	1135.7	.11	.00	.00	.07	.00	.00	.00	.00
215	2520.	7.66	1.92	.0214	.0271	1.2143	.0371	.0000	1471.4	.11	.00	.00	.07	.00	.00	.00	.00
216	2920.	7.64	2.01	.0221	.0257	1.2214	.0357	.0000	1807.1	.11	.00	.00	.07	.00	.00	.00	.00
217	2920.	7.61	2.10	.0229	.0243	1.2286	.0343	.0000	2142.9	.11	.00	.00	.07	.00	.00	.00	.00
218	2920.	7.59	2.19	.0236	.0229	1.2357	.0329	.0000	2478.6	.11	.00	.00	.07	.00	.00	.00	.00
219	3020.	7.57	2.28	.0243	.0214	1.2429	.0314	.0000	2814.3	.11	.00	.00	.07	.00	.00	.00	.00
220	3020.	7.55	2.37	.0250	.0200	1.2500	.0300	.0000	3150.0	.11	.00	.00	.07	.00	.00	.00	.00
221	2520.	7.53	2.46	.0257	.0186	1.2571	.0286	.0000	3485.7	.11	.00	.00	.08	.00	.00	.00	.00
222	2820.	7.51	2.55	.0264	.0171	1.2643	.0271	.0000	3821.4	.11	.00	.00	.08	.00	.00	.00	.00
223	2320.	7.49	2.64	.0271	.0157	1.2714	.0257	.0000	4157.1	.11	.00	.00	.08	.00	.00	.00	.00
224	2520.	7.46	2.73	.0279	.0143	1.2786	.0243	.0000	4492.9	.11	.00	.00	.08	.00	.00	.00	.00
225	2720.	7.44	2.82	.0286	.0129	1.2857	.0229	.0000	4828.6	.11	.00	.00	.08	.00	.00	.00	.00
226	2620.	7.42	2.91	.0293	.0114	1.2929	.0214	.0000	5164.3	.11	.00	.00	.08	.00	.00	.00	.00
227	2720.	7.40	3.00	.0300	.0100	1.3000	.0200	-.0000	5500.0	.11	-.00	-.00	.08	-.00	-.00	-.00	-.00
228	2620.	7.46	3.00	.0295	.0105	1.3364	.0200	.0000	5386.4	.11	.00	.00	.08	.00	.00	.00	.00
229	2220.	7.53	3.00	.0291	.0109	1.3727	.0200	.0000	5272.7	.11	.00	.00	.08	.00	.00	.00	.00
230	2020.	7.59	3.00	.0286	.0114	1.4091	.0200	.0000	5159.1	.11	.00	.00	.09	.00	.00	.00	.00
231	2420.	7.65	3.00	.0282	.0116	1.4455	.0200	.0000	5045.5	.11	.00	.00	.09	.00	.00	.00	.00
232	2420.	7.72	3.00	.0277	.0123	1.4818	.0200	.0000	4931.8	.11	.00	.00	.09	.00	.00	.00	.00
233	2020.	7.78	3.00	.0273	.0127	1.5182	.0200	.0000	4818.2	.12	.00	.00	.09	.00	.00	.00	.00
234	1820.	7.85	3.00	.0268	.0132	1.5545	.0200	.0000	4704.5	.12	.00	.00	.10	.00	.00	.00	.00
235	1820.	7.91	3.00	.0264	.0136	1.5909	.0200	.0000	4590.9	.12	.00	.00	.10	.00	.00	.00	.00
236	2020.	7.97	3.00	.0259	.0141	1.6273	.0200	.0000	4477.3	.12	.00	.00	.10	.00	.00	.00	.00
237	2120.	8.04	3.00	.0255	.0145	1.6636	.0200	.0000	4363.6	.12	.00	.00	.10	.00	.00	.00	.00
238	2320.	8.10	3.00	.0250	.0150	1.7000	.0200	.0000	4250.0	.12	.00	.00	.10	.00	.00	.00	.00
239	2320.	8.16	3.00	.0245	.0155	1.7364	.0200	.0000	4136.4	.12	.00	.00	.11	.00	.00	.00	.00
240	2420.	8.23	3.00	.0241	.0159	1.7727	.0200	.0000	4022.7	.12	.00	.00	.11	.00	.00	.00	.00
241	2420.	8.29	3.00	.0236	.0164	1.8091	.0200	.0000	3909.1	.12	.00	.00	.11	.00	.00	.00	.00
242	2420.	8.35	3.00	.0232	.0168	1.8455	.0200	.0000	3795.5	.12	.00	.00	.11	.00	.00	.00	.00
243	2520.	8.42	3.00	.0227	.0173	1.8818	.0200	.0000	3681.8	.12	.00	.00	.12	.00	.00	.00	.00
244	2620.	8.48	3.00	.0223	.0177	1.9182	.0200	.0000	3568.2	.13	.00	.00	.12	.00	.00	.00	.00
245	2420.	8.55	3.00	.0218	.0182	1.9545	.0200	.0000	3454.5	.13	.00	.00	.12	.00	.00	.00	.00
246	2820.	8.61	3.00	.0214	.0186	1.9909	.0200	.0000	3340.9	.13	.00	.00	.12	.00	.00	.00	.00
247	2920.	8.67	3.00	.0209	.0191	2.0273	.0200	.0000	3227.3	.13	.00	.00	.13	.00	.00	.00	.00
248	2920.	8.74	3.00	.0205	.0195	2.0636	.0200	.0000	3113.6	.13	.00	.00	.13	.00	.00	.00	.00
249	2920.	8.80	3.00	.0200	.0200	2.1000	.0200	-.0000	3000.0	.13	-.00	-.00	.13	-.00	-.00	-.00	-.00
250	2920.	8.89	2.91	.0192	.0165	2.0923	.0200	.0000	2923.1	.13	.00	.00	.13	.00	.00	.00	.00
251	2920.	8.98	2.82	.0185	.0169	2.0846	.0200	.0000	2846.2	.13	.00	.00	.13	.00	.00	.00	.00
252	2920.	9.08	2.72	.0177	.0154	2.0769	.0200	.0000	2769.2	.13	.00	.00	.13	.00	.00	.00	.00
253	2920.	9.17	2.63	.0169	.0138	2.0692	.0200	.0000	2692.3	.12	.00	.00	.14	.00	.00	.00	.00
254	2920.	9.26	2.54	.0162	.0123	2.0615	.0200	.0000	2615.4	.12	.00	.00	.14	.00	.00	.00	.00
255	2920.	9.35	2.45	.0154	.0108	2.0538	.0200	.0000	2538.5	.12	.00	.00	.14	.00	.00	.00	.00
256	3020.	9.45	2.35	.0146	.0092	2.0462	.0200	.0000	2461.5	.12	.00	.00	.14	.00	.00	.00	.00
257	3120.	9.54	2.26	.0138	.0077	2.0385	.0200	.0000	2384.6	.12	.00	.00	.14	.00	.00	.00	.00
258	3020.	9.63	2.17	.0131	.0062	2.0308	.0200	.0000	2307.7	.12	.00	.00	.14	.00	.00	.00	.00
259	2920.	9.72	2.08	.0123	.0046	2.0231	.0200	.0000	2230.8	.11	.00	.00	.15	.00	.00	.00	.00
260	2620.	9.82	1.98	.0115	.0031	2.0154	.0200	.0000	2153.8	.11	.00	.00	.15	.00	.00	.00	.00
261	2820.	9.91	1.89	.0108	.0015	2.0077	.0200	.0000	2076.9	.11	.00	.00	.15	.00	.00	.00	.00
262	3020.	10.00	1.80	.0100	.0000	2.0000	.0200	-.0000	2000.0	.11	-.00	-.00	.15	-.00	-.00	-.00	-.00
263	2820.	10.00	1.79	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00

264	2920.	10.00	1.78	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
265	2920.	10.00	1.77	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
266	2920.	10.00	1.77	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
267	2920.	10.00	1.76	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
268	2920.	10.00	1.75	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
269	2920.	10.00	1.74	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
270	2920.	10.00	1.73	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
271	3020.	10.00	1.72	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
272	3020.	10.00	1.71	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
273	3020.	10.00	1.71	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
274	3020.	10.00	1.70	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
275	3020.	10.00	1.69	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
276	3020.	10.00	1.68	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
277	3020.	10.00	1.67	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
278	2420.	10.00	1.66	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
279	3020.	10.00	1.65	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
280	3020.	10.00	1.65	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
281	2920.	10.00	1.64	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
282	3020.	10.00	1.63	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
283	3020.	10.00	1.62	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
284	3020.	10.00	1.61	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
285	3020.	10.00	1.60	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
286	2420.	10.00	1.59	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
287	3120.	10.00	1.58	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
288	3320.	10.00	1.58	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
289	3020.	10.00	1.57	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
290	3020.	10.00	1.56	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
291	3020.	10.00	1.55	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
292	3020.	10.00	1.54	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
293	3020.	10.00	1.53	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
294	3020.	10.00	1.52	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
295	3020.	10.00	1.52	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
296	3020.	10.00	1.51	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
297	3120.	10.00	1.50	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
298	3120.	10.00	1.49	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
299	3020.	10.00	1.48	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
300	3020.	10.00	1.47	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
301	3020.	10.00	1.46	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
302	2920.	10.00	1.46	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
303	3020.	10.00	1.45	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
304	3020.	10.00	1.44	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
305	3220.	10.00	1.43	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
306	3220.	10.00	1.42	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
307	3320.	10.00	1.41	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
308	3120.	10.00	1.40	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
309	3220.	10.00	1.40	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
310	3120.	10.00	1.39	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
311	3220.	10.00	1.38	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
312	3220.	10.00	1.37	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
313	3320.	10.00	1.36	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
314	3120.	10.00	1.35	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
315	3220.	10.00	1.34	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
316	3220.	10.00	1.34	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
317	3220.	10.00	1.33	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
318	3220.	10.00	1.32	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
319	3320.	10.00	1.31	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
320	3520.	10.00	1.30	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
321	3520.	10.00	1.29	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
322	3620.	10.00	1.28	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
323	3520.	10.00	1.27	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00

324	3420.	10.00	1.27	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
325	3520.	10.00	1.26	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
326	3520.	10.00	1.25	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
327	3520.	10.00	1.24	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
328	3520.	10.00	1.23	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
329	3620.	10.00	1.22	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
330	3820.	10.00	1.21	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
331	4020.	10.00	1.21	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
332	4020.	10.00	1.20	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
333	4220.	10.00	1.19	.0100	.0000	2.0000	.0200	.0000	2000.0	.11	.00	.00	.15	.00	.00	.00	.00
334	4620.	10.00	1.18	.0100	.0000	2.0000	.0200	-.0000	2000.0	.11	-.00	-.00	.15	-.00	-.00	-.00	-.00

MISCELLANEOUS VARIABLES

THE FOLLOWING CONSTITUENTS ARE BEING MODELED

DISSOLVED OXYGEN
COLIFORMS
BOD
NH3-N MODELED BY 1ST ORDER REACTION
NO2-N MODELED BY 1ST ORDER REACTION
NO3-N MODELED BY 1ST ORDER REACTION
PO4-P MODELED BY 2ND ORDER REACTION
1 HEAVY METAL (AND ITS ASSOCIATED ION)
TOTAL NITROGEN

TEMPERATURE CORRECTION CONSTANT FOR COLIFORM REACTION COEFFICIENT =	1.07000
COEFFICIENT ON BOD IN COLIFORM CALCULATION =	.00000
COEFFICIENT ON HEAVY METAL 1 IN COLIFORM CALCULATION =	.00000
HEAVY METAL 1 CONCENTRATION LIMIT (MG/L) IN COLIFORM CALCULATION =	20.00000
TEMPERATURE CORRECTION CONSTANT FOR BOD REACTION COEFFICIENT =	1.07000
BOD OXYGEN QUOTIENT =	1.50000
NON-REFRACTORY FRACTION OF ORGANIC MATERIAL =	.50000
CARBON TO PHOSPHORUS RATIO IN BOD =	106.00000
NITROGEN TO PHOSPHORUS RATIO IN BOD =	16.00000
DRY WEIGHT FRACTION OF CARBON IN BOD =	.50000
TEMPERATURE CORRECTION CONSTANT FOR NH3 DECAY COEFFICIENT =	1.10000
COEFFICIENT FOR NH3 VOLITIZATION =	.01000
TEMPERATURE CORRECTION CONSTANT FOR NH3 VOLITIZATION PROCESS =	.17000
TEMPERATURE CORRECTION CONSTANT FOR NO2 DECAY COEFFICIENT =	1.10000
TEMPERATURE CORRECTION CONSTANT FOR NO3 DECAY COEFFICIENT =	1.12000
BOD BENTHAL RELEASE RATE (MG/SQUARE METER-HR) =	61.00000
PHOSPHORUS BENTHAL RELEASE RATE (MG/SQUARE METER-HR) =	.12500
TEMPERATURE CORRECTION CONSTANT FOR PO4 DECAY COEFFICIENT =	1.08400
NITROGEN BENTHAL RELEASE RATE (MG/SQUARE METER-HR) =	.10600
BENTHAL OXYGEN DEMAND (MG/SQUARE METER-HR) =	75.00000
FRACTION OF HEAVY METAL 1 IN ION FORM =	-.00000
LAKE ELEVATION (FEET) =	1534.00000
AVERAGE TEMPERATURE (CENTIGRADE) =	12.00000
LAKE LATITUDE (DEGREES) =	49.00000
DIFFUSION COEFFICIENT 1 (10**-6) =	1.00000
DIFFUSION COEFFICIENT 2 (10**-10) =	1.00000

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 152 EXECUTION INTERVAL 2

GENERAL SYSTEM INFORMATION

RESERVOIR ELEVATION	31.41 M	SURFACE AIR TEMP	11.67 DEG C
SURFACE ELEMENT	1.41 M	SURFACE WATER TEMP	12.22 DEG C
TOTAL SYSTEM INFLOW	728.3 CMS	EVAPORIZATION RATE	4.46-01 CMS
TOTAL SYSTEM OUTFLOW	719.3 CMS	CULM EVAPORIZATION	.002 M
ELEV THERMOCLINE	29.0 M	INFLOW TEMPERATURE	12.00 DEG C
DOWNSTREAM TEMP	12.00 DEG C	LOWEST MIXED ELEV	30.0 M
RETENTION TIME	4.9 DAYS	OBJECTIVE TEMP	12.00 DEG C

SURFACE HEAT EXCHANGES

QNS	5.156-02 KC/M2/S
QNA	7.464-02 KC/M2/S
QW	8.764-02 KC/M2/S
QE	1.356-02 KC/M2/S
QC	5.004-04 KC/M2/S

SYSTEM OUTFLOWS

NO	ELEM	ELEV	FLOW	TEMP	DEN GRAD
1	22	21.0	719.25	12.00	0.000

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 152 EXECUTION INTERVAL 2

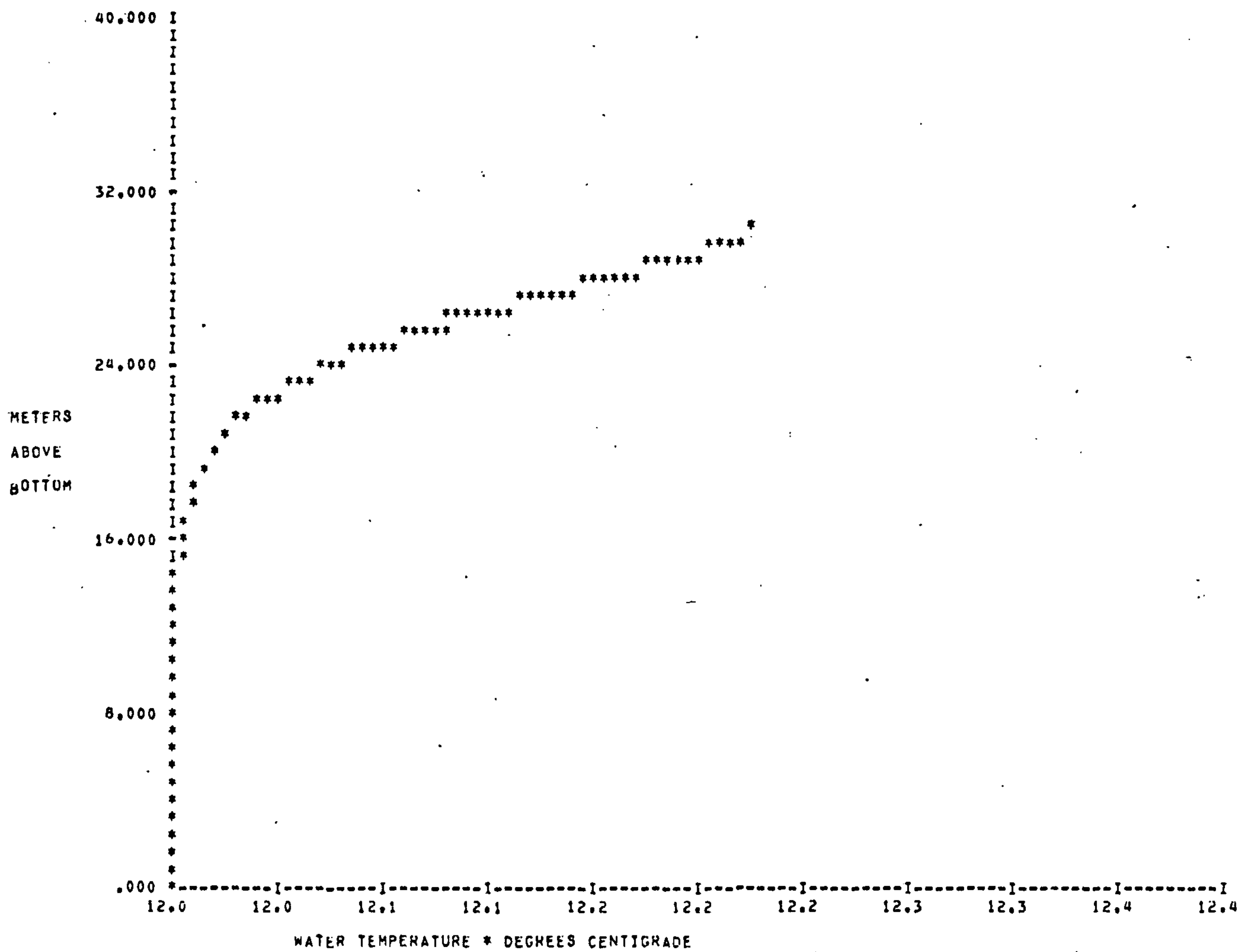
NO	ELEVATION	TEMP DEG C	TEMP DEG F	HORZ OUT	HORZ IN	RATE OF CHG	DIFF COEF	VAR	MAR
1	.0	12.0000	53.6000	1.1708	1.1855	7.832-10	0.000	.00	.10
2	1.0	12.0000	53.6000	2.5994	2.6322	8.692-10	2.500-01	.00	.10
3	2.0	12.0000	53.6000	4.0281	4.0788	1.046-09	2.500-01	.00	.10
4	3.0	12.0000	53.6001	5.4567	5.5255	1.341-09	2.500-01	.00	.10
5	4.0	12.0000	53.6001	6.8854	6.9721	1.787-09	2.500-01	.00	.10
6	5.0	12.0001	53.6001	8.3140	8.4188	2.461-09	2.500-01	.00	.10
7	6.0	12.0001	53.6001	9.7427	9.8654	3.464-09	2.500-01	.00	.10
8	7.0	12.0001	53.6002	11.1713	11.3121	4.963-09	2.500-01	.01	.10
9	8.0	12.0002	53.6003	12.6000	12.7587	7.193-09	2.500-01	.01	.10
10	9.0	12.0002	53.6004	14.0286	14.2054	1.051-08	2.500-01	.01	.10
11	10.0	12.0003	53.6006	15.4573	15.6520	1.545-08	2.500-01	.01	.10
12	11.0	12.0005	53.6009	16.8859	17.0987	2.284-08	2.500-01	.01	.10
13	12.0	12.0008	53.6014	18.3146	18.5453	3.388-08	2.500-01	.01	.10
14	13.0	12.0011	53.6020	19.7432	19.9920	5.043-08	2.500-01	.01	.10
15	14.0	12.0017	53.6030	21.1719	21.4386	7.530-08	2.500-01	.01	.10
16	15.0	12.0025	53.6046	22.6005	22.8853	1.127-07	2.500-01	.01	.10
17	16.0	12.0037	53.6067	24.0292	24.3319	1.227-07	2.500-01	.01	.10
18	17.0	12.0053	53.6095	25.4578	25.7786	2.104-07	2.500-01	.01	.10
19	18.0	12.0075	53.6135	26.8865	27.2252	2.945-07	2.500-01	.01	.10
20	19.0	12.0107	53.6193	28.3151	28.6719	4.126-07	2.500-01	.01	.10
21	20.0	12.0152	53.6274	29.7438	30.1185	5.756-07	2.500-01	.01	.10
22	21.0	12.0215	53.6387	31.1724	31.5652	7.967-07	2.500-01	.01	.10
23	22.0	12.0302	53.6544	32.6011	33.0118	1.090-06	2.500-01	.02	.10
24	23.0	12.0421	53.6757	34.0297	34.4585	1.470-06	2.500-01	.02	.10
25	24.0	12.0579	53.7042	35.4584	35.9051	1.940-06	2.500-01	.02	.10
26	25.0	12.0785	53.7413	36.8870	37.3518	2.488-06	2.500-01	.02	.10
27	26.0	12.1044	53.7880	38.3157	38.7984	3.055-06	2.500-01	.02	.10
28	27.0	12.1351	53.8433	39.7443	40.2451	3.497-06	2.500-01	.02	.10
29	28.0	12.1681	53.9026	41.1730	41.6917	3.501-06	2.500-01	.02	.10
30	29.0	12.1972	53.9550	42.6016	43.1384	2.446-06	2.500-01	.02	.10
31	30.0	12.2190	53.9943	62.6654	63.4549	1.157-06	2.500-01	.01	.10

ELEMENT CONCENTRATIONS FOR DAY 152 EXECUTION INTERVAL 2

ELEMENT NUMBER	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
1	6.74	2.66	.0143	.0003	.2770	.0121	.0000	754.2	.053	.000	.000	.014*	.000	.000	.000	.000
2	7.83	1.23	.0106	.0003	.2770	.0089	.0000	754.2	.053	.000	.000	.014*	.000	.000	.000	.000
3	8.04	.97	.0099	.0003	.2770	.0083	.0000	754.2	.053	.000	.000	.014*	.000	.000	.000	.000
4	8.13	.84	.0096	.0003	.2770	.0080	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
5	8.19	.77	.0094	.0003	.2770	.0079	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
6	8.23	.72	.0093	.0003	.2770	.0078	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
7	8.25	.68	.0092	.0003	.2770	.0077	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
8	8.27	.66	.0091	.0003	.2770	.0076	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
9	8.29	.64	.0090	.0003	.2770	.0076	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
10	8.30	.62	.0090	.0003	.2770	.0076	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
11	8.31	.61	.0090	.0003	.2770	.0075	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
12	8.32	.60	.0089	.0003	.2770	.0075	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
13	8.32	.59	.0089	.0003	.2770	.0075	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
14	8.33	.58	.0089	.0003	.2770	.0075	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
15	8.33	.58	.0089	.0003	.2770	.0075	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
16	8.34	.57	.0089	.0003	.2770	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
17	8.34	.57	.0089	.0003	.2770	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
18	8.35	.56	.0088	.0003	.2770	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
19	8.35	.56	.0088	.0003	.2770	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
20	8.35	.55	.0088	.0003	.2770	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
21	8.35	.55	.0088	.0003	.2770	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
22	8.36	.55	.0088	.0003	.2765	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
23	8.36	.54	.0088	.0003	.2762	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
24	8.36	.54	.0088	.0003	.2758	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
25	8.36	.54	.0088	.0003	.2751	.0074	.0000	754.2	.052	.000	.000	.014*	.000	.000	.000	.000
26	8.36	.54	.0088	.0003	.2740	.0074	.0000	754.1	.052	.000	.000	.014*	.000	.000	.000	.000
27	8.36	.53	.0088	.0003	.2722	.0074	.0000	754.1	.052	.000	.000	.014*	.000	.000	.000	.000
28	8.37	.53	.0088	.0003	.2694	.0074	.0000	754.0	.052	.000	.000	.014*	.000	.000	.000	.000
29	8.37	.53	.0088	.0003	.2647	.0074	.0000	754.0	.052	.000	.000	.014*	.000	.000	.000	.000
30	8.39	.53	.0088	.0003	.2576	.0074	.0000	753.9	.054	.000	.000	.014*	.000	.000	.000	.000
31	9.13	.52	.0083	.0003	.2405	.0073	.0000	752.9	.048	.000	.000	.014*	.000	.000	.000	.000

* INDICATES SUM TOTAL OF THE NITROGEN IN CONSTITUENTS BEING MODELED EXCEEDS THE TOTAL NITROGEN BEING MODELED AS A CONSERVATIVE.

TEMPERATURE VERSUS DEPTH FOR JULIAN DAY 152



DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 200 EXECUTION INTERVAL 2

GENERAL SYSTEM INFORMATION

RESERVOIR ELEVATION	30.62 M	SURFACE AIR TEMP	26.66 DEG C
SURFACE ELEMENT	1.62 M	SURFACE WATER TEMP	20.71 DEG C
TOTAL SYSTEM INFLOW	122.3 CMS	EVAPORIZATION RATE	9.87-01 CMS
TOTAL SYSTEM OUTFLOW	141.9 CMS	CULM EVAPORIZATION	.206 M
ELEV THERMOCLINE	25.0 M	INFLOW TEMPERATURE	18.31 DEG C
DOWNSTREAM TEMP	17.41 DEG C	LOWEST MIXED ELEV	29.0 M
RETENTION TIME	23.9 DAYS	OBJECTIVE TEMP	18.31 DEG C

SURFACE HEAT EXCHANGES

QNS	7.311-02 KC/M2/S
QNA	8.989-02 KC/M2/S
QW	9.730-02 KC/M2/S
QE	3.051-02 KC/M2/S
QC	-6.747-03 KC/M2/S

SYSTEM OUTFLOWS

NO	ELEM	ELEV	FLOW	TEMP	DEN GRAD
1	22	21.0	141.87	17.41	5.254-02

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 200 EXECUTION INTERVAL 2

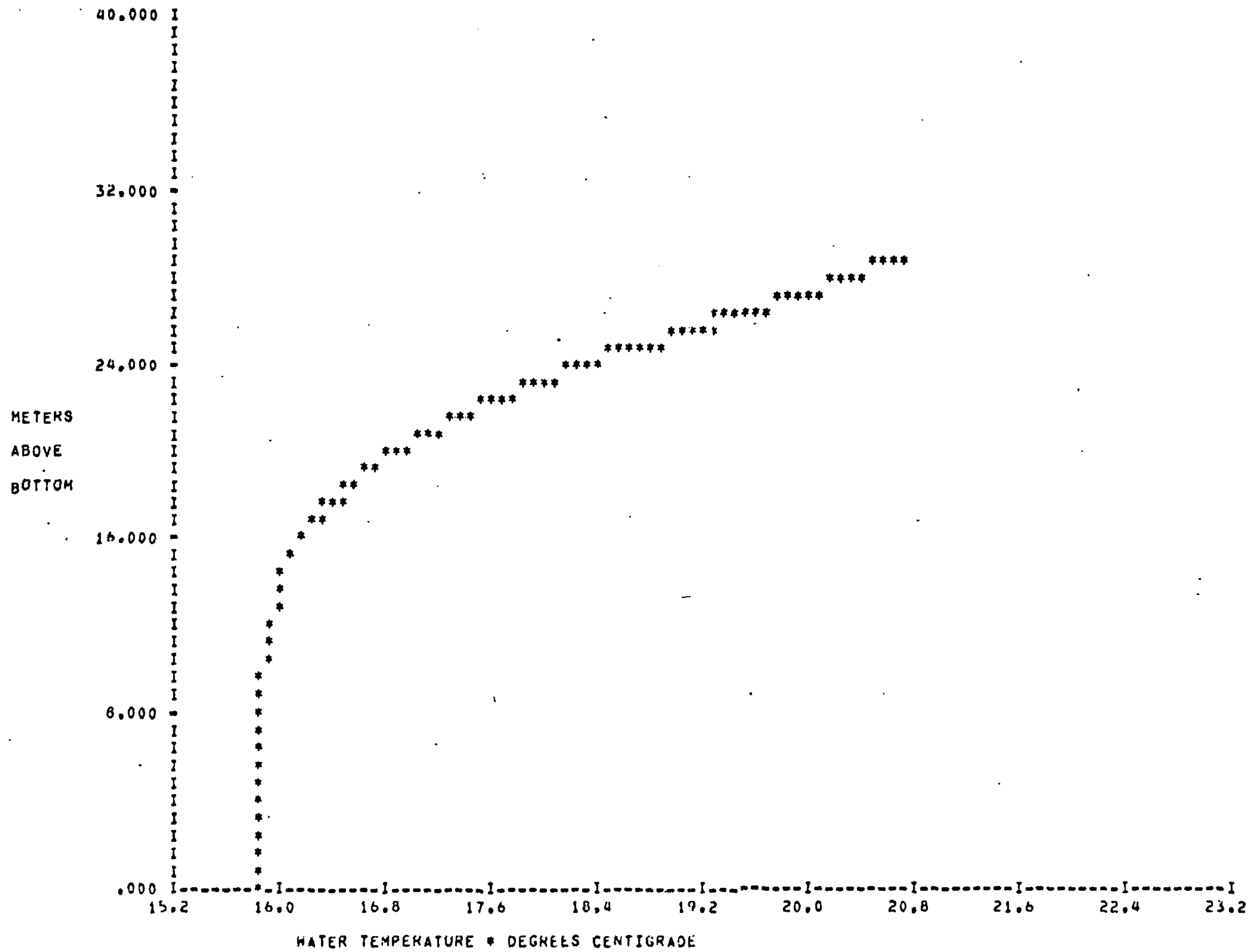
NO	ELEVATION	TEMP DEG C	TEMP DEG F	HORZ OUT	HORZ IN	RATE OF CHG	DIFF COEF	VAR	HAR
1	.0	15.8257	60.4862	.0000	.0000	3.546-07	0.000	.00	.00
2	1.0	15.8267	60.4881	.0000	.0000	3.538-07	2.500-01	.00	.00
3	2.0	15.8283	60.4910	.0000	.0000	3.494-07	2.500-01	.00	.00
4	3.0	15.8306	60.4952	.0000	.0000	3.551-07	2.500-01	.00	.00
5	4.0	15.8337	60.5006	.0000	.0000	3.533-07	2.500-01	.00	.00
6	5.0	15.8374	60.5073	.0000	.0000	3.549-07	2.500-01	.00	.00
7	6.0	15.8419	60.5154	.0000	.0000	3.571-07	2.500-01	.00	.00
8	7.0	15.8474	60.5254	.0000	.0000	3.492-07	2.500-01	.00	.00
9	8.0	15.8552	60.5393	.0000	.0000	3.511-07	1.954-01	.00	.00
10	9.0	15.8661	60.5589	.0000	.0000	3.557-07	1.543-01	.00	.00
11	10.0	15.8813	60.5864	.0000	.0000	3.624-07	1.219-01	.00	.00
12	11.0	15.9023	60.6242	.0000	.0000	3.771-07	9.764-02	.00	.00
13	12.0	15.9310	60.6759	.0000	.0000	3.910-07	7.857-02	.00	.00
14	13.0	15.9701	60.7463	.0000	.0000	4.198-07	6.323-02	.00	.00
15	14.0	16.0233	60.8420	.0000	.0000	4.566-07	5.103-02	.00	.00
16	15.0	16.0953	60.9715	.0000	.0000	5.286-07	4.132-02	.00	.00
17	16.0	16.1914	61.1446	9.9417	.0000	6.406-07	3.377-02	.04	.04
18	17.0	16.3176	61.3717	10.5328	.0000	8.086-07	2.765-02	.08	.04
19	18.0	16.4783	61.6609	11.1239	.0000	1.044-06	2.329-02	.12	.04
20	19.0	16.6748	62.0147	11.7149	.0000	1.341-06	1.996-02	.15	.04
21	20.0	16.9070	62.4326	12.3060	.0000	1.824-06	1.777-02	.19	.04
22	21.0	17.1774	62.9194	12.6971	.0000	2.410-06	1.616-02	.22	.04
23	22.0	17.4886	63.4794	13.4882	12.1675	3.122-06	1.462-02	.22	.04
24	23.0	17.8456	64.1221	14.0793	12.7007	3.662-06	1.288-02	.21	.04
25	24.0	18.2662	64.8792	14.6703	13.2339	4.177-06	1.107-02	.21	.04
26	25.0	18.7601	65.7682	15.2614	13.7671	4.706-06	9.546-03	.20	.04
27	26.0	19.3037	66.7467	15.8525	14.3003	5.265-06	8.603-03	.20	.04
28	27.0	19.8405	67.7129	.0000	14.8335	5.919-06	8.446-03	.19	.04
29	28.0	20.3111	68.5600	.0000	15.3667	6.959-06	9.465-03	.15	.04
30	29.0	20.7107	69.2793	.0000	25.9597	7.398-06	1.149-02	.07	.04

ELEMENT CONCENTRATIONS FOR DAY 200 EXECUTION INTERVAL 2

ELEMENT NUMBER	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
1	.00	119.45	.2276	.0099	.9587	.0641	.0000	682.7	.246	.000	.000	.036*	.000	.000	.000	.000
2	.00	45.79	.2225	.0135	.9616	.0631	.0000	682.7	.206	.000	.000	.036*	.000	.000	.000	.000
3	.00	25.86	.2185	.0151	.9641	.0637	.0000	682.6	.194	.000	.000	.036*	.000	.000	.000	.000
4	.00	15.65	.2091	.0159	.9704	.0637	.0000	688.9	.188	.000	.000	.036*	.000	.000	.000	.000
5	.00	9.12	.1814	.0181	.9818	.0603	.0000	695.4	.185	.000	.000	.036*	.000	.000	.000	.000
6	.00	4.97	.1470	.0207	1.0029	.0573	.0000	703.8	.183	.000	.000	.037*	.000	.000	.000	.000
7	.00	2.21	.1182	.0206	1.0295	.0559	.0000	713.0	.181	.000	.000	.037*	.000	.000	.000	.000
8	.89	1.14	.0868	.0181	1.0463	.0505	.0000	722.5	.180	.000	.000	.037*	.000	.000	.000	.000
9	2.02	1.00	.0621	.0165	1.0588	.0463	.0000	732.4	.179	.000	.000	.038*	.000	.000	.000	.000
10	3.25	.88	.0545	.0145	1.0671	.0427	.0000	788.3	.178	.000	.000	.040*	.000	.000	.000	.000
11	4.02	.79	.0495	.0132	1.0673	.0404	.0000	796.2	.177	.000	.000	.040*	.000	.000	.000	.000
12	4.75	.72	.0451	.0121	1.0719	.0383	.0000	826.8	.177	.000	.000	.041*	.000	.000	.000	.000
13	5.30	.66	.0416	.0113	1.0726	.0367	.0000	832.4	.176	.000	.000	.041*	.000	.000	.000	.000
14	5.83	.60	.0383	.0104	1.0738	.0351	.0000	838.1	.175	.000	.000	.041*	.000	.000	.000	.000
15	6.35	.55	.0352	.0096	1.0770	.0337	.0000	867.7	.173	.000	.000	.042*	.000	.000	.000	.000
16	6.91	.50	.0314	.0086	1.0342	.0320	.0000	879.8	.169	.000	.000	.043*	.000	.000	.000	.000
17	7.43	.46	.0277	.0076	.9495	.0306	.0000	919.0	.166	.000	.000	.044*	.000	.000	.000	.000
18	7.71	.44	.0258	.0073	.9178	.0301	.0000	988.5	.164	.000	.000	.045*	.000	.000	.000	.000
19	7.83	.43	.0251	.0073	.9255	.0302	.0000	1068.9	.163	.000	.000	.047*	.000	.000	.000	.000
20	7.90	.44	.0246	.0075	.9329	.0305	.0000	1150.2	.162	.000	.000	.048*	.000	.000	.000	.000
21	7.96	.46	.0243	.0078	.9353	.0309	.0000	1262.6	.160	.000	.000	.049*	.000	.000	.000	.000
22	8.01	.45	.0238	.0077	.8948	.0310	.0000	1283.8	.159	.000	.000	.049*	.000	.000	.000	.000
23	8.06	.47	.0234	.0080	.8690	.0313	.0000	1368.3	.157	.000	.000	.050*	.000	.000	.000	.000
24	8.09	.46	.0230	.0079	.8144	.0313	.0000	1366.4	.156	.000	.000	.050*	.000	.000	.000	.000
25	8.11	.45	.0227	.0078	.7522	.0313	.0000	1358.8	.156	.000	.000	.050*	.000	.000	.000	.000
26	8.13	.43	.0223	.0077	.6654	.0313	.0000	1345.9	.156	.000	.000	.050*	.000	.000	.000	.000
27	8.16	.42	.0215	.0075	.5330	.0312	.0000	1331.4	.153	.000	.000	.050*	.000	.000	.000	.000
28	8.21	.41	.0203	.0072	.3978	.0312	.0000	1321.0	.149	.000	.000	.050*	.000	.000	.000	.000
29	8.28	.40	.0177	.0067	.2292	.0311	.0000	1313.6	.141	.000	.000	.050*	.000	.000	.000	.000
30	8.40	.37	.0109	.0059	.0106	.0309	.0000	1311.8	.105	.000	.000	.050	.000	.000	.000	.000

* INDICATES SUM TOTAL OF THE NITROGEN IN CONSTITUENTS BEING MODELED EXCEEDS THE TOTAL NITROGEN BEING MODELED AS A CONSERVATIVE.

TEMPERATURE VERSUS DEPTH FOR JULIAN DAY 200



DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 240   EXECUTION INTERVAL 2

GENERAL SYSTEM INFORMATION

RESERVOIR ELEVATION	31.14 M	SURFACE AIR TEMP	24.44 DEG C
SURFACE ELEMENT	1.14 M	SURFACE WATER TEMP	20.17 DEG C
TOTAL SYSTEM INFLOW	68.5 CMS	EVAPORIZATION RATE	9.45-01 CMS
TOTAL SYSTEM OUTFLOW	54.4 CMS	CULM EVAPORIZATION	.485 M
ELEV THERMOCLINE	14.0 M	INFLOW TEMPERATURE	19.43 DEG C
DOWNSTREAM TEMP	19.50 DEG C	LOWEST MIXED ELEV	30.0 M
RETENTION TIME	51.1 DAYS	OBJECTIVE TEMP	19.43 DEG C

SURFACE HEAT EXCHANGES

QNS	5.356-02 KC/M2/S
QNA	8.669-02 KC/M2/S
QW	9.701-02 KC/M2/S
QE	2.872-02 KC/M2/S
QC	-4.373-03 KC/M2/S

SYSTEM OUTFLOWS

NO	ELEM	ELEV	FLOW	TEMP	DEN GRAD
1	22	21.0	54.37	19.50	2.210-02

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

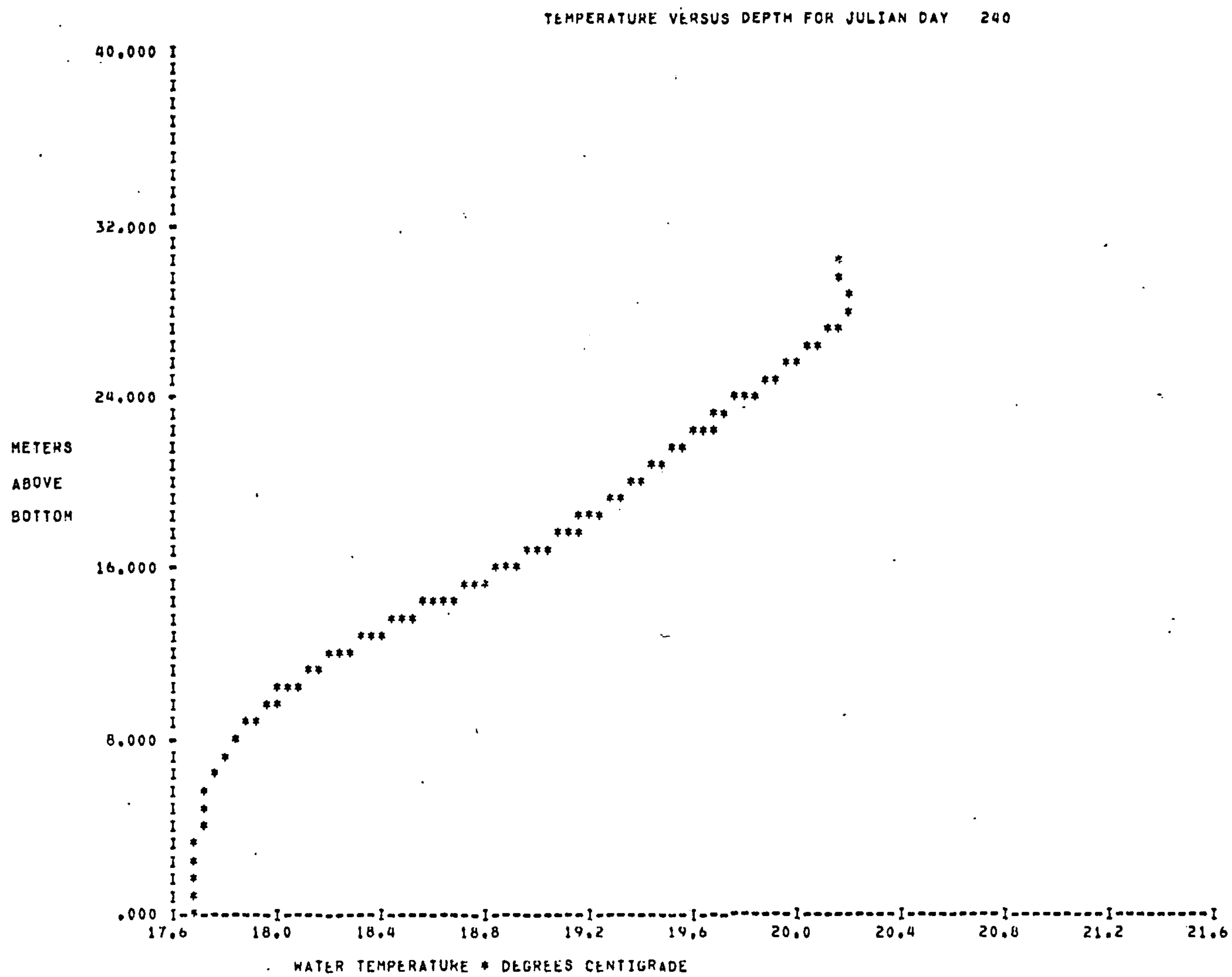
SUMMARY OF OUTPUT FOR SIMULATION DAY 240 EXECUTION INTERVAL 2

NO	ELEVATION	TEMP DEG C	TEMP DEG F	HORZ OUT	HORZ IN	RATE OF CHG	DIFF COEF	VAR	HAR
1	.0	17.6822	63.8279	.0000	.0000	6.271-07	0.000	.00	.00
2	1.0	17.6840	63.8312	.0000	.0000	6.196-07	2.500-01	.00	.00
3	2.0	17.6868	63.8363	.0000	.0000	6.192-07	2.500-01	.00	.00
4	3.0	17.6917	63.8450	.0000	.0000	6.018-07	2.500-01	.00	.00
5	4.0	17.7007	63.8612	.0000	.0000	5.866-07	1.573-01	.00	.00
6	5.0	17.7165	63.8897	.0000	.0000	5.698-07	1.056-01	.00	.00
7	6.0	17.7420	63.9356	.0000	.0000	5.488-07	7.564-02	.00	.00
8	7.0	17.7801	64.0041	.0000	.0000	5.261-07	5.686-02	.00	.00
9	8.0	17.8337	64.1007	.0000	.0000	4.991-07	4.461-02	.00	.00
10	9.0	17.9055	64.2300	.0000	.0000	4.672-07	3.619-02	.00	.00
11	10.0	17.9973	64.3952	.0000	.0000	4.317-07	3.030-02	.00	.00
12	11.0	18.1096	64.5973	.0000	.0000	3.860-07	2.613-02	.00	.00
13	12.0	18.2413	64.8343	.0000	.0000	3.412-07	2.321-02	.00	.00
14	13.0	18.3692	65.1006	.0000	.0000	2.897-07	2.125-02	.00	.00
15	14.0	18.5488	65.3878	.0000	.0000	2.522-07	2.005-02	.00	.00
16	15.0	18.7143	65.6857	.0000	.0000	2.337-07	1.951-02	.00	.00
17	16.0	18.8760	65.9768	.0000	4.8022	2.715-07	1.973-02	.02	.02
18	17.0	19.0235	66.2423	4.9335	5.0877	2.156-07	2.087-02	.02	.02
19	18.0	19.1542	66.4776	5.2104	5.3732	1.907-07	2.265-02	.02	.02
20	19.0	19.2711	66.6880	5.4872	5.6587	1.977-07	2.474-02	.02	.02
21	20.0	19.3779	66.8802	5.7641	5.9442	2.007-07	2.665-02	.02	.02
22	21.0	19.4800	67.0639	6.0410	6.2297	3.260-07	2.770-02	.02	.02
23	22.0	19.5838	67.2508	6.3178	6.5153	4.184-07	2.760-02	.02	.02
24	23.0	19.6947	67.4505	6.5947	6.8008	5.823-07	2.645-02	.02	.02
25	24.0	19.8148	67.6667	6.8715	7.0863	8.330-07	2.501-02	.02	.02
26	25.0	19.9400	67.8920	7.1484	7.3718	1.226-06	2.452-02	.02	.02
27	26.0	20.0568	68.1022	.0000	7.6573	1.832-06	2.656-02	.04	.02
28	27.0	20.1427	68.2569	.0000	.0000	2.208-06	3.519-02	.04	.00
29	28.0	20.1832	68.3298	.0000	.0000	2.580-06	6.706-02	.03	.00
30	29.0	20.1859	68.3345	.0000	.0000	2.878-06	2.500-01	.03	.00
31	30.0	20.1687	68.3036	.0000	.0000	1.929-06	2.500-01	.03	.00

ELEMENT CONCENTRATIONS FOR DAY 240 EXECUTION INTERVAL 2

ELEMENT NUMBER	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
1	.00	268.74	.2279	.0099	.9641	.0641	.0000	56.9	.267	.000	.000	.037*	.000	.000	.000	.000
2	.00	103.39	.2229	.0135	.9670	.0631	.0000	56.9	.213	.000	.000	.037*	.000	.000	.000	.000
3	.00	64.38	.2189	.0151	.9695	.0636	.0000	56.8	.198	.000	.000	.037*	.000	.000	.000	.000
4	.00	44.61	.2097	.0159	.9757	.0636	.0000	57.1	.190	.000	.000	.037*	.000	.000	.000	.000
5	.00	32.53	.1825	.0181	.9869	.0603	.0000	57.4	.186	.000	.000	.037*	.000	.000	.000	.000
6	.00	24.56	.1487	.0206	1.0076	.0573	.0000	57.7	.183	.000	.000	.037*	.000	.000	.000	.000
7	.00	18.91	.1200	.0205	1.0338	.0559	.0000	58.0	.181	.000	.000	.038*	.000	.000	.000	.000
8	.00	14.62	.1092	.0181	1.0506	.0554	.0000	58.2	.179	.000	.000	.038*	.000	.000	.000	.000
9	.00	11.23	.1024	.0166	1.0648	.0552	.0000	58.4	.178	.000	.000	.038*	.000	.000	.000	.000
10	.00	8.45	.0980	.0153	1.0878	.0555	.0000	60.4	.176	.000	.000	.040*	.000	.000	.000	.000
11	.00	6.31	.0930	.0142	1.0999	.0555	.0000	60.3	.173	.000	.000	.040*	.000	.000	.000	.000
12	.00	4.40	.0691	.0131	1.1203	.0555	.0000	86.7	.170	.000	.000	.042*	.000	.000	.000	.000
13	.00	2.97	.0851	.0120	1.1301	.0555	.0000	87.2	.166	.000	.000	.042*	.000	.000	.000	.000
14	.00	1.65	.0821	.0110	1.1453	.0556	.0000	117.5	.160	.000	.000	.043*	.000	.000	.000	.000
15	.25	.65	.0686	.0098	1.1569	.0534	.0000	116.9	.150	.000	.000	.044*	.000	.000	.000	.000
16	1.52	.47	.0484	.0098	1.1434	.0469	.0000	357.7	.136	.000	.000	.051*	.000	.000	.000	.000
17	2.49	.54	.0367	.0104	1.1341	.0436	.0000	631.2	.126	.000	.000	.058*	.000	.000	.000	.000
18	3.64	.54	.0334	.0097	.9951	.0417	.0000	756.6	.113	.000	.000	.064*	.000	.000	.000	.000
19	4.91	.52	.0298	.0086	.7646	.0409	.0000	801.3	.103	.000	.000	.068*	.000	.000	.000	.000
20	5.56	.51	.0278	.0080	.6470	.0404	.0000	825.3	.099	.000	.000	.070*	.000	.000	.000	.000
21	5.76	.52	.0273	.0078	.6200	.0402	.0000	850.1	.098	.000	.000	.070*	.000	.000	.000	.000
22	5.86	.56	.0277	.0079	.6451	.0395	.0000	945.5	.099	.000	.000	.072*	.000	.000	.000	.000
23	5.90	.56	.0276	.0079	.6424	.0394	.0000	958.6	.099	.000	.000	.072*	.000	.000	.000	.000
24	5.92	.55	.0274	.0079	.6296	.0393	.0000	958.0	.099	.000	.000	.072*	.000	.000	.000	.000
25	5.94	.54	.0272	.0079	.6087	.0393	.0000	956.4	.099	.000	.000	.072*	.000	.000	.000	.000
26	5.95	.53	.0271	.0079	.5762	.0392	.0000	954.6	.099	.000	.000	.072*	.000	.000	.000	.000
27	5.97	.52	.0269	.0079	.5265	.0392	.0000	950.6	.099	.000	.000	.072*	.000	.000	.000	.000
28	5.95	.43	.0264	.0076	.4049	.0399	.0000	840.5	.097	.000	.000	.071*	.000	.000	.000	.000
29	6.13	.42	.0257	.0074	.2886	.0398	.0000	835.7	.094	.000	.000	.070*	.000	.000	.000	.000
30	6.72	.41	.0230	.0068	.1220	.0398	.0000	836.2	.087	.000	.000	.070*	.000	.000	.000	.000
31	8.32	.38	.0122	.0053	.0022	.0396	.0000	837.6	.064	.000	.000	.070	.000	.000	.000	.000

* INDICATES SUM TOTAL OF THE NITROGEN IN CONSTITUENTS BEING MODELED EXCEEDS THE TOTAL NITROGEN BEING MODELED AS A CONSERVATIVE.


TEMPERATURE VERSUS DEPTH FOR JULIAN DAY 240
40.000
32.000
24.000
16.000
8.000
.000
METERS
ABOVE
BOTTOM
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
WATER TEMPERATURE * DEGREES CENTIGRADE

DEEP RESERVOIR MODEL

DRM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 333   EXECUTION INTERVAL 2

GENERAL SYSTEM INFORMATION

RESERVOIR ELEVATION	31.48 M	SURFACE AIR TEMP	.56 DEG C
SURFACE ELEMENT	1.48 M	SURFACE WATER TEMP	4.83 DEG C
TOTAL SYSTEM INFLOW	119.5 CMS	EVAPORIZATION RATE	1.53-01 CMS
TOTAL SYSTEM OUTFLOW	130.5 CMS	CULM EVAPORIZATION	.842 M
ELEV THERMOCLINE	30.0 M	INFLOW TEMPERATURE	7.21 DEG C
DOWNSTREAM TEMP	4.85 DEG C	LOWEST MIXED ELEV	.0 M
RETENTION TIME	27.4 DAYS	OBJECTIVE TEMP	7.21 DEG C

SURFACE HEAT EXCHANGES

QNS	4.953-03 KC/M2/S
QNA	6.045-02 KC/M2/S
QW	7.925-02 KC/M2/S
QE	4.681-03 KC/M2/S
QC	3.746-03 KC/M2/S

SYSTEM OUTFLOWS

NO	ELEM	ELEV	FLOW	TEMP	DEN GRAD
1	22	21.0	130.54	4.85	-1.119-04

DEEP RESERVOIR MODEL

ORM SIMULATION OF LONG LAKE--ONE TURBINE INTAKE--JUNE THRU NOV 1971
SYSTEMS CONTROL INC

SUMMARY OF OUTPUT FOR SIMULATION DAY 333 EXECUTION INTERVAL 2

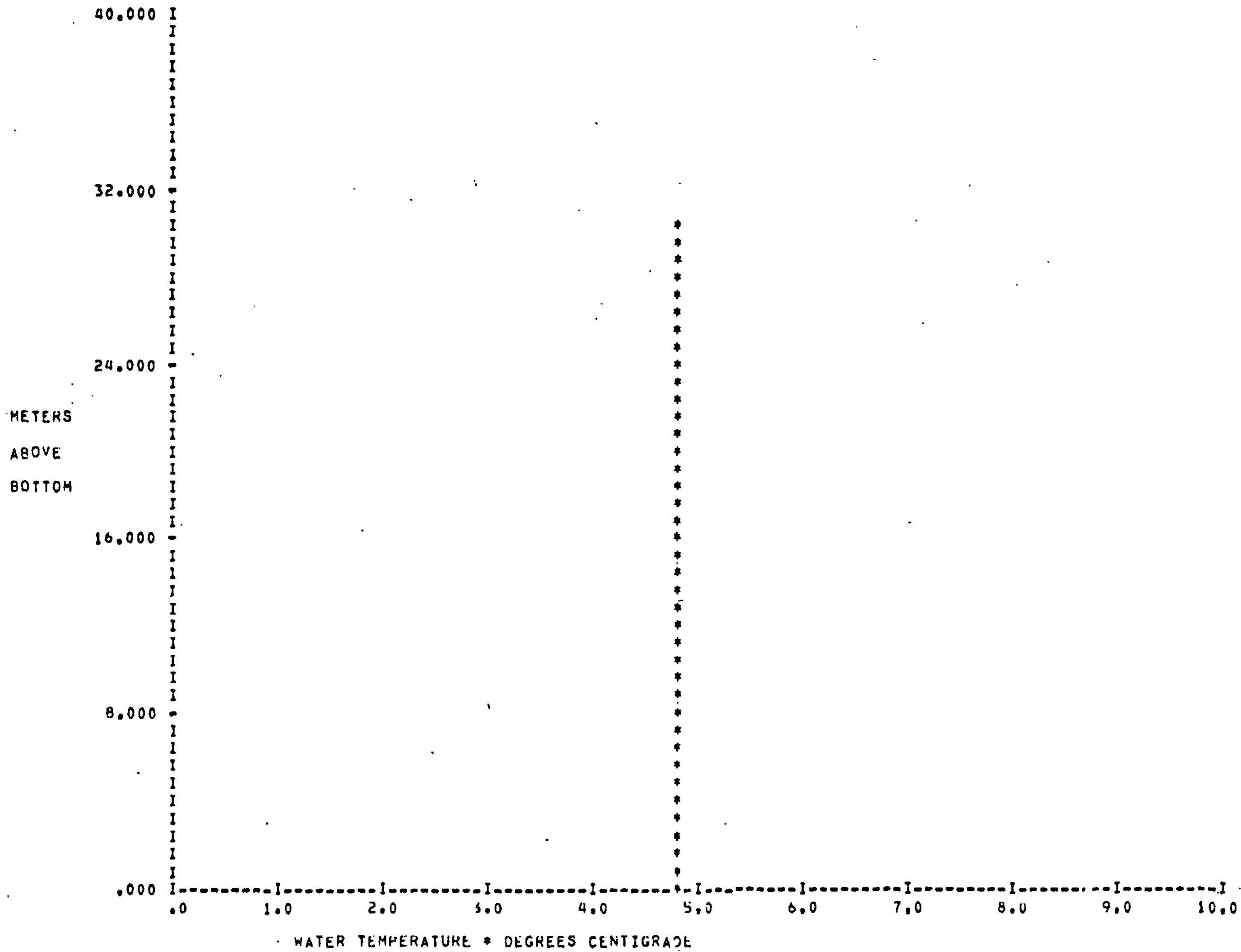
NO	ELEVATION	TEMP DEG C	TEMP DEG F	HORZ OUT	HORZ IN	RATE OF CHG	DIFF COEF	VAR	MAR
1	.0	4.8293	40.6928	.2115	.1937	8.528-07	0.000	.00	.02
2	1.0	4.8293	40.6928	.4697	.4300	8.523-07	2.500-01	.00	.02
3	2.0	4.8293	40.6928	.7278	.6663	8.511-07	2.500-01	.00	.02
4	3.0	4.8293	40.6928	.9660	.9026	8.487-07	2.500-01	.00	.02
5	4.0	4.8293	40.6928	1.2441	1.1389	8.457-07	2.500-01	.00	.02
6	5.0	4.8293	40.6928	1.5023	1.3752	8.417-07	2.500-01	.01	.02
7	6.0	4.8293	40.6928	1.7604	1.6115	8.365-07	2.500-01	.01	.02
8	7.0	4.8293	40.6928	2.0185	1.8478	8.299-07	2.500-01	.01	.02
9	8.0	4.8293	40.6928	2.2767	2.0841	8.215-07	2.500-01	.01	.02
10	9.0	4.8293	40.6928	2.5348	2.3204	8.109-07	2.500-01	.01	.02
11	10.0	4.8293	40.6928	2.7930	2.5567	7.978-07	2.500-01	.01	.02
12	11.0	4.8293	40.6928	3.0511	2.7930	7.813-07	2.500-01	.01	.02
13	12.0	4.8293	40.6928	3.3093	3.0293	7.609-07	2.500-01	.01	.02
14	13.0	4.8293	40.6928	3.5674	3.2656	7.355-07	2.500-01	.01	.02
15	14.0	4.8293	40.6928	3.8255	3.5019	7.039-07	2.500-01	.01	.02
16	15.0	4.8293	40.6928	4.0837	3.7382	6.641-07	2.500-01	.01	.02
17	16.0	4.8293	40.6928	4.3418	3.9745	6.145-07	2.500-01	.01	.02
18	17.0	4.8293	40.6928	4.6000	4.2108	5.523-07	2.500-01	.01	.02
19	18.0	4.8293	40.6928	4.8581	4.4471	4.738-07	2.500-01	.02	.02
20	19.0	4.8293	40.6928	5.1163	4.6834	3.742-07	2.500-01	.02	.02
21	20.0	4.8293	40.6928	5.3744	4.9197	2.479-07	2.500-01	.02	.02
22	21.0	4.8293	40.6928	5.6325	5.1560	8.867-08	2.500-01	.02	.02
23	22.0	4.8293	40.6928	5.8907	5.3923	-1.090-07	2.500-01	.02	.02
24	23.0	4.8293	40.6928	6.1488	5.6286	-3.512-07	2.500-01	.02	.02
25	24.0	4.8293	40.6928	6.4070	5.8649	-6.466-07	2.500-01	.02	.02
26	25.0	4.8293	40.6928	6.6651	6.1012	-1.033-06	2.500-01	.02	.02
27	26.0	4.8293	40.6928	6.9232	6.3375	-1.610-06	2.500-01	.02	.02
28	27.0	4.8293	40.6928	7.1814	6.5739	-2.522-06	2.500-01	.02	.02
29	28.0	4.8293	40.6928	7.4395	6.8102	-3.606-06	2.500-01	.02	.02
30	29.0	4.8293	40.6928	7.6977	7.0465	-3.143-06	2.500-01	.02	.02
31	30.0	4.8293	40.6928	11.9030	10.8960	-8.134-07	2.500-01	.02	.02

ELEMENT CONCENTRATIONS FOR DAY 333 EXECUTION INTERVAL 2

ELEMENT NUMBER	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
1	8.18	2.14	.0474	.0091	1.2715	.0429	.0000	830.7	.094	.000	.000	.140*	.000	.000	.000	.000
2	8.52	1.37	.0460	.0091	1.2715	.0413	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
3	8.59	1.22	.0458	.0091	1.2715	.0410	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
4	8.62	1.15	.0457	.0091	1.2715	.0409	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
5	8.63	1.11	.0456	.0091	1.2715	.0408	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
6	8.64	1.09	.0455	.0091	1.2715	.0408	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
7	8.65	1.07	.0455	.0091	1.2715	.0407	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
8	8.66	1.05	.0455	.0091	1.2715	.0407	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
9	8.66	1.04	.0455	.0091	1.2715	.0407	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
10	8.67	1.03	.0454	.0091	1.2715	.0407	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
11	8.67	1.03	.0454	.0091	1.2715	.0407	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
12	8.67	1.02	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
13	8.68	1.02	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
14	8.68	1.01	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
15	8.68	1.01	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
16	8.68	1.01	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
17	8.68	1.00	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
18	8.68	1.00	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
19	8.68	1.00	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
20	8.68	1.00	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
21	8.69	1.00	.0454	.0091	1.2715	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
22	8.69	.99	.0454	.0091	1.2709	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
23	8.69	.99	.0454	.0091	1.2706	.0406	.0000	830.7	.095	.000	.000	.140*	.000	.000	.000	.000
24	8.69	.99	.0454	.0091	1.2701	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
25	8.69	.99	.0454	.0091	1.2692	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
26	8.69	.99	.0454	.0091	1.2679	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
27	8.69	.99	.0454	.0091	1.2658	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
28	8.69	.99	.0454	.0091	1.2625	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
29	8.69	.99	.0454	.0091	1.2572	.0406	.0000	830.7	.093	.000	.000	.140*	.000	.000	.000	.000
30	8.69	.99	.0454	.0091	1.2488	.0406	.0000	830.7	.095	.000	.000	.140*	.000	.000	.000	.000
31	9.26	.97	.0449	.0091	1.2289	.0405	.0000	831.1	.088	.000	.000	.140*	.000	.000	.000	.000

* INDICATES SUM TOTAL OF THE NITROGEN IN CONSTITUENTS BEING MODELED EXCEEDS THE TOTAL NITROGEN BEING MODELED AS A CONSERVATIVE.

TEMPERATURE VERSUS DEPTH FOR JULIAN DAY. 333



OUTFLOW TEMPERATURES (CENTIGRADE)

DAY	TEMP	DAY	TEMP	DAY	TEMP	DAY	TEMP	DAY	TEMP	DAY	TEMP	DAY	TEMP
152	12.00	153	12.07	154	12.00	155	12.07	156	12.22	157	12.49	158	12.73
159	12.77	160	12.87	161	13.03	162	13.05	163	13.28	164	13.49	165	13.55
166	13.65	167	13.87	168	14.11	169	14.42	170	14.69	171	15.06	172	15.42
173	15.95	174	16.33	175	16.31	176	16.38	177	16.32	178	16.38	179	16.22
180	16.07	181	16.19	182	16.32	183	16.33	184	16.39	185	16.45	186	16.36
187	16.00	188	15.78	189	15.91	190	16.04	191	16.06	192	15.96	193	16.03
194	16.20	195	16.36	196	16.56	197	16.77	198	17.03	199	17.16	200	17.41
201	17.67	202	17.80	203	18.05	204	18.31	205	18.57	206	18.79	207	19.01
208	19.21	209	19.40	210	19.56	211	19.69	212	19.81	213	19.93	214	20.05
215	20.14	216	20.23	217	20.30	218	20.35	219	20.38	220	20.44	221	20.45
222	20.49	223	20.50	224	20.51	225	20.49	226	20.42	227	20.30	228	20.16
229	19.94	230	19.86	231	19.85	232	19.87	233	19.74	234	19.59	235	19.21
236	19.24	237	19.29	238	19.37	239	19.44	240	19.50	241	19.53	242	19.56
243	19.59	244	19.14	245	18.61	246	18.22	247	18.17	248	18.14	249	18.07
250	17.87	251	17.81	252	17.78	253	17.76	254	17.67	255	17.44	256	17.26
257	17.13	258	16.95	259	16.72	260	16.44	261	16.31	262	16.23	263	16.06
264	15.80	265	15.78	266	15.73	267	15.59	268	15.37	269	15.20	270	15.04
271	14.77	272	14.53	273	14.31	274	14.16	275	14.06	276	13.97	277	13.94
278	14.02	279	14.08	280	14.10	281	14.08	282	14.05	283	14.02	284	13.94
285	13.75	286	13.51	287	13.09	288	12.79	289	12.36	290	12.01	291	11.78
292	11.52	293	11.10	294	10.94	295	10.78	296	10.64	297	10.45	298	10.18
299	9.81	300	9.40	301	9.02	302	8.75	303	8.48	304	8.24	305	7.94
306	7.66	307	7.47	308	7.21	309	6.85	310	6.64	311	6.46	312	6.32
313	6.25	314	6.22	315	6.21	316	6.19	317	6.13	318	6.05	319	5.97
320	5.90	321	5.82	322	5.70	323	5.59	324	5.56	325	5.55	326	5.50
327	5.36	328	5.25	329	5.17	330	5.06	331	4.97	332	4.91	333	4.85
334	4.80												

LAKE OUTFLOW CONCENTRATIONS

DAY NUMBER	FLOW (CFS)	DO (MG/L)	BOD (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	PHYTO (MG/L)	COLIFORMS (MPN/100)	HM1 (MG/L)	HM2 (MG/L)	HM3 (MG/L)	TOT N (MG/L)	CHLOR (MG/L)	HMI1 (MG/L)	HMI2 (MG/L)	HMI3 (MG/L)
152	719.25	8.41	.57	.0088	.0003	.2709	.0074	.0000	754.1	.052	.000	.000	.014	.000	.000	.000	.000
153	710.76	8.97	.51	.0102	.0006	.3504	.0101	.0000	822.7	.092	.000	.000	.016	.000	.000	.000	.000
154	707.92	9.39	.47	.0110	.0008	.4141	.0120	.0000	917.6	.122	.000	.000	.016	.000	.000	.000	.000
155	696.60	9.71	.44	.0113	.0010	.4659	.0133	.0000	1031.8	.145	.000	.000	.017	.000	.000	.000	.000
156	696.60	9.96	.42	.0114	.0011	.5083	.0143	.0000	1159.5	.161	.000	.000	.018	.000	.000	.000	.000
157	679.61	10.15	.40	.0112	.0012	.5427	.0148	.0000	1294.1	.173	.000	.000	.018	.000	.000	.000	.000
158	637.13	10.31	.37	.0108	.0013	.5709	.0151	.0000	1432.2	.181	.000	.000	.018	.000	.000	.000	.000
159	631.47	10.42	.37	.0105	.0013	.5941	.0152	.0000	1575.8	.186	.000	.000	.019	.000	.000	.000	.000
160	605.98	10.50	.36	.0102	.0014	.6142	.0152	.0000	1717.1	.189	.000	.000	.019	.000	.000	.000	.000
161	622.97	10.57	.36	.0097	.0014	.6301	.0151	.0000	1863.2	.190	.000	.000	.019	.000	.000	.000	.000
162	588.99	10.61	.37	.0094	.0014	.6474	.0149	.0000	2010.3	.190	.000	.000	.019	.000	.000	.000	.000
163	569.17	10.64	.36	.0089	.0014	.6596	.0145	.0000	2151.5	.188	.000	.000	.019	.000	.000	.000	.000
164	566.34	10.67	.35	.0084	.0013	.6704	.0141	.0000	2296.1	.186	.000	.000	.019	.000	.000	.000	.000
165	555.01	10.66	.36	.0081	.0014	.6825	.0139	.0000	2404.4	.184	.000	.000	.020	.000	.000	.000	.000
166	545.69	10.64	.36	.0081	.0015	.6937	.0138	.0000	2482.1	.182	.000	.000	.020	.000	.000	.000	.000
167	555.01	10.60	.37	.0083	.0017	.7034	.0139	.0000	2532.0	.181	.000	.000	.021	.000	.000	.000	.000
168	532.36	10.58	.37	.0085	.0019	.7114	.0140	.0000	2558.3	.179	.000	.000	.021	.000	.000	.000	.000
169	521.03	10.54	.38	.0088	.0022	.7205	.0143	.0000	2573.7	.178	.000	.000	.022	.000	.000	.000	.000
170	509.71	10.51	.37	.0090	.0025	.7274	.0145	.0000	2575.9	.177	.000	.000	.023	.000	.000	.000	.000
171	470.06	10.47	.37	.0093	.0027	.7350	.0148	.0000	2568.4	.176	.000	.000	.024	.000	.000	.000	.000
172	461.57	10.40	.38	.0098	.0030	.7407	.0153	.0000	2545.8	.175	.000	.000	.025	.000	.000	.000	.000
173	424.75	10.34	.37	.0101	.0033	.7444	.0157	.0000	2516.4	.174	.000	.000	.026	.000	.000	.000	.000
174	410.60	10.27	.37	.0105	.0036	.7456	.0162	.0000	2486.7	.173	.000	.000	.027	.000	.000	.000	.000
175	419.09	10.19	.38	.0111	.0039	.7490	.0167	.0000	2448.0	.172	.000	.000	.028	.000	.000	.000	.000
176	390.77	10.09	.39	.0118	.0042	.7556	.0173	.0000	2403.7	.171	.000	.000	.029	.000	.000	.000	.000
177	387.94	9.98	.40	.0128	.0045	.7632	.0179	.0000	2342.8	.171	.000	.000	.030	.000	.000	.000	.000
178	390.77	9.88	.41	.0135	.0048	.7694	.0185	.0000	2294.5	.171	.000	.000	.031	.000	.000	.000	.000
179	366.12	9.74	.43	.0146	.0052	.7800	.0192	.0000	2241.5	.170	.000	.000	.032	.000	.000	.000	.000
180	353.96	9.56	.46	.0162	.0057	.7908	.0201	.0000	2182.7	.170	.000	.000	.033	.000	.000	.000	.000
181	342.64	9.55	.44	.0162	.0058	.7920	.0205	.0000	2150.4	.169	.000	.000	.034	.000	.000	.000	.000
182	294.50	9.52	.43	.0162	.0059	.7850	.0209	.0000	2093.9	.168	.000	.000	.035	.000	.000	.000	.000
183	177.55	9.48	.41	.0167	.0058	.7902	.0213	.0000	2004.7	.168	.000	.000	.036	.000	.000	.000	.000
184	151.78	9.40	.41	.0174	.0059	.8122	.0218	.0000	1919.9	.169	.000	.000	.037	.000	.000	.000	.000
185	133.75	9.30	.41	.0181	.0060	.8162	.0223	.0000	1836.8	.169	.000	.000	.037	.000	.000	.000	.000
186	154.33	9.19	.40	.0183	.0061	.7637	.0228	.0000	1757.7	.165	.000	.000	.038	.000	.000	.000	.000
187	160.84	9.18	.37	.0177	.0061	.7023	.0230	.0000	1691.6	.161	.000	.000	.038	.000	.000	.000	.000
188	161.41	8.49	.50	.0240	.0076	.7791	.0254	.0000	1618.2	.165	.000	.000	.039	.000	.000	.000	.000
189	161.41	8.81	.43	.0208	.0069	.7515	.0247	.0000	1580.5	.163	.000	.000	.040	.000	.000	.000	.000
190	159.14	8.79	.41	.0208	.0070	.7566	.0250	.0000	1534.1	.163	.000	.000	.041	.000	.000	.000	.000
191	147.53	8.74	.42	.0209	.0072	.7549	.0255	.0000	1495.1	.162	.000	.000	.041	.000	.000	.000	.000
192	176.13	8.61	.43	.0219	.0076	.7487	.0264	.0000	1465.6	.160	.000	.000	.042	.000	.000	.000	.000
193	172.45	8.53	.43	.0222	.0078	.7511	.0270	.0000	1436.9	.159	.000	.000	.043	.000	.000	.000	.000
194	147.25	8.51	.43	.0222	.0077	.7714	.0273	.0000	1406.3	.162	.000	.000	.044	.000	.000	.000	.000
195	146.68	8.45	.43	.0223	.0078	.7897	.0278	.0000	1382.0	.161	.000	.000	.045	.000	.000	.000	.000
196	148.10	8.36	.44	.0227	.0079	.8011	.0284	.0000	1365.7	.161	.000	.000	.046	.000	.000	.000	.000
197	163.39	8.26	.45	.0231	.0079	.8078	.0291	.0000	1341.1	.161	.000	.000	.047	.000	.000	.000	.000
198	174.43	8.16	.45	.0233	.0079	.8030	.0298	.0000	1312.0	.160	.000	.000	.047	.000	.000	.000	.000
199	130.54	8.08	.45	.0235	.0078	.8288	.0303	.0000	1288.2	.160	.000	.000	.048	.000	.000	.000	.000
200	141.87	7.97	.45	.0238	.0077	.8191	.0309	.0000	1242.6	.159	.000	.000	.049	.000	.000	.000	.000
201	138.19	7.86	.44	.0240	.0076	.8107	.0316	.0000	1200.0	.158	.000	.000	.049	.000	.000	.000	.000
202	113.27	7.76	.44	.0242	.0075	.8385	.0322	.0000	1173.2	.157	.000	.000	.050	.000	.000	.000	.000
203	114.97	7.64	.44	.0244	.0074	.8350	.0328	.0000	1133.5	.156	.000	.000	.050	.000	.000	.000	.000

204	122.05	7.51	.43	.0245	.0074	.8278	.0335	.0000	1096.0	.155	.000	.000	.051	.000	.000	.000	.000
205	111.00	7.38	.44	.0246	.0073	.8315	.0342	.0000	1070.9	.154	.000	.000	.051	.000	.000	.000	.000
206	122.90	7.25	.43	.0246	.0073	.8215	.0349	.0000	1031.1	.153	.000	.000	.052	.000	.000	.000	.000
207	111.29	7.13	.43	.0247	.0073	.8175	.0356	.0000	990.6	.151	.000	.000	.052	.000	.000	.000	.000
208	107.60	7.01	.44	.0247	.0075	.8189	.0362	.0000	949.4	.149	.000	.000	.053	.000	.000	.000	.000
209	103.07	6.89	.44	.0248	.0077	.8203	.0369	.0000	901.5	.147	.000	.000	.053	.000	.000	.000	.000
210	91.75	6.78	.45	.0249	.0079	.8216	.0375	.0000	846.3	.145	.000	.000	.054	.000	.000	.000	.000
211	92.03	6.68	.45	.0250	.0081	.8198	.0381	.0000	787.0	.143	.000	.000	.054	.000	.000	.000	.000
212	69.38	6.57	.46	.0254	.0085	.8604	.0389	.0000	749.8	.142	.000	.000	.056	.000	.000	.000	.000
213	77.31	6.47	.47	.0255	.0088	.8611	.0394	.0000	683.8	.139	.000	.000	.056	.000	.000	.000	.000
214	61.73	6.37	.48	.0258	.0091	.8744	.0399	.0000	643.4	.137	.000	.000	.057	.000	.000	.000	.000
215	65.41	6.27	.49	.0261	.0091	.8823	.0402	.0000	618.4	.135	.000	.000	.058	.000	.000	.000	.000
216	75.89	6.18	.51	.0265	.0093	.8922	.0405	.0000	618.5	.133	.000	.000	.058	.000	.000	.000	.000
217	76.17	6.09	.53	.0269	.0094	.9049	.0407	.0000	640.6	.131	.000	.000	.059	.000	.000	.000	.000
218	76.46	6.00	.56	.0275	.0094	.9173	.0409	.0000	676.8	.129	.000	.000	.060	.000	.000	.000	.000
219	70.51	5.91	.58	.0282	.0095	.9324	.0409	.0000	729.0	.128	.000	.000	.061	.000	.000	.000	.000
220	93.73	5.82	.58	.0283	.0092	.9092	.0405	.0000	756.7	.127	.000	.000	.061	.000	.000	.000	.000
221	88.07	5.74	.64	.0298	.0096	.9605	.0407	.0000	883.4	.125	.000	.000	.063	.000	.000	.000	.000
222	74.19	5.64	.65	.0306	.0095	.9730	.0405	.0000	949.0	.123	.000	.000	.063	.000	.000	.000	.000
223	68.53	5.54	.66	.0314	.0095	.9846	.0404	.0000	1011.8	.122	.000	.000	.064	.000	.000	.000	.000
224	76.46	5.46	.67	.0321	.0095	.9921	.0401	.0000	1094.1	.121	.000	.000	.065	.000	.000	.000	.000
225	76.46	5.38	.69	.0328	.0095	1.0005	.0398	.0000	1183.0	.120	.000	.000	.065	.000	.000	.000	.000
226	76.46	5.51	.66	.0315	.0089	.9152	.0394	.0000	1175.3	.116	.000	.000	.065	.000	.000	.000	.000
227	40.49	5.37	.69	.0329	.0091	.9499	.0391	.0000	1284.8	.116	.000	.000	.065	.000	.000	.000	.000
228	75.89	5.80	.58	.0277	.0077	.7014	.0392	.0000	1059.7	.108	.000	.000	.063	.000	.000	.000	.000
229	75.89	5.78	.58	.0279	.0077	.6939	.0392	.0000	1067.3	.107	.000	.000	.063	.000	.000	.000	.000
230	79.57	5.78	.57	.0281	.0078	.6872	.0392	.0000	1070.4	.106	.000	.000	.064	.000	.000	.000	.000
231	66.83	5.68	.60	.0290	.0080	.7172	.0390	.0000	1131.5	.106	.000	.000	.065	.000	.000	.000	.000
232	56.35	5.82	.55	.0278	.0077	.6483	.0393	.0000	1039.3	.103	.000	.000	.065	.000	.000	.000	.000
233	23.50	5.87	.52	.0278	.0078	.6375	.0395	.0000	1008.8	.101	.000	.000	.066	.000	.000	.000	.000
234	32.28	6.39	.47	.0242	.0069	.4718	.0398	.0000	895.7	.095	.000	.000	.066	.000	.000	.000	.000
235	56.92	6.51	.47	.0241	.0070	.4519	.0398	.0000	900.2	.095	.000	.000	.067	.000	.000	.000	.000
236	43.61	5.96	.48	.0265	.0075	.5613	.0400	.0000	881.9	.098	.000	.000	.067	.000	.000	.000	.000
237	65.98	5.66	.49	.0275	.0078	.6090	.0402	.0000	861.3	.101	.000	.000	.067	.000	.000	.000	.000
238	74.19	5.56	.49	.0278	.0079	.6259	.0403	.0000	854.9	.101	.000	.000	.067	.000	.000	.000	.000
239	65.41	5.64	.49	.0277	.0079	.6229	.0401	.0000	857.4	.099	.000	.000	.069	.000	.000	.000	.000
240	54.37	5.56	.54	.0282	.0081	.6700	.0399	.0000	897.7	.100	.000	.000	.070	.000	.000	.000	.000
241	60.32	5.43	.56	.0289	.0084	.7150	.0398	.0000	911.1	.102	.000	.000	.072	.000	.000	.000	.000
242	74.76	5.27	.56	.0296	.0085	.7519	.0399	.0000	896.3	.102	.000	.000	.073	.000	.000	.000	.000
243	85.23	5.29	.51	.0287	.0083	.6533	.0406	.0000	808.3	.099	.000	.000	.072	.000	.000	.000	.000
244	75.89	5.28	.48	.0303	.0082	.6060	.0414	.0000	734.6	.099	.000	.000	.071	.000	.000	.000	.000
245	75.61	5.23	.54	.0342	.0087	.6113	.0423	.0000	700.6	.101	.000	.000	.071	.000	.000	.000	.000
246	80.70	4.94	.74	.0399	.0098	.6559	.0434	.0000	691.8	.105	.000	.000	.071	.000	.000	.000	.000
247	72.49	5.01	.73	.0401	.0104	.6603	.0435	.0000	691.1	.105	.000	.000	.072	.000	.000	.000	.000
248	57.48	5.17	.68	.0391	.0107	.6557	.0435	.0000	689.0	.104	.000	.000	.074	.000	.000	.000	.000
249	77.87	4.21	3.47	.0635	.0127	.7295	.0470	.0000	653.5	.113	.000	.000	.072	.000	.000	.000	.000
250	89.76	3.86	2.98	.0730	.0142	.7331	.0488	.0000	651.5	.113	.000	.000	.073	.000	.000	.000	.000
251	76.17	3.63	2.57	.0792	.0160	.7364	.0502	.0000	648.2	.112	.000	.000	.075	.000	.000	.000	.000
252	91.75	3.38	2.23	.0829	.0176	.7405	.0514	.0000	643.8	.112	.000	.000	.076	.000	.000	.000	.000
253	107.89	3.23	1.92	.0845	.0189	.7427	.0521	.0000	638.5	.112	.000	.000	.078	.000	.000	.000	.000
254	57.77	3.19	1.74	.0853	.0200	.7510	.0529	.0000	632.2	.111	.000	.000	.079	.000	.000	.000	.000
255	51.82	3.26	1.55	.0845	.0207	.7534	.0535	.0000	625.2	.111	.000	.000	.080	.000	.000	.000	.000
256	107.59	3.33	1.40	.0830	.0211	.7576	.0538	.0000	619.4	.110	.000	.000	.082	.000	.000	.000	.000
257	95.43	3.43	1.27	.0811	.0212	.7642	.0540	.0000	614.3	.110	.000	.000	.083	.000	.000	.000	.000
258	95.15	3.55	1.17	.0789	.0212	.7703	.0541	.0000	607.4	.110	.000	.000	.085	.000	.000	.000	.000
259	70.51	3.69	1.08	.0765	.0210	.7752	.0542	.0000	598.7	.109	.000	.000	.086	.000	.000	.000	.000
260	77.02	3.84	1.01	.0741	.0206	.7786	.0542	.0000	588.7	.109	.000	.000	.088	.000	.000	.000	.000
261	65.70	3.97	.95	.0717	.0202	.7818	.0542	.0000	578.2	.108	.000	.000	.089	.000	.000	.000	.000
262	41.06	4.11	.90	.0692	.0197	.7844	.0541	.0000	569.0	.107	.000	.000	.091	.000	.000	.000	.000
263	93.73	4.26	.85	.0667	.0192	.7844	.0541	.0000	559.4	.107	.000	.000	.092	.000	.000	.000	.000

264	99.11	4.35	.82	.0644	.0186	.7876	.0539	.0000	552.2	.106	.000	.000	.093	.000	.000	.000	.000
265	77.02	4.37	.79	.0623	.0180	.7925	.0538	.0000	545.7	.106	.000	.000	.094	.000	.000	.000	.000
266	84.10	4.53	.77	.0601	.0175	.7946	.0536	.0000	540.1	.105	.000	.000	.096	.000	.000	.000	.000
267	84.10	4.68	.75	.0582	.0169	.7973	.0534	.0000	535.3	.105	.000	.000	.097	.000	.000	.000	.000
268	84.10	4.83	.74	.0563	.0164	.8004	.0533	.0000	531.6	.104	.000	.000	.098	.000	.000	.000	.000
269	86.08	4.95	.72	.0547	.0158	.8040	.0531	.0000	528.5	.104	.000	.000	.099	.000	.000	.000	.000
270	94.01	5.09	.72	.0531	.0153	.8082	.0528	.0000	526.4	.104	.000	.000	.101	.000	.000	.000	.000
271	82.40	5.23	.71	.0517	.0149	.8138	.0526	.0000	526.1	.103	.000	.000	.102	.000	.000	.000	.000
272	83.54	5.37	.71	.0504	.0144	.8194	.0524	.0000	526.3	.103	.000	.000	.103	.000	.000	.000	.000
273	82.69	5.50	.71	.0492	.0140	.8249	.0521	.0000	527.0	.102	.000	.000	.104	.000	.000	.000	.000
274	85.52	5.63	.71	.0482	.0136	.8304	.0519	.0000	527.9	.102	.000	.000	.105	.000	.000	.000	.000
275	80.99	5.75	.71	.0472	.0132	.8357	.0516	.0000	529.0	.102	.000	.000	.106	.000	.000	.000	.000
276	80.70	5.81	.71	.0464	.0129	.8412	.0514	.0000	530.1	.101	.000	.000	.107	.000	.000	.000	.000
277	80.14	5.82	.70	.0456	.0126	.8466	.0512	.0000	531.0	.101	.000	.000	.108	.000	.000	.000	.000
278	83.82	5.92	.64	.0444	.0123	.8376	.0508	.0000	527.5	.100	.000	.000	.109	.000	.000	.000	.000
279	95.71	5.94	.62	.0434	.0120	.8394	.0505	.0000	528.9	.100	.000	.000	.110	.000	.000	.000	.000
280	72.21	5.63	.61	.0436	.0118	.8967	.0502	.0000	530.4	.102	.000	.000	.111	.000	.000	.000	.000
281	86.65	5.96	.59	.0415	.0115	.8411	.0499	.0000	529.7	.099	.000	.000	.112	.000	.000	.000	.000
282	79.85	5.91	.60	.0411	.0112	.8551	.0497	.0000	530.0	.099	.000	.000	.113	.000	.000	.000	.000
283	81.27	5.85	.61	.0408	.0111	.8673	.0495	.0000	530.5	.098	.000	.000	.114	.000	.000	.000	.000
284	77.31	5.79	.74	.0421	.0111	.8804	.0499	.0000	530.5	.098	.000	.000	.115	.000	.000	.000	.000
285	81.27	5.90	.74	.0418	.0109	.8823	.0497	.0000	531.9	.098	.000	.000	.115	.000	.000	.000	.000
286	77.87	5.98	.73	.0416	.0108	.8802	.0497	.0000	527.3	.098	.000	.000	.116	.000	.000	.000	.000
287	107.89	6.09	.73	.0413	.0107	.8862	.0494	.0000	531.8	.098	.000	.000	.117	.000	.000	.000	.000
288	79.00	6.21	.73	.0410	.0105	.8942	.0492	.0000	538.8	.097	.000	.000	.118	.000	.000	.000	.000
289	80.99	6.32	.74	.0408	.0104	.8996	.0490	.0000	542.7	.097	.000	.000	.119	.000	.000	.000	.000
290	78.15	6.42	.74	.0407	.0103	.9052	.0488	.0000	546.8	.097	.000	.000	.119	.000	.000	.000	.000
291	92.31	6.52	.74	.0406	.0102	.9111	.0486	.0000	551.2	.097	.000	.000	.120	.000	.000	.000	.000
292	83.25	6.62	.75	.0405	.0101	.9176	.0484	.0000	555.8	.096	.000	.000	.121	.000	.000	.000	.000
293	79.57	6.71	.76	.0405	.0100	.9241	.0482	.0000	560.6	.096	.000	.000	.122	.000	.000	.000	.000
294	83.54	6.80	.76	.0405	.0099	.9306	.0480	.0000	565.5	.096	.000	.000	.122	.000	.000	.000	.000
295	94.58	6.88	.77	.0405	.0099	.9375	.0478	.0000	570.3	.096	.000	.000	.123	.000	.000	.000	.000
296	76.46	6.95	.77	.0405	.0098	.9444	.0476	.0000	575.1	.096	.000	.000	.124	.000	.000	.000	.000
297	77.87	7.04	.78	.0405	.0097	.9515	.0474	.0000	580.9	.095	.000	.000	.124	.000	.000	.000	.000
298	84.67	7.12	.79	.0405	.0097	.9586	.0472	.0000	586.8	.095	.000	.000	.125	.000	.000	.000	.000
299	95.43	7.20	.80	.0406	.0096	.9658	.0470	.0000	592.0	.095	.000	.000	.125	.000	.000	.000	.000
300	92.31	7.27	.80	.0407	.0096	.9738	.0468	.0000	597.7	.095	.000	.000	.126	.000	.000	.000	.000
301	92.88	7.34	.81	.0409	.0096	.9823	.0466	.0000	603.7	.095	.000	.000	.127	.000	.000	.000	.000
302	86.08	7.42	.82	.0410	.0095	.9904	.0465	.0000	608.8	.095	.000	.000	.127	.000	.000	.000	.000
303	76.17	7.50	.83	.0412	.0095	.9992	.0463	.0000	615.0	.094	.000	.000	.128	.000	.000	.000	.000
304	75.04	7.58	.84	.0413	.0095	1.0076	.0461	.0000	621.1	.094	.000	.000	.128	.000	.000	.000	.000
305	83.25	7.66	.85	.0415	.0094	1.0174	.0459	.0000	629.4	.094	.000	.000	.129	.000	.000	.000	.000
306	83.82	7.74	.86	.0416	.0094	1.0270	.0457	.0000	637.6	.094	.000	.000	.129	.000	.000	.000	.000
307	85.80	7.82	.87	.0417	.0093	1.0369	.0454	.0000	646.5	.094	.000	.000	.130	.000	.000	.000	.000
308	88.63	7.88	.88	.0419	.0093	1.0454	.0453	.0000	653.3	.094	.000	.000	.130	.000	.000	.000	.000
309	93.45	7.95	.89	.0421	.0093	1.0550	.0451	.0000	661.3	.094	.000	.000	.131	.000	.000	.000	.000
310	76.74	8.02	.90	.0423	.0093	1.0635	.0449	.0000	668.0	.093	.000	.000	.131	.000	.000	.000	.000
311	93.45	8.09	.91	.0425	.0093	1.0725	.0447	.0000	675.7	.093	.000	.000	.132	.000	.000	.000	.000
312	94.30	8.14	.92	.0427	.0092	1.0817	.0445	.0000	683.1	.093	.000	.000	.132	.000	.000	.000	.000
313	92.31	8.17	.92	.0429	.0092	1.0914	.0443	.0000	691.1	.093	.000	.000	.133	.000	.000	.000	.000
314	93.45	8.18	.93	.0431	.0092	1.0995	.0442	.0000	696.7	.093	.000	.000	.133	.000	.000	.000	.000
315	85.08	8.16	.94	.0434	.0092	1.1085	.0440	.0000	703.0	.093	.000	.000	.134	.000	.000	.000	.000
316	103.07	8.15	.94	.0436	.0092	1.1168	.0438	.0000	709.0	.093	.000	.000	.134	.000	.000	.000	.000
317	90.33	8.12	.95	.0438	.0092	1.1262	.0437	.0000	714.8	.093	.000	.000	.134	.000	.000	.000	.000
318	79.57	8.17	.95	.0440	.0093	1.1334	.0435	.0000	720.2	.093	.000	.000	.135	.000	.000	.000	.000
319	99.11	8.20	.95	.0442	.0093	1.1415	.0433	.0000	726.5	.092	.000	.000	.135	.000	.000	.000	.000
320	98.54	8.25	.96	.0443	.0093	1.1509	.0431	.0000	734.5	.092	.000	.000	.136	.000	.000	.000	.000
321	92.88	8.30	.96	.0444	.0093	1.1597	.0429	.0000	742.0	.092	.000	.000	.136	.000	.000	.000	.000
322	102.22	8.35	.97	.0445	.0092	1.1689	.0427	.0000	750.3	.092	.000	.000	.136	.000	.000	.000	.000
323	105.34	8.40	.97	.0447	.0092	1.1774	.0426	.0000	757.3	.092	.000	.000	.137	.000	.000	.000	.000

324	93.73	8.41	.98	.0448	.0092	1.1853	.0424	.0000	762.9	.092	.000	.000	.137	.000	.000	.000	.000
325	95.71	8.41	.98	.0450	.0092	1.1935	.0422	.0000	769.1	.092	.000	.000	.137	.000	.000	.000	.000
326	99.39	8.46	.98	.0451	.0093	1.2008	.0420	.0000	775.1	.092	.000	.000	.138	.000	.000	.000	.000
327	102.79	8.51	.99	.0452	.0093	1.2083	.0419	.0000	781.0	.092	.000	.000	.138	.000	.000	.000	.000
328	98.26	8.55	.99	.0453	.0093	1.2157	.0417	.0000	786.7	.092	.000	.000	.138	.000	.000	.000	.000
329	98.26	8.59	.99	.0454	.0093	1.2235	.0415	.0000	793.1	.092	.000	.000	.139	.000	.000	.000	.000
330	118.65	8.62	.99	.0455	.0092	1.2324	.0413	.0000	801.2	.092	.000	.000	.139	.000	.000	.000	.000
331	130.26	8.66	1.00	.0454	.0092	1.2429	.0411	.0000	811.0	.092	.000	.000	.139	.000	.000	.000	.000
332	109.30	8.70	1.00	.0454	.0092	1.2551	.0409	.0000	820.2	.092	.000	.000	.140	.000	.000	.000	.000
333	130.54	8.73	1.01	.0454	.0091	1.2642	.0406	.0000	830.8	.092	.000	.000	.140	.000	.000	.000	.000
334	144.13	8.77	1.01	.0452	.0090	1.2777	.0403	.0000	844.5	.092	.000	.000	.140	.000	.000	.000	.000

SECTION XI

PROGRAM LISTING

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TYPICAL JCL

A typical JCL deck for executing a LAKSCI run is listed here. (JCL variations may occur according to machine or installation.)

```
//EXEC FORTGCL,REGION=280K
//FORT.SYSIN DD *
     LAKSCI FORTRAN SOURCE DECK
//*
//LKED.SYSLMOD  DD  DSN=B.YRHB10.ZAS.LK2(LKH2).
//    UNIT=3330.VOL=SER=PR3002.SPACE=(1024,(140,10,1),RLSE),DISP=(,KEEP)
//    EXEC PGM=LKH2.REGION=280K
//STEPLIB  DD  DSN=B.YRHB10.ZAS.LK2(LKH2),UNIT=3330,
//    VOL=SER=PR3002,DSIP=SHR
//FT06F001  DD  SYSOUT=A
//GO.FT18001  DD  DSN=CN1752.ZAS.ITP,DISP=NEW,
//    UNIT=SYSDA,SPACE=(TRK,(15,15)),
//    DCB=(RECFM=VBS,LRECL=1000,BLKSIZE=1004)
//FT05F001  DD  *

     LAKSCI DATA DECK

/*
//
```

```
      SUBROUTINE BAL
      INTEGER MONTH(12)
      COMMON ZF(365), V(365), FLOW(365,3), ERR(365), OUT(365,3), IT(365)
     A  , ZM(365)
      DATA MONTH/31,28,31,30,31,30,31,31,30,31,30,31/
      A(X) = C1 + C2*X + C3 * X ** 2
      S(X) = C1 * X + ( C2 / 2.0 ) * X ** 2 + ( C3 / 3.0 ) * X ** 3

      DO 1 I=1,4015
1     ZF(I)=0.
      READ(5,502) ITAPE,IDAY,LDAY,C1,C2,C3
C     RSELI IS THE INITIAL SURFACE ELEVATION IN FEET, REFERENCED
C     TO THE LAKE BOTTOM.
C     BOTEL IS ELEVATION OF LAKE BOTTOM IN FEET ABOVE SEA LEVEL
      READ(5,503) RSELI,BOTEL,GWFLOW,FACIN
      IF(FACIN.EQ.0.)  FACIN=1.
502   FORMAT(3I10,3F10.2)
503   FORMAT(4F10.0)

C **** READ INPUT DATA

      READ(5,501) (FLOW(J,1),FLOW(J,2),FLOW(J,3),J=IDAY,LDAY)
      DO 5 J=1,3
5     CALL FILL(FLOW(IDAY,J),LDAY-IDAY+1,0.)
      TOTIN=0.
      TOTOUT=0.
      DO 20 J=IDAY,LDAY
      TOTIN=TOTIN+FLOW(J,1)*86400.
20    TOTOUT=TOTOUT+FLOW(J,2)*86400.
      DIFPD=(TOTOUT-TOTIN)/(LDAY-IDAY+1.)
      DIFPD=-DIFPD
      DIFCFS=DIFPD/86400.
      DIFAF=(TOTIN-TOTOUT)/43560.
      DO 10 J=IDAY,LDAY
10    FLOW(J,1)=FLOW(J,1)*FACIN+GWFLOW
      WRITE(6,500) RSELI,BOTEL,TOTIN,TOTOUT,DIFAF,DIFCFS,FACIN,GWFLOW
500   FORMAT(//' INITIAL SURFACE ELEVATION, REFERENCED TO LAKE BOTTOM ='
     *,F15.0,'(FT)'/
     *3X,' ELEVATION OF LAKE BOTTOM, REFERENCED TO SEA LEVEL =',F15.0,
     *'(FT)'/
     *19X,'TOTAL INFLOW FOR SIMULATION PERIOD =',F15.0,'(FT**3)'/
     *18X,'TOTAL OUTFLOW FOR SIMULATION PERIOD =',F15.0,'(FT**3)'/
     *43X,'DIFFERENCE =',F15.0,'(ACRE FEET)'/
     *43X,'DIFFERENCE =',F15.0,'(CFS)'//
     *3X,' INFLOW FACTOR =',F10.4/
     *' GROUNDWATER FLOW =',F10.4,'(CFS)')
      WRITE(6,504) C1,C2,C3

C **** PERFORM WATER BALANCE

      ZF(IDAY-1)=RSELI
      V(IDAY - 1 ) = S( ZF(IDAY-1) )
      TA = 8.64E4 / 4.3560E4
      DO 125 J = IDAY, LDAY
      IT(J) = 0
      V(J) = V(J-1) + TA * ( FLOW(J,1) - FLOW(J,2) )
      X1 = ZF(J-1)
      DO 121 K = 1, 10
      IT(J) = K
      X2 = X1 - ( S(X1)- V(J) ) / A(X1)
```

```
      IF( ABS(X2 -X1 ) .LT. 0.005 ) GO TO 123
      X1 = X2
  121 CONTINUE
  123 ZF(J) = X2
      ERR(J) =   V(J) - S(ZF(J) )
  125 CONTINUE
      DO 131 J = IDAY, LDAY
      OUT(J,1) = 0.028317* FLOW(J,1)
      OUT(J,2) = 0.028317 * FLOW(J,2)
      OUT(J,3)=FLOW(J,3)
      FLOW(J,3)=FLOW(J,3)/.55555+32.
      ZM(J) = 0.3048 * ( (ZF(J-1)+ZF(J) ) / 2.0 )
  131 CONTINUE
      DO 135 J = IDAY, LDAY
135   ZF(J)=ZF(J)+BOTEL

C ****  WRITE OUTPUT

      WRITE(6,601)
      WRITE(6,603) ( J,ZF(J),V(J),ERR(J),IT(J),(FLOW(J,K),K=1,3),
     A  (OUT(J,K),K=1,3),ZM(J),J=IDAY,LDAY)
      IF(ITAPE.LE.0)  RETURN
      REWIND ITAPE
      WRITE(ITAPE) IDAY, LDAY
      WRITE(ITAPE) ( ZM(J), (  OUT(J,K), K = 1, 3 ), J = IDAY, LDAY )
      RETURN

601   FORMAT(1H1/T9,'DAY',T16,'ELEV(FT)',T27,'V(ACFT)',T40,'ERR',T54,
     *'ITER',T60,'IN(CFS)',T71,'OUT(CFS)',T83,'TEMP(F)',T95,'IN(CMS)',
     *T105,'OUT(CMS)',T115,'TEMP(C)',T123,'DEPTH(M)')
  603 FORMAT( I11,F11.2,1PE11.3,E11.3,I11,0P2F11.1,F11.2, 2F11.1,F10.2,
     A  F8.2 )
501   FORMAT(12F6.0)
504   FORMAT(//' VOLUME = C1*D + (C2/2)*D**2 + (C3/3)*D**3'/
     *'    AREA = C1 + C2*D + C3*D**2'/
     *' WITH VOLUME IN ACRE FEET AND D IN FEET ABOVE LAKE BOTTOM'//
     *10X,'C1 =',E16.8/10X,'C2 =',E16.8/10X,'C3 =',E16.8)
      END
      FUNCTION BETA( MIN, MAX,DATA, N )

      COMMON/ABLK/ ABAR(200), AREA(200), DC(200), DENS(200), DHI(200),
     A  DVOL(200), DZ(200), DZI(200), QHI(200), QHO(200), T(200),
     B  TOUT(200), TFX(200), THI(200), VOL(200), Z(200), ZMID(200)

      REAL  DATA(N)

      IF( MIN .LT. 1 ) MIN = 1
      XBAR = 0.0
      YBAR = 0.0
      TA = 0.0
      TB = 0.0

C ** CALCULATE MEANS

      DO 117 J = MIN, MAX
      XBAR = XBAR + ZMID(J)
      YBAR = YBAR + DATA(J)
  117 CONTINUE
      XBAR = XBAR / FLOAT( MAX - MIN + 1 )
      YBAR = YBAR / FLOAT( MAX - MIN + 1 )
```

```
C ** CALCULAT SLOPE OF LEAST SQUARES FIT

      DO 121 J = MIN, MAX
      TC = ZMID(J) - XBAR
      TA = TA + TC * ( DATA(J) - YBAR )
      TB = TB + TC * TC
  121 CONTINUE
      BETA =   TA / TB
      RETURN
      END
      BLOCK DATA
      COMMON/LAB/ TITLE(18),XLAB(11),YLAB(6)
     1,HORIZ(20),VERT(6)
      DATA VERT/4HMETE ,4HRS  ,4HABOV,4HE   ,4HBOTT,4HOM  /
      DATA TITLE/8*4H    ,4H TEM,4HPERA,4HTURE,4H VER,4HSUS ,4HDEPT,
     A 4HH FO,4HR JU,4HLIAN, 4H DAY /
      DATA HORIZ/4HWATE,4HR TE,4HMPER,4HATUR,4HE * ,4HDEGR,4HEES ,
     A4HCENT,4HIGRA,4HDE  ,10*4H    /
      END
      SUBROUTINE CURVE(X,Y,NPT,NCV,NPLOT)
      DIMENSION X(203,1),Y(203,1),NPT(1)
      COMMON/LAB/ TITLE(18),XLAB(11),YLAB(6)
     1,HORIZ(20),VERT(6)
C ******* CURVE IS THE ENTRY TO A GENERALIZED PRINTER PLOT ROUTINE. THE
C         ROUTINE PLOTS SEQUENTIALLY PAIRED VALUES TAKEN FROM THE X AND
C         Y ARRAYS. THE SCALING VALUES FOR BOTH ARRAYS ARE STORED IN THE
C         LAST TWO ARRAY LOCATIONS IN THE SAME MANNER AS CALCOMP SCALING
C
C         THE ARGUEMENTS IN THE CALLING SEQUENCE ARE DEFINED BELOW...
C
C                  X...THE ARRAY CONTAINING THE X AXIS COORDINATES OF TH
C                      POINTS TO BE PLOTTED.
C
C                  Y...THE ARRAY CONTAINING THE Y AXIS COORDINATES OF TH
C                      POINTS TO BE PLOTTED.
C
C                NPT...THE NUMBER OF POINTS TO BE PLOTTED.
C
C                NCV...THIS VALUE IS ALWAYS ONE (1).
C
C              NPLOT...USED FOR PLOT IDENTIFICATION, THIS VALUE IS
C                      PRINTED ABOVE EACH PLOT FOR EACH CALL TO CURVE...

      NPTS=NPT(1)*NCV
C
C                                         SET UP X AND Y SCALES
C
      AXLEN=10.
      CALL SCALE(X,AXLEN,NPTS,1)
      AXLEN=5.
      CALL SCALE(Y,AXLEN,NPTS,1)
C
C                                         FORM X LABELS AND FACTORS
C
      XMIN=X(NPTS+1,1)
      DELTX=X(NPTS+2,1)
      XLAB(1)=XMIN
      DO 260 I=1,10
  260 XLAB(I+1)=XLAB(I)+DELTX
      XSCAL=100./(XLAB(11)-XMIN)
C
```

```
      RETURN
      END
      SUBROUTINE GETAVI(NDAY,NHR,DELT,AVI,PDL)
      REAL NHR
      COMMON/PASS/TOTL,DAWN,DUSK
      F1(X)=A1*X+B1
      F3(X)=A3*X+B3
      CALL SUN(NDAY)
      DAY=DUSK-DAWN
      B2=4.*TOTL/(3.*DAY)
      D4=DAY/4.
      A1=B2/D4
      B1=-A1*DAWN
      A3=-A1
      B3=-A3*DUSK
      T1=NHR-DELT
      T2=NHR
      IF(T1.LT.0.)  T1=0.
      TOT=0.
      PDL=0.
      IF(T1.GT.DAWN+D4   .OR.   T2.LT.DAWN)   GO TO 10
      START=AMAX1(DAWN,T1)
      STOP=AMIN1(DAWN+D4,T2)
      AREA=(STOP-DAWN)*F1(STOP)/2.-(START-DAWN)*F1(START)/2.
      TOT=TOT+AREA
   10 CONTINUE
      IF(T1.GT.DUSK-D4   .OR.   T2.LT.DAWN+D4)   GO TO 20
      START=AMAX1(DAWN+D4,T1)
      STOP=AMIN1(DUSK-D4,T2)
      AREA=(STOP-START)*B2
      TOT=TOT+AREA
   20 CONTINUE
      IF(T1.GT.DUSK   .OR.   T2.LT.DUSK-D4)   GO TO 30
      START=AMAX1(DUSK-D4,T1)
      STOP=AMIN1(DUSK,T2)
      AREA=(DUSK-START)*F3(START)/2.-(DUSK-STOP)*F3(STOP)/2.
      TOT=TOT+AREA
   30 CONTINUE
      AVI=TOT/(DELT*60.)
C     AVI IS THE AVERAGE INTENSITY IN LANGLEYS/MIN OVER DELT
C     PDL IS TH PERCENT OF DELT DURING WHICH THE SAUN SHINES
      IF(T2.LT.DAWN   .OR.   T1.GT.DUSK)   RETURN
      DLS=AMAX1(T1,DAWN)
      DLSTOP=AMIN1(T2,DUSK)
      PDL=(DLSTOP-DLS)/DELT
      RETURN
      END
      SUBROUTINE GETCON(IO,DELT,IND,DEPTH,BOT)
C
C     PHYTOPLANKTON IS THE ONLY TYPE OF ALGAE MODELED BY THIS ROUTINE
C
C     IO IS THE AVERAGE LIGHT ITENSITY IN LANGLEYS/MIN DURING THE TIME
C     STEP
C     DELT IS THE TIME STEP LENGTH IN HOURS
C     DEPTH IS LAKE ELEMENT ELEVATION ABOVE BOTTOM IN METERS
C     IND IS THE LAKE ELEMENT NUMBER
C     BOT IS LAKE BOTTOM AREA OF LEVEL IN SQUARE METERS
C     RESEL IS SURFACE ELEVATION ABOVE BOTTOM IN METERS
C     NUME IS IND FOR SURFACE
C     VOL IS VOLUME IN CUBIC METERS
      COMMON/NDV/A1(36),NUME,NUMP(6),RESEL
```

```
C                                                 FORM Y LABELS AND FACTORS
C
      YMIN=Y(NPTS+1,1)
      DELTY=Y(NPTS+2,1)
      YLAB(6)=YMIN
      DO 270 I=1,5
  270 YLAB(6-I)=YLAB(7-I)+DELTY
      YSCAL=50./(YLAB(1)-YMIN)
C
C                                                 INITIALIZE PLOT OUTLINE
C
      NCD=100
      CALL PPLOT(0,0,NCD,NPLOT)
      K = 1
C
C                                                 DRAW IN EACH CURVE
C
      DO 450 L=1,NCV
       IF(NPT(L).EQ.0) GO TO 440
C
C                                                 JOINING XO YO AND XT YT
C
      XO=XSCAL*(X(1,L)-XMIN)
      YO=YSCAL*(Y(1,L)-YMIN)
      NPOINT = NPT(L)
      DO 400 N = 2,NPOINT
      XT = XSCAL*(X(N,L) - XMIN)
      YT = YSCAL*(Y(N,L) - YMIN)
      CALL PINE(XO,YO,XT,YT,K,NPLOT)
      XO = XT
      YO = YT
  400 CONTINUE
  420 CONTINUE
  440 K = K + 1
  450 CONTINUE
C
C                                                 OUTPUT FINAL PLOT
C
      NC=99
      CALL PPLOT(0,0,NC,NPLOT)
      RETURN
      END
      SUBROUTINE FILL(DATA,N,WORD)
      DIMENSION DATA(1)
      DEL=0.
      M=1
      DO 104 J=2,N
      NLO=M+1
      DO 101 K=NLO,N
      IF(DATA(K).EQ.WORD) GO TO 101
      DEL=(DATA(K)-DATA(M))/(K-M)
      M=K
      IF(K.EQ.NLO)  GO TO 104
      GO TO 102
  101 CONTINUE
      M=N+1
  102 MM1=M-1
      DO 103 K=NLO,MM1
  103 DATA(K)=DATA(K-1)+DEL
      IF(MM1.GE.N-1)  RETURN
  104 CONTINUE
```

```
            COMMON CINFLO(365,16),CLAK(100,16),SPACE(7640),DCON(100,16)
            COMMON/DBUG/IBUG
            COMMON/ABLK/ABAR(200),AREA(800),DVOL(1800),VOL(200)
            COMMON/LAK2/DZTOP2,ATOP2,VTOP2,ELEV
            COMMON/BBLK/BBLK(10),KIND
            COMMON/LAK/LAK(5),SDZ,DZTOP,ATOP,VTOP,NHOUR,PDL,SD3DND
      C
            COMMON/CONBEG/DO,BOD,NH3,NO2,NO3,PO4,ALG,COL,HM1,HM2,HM3,HM,TOTN
            COMMON/CONEND/DOE,BODE,NH3E,NO2E,NO3E,PO4E,ALGE,COLE,HM1E,HM2E,
           *HM3E,HME,TOTNE
            REAL NH3,NO2,NO3,NH3E,NO2E,NO3E
            COMMON/CONST/THKCOL,ABOD,AHM,CHMOC,THKNH3,VOLITK,THVOLK,BODC,
           *BODN,BODPC,BODDO,NOREFR,GRMAX,THGRMX,CHMOA,HMKA,MPO4,M1NO3,M2NO3,
           *MNH3,ML,APR,NR,ASR,AND,ATD,BRRBOD,BRRPO4,BRRNH3,BENOD
           *,AHM2,AHM3,ATD2,ATD3,PIHM1,PIHM2,PIHM3,CHMO2C,CHMO3C,CHMOA2,CHMOA3
           *,HMKA2,HMKA3,THNO3K,THPO4K
            COMMON/RCHVAR/COLK(100),BODK(100),BODKS(100),NH3K(100),NO2K(100),
           *EXTK(100),DOK2(100),HM1K(100),HM2K(100),HM3K(100)
           *,PO4K(100),NO3K(100)
            COMMON/TEMPER/TEMPAV,TEMREA(100),SATREA(100)
            REAL NH3K,NO2K,MPO4,M1NO3,M2NO3,IO,NR,IBAR,ML
            REAL NO3K
            REAL NOREFR
            COMMON/OPTION/IFN,IK2,ICOL,ICOMB,INH3,INO2,INO3,IPO4,IALG,IFIRST
            COMMON/OPT3/IP,INH,IN2,IN3
            COMMON/DELTAS/DELCOL,DLBODD,DLBODS,DBODAG,DBODAR,DBODAS,DBODAD,
           *DBODBR,DNH3BD,DNH3,DNH3V,DNH3AG,DNH3AR,DNH3BR,DNO2H3,DNO2,DNO3BD,
           *DNO3H3,DNO302,DNO3AG,DNO3AR,DNO3BR,DPO4BD,DPO4AG,DPO4AR,DPO4BR,
           *DELA,DARES,DALSNK,DADTH,DELO,ONEED,OGIVE
            DIMENSION DELTS(1)
            EQUIVALENCE (DELTS,DELCOL)
            DATA BLAN,ASTER/' ','*'/
      C
      C
      C     DELCOL IS CHANGE IN COLIFORM      CONC, DUE TO DECAY(GROWTH)(-OR+)
      C     DLBOOD IS CHANGE IN BOD           CONC, DUE TO DECAY(-)
      C     DLBODS IS CHANGE IN BOD           CONC, DUE TO SETTLING(-)
      C     DBODAG IS CHANGE IN BOD           CONC, DUE TO ALGAL GROWTH(+)
      C     DBODAR IS CHANGE IN BOD           CONC, DUE TO ALGAL RESPIRATION(-
      C     DBODAS IS CHANGE IN BOD           CONC, DUE TO ALGAL SETTLING(-)
      C     DBODAD IS CHANGE IN BOD           CONC, DUE TO ALGAL DEATH(+)
      C     DBODBR IS CHANGE IN BOD           CONC, DUE TO BENTHAL RELEASE(+)
      C     DNH3BD IS CHANGE IN NH3-N         CONC, DUE TO BOD DECAY(+)
      C     DNH3   IS CHANGE IN NH3-N         CONC, DUE TO NH3 DECAY(-)
      C     DNH3V  IS CHANGE IN NH3-N         CONC, DUE TO NH3 VOLITIZATION(-)
      C     DNH3AG IS CHANGE IN NH3-N         CONC, DUE TO ALGAL GROWTH(-)
      C     DNH3AR IS CHANGE IN NH3-N         CONC, DUE TO ALGAL RESPIRATION(+
      C     DNH3BR IS CHANGE IN NH3-N         CONC, DUE TO BENTHAL RELEASE(+)
      C     DNO2H3 IS CHANGE IN NO2-N         CONC, DUE TO NH3 DECAY(+)
      C     DNO2   IS CHANGE IN NO2-N         CONC, DUE TO NO2 DECAY(-)
      C     DNO3BD IS CHANGE IN NO3-N         CONC, DUE TO BOD DECAY(+)
      C     DNO3H3 IS CHANGE IN NO3-N         CONC, DUE TO NH3 DECAY(+)
      C     DNO302 IS CHANGE IN NO3-N         CONC, DUE TO NO2 DECAY(+)
      C     DNO3AG IS CHANGE IN NO3-N         CONC, DUE TO ALGAL GROWTH(-)
      C     DNO3AR IS CHANGE IN NO3-N         CONC, DUE TO ALGAL RESPIRATION(+
      C     ONLY 30 CONSECUTIVE COMMENTS ARE ALLOWED
            FAKIT=1.
      C     DNO3BR IS CHANGE IN NO3-N         CONC, DUE TO BENTHAL RELEASE(+)
      C     DPO4BD IS CHANGE IN PO4-P         CONC, DUE TO BOD DECAY(+)
      C     DPO4AG IS CHANGE IN PO4-P         CONC, DUE TO ALGAL GROWTH(-)
      C     DPO4AR IS CHANGE IN PO4-P         CONC, DUE TO ALGAL RESPIRATION(+
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C     DPO4BR IS CHANGE IN PO4-P          CONC. DUE TO BENTHAL RELEASE(+)
C     DELA   IS CHANGE IN PHYTOPLANKTON CONC. DUE TO GROWTH(+)
C     DARES  IS CHANGE IN PHYTOPLANKTON CONC. DUE TO RESPIRATION(-)
C     DALSNK IS CHANGE IN PHYTOPLANKTON CONC. DUE TO SINKING(-)
C     DADTH  IS CHANGE IN PHYTOPLANKTON CONC. DUE TO DEATH(NATURAL+TOXIC
C     DELO   IS CHANGE IN DO            CONC. DUE TO ALL REACTIONS(+OR-)
C     ONEED  IS CHANGE IN DO            CONC. DUE TO ALL OX-DEMANDS(-)
C     OGIVE  IS CHANGE IN DO            CONC. DUE TO ALL OX-GENERATION(+
C
C
      IF(IFIRST.NE.1)  GO TO 8
      NOUT=6
      IFIRST=0
      BODWT=BODC*12./BODPC
      BODNWR=BODN*14./BODWT
      BODPWR=32./BODWT
      FAC1=BODOO*NOREFR/(APR*BODPWR)
    8 CONTINUE
      IF(IBUG.EQ.1) WRITE(NOUT,1023) IND,IO,DELT,DEPTH,COL,BOD,NH3,
     *NO2,NO3,PO4,ALG,DO,HM1,HM2,HM3,TOTN
      DO 9 I=1,33
    9 DELTS(I)=0.
      DNO3DS=0.
      DPO4DS=0.
      DOD=0.
      DOBEN=0.
      TCOR=TEMREA(IND)-20.
C     CALCULATE FACTOR TO BE APPLIED TO RELEASE RATES.  RATE AT SURFACE
C     IS HALF OF RATE AT BOTTOM.  RATES ARE MULTIPLIED BY 2.5 ID DO IS
C     LESS THAN .5
      FAC2=(1.-DEPTH/(2.*RESEL))*DELT
      IF(DO.LT..5) FAC2=FAC2*2.5
      XX=DVOL(IND)
      IF(IND.EQ.NUME)  XX=VTOP
      FAC2=FAC2*BOT/(1000.*XX)
      IF(ICOL.EQ.0)  GO TO 10
C
C     CALCULATE COLIFORM CONCENTRATION CHANGE DUE TO DECAY(GROWTH)
C
      XTEMP=COLK(IND)*THKCOL**TCOR
      FACHM1=HM1-CHMOC
      FACHM2=HM2-CHMO2C
      FACHM3=HM3-CHMO3C
      DELK=ABOD*BOD
      IF(FACHM1.GT.0.) DELK=DELK+AHM *FACHM1
      IF(FACHM2.GT.0.) DELK=DELK+AHM2*FACHM2
      IF(FACHM3.GT.0.) DELK=DELK+AHM3*FACHM3
      IF(ABS(DELK).GT.ABS(XTEMP)) DELK=SIGN(XTEMP,DELK)
      XK=XTEMP+DELK
      DELCOL=COL*(EXP(-XK*DELT)-1.)
      IF(IBUG.EQ.1) WRITE(NOUT,1008) XTEMP,FACHM1,FACHM2,FACHM3,DELK,
     *XK,DELCOL
   10 CONTINUE
      IF(ICOMB.EQ.18)  GO TO 110
      IF(ICOMB.GT.11)  GO TO 20
C
C     CALCULATE BOD CHANGE DUE TO DECAY AND SETTLING
C
      XTEMP=BODK(IND)*THKCOL**TCOR
      DLBODD=BOD*(EXP(-XTEMP*DELT)-1.)
      DBOTOT=BOD*(EXP((-XTEMP-BODKS(IND))*DELT)-1.)
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      DLBODS=DBOTOT-DLBODD
      IF(IBUG.EQ.1) WRITE(NOUT,1009) XTEMP,DLBODD,DLBODS
      ONEED=ONEED+DLBODD
C
C     CALCULATE CHANGES IN PO4,NH3, AND NO3 DUE TO BOD DECAY
C
      BODMTL=ABS(DLBODD)/BODOO
      BODMC=BODMTL*NOREFR
      IF(IPO4.EQ.1) DPO4BD=BODMC*BODPWR
      IF(INH3.EQ.0)  GO TO 15
      DNH3BD=BODMC*BODNWR
      GO TO 20
   15 CONTINUE
      IF(INO3.EQ.0)  GO TO 20
      DNO3BD=BODMC*BODNWR
      ONEED=ONEED-DNO3BD*4.33
   20 CONTINUE
      IF(ICOMB.LE.11 .AND. IBUG.EQ.1) WRITE(NOUT,1010) DNH3BD,DNO3BD,
     *DPO4BD,ONEED
C     NITRIFICATION DOES NOT OCCUR IF DO IS LESS THAN 2 MG/L
      IF(DO.LT.2.)  GO TO 40
      IF(INH3.EQ.0)  GO TO 30
C
C     NH3 DECAYS TO EITHER NO2 OR NO3
C
      XTEMP=NH3K(IND)*THKNH3**TCOR
      TEMP1=XTEMP*DELT
      IF(INH.EQ.1) DNH3=NH3*(EXP(-TEMP1)-1.)
      IF(INH.EQ.2) DNH3=(-TEMP1*NH3**2)/(1.+TEMP1*NH3)
      IF(INO2.EQ.0)  GO TO 25
      ONEED=ONEED+3.22*DNH3
      DNO2H3=-DNH3
      GO TO 30
   25 CONTINUE
      DNO3H3=-DNH3
      ONEED=ONEED+4.33*DNH3
   30 CONTINUE
      IF(IBUG.EQ.1) WRITE(NOUT,1011) XTEMP,DNH3,DNO2H3,DNO3H3,ONEED
      IF(INO2.EQ.0)  GO TO 35
C
C     NO2 (AVAILABLE AT THE START OF THE STEP) DECAYS TO NO3
C
      XTEMP=NO2K(IND)*THKNH3**TCOR
      TEMP1=XTEMP*DELT
      IF(IN2.EQ.1) DNO2=NO2*(EXP(-TEMP1)-1.)
      IF(IN2.EQ.2) DNO2=(-TEMP1*NO2**2)/(1.+TEMP1*NO2)
      DNO3O2=-DNO2
      ONEED=ONEED+1.11*DNO2
      IF(IBUG.EQ.1) WRITE(NOUT,1012) XTEMP,DNO2,DNO3O2,ONEED
   35 CONTINUE
      IF(INO3.EQ.0)  GO TO 33
C
C     DECAY (SETTLING) OF NO3
C
C     DNO3DS IS CALCULATED IN LAKCON
      DNO3DS=SD3OND
      IF(ABS(DNO3DS).GT. .9*NO3) DNO3DS=-.9*NO3
   33 CONTINUE
      IF(IPO4.EQ.0)  GO TO 34
C
C     DECAY (SETTLING) OF PO4
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C
      XTEMP=PO4K(IND)*THPO4K**TCOR*DELT
      IF(IP.EQ.1) DPO4DS=PO4*(EXP(-XTEMP)-1.)
      IF(IP.EQ.2) DPO4DS=(-XTEMP*PO4**2)/(1.+XTEMP*PO4)
   34 CONTINUE
      IF(IBUG.EQ.1) WRITE(NOUT,1025) DNO3DS,DPO4DS
C
C     VOLITIZATION OF NH3
C
      IF(VOLITK.EQ.0.  .OR.  INH3.EQ.0)  GO TO 40
      IF(IND.NE.NUME)  GO TO 40
      DNH3V=(-NH3*(VOLITK*EXP(THVOLK*TCOR)))*DELT
      IF(IBUG.EQ.1) WRITE(NOUT,1013) XTEMP,DNH3V
   40 CONTINUE
      IF(IALG.EQ.0)  GO TO 90
C
C     CALCULATE PHYTOPLANKTON(ALGAL) GROWTH
C
      IF(IO.EQ.0.)  GO TO 70
      GRMAXT=GRMAX*THGRMX**TCOR
      FHM1=1.
      IF(HM1.GT.CHMOA ) FHM1=EXP(-HMKA *(HM1-CHMOA ))
      FHM2=1.
      IF(HM2.GT.CHMOA2) FHM2=EXP(-HMKA2*(HM2-CHMOA2))
      FHM3=1.
      IF(HM3.GT.CHMOA3) FHM3=EXP(-HMKA3*(HM3-CHMOA3))
      FHM=AMIN1(FHM1,FHM2,FHM3)
      FP=(PO4/(HPO4+PO4))*(NO3/(M1NO3+NO3))
      FNO3=NO3/(M2NO3+NO3)
      FNH3=NH3/(MNH3+NH3)
      IF(IFN.EQ.2)  FN=AMAX1(FNO3,FNH3)
      IF(IFN.EQ.0  .OR.  IFN.EQ.1) FN=IFN*FNH3+(1-IFN)*FNO3
      IF(IBUG.EQ.1) WRITE(NOUT,1014) FHM,FP,FNO3,FNH3,FN
      IBAR=IO/PDL
      FL=IBAR/(ML+IBAR)
      FLIM=AMIN1(FP,FN,FL)
      GRLIM=GRMAXT*FHM*FLIM
      DELA=ALG*GRLIM*PDL*DELT
      IF(IBUG.EQ.1) WRITE(NOUT,1015) IBAR,FL,GRLIM,DELA
   50 CONTINUE
C
C     CALCULATE CHANGES IN BOD,PO4,NO3, AND NH3 DUE TO ALGAL GROWTH
C
      IF(ABS(DELA).LT. .00001) DELA=0.
      DBODAG=DELA*FAC1
      IF(ICOMB.GT.11)  DBODAG=0.
      DPO4AG=-DELA/APR
      IF(IBUG.EQ.1) WRITE(NOUT,1016) DBODAG,DPO4AG
      IF(ABS(DPO4AG).LE.PO4)  GO TO 55
      DELA=.9*DELA
      GO TO 50
   55 CONTINUE
C     DN, THE NITROGEN DEMAND, IS POSITIVE
      DN=-DPO4AG*BODNWR/BODPWR
      IF(DN.GT. .9*NO3)  GO TO 60
      DNO3AG=-DN
      DNH3AG=0.
      GO TO 70
   60 CONTINUE
      IF(INH3.NE.0  .AND.  DN.LE. .9*NO3+.8*NH3)  GO TO 65
      DELA=.9*DELA
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      GO TO 50
65    CONTINUE
      DNO3AG=-.9*NO3
      DNH3AG=-(DN+DNO3AG)
70    CONTINUE
      OGIVE=OGIVE+DELA*BODOQ/(APR*BODPWR)
      IF(IBUG.EQ.1) WRITE(NOUT,1017) DNO3AG,DNH3AG,OGIVE
C
C     CALCULATE ALGAL RESPIRATION QUANTITIES
C
      ARR=NR*TEMREA(IND)
      DARES=-ALG*ARR*DELT
      DBODAR=DARES*BODOQ/(APR*BODPWR)
      IF(ICOMB.GT.11)  DBODAR=0.
      DPO4AR=-DARES/APR
      ONEED=ONEED-DPO4AR*BODOQ/BODPWR
      IF(INH3.EQ.0)  GO TO 75
      DNH3AR=DPO4AR*BODNWR/BODPWR
      GO TO 80
75    CONTINUE
      DNO3AR=DPO4AR*BODNWR/BODPWR
      ONEED=ONEED-DNO3AR*4.33
80    CONTINUE
      IF(IBUG.EQ.1) WRITE(NOUT,1018) DARES,DBODAR,DPO4AR,DNH3AR,DNO3AR,
     *ONEED
C
C     CALCULATE ALGAL SINKING AND DEATH TERMS
C
      XDEP=SDZ
      IF(IND.EQ.NUME) XDEP=DZTOP
      DALSNK=-ASR*ALG*DELT/XDEP
      IF(ICOMB.LE.11) DBODAS=DALSNK*FAC1
      DALND=-AND*ALG*DELT
      FACM1=HM1-CHMOA
      FACM2=HM2-CHMOA2
      FACM3=HM3-CHMOA3
      FACX=0.
      IF(FACM1.GT.0.) FACX=ATD*FACM1
      IF(FACM2.GT.0.) FACX=FACX+ATD2*FACM2
      IF(FACM3.GT.0.) FACX=FACX+ATD3*FACM3
      DALTOX=-FACX*ALG*DELT
      DADTH=DALND+DALTOX
      IF(IBUG.EQ.1) WRITE(NOUT,1019) DALSNK,DBODAS,DALND,DALTOX,DBODAD
90    CONTINUE
C
C     CALCULATE BENTHAL RELEASE TERMS
C
      IF(ICOMB.LT.11) DBODBR=BRRBOD*FAC2
      IF(IPO4.EQ.0)  GO TO 91
      DPO4BR=BRRPO4*FAC2
91    IF(INH3.EQ.0)  GO TO 92
      DNH3BR=BRRNH3*FAC2
      GO TO 95
92    IF(INO3.EQ.0)  GO TO 95
      DNO3BR=BRRNH3*FAC2
      ONEED=ONEED-4.33*DNO3BR
95    CONTINUE
      IF(IBUG.EQ.1) WRITE(NOUT,1020) DBODBR,DPO4BR,DNO3BR,DNH3BR,ONEED
C
C     CALCULATE OXYGEN REAERATION TERM AND BENTHAL DEMAND TERM
C
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      IF(IND.NE.NUME)  GO TO 96
      DM=2.05*1.037**TCOR/1.E3
      XK=DM/(200.-60.*SQRT(WIND))
      XK=XK*3600.
      TT=TEMREA(IND)
      OSAT=(14.62-(.3898*TT)+(.006969*TT**2)-(.00005897*TT**3))
     **((1.-(.00000697*ELEV))**5.167)
      ASLOP=(ATOP2-ATOP)/24.
      VSLOP=(VTOP2-VTOP)/24.
      VO=VTOP+(NHOUR-DELT)*VSLOP
      AO=ATOP+(NHOUR-DELT)*ASLOP
      AT=AO+DELT*ASLOP
      VT=VO+DELT*VSLOP
      XX=AO/VO+AT/VT
      IF(IBUG.EQ.1) WRITE(NOUT,1026) DM,XK,WIND,TT,OSAT,ASLOP,VSLOP,AO,V
     *O,AT,VT,XX
      DOD=(OSAT-DO)*(1.-(VO/VT)*EXP(-.5*XK*XX*DELT))
      OGIVE=OGIVE+DOD
   96 CONTINUE
      DOBEN=BENOD*1.07**TCOR*(1.-EXP(-1.22*DO))*FAC2
      DOBEN=-DOBEN
      IF(DO.LT. .5)  DOBEN=DOBEN/2.5
      ONEED=ONEED+DOBEN
   97 CONTINUE
      DELO=ONEED+OGIVE
      IF(IBUG.EQ.1) WRITE(NOUT,1021) XK,DOD,DOBEN,OGIVE,ONEED,DELO
      IF(DELO.GE.0.  .OR.  ABS(DELO).LE.DO)  GO TO 110
C
C     OXYGEN DEMAND EXCEEDS SUPPLY.  REDUCE ALL REACTIONS.
C
      OFAC=DO/ABS(DELO)
      IF(IBUG.EQ.1) WRITE(NOUT,1022) OFAC,IND
      DLBODD=DLBODD*OFAC
      DPO4BD=DPO4BD*OFAC
      DNH3BD=DNH3BD*OFAC
      DNO3BD=DNO3BD*OFAC
      DNH3=DNH3*OFAC
      DNO2H3=DNO2H3*OFAC
      DNO3H3=DNO3H3*OFAC
      DNO2=DNO2*OFAC
      DNO3O2=DNO3O2*OFAC
      DARES=DARES*OFAC
      DPO4AR=DPO4AR*OFAC
      DNO3AR=DNO3AR*OFAC
      DPO4BR=DPO4BR*OFAC
      DNO3BR=DNO3BR*OFAC
      DBODAR=DBODAR*OFAC
      DNH3AR=DNH3AR*OFAC
      DNH3BR=DNH3BR*OFAC
      DELO=-DO
  110 CONTINUE
C
C     HEAVY METALS
C
      DELHM1=HM1*(EXP(-HM1K(IND)*DELT)-1.)
      DELHM2=HM2*(EXP(-HM2K(IND)*DELT)-1.)
      DELHM3=HM3*(EXP(-HM3K(IND)*DELT)-1.)
      IF(IBUG.EQ.1) WRITE(NOUT,1001) DELHM1,DELHM2,DELHM3
 1001 FORMAT(' DELHM1,DELHM2,DELHM3=',3E16.8)
C
C     UPDATE CONSTITUENT CONCENTRATIONS
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C
      COLE=COL+DELCOL
      BODE=BOD+DLBODD+DLBODS+DBODAG+DBODAR+DBODAS+DBODAD+DBODBR
      NH3E=NH3+DNH3BD+DNH3+DNH3V+DNH3AG+DNH3AR+DNH3BR
      NO2E=NO2+DNO2H3+DNO2
      NO3E=NO3+DNO3BD+DNO3H3+DNO3O2+DNO3AG+DNO3AR+DNO3BR+DNO3DS
      PO4E=PO4+DPO4BD+DPO4AG+DPO4AR+DPO4BR+DPO4DS
      ALGE=ALG+DELA+DARES+DALSNK+DADTH
      DOE=DO+DELO
      HM1E=HM1+DELHM1
      HM2E=HM2+DELHM2
      HM3E=HM3+DELHM3
      HME=HM1E+HM2E+HM3E
      TOTNE=NH3E+NO2E+NO3E+BODE*BODNWR/BODOO
      IF(IBUG.EQ.1) WRITE(NOUT,1024) IND,COLE,BODE,NH3E,NO2E,NO3E,PO4E,
     *ALGE,DOE,HM1E,HM2E,HM3E,TOTNE
C     UPDATE THE CONCENTRATIONS OF ELEMENT IND-1 DUE TO SETTLING AND
C     SINKING FROM ELEMENT IND
      IF(IND.EQ.1) RETURN
      XX=DVOL(IND)
      IF(IND.EQ.NUME)  XX=VTOP
      YY=AREA(IND+1)
      IF(IND.EQ.NUME)  YY=ATOP
      RAT=XX*AREA(IND)/(DVOL(IND-1)*YY)
      IF(IBUG.EQ.1) WRITE(NOUT,1027) RAT
      DCON(IND-1,2)=-(DLBODS+DBODAS)*RAT
      DCON(IND-1,6)=-DPO4DS*RAT
      DCON(IND-1,7)=-DALSNK*RAT
      DCON(IND-1,9)=-DELHM1*RAT
      DCON(IND-1,10)=-DELHM2*RAT
      DCON(IND-1,11)=-DELHM3*RAT
      IF(PIHM1.NE.0.) DCON(IND-1,14)=DCON(IND-1,9)*PIHM1
      IF(PIHM2.NE.0.) DCON(IND-1,15)=DCON(IND-1,10)*PIHM2
      IF(PIHM3.NE.0.) DCON(IND-1,16)=DCON(IND-1,11)*PIHM3
      RETURN
C
C
C     THE FOLLOWING ARE DEBUG FORMAT STATEMENTS
C
C
 1008 FORMAT(' XTEMP,FACHM1,FACHM2,FACHM3=',4E16.8/' DELK,XK,DELCOL=',
     *3E16.8)
 1009 FORMAT(' XTEMP,DLBODD,DLBODS=',3E16.8)
 1010 FORMAT(' DNH3BD,DNO3BD,DPO4BD,ONEED=',4E16.8)
 1011 FORMAT(' XTEMP,DNH3,DNO2H3,DNO3H3,ONEED=',5E16.8)
 1012 FORMAT(' XTEMP,DNO2,DNO3O2,ONEED=',4E16.8)
 1013 FORMAT(' XTEMP,DNH3V=',2E16.8)
 1014 FORMAT(' FHM,FP,FNO3,FNH3,FN=',5E16.8)
 1015 FORMAT(' IBAR,FL,GRLIM,DELA=',4E16.8)
 1016 FORMAT(' DBODAG,DPO4AG=',2E16.8)
 1017 FORMAT(' DNO3AG,DNH3AG,OGIVE=',3E16.8)
 1018 FORMAT(' DARES,DBODAR,DPO4AR,DNH3AR,DNO3AR=',5E16.8/
     *' ONEED=',E16.8)
 1019 FORMAT(' DALSNK,DBODAS,DALNO,DALTOX,DBODAD=',5E16.8)
 1020 FORMAT(' DBODBR,DPO4BR,DNO3BR,DNH3BR,ONEED=',5E16.8)
 1021 FORMAT(' XK,DOD,DOBEN,OGIVE,ONEED,DELO=',6E16.8)
 1022 FORMAT(' FACTOR =',E16.8,' ON REACH',I6)
 1023 FORMAT(//' INITIAL CONDITIONS FOR REACH',I5/' IO,DELT,DEPTH=',3F12
     *.4/
     *' COL,BOD,NH3,NO2,NO3=',5E16.8/
     *' PO4,ALG,DO=',3E16.8/
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     *' HM1,HM2,HM3,TOTN=',4E16,8//)
1024  FORMAT(/' FINAL CONDITIONS FOR REACH',I5/' COL,BOD,NH3,NO2,NO3=',5
     *E16,8/' PO4,ALG,DO=',3E16,8/
     *' HM1,HM2,HM3,TOTN=',4E16,8//)
1025  FORMAT(' DNO3DS,DPO4DS=',2E16,8)
1026  FORMAT(' DM,XK,KIND,TT,OSAT,ASLOP=',6E16,8/' VSLOP,AO,VO,AT,VT,
     *XX=',6E16,8)
1027  FORMAT(' RAT =',E16,8)
      END
      SUBROUTINE LAKCON
      COMMON/CONBEG/CONSTR(13)/CONEND/CONSTP(13)
      COMMON/OPTION/IFN(6),INO3,IPO4,IALG
      COMMON/CONST/THKOL(34),PIHM1,PIHM2,PIHM3,CHMO2K(6),THNO3K
      COMMON/RCHVAR/COLK(1100),NO3K(100)
      REAL NO3K
      COMMON CINFLO(365,16),CLAK(100,16),SPACE(7440),QVI(100),QVO(100),
     *DCON(100,16)
      COMMON/OPT2/IHEAVY,ITOTN
      COMMON/LAK/KCON,DU,E1,E2,NOWDAY,SDZ,DZTOP,ATOP,VTOP,NHOUR,PDL,
     *DNO3DS
      COMMON/NDV/A1(3),DELT,DDIN(7),EXCO,GMAX(23),NUM,NUME,NUMP(6),RESEL
      EQUIVALENCE (GMAX(7),IMIX)
      COMMON/DBUG/IBUG
      COMMON/ABLK/ABAR(200),AREA(200),DC(600),DVOL(200),DZ(400),QHI(200)
     *,QHO(1000),VOL(200),Z(200),ZMID(200)
      COMMON/FORGOT/LKAST(100)
      COMMON/TEMPER/TEMPAV,TEMLEV(100)
      DATA LANK,ISTER/' ','*'/
      DIMENSION IBRSAV(100)
      DIMENSION PRTMAS(16)
      REAL IBRSAV
      REAL IBARI
      REAL IBOT,ITOP
      COMMON/OPT3/IP,INH,IN2,IN3
      COMMON/LAK2/LAK2(4),IFIRST
C     CALCULATE VERTICAL FLOWS IN AND OUT OF EACH ELEMENT
      QVI(1)=0.
      QVO(1)=QHI(1)-QHO(1)
      DO 1 I=2,NUME
      QVO(I)=QHI(I)+QVO(I-1)-QHO(I)
1     QVI(I)=QVO(I-1)
      QVO(NUME)=0.
      IF(IBUG.EQ.1) WRITE(6,1000) QVI,QVO
      DO 2 I=1,NUME
      DO 2 J=1,KCON
2     DCON(I,J)=0.
C     CALCULATE CONCENTRATION CHANGE DUE TO DIFFUSION
C     FIND THE THERMOCLINE
      NTHERM=1
      DTDDM=0.
      DO 80 I=2,NUME
      DD=SDZ
      IF(I.EQ.NUME) DD=DZTOP
      VAR=(TEMLEV(I)-TEMLEV(I-1))/DD
      IF(VAR.LT.DTDDM)  GO TO 80
      DTDDM=VAR
      NTHERM=I-1
80    CONTINUE
      IF(IBUG.EQ.1) WRITE(6,1009) DTDDM,NTHERM
      DO 4 I=1,NUM
      E=E1
```

```
      IF(I.LE.NTHERM) E=E2
      DZZ=SDZ
      IF(I.EQ.NUM) DZZ=DZTOP
      XVOL=DVOL(I+1)
      IF(I.EQ.NUM) XVOL=VTOP
      FAC=2.*E*AREA(I+1)/(SDZ+DZZ)
      IF(IBUG.EQ.1) WRITE(6,1006) I,IMIX,E,AREA(I),DZZ,FAC,DVOL(I)
      DO 3 J=1,KCON
      DELMAS=FAC*(CLAK(I,J)-CLAK(I+1,J))*DELT
      DCON(I,J)=DCON(I,J)-DELMAS/DVOL(I)
3     DCON(I+1,J)=DCON(I+1,J)+DELMAS/XVOL
4     CONTINUE
      IF(IBUG.NE.1)  GO TO 5
      WRITE(6,1001)  ((DCON(I,J),J=1,KCON),I=1,NUM)
5     CONTINUE
C     CALCULATE CONCENTRATION CHANGE DUE TO MASS ADDITION
      DO 20 I=1,NUME
      FLOIN=QHI(I)
      IF(QVI(I).GT.0.) FLOIN=FLOIN+QVI(I)
      IF(QVO(I).LT.0.) FLOIN=FLOIN-QVO(I)
      FLOUT=QHO(I)
      IF(QVI(I).LT.0.) FLOUT=FLOUT-QVI(I)
      IF(QVO(I).GT.0.) FLOUT=FLOUT+QVO(I)
      XVOL=DVOL(I)
      IF(I.EQ.NUME) XVOL=VTOP
      XVOL1=XVOL
      IF(I.EQ.NUME) XVOL1=VTOP+(FLOIN-FLOUT)*DELT
      FAC1=XVOL/XVOL1
      IF(IBUG.EQ.1) WRITE(6,1007) I,FLOIN,FLOUT,XVOL,FAC1
      DO 10 J=1,KCON
      HMSIN=QHI(I)*CINFLO(NOWDAY,J)*DELT
      HMSOUT=QHO(I)*CLAK(I,J)*DELT
      VMSIN=0.
      IF(QVI(I).GT.0.) VMSIN=QVI(I)*CLAK(I-1,J)*DELT
      IF(QVO(I).LT.0.) VMSIN=VMSIN-QVO(I)*CLAK(I+1,J)*DELT
      VMSOUT=0.
      IF(QVI(I).LT.0.) VMSOUT=-QVI(I)*CLAK(I,J)*DELT
      IF(QVO(I).GT.0.) VMSOUT=VMSOUT+QVO(I)*CLAK(I,J)*DELT
      XMADD=HMSIN+VMSIN-HMSOUT-VMSOUT
      PRTMAS(J)=XMADD/XVOL1
      FIXERR=DCON(I,J)+XMADD/XVOL1+FAC1*CLAK(I,J)
10    DCON(I,J)=FIXERR
      IF(IBUG.EQ.1) WRITE(6,1008) PRTMAS
20    CONTINUE
      DO 50 I=1,NUME
      DO 50 J=1,KCON
      CLAK(I,J)=DCON(I,J)
      IF(CLAK(I,J).LT.0.)  CLAK(I,J)=0.
50    DCON(I,J)=0.
C     SET UP INTERFACE FOR GETCON
C     CALCULATE AVERAGE LIGHT ITENSITY AT SURFACE IF MODELING ALGAE OR
C     IF SIMULATING ALGAE WITH NO3 REMOVAL.  EXCO INCLUDES ALGAL
C     EFFECTS IF NOT MODELING ALGAE.  EXCO DOESN'T IF MODELING ALGAE.
      AVINT=0.
      XHOUR=NHOUR
      IF(IALG+INO3.NE.0) CALL GETAVI(NOWDAY,XHOUR,DELT/3600.,AVINT,PDL)
      IF(IBUG.EQ.1) WRITE(6,1002) NOWDAY,NHOUR,AVINT,PDL
      AVSAV=AVINT
      IBOT=AVINT
      DO 30 JBAC=1,NUME
      J=NUME-JBAC+1
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      IF(VI.NE.0.)  BFAC=VOLMIX*BGDNO3/VI
      IF(IBUG.EQ.1) WRITE(6,1005) AVNO3,XNO3,AVTEM,TMIX,VOLMIX,XTEMP,
     *BGDNO3,BFAC,VI,(IBRSAV(JL),JL=1,NUME)
 1000 FORMAT(' QVI,QVO='/(10F12.4))
 1001 FORMAT(' DCON='/(7F8.5,F8.1,8F8.5))
 1002 FORMAT(' NOWDAY,NHOUR,AVINT,PDL=',2I5,2E16.8)
 1003 FORMAT(' XK,ITOP,IBOT,THK=',4E16.8)
 1004 FORMAT(' DEX,DEP,DU,NDU,NLAY=',3E16.8,2I10)
 1005 FORMAT(' AVNO3,XNO3,AVTEM,TMIX,VOLMIX=',5E16.8/' XTEMP,BGDNO3,BFAC
     *,VI=',4E16.8/' IBRSAV='/(8E16.8))
 1006 FORMAT(' I,IMIX,E,AREA,DZZ,FAC,DVOL=',2I3,5E15.8)
 1007 FORMAT(' I,FLCIN,FLOUT,XVOL,FAC1=',I5,4E16.8)
 1008 FORMAT(' MASS ADDED'/(8E16.8))
 1009 FORMAT(' DTDDM,NTHERM=',E16.8,I10)
   66 CONTINUE
      DNO3DS=BFAC*IBRSAV(J)
   70 CONTINUE
      CALL GETCON(AVINT,DELT/3600.,J,ZMID(J),BOT)
      DO 37 JL=1,11
   37 CLAK(J,JL)=CONSTP(JL)
      IF(PIHM1.NE.0.)  CLAK(J,14)=PIHM1*CLAK(J,9)
      IF(PIHM2.NE.0.)  CLAK(J,15)=PIHM2*CLAK(J,10)
      IF(PIHM3.NE.0.)  CLAK(J,16)=PIHM3*CLAK(J,11)
      LKAST(J)=LANK
      IF(ITOTN.EQ.1  .AND.  CONSTP(13).GT.CLAK(J,12)) LKAST(J)=ISTER
   30 CONTINUE
      DO 55 I=1,NUME
      DO 55 J=1,KCON
   55 CLAK(I,J)=CLAK(I,J)+DCON(I,J)
      RETURN
      END
      SUBROUTINE NEWIN
      COMMON/ABLK/ABAR(2000),TEM(1)
      COMMON/CONST/THKCOL,ABOD,AHM,CHMOC,THKNH3,VOLITK,THVOLK,BODC,
     *BODN,BODPC,BODDQ,NOREFR,GRMAX,THGRMX,CHMOA,HMKA,MPO4,M1NO3,M2NO3,
     *MNH3,ML,APR,NR,ASR,AND,ATD,BRRBOD,BRRPO4,BRRNH3,BENOD
     *,AHM2,AHM3,ATD2,ATD3,PIHM1,PIHM2,PIHM3,CHMO2C,CHMO3C,CHMOA2,CHMOA3
     *,HMKA2,HMKA3,THNO3K,THPO4K
      COMMON/NDV/FIL1(17),IDAY,FIL2(7),LDAY,MAXE
      COMMON CINFLO(365,16),C(100,16)
      DIMENSION ZERO(1)
      EQUIVALENCE (ZERO,CINFLO)
      COMMON/LAK/KCON,DU,E1,E2
      COMMON/LAK2/DZTOP2(3),ELEV,IFIR
      DIMENSION ARCON(1)
      EQUIVALENCE (ARCON,THKCOL)
      COMMON/MISC/XLAT,NDAY1
      DATA NI,NJ/5,6/
      COMMON/RCHVAR/COLK(100),BODK(100),BODKS(100),NH3K(100),NO2K(100),
     *EXTK(100),DOK2(100),HM1K(100),HM2K(100),HM3K(100)
     *,PO4K(100),NO3K(100)
      COMMON/TEMPER/TEMPAV,TEMREA(100),SATREA(100)
      COMMON/OPTION/IFN,IK2,ICOL,ICOMB,INH3,INO2,INO3,IPO4,IALG,IFIRST
      COMMON/OPT2/IHEAVY,ITOTN,ICHLOR
      COMMON/OPT3/IP,INH,IN2,IN3
      COMMON/CBLK/CBLK(730),QIN(365)
      REAL NOREFR
      REAL NO3K
      REAL MPO4,M1NO3
      REAL M2NO3,MNH3,ML,NR,NH3K,NO2K
      DIMENSION DEFALT(30)
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      DATA DEFALT/1.07 , 0.0 , 0.0 , 20.0 , 1.1 , .01 , .17 , 106. , 16.
     *0 , .5 , 1.5 , .5 , .1 , 1.07 , 20. , .01 , .03 , .028 , .045 , .0
     *45 , .03 , .6 , .0001 , .05 , .001 , .001 , 61. , .125 , .108,15./
      DATA XP,XN3,XCK,XNH,XN2,XEX,XDOK/.0009,.004,.004,.004,.015,.04,
     *1./
      DO 1 I=1,14880
    1 ZERO(I)=1.E20
      DO 2 I=1,1200
    2 COLK(I)=0.
      DO 3 I=1,100
    3 TEMREA(I)=TEM(I)
      CMSCFS=1./.028317
      IFIR=1
      KCON=16
C     READ INFLOW CONCENTRATIONS
      DO 520 I=1,365
      READ(NI,305) NDAY
      IF(NDAY.GT.400) GO TO 530
      READ(NI,440) (CINFLO(NDAY,JL),JL=1,KCON)
  520 CONTINUE
  530 CONTINUE
      DO 540 I=1,KCON
  540 CALL FILL(CINFLO(IDAY,I),LDAY-IDAY+1,1,E20)
      READ(NI,313) ELEV,TEMPAV,XLAT,E1,E2
      NDAY1=IDAY
  313 FORMAT(3F10.4,2E10.0)
      XLATD=XLAT
      E1106=E1*1.E6
      E2106=E2*1.E10
      XLAT=XLAT/57.2958
      WRITE(NJ,111)
  111 FORMAT(1H1,//45X,'LAKE ELEMENT VARIABLES',//)
      WRITE(NJ,112)
  112 FORMAT(' ELEM',5X,'BOD',8X,'BOD',6X,'COLIFORM',5X,'NH3',8X,'NO2',
     *8X,'NO3',8X,'PO4',6X,'HEAVY',6X,'HEAVY',6X,'HEAVY',6X,'TEMP'/
     *' NUM   REACTION   SETTLING',4('   REACTION'),'   SETTLING',3X,
     *'MET 1',6X,'MET 2',6X,'MET 3',6X,'(DEG='/
     *10X,6('COEF',7X),'COEF',6X,'COEF',7X,'COEF',7X,'COEF',6X,'CEN)')
      DO 113 K=1,101
      READ(NI,305) I
      IF(I.GT.100)  GO TO 200
      READ(NI,213)   BODK(I),BODKS(I),DOK2(I),COLK(I),NH3K(I),NO2K(I),
     *NO3K(I),PO4K(I),EXTK(I),
     *HM1K(I),HM2K(I),HM3K(I)
C     READ IN INITIAL CONCENTRATIONS IN MG/L EXCEPT FOR COLIFORMS
C     IN MPN/100 ML
      READ(NI,440) (C(I,JL),JL=1,KCON)
  113 CONTINUE
  200 CONTINUE
      DO 204 K=1,KCON
  204 CALL FILL(C(1,K),MAXE,1,E20)
  440 FORMAT(8F10.4)
  213 FORMAT(13F6.0)
  305 FORMAT(I5)
      DO 300 IK=1,MAXE
      IF(BODK(IK).EQ.0.)  BODK(IK)=.2/24.
      IF(BODKS(IK).EQ.0.) BODKS(IK)=XP
      IF(TEMREA(IK).EQ.0.) TEMREA(IK)=TEMPAV
      IF(PO4K(IK).EQ.0.)  PO4K(IK)=XP
      IF(NO3K(IK).EQ.0.)  NO3K(IK)=XN3
      IF(COLK(IK).EQ.0.)  COLK(IK)=XCK
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      IF(NH3K(IK).EQ.0.)  NH3K(IK)=XNH
      IF(NO2K(IK).EQ.0.)  NO2K(IK)=XN2
      IF(EXTK(IK).EQ.0.)  EXTK(IK)=XEX
      IF(DOK2(IK).EQ.0.)  DOK2(IK)=XDOK
      IF(HM1K(IK).EQ.0.)  HM1K(IK)=XCK
      WRITE(NJ,217) IK,BODK(IK),BODKS(IK),COLK(IK),NH3K(IK),NO2K(IK),
     *NO3K(IK),PO4K(IK),HM1K(IK),HM2K(IK),HM3K(IK),TEMREA(IK)
217   FORMAT(I4,F10.3,F11.6,5F11.4,F10.4,F11.4,F11.4,F10.2)
300   CONTINUE
      WRITE(NJ,908)
908   FORMAT(1H1,//45X,'INITIAL CONCENTRATIONS',//)
      WRITE(NJ,607)
607   FORMAT('     ELEMENT          DO     BOD     NH3-N   NO2-N NO3-N PO4-P
     *  PHYTO  COLIFORMS  HM1     HM2     HM3    TOT N    CHLOR  HMI1    HMI2
     *    HMI3'/ '       NUMBER       (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
     *G/L) (MG/L) (MPN/100) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
     *G/L) (MG/L)'/)
      DO 302 IK=1,MAXE
302   WRITE(NJ,818) IK,(C(IK,LJ),LJ=1,KCON)
818   FORMAT(I10,6X,F8.2,F7.2,5F7.4,F10.1,8F7.2)
      WRITE(NJ,909)
909   FORMAT(1H1,//35X,'LAKE INFLOW CONCENTRATIONS',//)
      WRITE(NJ,608)
608   FORMAT('      DAY      FLOW    DO     BOD     NH3-N   NO2-N NO3-N PO4-P
     *  PHYTO  COLIFORMS  HM1     HM2     HM3    TOT N    CHLOR  HMI1    HMI2
     *    HMI3'/ '  NUMBER     (CFS) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
     *G/L) (MG/L) (MPN/100) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
     *G/L) (MG/L)'/)
      DO 303 I=IDAY,LDAY
      CFSQ=QIN(I)*CMSCFS
303   WRITF(NJ,819) I,CFSQ,(CINFLO(I,LJ),LJ=1,KCON)
819   FORMAT(I8,F9.0,F7.2,F7.2,5F7.4,F10.1,8F7.2)
116   CONTINUE
      WRITE(NJ,1211)
1211  FORMAT(1H1)
      WRITE(NJ,121)
121   FORMAT(35X,'MISCELLANEOUS VARIABLES'//)
      READ(NI,122) IFN,ICOL,ICOMB,IHEAVY,ITOTN,ICHLOR,INH,IN2,IN3,IP
      IF(INH.NE.2) INH=1
      IF(IN2.NE.2) IN2=1
      IF(IN3.NE.2) IN3=1
      IF(IP.NE.1) IP=2
      CALL SETOPT
122   FORMAT(10I5)
      READ(NI,123) (ARCON(I),I=1,45)
123   FORMAT(10X,7F10.4)
      DO 10 I =1,30
      IF(ARCON(I).EQ.0.)  ARCON(I)=DEFALT(I)
10    CONTINUE
      IF(THNO3K.EQ.0.)  THNO3K=1.12
      IF(THPO4K.EQ.0.)  THPO4K=1.084
      IF(ICOL.EQ.0) GO TO 400
      WRITE(NJ,1004) THKCOL
      WRITE(NJ,1005) ABOD
      IF(IHEAVY.NE.0) WRITE(NJ,1006) AHM
      IF(IHEAVY.GT.1) WRITE(NJ,1007) AHM2
      IF(IHEAVY.GT.2) WRITE(NJ,1008) AHM3
      IF(IHEAVY.NE.0) WRITE(NJ,1009) CHMOC
      IF(IHEAVY.GT.1) WRITE(NJ,1010) CHMO2C
      IF(IHEAVY.GT.2) WRITE(NJ,1011) CHMO3C
400   CONTINUE
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      IF(ICOMB.GT.11) GO TO 405
      WRITE(NJ,1047) THKCOL
      IF(INH3+INO2+INO3+IPO4.EQ.0) GO TO 405
      WRITE(NJ,1018) BODOQ
      WRITE(NJ,1019) NOREFR
      WRITE(NJ,1015) BODC
      WRITE(NJ,1016) BODN
      WRITE(NJ,1017) BODPC
405   CONTINUE
      IF(INH3.EQ.0) GO TO 410
      WRITE(NJ,1012) THKNH3
      WRITE(NJ,1013) VOLITK
      WRITE(NJ,1014) THVOLK
410   CONTINUE
      IF(INO2.EQ.0) GO TO 415
      WRITE(NJ,1048) THKNH3
415   CONTINUE
      IF(INO3.EQ.1) WRITE(NJ,1049) THNO3K
      IF(IALG.EQ.0) GO TO 420
      WRITE(NJ,1001) IFN
      WRITE(NJ,1002) ICOMB
      WRITE(NJ,1020) GRMAX
      WRITE(NJ,1021) THGRMX
      IF(IHEAVY.NE.0) WRITE(NJ,1022) CHMOA
      IF(IHEAVY.GT.1) WRITE(NJ,1023) CHMOA2
      IF(IHEAVY.GT.2) WRITE(NJ,1024) CHMOA3
      IF(IHEAVY.NE.0) WRITE(NJ,1025) HMKA
      IF(IHEAVY.GT.1) WRITE(NJ,1026) HMKA2
      IF(IHEAVY.GT.2) WRITE(NJ,1027) HMKA3
      IF(IPO4.NE.0) WRITE(NJ,1028) MPO4
      IF(IPO4.NE.0 .AND. INO3.NE.0) WRITE(NJ,1029) M1NO3
      IF(INO3.NE.0) WRITE(NJ,1030) M2NO3
      IF(INO3.NE.0) WRITE(NJ,1031) MNH3
      WRITE(NJ,1032) ML
      WRITE(NJ,1033) APR
      WRITE(NJ,1034) NR
      WRITE(NJ,1035) ASR
      WRITE(NJ,1036) AND
      IF(IHEAVY.GT.0) WRITE(NJ,1037) ATD
      IF(IHEAVY.GT.1) WRITE(NJ,1038) ATD2
      IF(IHEAVY.GT.2) WRITE(NJ,1039) ATD3
420   CONTINUE
      IF(ICOMB.LT.12) WRITE(NJ,1040) BRRBOD
      IF(IPO4.NE.0) WRITE(NJ,1041) BRRPO4
      IF(IPO4.EQ.1) WRITE(NJ,1050) THPO4K
      IF(INH3.NE.0 .OR. INO3.NE.0) WRITE(NJ,1042) BRRNH3
      IF(ICOMB.NE.18)  WRITE(NJ,1043) BENOD
      IF(IHEAVY.NE.0) WRITE(NJ,1044) PIHM1
      IF(IHEAVY.GT.1) WRITE(NJ,1045) PIHM2
      IF(IHEAVY.GT.2) WRITE(NJ,1046) PIHM3
      WRITE(NJ,1052) ELEV,TEMPAV,XLATD,E1106,E2106
C     CHECK TO INSURE THAT BOD-N EXCEEDS THE ALGAL-N IN EACH JUNCTION
      BODWT=BODC*12./BODPC
      BODNWR=BODN*14./BODWT
      BODPWR=32./BODWT
      DO 460 K=1,MAXE
      BODNX=C(K,2)*BODNWR/BODOQ
      ALGN=C(K,7)*BODNWR/(APR*BODPWR)
      IF(BODNX.LT.ALGN) WRITE(NJ,1051)  BODNX,ALGN,K
460   CONTINUE
1002  FORMAT(' CONSTITUENT SELECTION OPTION =',64X,I5)
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      1001 FORMAT(' PHYTOPLANKTON GROWTH FUNCTION OPTION =',56X,I5)
      1003 FORMAT(' COLIFORM OPTION =',78X,I5)
      1004 FORMAT(' TEMPERATURE CORRECTION CONSTANT FOR COLIFORM REACTION COF
     *FFICIENT =',28X,F10.5)
      1005 FORMAT(' COEFFICIENT ON BOD IN COLIFORM CALCULATION =',51X,F10.5)
      1006 FORMAT(' COEFFICIENT ON HEAVY METAL 1 IN COLIFORM CALCULATION =',4
     *1X,F10.5)
      1007 FORMAT(' COEFFICIENT ON HEAVY METAL 2 IN COLIFORM CALCULATION =',4
     *1X,F10.5)
      1008 FORMAT(' COEFFICIENT ON HEAVY METAL 3 IN COLIFORM CALCULATION =',4
     *1X,F10.5)
      1009 FORMAT(' HEAVY METAL 1 CONCENTRATION LIMIT (MG/L) IN COLIFORM CALC
     *ULATION =',29X,F10.5)
      1010 FORMAT(' HEAVY METAL 2 CONCENTRATION LIMIT (MG/L) IN COLIFORM CALC
     *ULATION =',29X,F10.5)
      1011 FORMAT(' HEAVY METAL 3 CONCENTRATION LIMIT (MG/L) IN COLIFORM CALC
     *ULATION =',29X,F10.5)
      1012 FORMAT(' TEMPERATURE CORRECTION CONSTANT FOR NH3 DECAY COEFFICIENT
     * =',36X,F10.5)
      1013 FORMAT(' COEFFICIENT FOR NH3 VOLITIZATION =',61X,F10.5)
      1014 FORMAT(' TEMPERATURE CORRECTION CONSTANT FOR NH3 VOLITIZATION PROC
     *ESS =',33X,F10.5)
      1015 FORMAT(' CARBON TO PHOSPHORUS RATIO IN BOD =', 60X,F10.5)
      1016 FORMAT(' NITROGEN TO PHOSPHORUS RATIO IN BOD =',58X,F10.5)
      1017 FORMAT(' DRY WEIGHT FRACTION OF CARBON IN BOD =',57X,F10.5)
      1018 FORMAT(' BOD OXYGEN QUOTIENT =',74X,F10.5)
      1019 FORMAT(' NON-REFRACTORY FRACTION OF ORGANIC MATERIAL =',50X,F10.5)
      1020 FORMAT(' MAXIMUM GROWTH RATE (PER HOUR) AT 20 DEG FOR PHYTOPLANKTO
     *N =',35X,F10.5)
      1021 FORMAT(' TEMPERATURE CORRECTION CONSTANT FOR PHYTOPLANKTON GROWTH
     *RATE =',32X,F10.5)
      1022 FORMAT(' HEAVY METAL 1 CONCENTRATION LIMIT (MG/L) FOR PHYTOPLANKTO
     *N GROWTH =',28X,F10.5)
      1023 FORMAT(' HEAVY METAL 2 CONCENTRATION LIMIT (MG/L) FOR PHYTOPLANKTO
     *N GROWTH =',28X,F10.5)
      1024 FORMAT(' HEAVY METAL 3 CONCENTRATION LIMIT (MG/L) FOR PHYTOPLANKTO
     *N GROWTH =',28X,F10.5)
      1025 FORMAT(' HEAVY METAL 1 COEFFICIENT FOR PHYTOPLANKTON GROWTH CALCUL
     *ATION =',31X,F10.5)
      1026 FORMAT(' HEAVY METAL 2 COEFFICIENT FOR PHYTOPLANKTON GROWTH CALCUL
     *ATION =',31X,F10.5)
      1027 FORMAT(' HEAVY METAL 3 COEFFICIENT FOR PHYTOPLANKTON GROWTH CALCUL
     *ATION =',31X,F10.5)
      1028 FORMAT(' MICHAELIS-MENTON CONSTANT (MG P/L) FOR PHOSPHORUS LIMITAT
     *ION OF PHYTOPLANKTON GROWTH =', 9X,F10.5)
      1029 FORMAT(' MICHAELIS-MENTON CONSTANT (MG N/L) FOR PHOSPHORUS LIMITAT
     *ION OF PHYTOPLANKTON GROWTH =', 9X,F10.5)
      1030 FORMAT(' MICHAELIS-MENTON CONSTANT (MG NO3-N/L) FOR NITROGEN LIMIT
     *ATION OF PHYTOPLANKTON GROWTH =',7X,F10.5)
      1031 FORMAT(' MICHAELIS-MENTON CONSTANT (MG NH3-N/L) FOR NITROGEN LIMIT
     *ATION OF PHYTOPLANKTON GROWTH =',7X,F10.5)
      1032 FORMAT(' LIGHT INTENSITY CALCULATION FACTOR (LANGLEYS/MIN) =',44X,
     *F10.5)
      1033 FORMAT(' PHYTOPLANKTON TO PHOSPHORUS RATIO =',60X,F10.5)
      1034 FORMAT(' PHYTOPLANKTON RESPIRATION FACTOR =',61X,F10.5)
      1035 FORMAT(' PHYTOPLANKTON SINKING RATE (FT/HR) =',59X,F10.5)
      1036 FORMAT(' PHYTOPLANKTON NATURAL DEATH RATE ( /HR) =',54X,F10.5)
      1037 FORMAT(' PHYTOPLANKTON TOXIC DEATH COEFFICIENT FOR HEAVY METAL 1 =
     *',38X,F10.5)
      1038 FORMAT(' PHYTOPLANKTON TOXIC DEATH COEFFICIENT FOR HEAVY METAL 2 =
     *',38X,F10.5)
```

```
 1039 FORMAT(! PHYTOPLANKTON TOXIC DEATH COEFFICIENT FOR HEAVY METAL 3 =
     *!,38X,F10.5)
 1040 FORMAT(! BOD BENTHAL RELEASE RATE (MG/SQUARE METER-HR) =!,40X,F10.
     *5)
 1041 FORMAT(! PHOSPHORUS BENTHAL RELEASE RATE (MG/SQUARE METER-HR) =!,4
     *1X,F10.5)
 1042 FORMAT(! NITROGEN BENTHAL RELEASE RATE (MG/SQUARE METER-HR) =!,43X
     *,F10.5)
 1043 FORMAT(! BENTHAL OXYGEN DEMAND (MG/SQUARE METER-HR) =!,51X,F10.5)
 1044 FORMAT(! FRACTION OF HEAVY METAL 1 IN ION FORM =!,56X,F10.5)
 1045 FORMAT(! FRACTION OF HEAVY METAL 2 IN ION FORM =!,56X,F10.5)
 1046 FORMAT(! FRACTION OF HEAVY METAL 3 IN ION FORM =!,56X,F10.5)
 1047 FORMAT(! TEMPERATURE CORRECTION CONSTANT FOR BOD REACTION COEFFICI
     *ENT =!,33X,F10.5)
 1048 FORMAT(! TEMPERATURE CORRECTION CONSTANT FOR NO2 DECAY COEFFICIENT
     * =!,36X,F10.5)
 1049 FORMAT(! TEMPERATURE CORRECTION CONSTANT FOR NO3 DECAY COEFFICIENT
     * =!,36X,F10.5)
 1050 FORMAT(! TEMPERATURE CORRECTION CONSTANT FOR PO4 DECAY COEFFICIENT
     * =!,36X,F10.5)
 1051 FORMAT(! ***BOD NITROGEN =!,F10.6,! AND ALGAL NITROGEN =!,F10.6,
     *! IN ELEMENT!,I5,! ***!)
 1052 FORMAT(! LAKE ELEVATION (FEET) =!,67X,F15.5/
     *! AVERAGE TEMPERATURE (CENTIGRADE) =!,61X,F10.5/
     *! LAKE LATITUDE (DEGREES) =!,70X,F10.5/
     *! DIFFUSION COEFFICIENT 1 (10**-6) =!,61X,F10.5/
     *! DIFFUSION COEFFICIENT 2 (10**-10) =!,60X,F10,5)
      RETURN
      END
      SUBROUTINE PINE(X1,Y1,X2,Y2,NSYM,NCT)
      AXA=X1
      AXB=X2
      AYA=Y1
      AYB=Y2
      N=1
      IF(ABS(AXB-AXA).LT.ABS(AYB-AYA)) GO TO 290
C
C     SET PARAMETERS FOR X DIRECTION
C
      IF(AXB.GT.AXA) GO TO 245
      AXA=X2
      AXB=X1
      AYA=Y2
      AYB=Y1
  245 CONTINUE
      IXA=AXA+.5
      IXB=AXB+.5
      IYA=AYA+.5
      IYB=AYB+.5
  250 CONTINUE
      IF(IXA.LT.0.OR.IXA.GT.100) GO TO 260
      IF(IYA.LT.0.OR.IYA.GT.50) GO TO 260
      CALL PPLOT(IXA,IYA,NSYM,NCT)
  260 CONTINUE
      IXA=IXA+1
      YA=(N*(AYB-AYA))/(AXB-AXA)
      IYA=AYA+YA+0.5
      N=N+1
      IF(IXA.LE.IXB) GO TO 250
      GO TO 400
C
```

```
C      SET PARAMETERS FOR Y DIRECTION
C
   290 CONTINUE
       IF(AYB.GT.AYA)   GO TO 295
       AYB=Y1
       AYA=Y2
       AXB=X1
       AXA=X2
   295 CONTINUE
       IXA=AXA+.5
       IXB=AXB+.5
       IYA=AYA+.5
       IYB=AYB+.5
   300 CONTINUE
       IF(IXA.LT.0.OR.IXA.GT.100) GO TO 310
       IF(IYA.LT.0.OR.IYA.GT.50) GO TO 310
       CALL PPLOT(IXA,IYA,NSYM,NCT)
   310 CONTINUE
       IYA=IYA+1
       XA=(N*(AXB-AXA))/(AYB-AYA)
       IXA=XA+AXA+0.5
       N=N+1
       IF(IYA-IYB) 300,320,400
   320 IXA = IXB
       GO TO 300
   400 RETURN
       END
       SUBROUTINE PPLOT(IX,IY,K,NCT)
       COMMON SPACE(16680),A(51,101)
       DIMENSION SYM(9)
       COMMON /LAB/ TITLE(18),XLAB(11),YLAB(6)
      1,HORIZ(20),VERT(6)
       DATA SYM / 4H****,4H++++, 4H'''', 4HXXXX, 4H...., 4H2222,
      1 4H    , 4HIIII, 4H---- /
       IF(K-99) 200,220,230
   200 A(51-IY,IX+1)=SYM(K)
       RETURN
   220 CONTINUE
       I=0
       WRITE(6,103) TITLE,NCT
       DO 225 II=1,6
       I=I+1
       WRITE(6,101) YLAB(II),(A(I,J),J=1,101)
       IF(II.EQ.6) GO TO 228
       DO 224 JJ=1,9
       I=I+1
       IF(I.NE.28) GO TO 221
       WRITE(6,106) VERT(5),VERT(6),(A(I,J),J=1,101)
       GO TO 224
   221 IF(I.NE.24) GO TO 222
       WRITE(6,106) VERT(1),VERT(2),(A(I,J),J=1,101)
       GO TO 224
   222 IF(I.NE.26) GO TO 223
       WRITE(6,106) VERT(3),VERT(4),(A(I,J),J=1,101)
       GO TO 224
   223 WRITE(6,100) (A(I,J),J=1,101)
   224 CONTINUE
   225 CONTINUE
   228 CONTINUE
       WRITE(6,102) XLAB
       WRITE(6,105) HORIZ
```

```
    100 FORMAT(18X,101A1)
    101 FORMAT(F17.3,1X,101A1)
    102 FORMAT(F20.1,10F10.1)
    103 FORMAT(1H1,20X,18A4,I6/)
    105 FORMAT(/30X,20A4)
    106 FORMAT(3X,2A4,7X,101A1)
    230 DO 250 I=1,50
        DO 240 J=1,101
    240 A(I,J)=SYM(7)
        A(I,1)=SYM(8)
    250 CONTINUE
        DO 260 J=1,101
    260 A(51,J)=SYM(9)
        DO 270  I=1,101,10
    270 A(51,I)=SYM(8)
        DO 290 I=11,41,10
        A(I,1)=SYM(9)
    290 CONTINUE
        RETURN
        END
        SUBROUTINE OPRINT(NDAY,NXEQ,NJ)
        COMMON/LAK/KCON
        COMMON CINFLO(365,16),C(100,16)
        COMMON/FORGOT/LKAST(100)
        DATA LANK/' '/
        DATA N6/6/
        WRITE(N6,908) NDAY,NXEQ
908     FORMAT(1H1,//,10X,'ELEMENT CONCENTRATIONS FOR DAY',I5,10X,
       *'EXECUTION INTERVAL',I5//)
        WRITE(N6,607)
        IFLAG=0
        DO 2 LJ=1,NJ
        IF(LKAST(LJ).NE.LANK) IFLAG=1
2       WRITE(N6,818) LJ,(C(LJ,LK),LK=1,12),LKAST(LJ),
       *(C(LJ,LK),LK=13,KCON)
        IF(IFLAG.EQ.1) WRITE(N6,100)
        RETURN
607     FORMAT('     ELEMENT          DO     BOD     NH3-N    NO2-N NO3-N PO4-P
       *  PHYTO  COLIFORMS  HM1     HM2     HM3    TOT N    CHLOR  HMI1    HMI2
       *    HMI3'/ '   -    NUMBER      (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
       *G/L) (MG/L) (MPN/100) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
       *G/L) (MG/L)'/)
818     FORMAT(I10,6X,F8.2,F7.2,5F7.4,F10.1,4F7.3,A1,F6.3,3F7.3)
100     FORMAT(' * INDICATES SUM TOTAL OF THE NITROGEN IN CONSTITUENTS BEI
       *NG MODELED EXCEEDS THE TOTAL NITROGEN BEING MODELED AS A CONSERVAT
       *IVE.')
        END
        SUBROUTINE SCALE (ARRAY,AXLEN,NPTS,INC)
        DIMENSION ARRAY(NPTS),INT(5)
        DATA INT/2,4,5,8,10/
        INCT=IABS(INC)
C
C                                         SCAN FOR MAX AND MIN
C
        AMAX=ARRAY(1)
        AMIN=ARRAY(1)
        DO 250 N=1,NPTS,INCT
        IF(AMAX.LT.ARRAY(N)) AMAX=ARRAY(N)
        IF(AMIN.GT.ARRAY(N)) AMIN=ARRAY(N)
    250 CONTINUE
        IF( AMAX - AMIN ) 275,255,275
```

```
C
C                                              RESET MAX AND MIN FOR ZERO RANGE
C
  255 IF( AMIN ) 265, 400, 260
  260 AMIN = 0.0
      AMAX = 2.0 * AMAX
      GO TO 275
  265 AMAX = 0.0
      AMIN = 2.0 * AMIN
  275 CONTINUE
C
C                                              COMPUTE UNITS/INCH
C
      RATE=(AMAX-AMIN)/AXLEN
C
C                                                         SCALE INTERVAL TO
C                                                         LESS THAN 10
      A=ALOG10(RATE)
      N=A
      IF(A.LT.0) N=A-0.9999
      RATE=RATE/(10.**N)
      L=RATE+1.00
C
C                                              FIND NEXT HIGHER INTERVAL
C
  280 DO 300 I=1,5
      IF(L-INT(I)) 320,320,300
  300 CONTINUE
C
C                                              L IS NEXT HIGHER INTERVAL
C                                              RANGE IS SCALED BACK TO FULL SET
C
  320 L=INT(I)
      RANGE=FLOAT(L)*10.**N
      IF(INC.LT.0) GO TO 350
C
C                                              SET UP POSITIVE STEPS
C
      K=AMIN/RANGE
      IF(AMIN.LT.0.) K=K-1
C
C                                              CHECK FOR MAX VALUE IN RANGE
C
      IF(AMAX.GT.(K+AXLEN)*RANGE) GO TO 330
      I=NPTS*INCT+1
      ARRAY(I)=K*RANGE
      I=I+INCT
      ARRAY(I)=RANGE
      RETURN
C
C                                              IF OUTSIDE RANGE RESET L AND N
C
  330 L=L+1
      IF(L.LT.11) GO TO 280
      L=2
      N=N+1
  340 GO TO 280
C
C                                              SET UP NEGATIVE STEPS
C
  350 K=AMAX/RANGE
```

```
      IF(AMAX.GT.0.) K=K+1
      IF(AMIN.LT.(K+AXLEN)*RANGE) GO TO 330
      I=INCT*NPTS+1
      ARRAY(I)=K*RANGE
      I=I+INCT
      ARRAY(I)=-RANGE
      RETURN
  400 WRITE(6,100)
  100 FORMAT( // 10X, 'RANGE AND SCALE ARE ZERO ON PLOT ATTEMPT'  )
      RETURN
      END
      SUBROUTINE SETOPT
      COMMON/OPTION/IFN,IK2,ICOL,ICOMB,INH3,INO2,INO3,IPO4,IALG,IFIRST
      COMMON/OPT2/IHEAVY,ITOTN,ICHLOR
      COMMON/OPT3/IP,INH,IN2,IN3
      DATA IFIR,I2ND,NH3,NO2,NO3,LPO4,N,LP/'1ST ','2ND ','NH3-','NO2-',
     *'NO3-','PO4-','N   ','P   '/
      DIMENSION LAB(10)
      DATA LAB/'    ','    ','MODE','LED ','BY  ','    ','    ',' ORD',
     *'ER R','EACT','ION '/
      IFIRST=1
      NOUT=6
      INH3=0
      INO2=0
      INO3=0
      IPO4=0
      IALG=0
      IF(ICOMB.EQ.18)  GO TO 800
      INH3=1
      IF(ICOMB.GE.7 .AND. ICOMB.LE.11  .OR.  ICOMB.GE.16)  INH3=0
      IF(ICOMB.EQ.19  .OR.  ICOMB.EQ.20)  INH3=1
      INO2=0
      IF(ICOMB.LE.2 .OR. ICOMB.EQ.4  .OR.  ICOMB.EQ.12  .OR.
     *ICOMB.EQ.13)  INO2=1
      IF(ICOMB.EQ.19)  INO2=1
      INO3=1
      IF(ICOMB.EQ.10  .OR.  ICOMB.EQ.11)  INO3=0
      IF(ICOMB.GT.21)  INO3=0
      IPO4=1
      IF(ICOMB.EQ.4  .OR.  ICOMB.EQ.6  .OR.  ICOMB.EQ.9  .OR.
     *ICOMB.EQ.11)  IPO4=0
      IF(ICOMB.GE.19 .AND. ICOMB.LE.21  .OR.  ICOMB.EQ.23)  IPO4=0
      IALG=0
      IF(ICOMB.EQ.1  .OR.  ICOMB.EQ.3  .OR.  ICOMB.EQ.7  .OR.
     *ICOMB.EQ.12  .OR.  ICOMB.EQ.14  .OR.  ICOMB.EQ.16)  IALG=1
  800 CONTINUE
      IF(ICOMB.NE.18)  WRITE(NOUT,1000)
      IF(ICOMB.EQ.18) WRITE(NOUT,999)
      IF(ICOL.EQ.1) WRITE(NOUT,1001)
      IF(ICOMB.LE.11) WRITE(NOUT,1002)
      IF(INH3.EQ.0)  GO TO 10
      LAB(1)=NH3
      LAB(2)=N
      LAB(6)=IFIR
      IF(INH.EQ.2) LAB(6)=I2ND
      WRITE(NOUT,1003) LAB
   10 CONTINUE
      IF(INO2.EQ.0)  GO TO 20
      LAB(1)=NO2
      LAB(2)=N
      LAB(6)=IFIR
```

```
      IF(IN2.EQ.2) LAB(6)=I2ND
      WRITE(NOUT,1003) LAB
20    CONTINUE
      IF(INO3.EQ.0)  GO TO 30
      LAB(1)=NO3
      LAB(2)=N
      LAB(6)=IFIR
      IF(IN3.EQ.2) LAB(6)=I2ND
      WRITE(NOUT,1003) LAB
30    CONTINUE
      IF(IPO4.EQ.0)  GO TO 40
      LAB(1)=LPO4
      LAB(2)=LP
      LAB(6)=IFIR
      IF(IP.EQ.2)  LAB(6)=I2ND
      WRITE(NOUT,1003) LAB
40    CONTINUE
      IF(IALG.EQ.1) WRITE(NOUT,1007)
      IF(IHEAVY.EQ.1) WRITE(NOUT,1008) IHEAVY
      IF(IHEAVY.GT.1) WRITE(NOUT,1111) IHEAVY
      IF(ITOTN.NE.0)  WRITE(NOUT,1009)
      IF(ICHLOR.NE.0) WRITE(NOUT,1010)
      WRITE(NOUT,1112)
      RETURN
999   FORMAT(' THE FOLLOWING CONSTITUENTS ARE BEING MODELED')
1000  FORMAT(' THE FOLLOWING CONSTITUENTS ARE BEING MODELED   DISSOLVED
     *OXYGEN')
1001  FORMAT(48X,'COLIFORMS')
1002  FORMAT(48X,'BOD')
1003  FORMAT(48X,10A4)
1007  FORMAT(48X,'PHYTOPLANKTON')
1008  FORMAT(48X,I1,' HEAVY METAL (AND ITS ASSOCIATED ION)')
1009  FORMAT(48X,'TOTAL NITROGEN')
1010  FORMAT(48X,'CHLORIDES')
1111  FORMAT(48X,I1,' HEAVY METALS (AND THEIR ASSOCIATED IONS)')
1112  FORMAT(//)
      END
      SUBROUTINE SUBA

      COMMON DATA(2920,7),ALPHA(20),INDEX(7)

      COMMON/NDV/ A, B, IDAY, ITAPE, IYR, LAT, LDAY, LOG, NOBS, PTEMP,
     A  RESEL, SRO, SSO, NGO, NINT

      INTEGER MONTH(12)
      DATA MONTH/31,28,31,30,31,30,31,31,30,31,30,31/
      REAL LAT, LOG

C ** INITIALIZE NECESSARY VARIABLES
      DO 1 I=1,7
      DO 1 J=1,2920
1     DATA(J,I)=0.

      SRO = 0.0
      SSO = 0.0
      PTEMP = 0.0
      DO 7 J = 1, 7
      INDEX(J) = 0
    7 CONTINUE

C ** READ AND WRITE RUN DATA
```

```
      READ(5,501) ALPHA
      WRITE(6,601) ALPHA
      READ(5,503) IYR, IDAY, LDAY, NOBS, ITAPE
      WRITE(6,602) IYR, IDAY, LDAY, NOBS, ITAPE
      NGO = 1
      NINT = NOBS * ( LDAY - IDAY + 1 )
      MONF=IDAY/30+1
      MONL=LDAY/30
      READ(5,509) A, B, LAT, LOG, RESEL
      WRITE(6,603) A, B, LAT, LOG, RESEL

C ** READ A METOROLOGIC DATA SET

    9 READ(5,507,END=45) ID,CV,CVA,CVB
      IF(ID.GT.100)  GO TO 45

C ** CHECK ON INPUT STATUS

      IB = ID
      INDEX(ID) = ID
      IF( ID .GT. 5 ) ID = ID - 1
      NUP = 0
      DO 55 L=MONF,MONL
      NLO = NUP + 1
      NUP = NUP + MONTH(L)
      READ(5,511) ( DATA(J,ID), J = NLO, NUP )
   55 CONTINUE

C ** MAKE UNITS CONVERSIONS

      DO 113 J = NGO, NINT
      DATA(J,ID) = CV * ( DATA(J,ID) - CVA ) + CVB
  113 CONTINUE

C ** WRITE OUT COMMENT FOR EACH INPUT

   19 GO TO ( 21,22,23,24,25,26,27 ) , IB
   21 WRITE(6,621)
      GO TO 35
   22 WRITE(6,622)
      GO TO 35
   23 WRITE(6,623)
      GO TO 35
   24 WRITE(6,624)
      GO TO 35
   25 WRITE(6,625)
      GO TO 35
   26 WRITE(6,626)
      GO TO 35
   27 WRITE(6,627)
   35 WRITE(6,620) CV, CVA, CVB
      GO TO 9

C ** END OF RAW DATA INPUT

   45 WRITE(6,635)

      RETURN

C ** INPUT FORMAT STATEMENTS
```

```
      501 FORMAT( 20A4 )
      503 FORMAT( 8I10 )
      505 FORMAT( 16F5.0 )
      507 FORMAT( I10, 3E10.0 )
      509 FORMAT( 8E10.0 )
 511    FORMAT(5X,F5.0,7F10.0)

 C ** OUTPUT FORMAT STATEMENTS

 601    FORMAT(1H1,//,10X,20A4)

      602 FORMAT( /// 26X, 4HYEAR  I10 /
         A              21X, 9HFIRST DAY I10 / 22X, 8HLAST DAY I10 /
         B  27X, 3HOBS I10 / 22X, 8HTAPE OUT I10 )

      603 FORMAT( // 29X, 1HA,1PE10.2/ 29X, 1HB, F10.2/ 22X,8HLATITUDE
         A0PF10.1  / 21X, 9HLONGITUDE F10.1 / 21X, 9HELEVATION  F10.1 )

      620 FORMAT( 1H+, 60X, 11HCONVERSIONS  1P3E15.3, I10 )

      621 FORMAT( // 20X, 26HATMOSPHERIC PRESSURE INPUT )

      622 FORMAT( // 20X, 16HCLOUDINESS INPUT )

      623 FORMAT( // 20X, 16HWIND SPEED INPUT )

      624 FORMAT( // 20X, 26HDRY BULB TEMPERATURE INPUT )

      625 FORMAT( // 20X, 26HWET BULB TEMPERATURE INPUT )

      626 FORMAT( // 20X, 27HDEW POINT TEMPERATURE INPUT  )

      627 FORMAT( // 20X, 32HSHORT WAVE SOLAR RADIATION INPUT )

      635 FORMAT( //// 50X, 14HEND DATA INPUT )

          END
          SUBROUTINE SUBB

          COMMON/ABLK/ ABAR(200), AREA(200), DC(200), DENS(200), DHI(200),
         A  DVOL(200), DZ(200), DZI(200), QHI(200), QHO(200), T(200),
         B  TDOT(200), TEX(200), THI(200), VOL(200), Z(200), ZMID(200)

          COMMON/BBLK/ A, AT, BB, EV, NAVG, QC, QE, QN, QNA, QNS, QW

          COMMON/CBLK/ DST(365), POOL(365), QIN(365), RESTM(365), TIN(365)

          COMMON/DBLK/ DRODZ(5), ELOUT(5), NOU(5), QOT(365,3), TOUT(365,3),
         A  TSPEC(365), WOT(5)
         *,ISRNOU(3)

          COMMON/FBLK/ EUP(5), QUP(5), TUP(5),WUP(5), IDOUT(50), QORO(365)

          COMMON/NDV/ A1, A2, A3, DELT, DQIN, DTRY2, DZT, EDMAX, ELTC, EVA,
         A  EVAP, EXCO, GMAX, GMIN, GSWH, IAT, IBT, IDAY, IMIX, INTP, IONE,
         B  IPRT, ITAPE, ITWO, IVAL, LDAY, MAXE, MAXP, NLETS, NOBS, NOUTS,
         C  NTC, NREP, NSD, NSEG, NUM, NUME, NUMP, NUSI, NTRIBS, NXEQ, QI,
         D  QOUT, RESEL, RLEN, SDZ, SHEAT, STABLE, VONE, VSUM, VTOP, INT,
         E  C1, C2, C3
```

```
      DIMENSION CMENT(40), TF(200), VH(200), VZ(200)

C ** INITIALIZE SYSTEM CONSTANTS AND PARAMETERS

      NPAGE = 1
      NSEG = 0
      READ(5,520) INT
520   FORMAT(I10)
      GMAX = 3.5

C ****  READ UPSTREAM FLOW FILE

      REWIND INT
      READ(INT) IDAY, LDAY
      READ(INT) ( POOL(L), QIN(L), QOT(L,1), TIN(L), L = IDAY, LDAY )

C ** READ METOROLOGIC INPUT FILE

      READ(5,505) IDAY, LDAY
      READ(INT) IYR, IA, IB, NOBS
      IF( IA .LE. IDAY .AND. IB .GE. LDAY ) GO TO 33
      WRITE(6,659) MAX, IA, IB
      STOP
   33 IF( IA .EQ. IDAY ) GO TO 99
      IC = NOBS * ( IDAY - IA )
      DO 35 J = 1, IC
      READ(INT) TA
   35 CONTINUE

C ** READ AND WRITE SEGMENT CARD INPUT

   99 READ(5,501) CMENT
      WRITE(6,601) CMENT
      READ(5,504) SDZ, ELMAX, EDMAX, A, BB, GMIN
      WRITE(6,603) IDAY, LDAY, SDZ,  ELMAX
      EXCO = 6.908 / EDMAX
  103 WRITE(6,604) EDMAX, A, BB, GMIN, EXCO

C ** READ AND WRITE SEGMENT RUN PARAMETERS

      READ(5,505) NSEG,  NTP, NSD, IPRT, INTP, ITAPE, NOUTS,
     A  NXEQ, IVAL
      WRITE(6,605) NSEG,  NTP, NSD, IPRT, INTP, ITAPE, NOUTS,
     A  NXEQ, IVAL, NOBS
      READ(5,504) GSWH, A1, A2, A3,  RLEN
      WRITE(6,663) GSWH, A1, A2, A3, RLEN

C  ****  READ AND WRITE AREA COEFFICENTS

      READ(5,504) C1, C2, C3
      WRITE(6,609) C1, C2, C3

C ** READ AND WRITE OUTLET POSITIONS

      DO 104 J = 1, NOUTS
      READ(5,509) N,ELOUT(N),WOT(N),ISRNOU(N)
  104 CONTINUE
      WRITE(6,606) ( J,  ELOUT(J), WOT(J), J = 1, NOUTS )

C ** INITIALIZE SELECTED ARRAYS

```

```
      DO 105 J = 1, 200
      AREA(J) = 0.0
      DVOL(J) = 0.0
      T(J) = 0.0
      TDOT(J)= 0.0
      VOL(J) = 0.0
      Z(J) = 0.0
  105 CONTINUE

C ** GENERATE ELEVATION PROFILE

      TC = 0.5 * SDZ
      DO 107 J = 2, 200
      Z(J) = Z(J-1) + SDZ
      ZMID(J-1) = Z(J-1) + TC
      DZ(J-1) = SDZ
  107 CONTINUE
      MAXE = ( ELMAX + TC ) / SDZ
      MAXP = MAXE + 1

C  ****  GENERATE AREA AND VOLUME PROFILES

  113 DO 115 J = 1, MAXP
      AREA(J) = C1 + C2 * Z(J) + C3 * Z(J) ** 2
      VOL(J) = C1 * Z(J) + ( C2 / 2.0 ) * Z(J) ** 2 +(C3 / 3.0 ) *
     A  Z(J) ** 3
  115 CONTINUE
      DO 117 J = 1, MAXE
      DVOL(J) = VOL(J+1) - VOL(J)
  117 CONTINUE

C ** INPUT TEMPERATURE INITIALIZATION DATA POINTS

  131 IF( NTP .GT. 1 ) GO TO 139
      READ(5,504) TA, TB
      DO 135 J = 1, MAXP
      T(J) = TB
  135 CONTINUE
      GO TO 147
  139 DO 145 J = 1, NTP
      READ(5,504) TA, TB
      DO 143 K = 1, MAXP
      IF( TA .GT. ZMID(K) ) GO TO 143
      T(K) = TB
      GO TO 145
  143 CONTINUE
  145 CONTINUE

      CALL SUBG( NTP, T, 200 )

C ** INPUT DAYS FOR SPECIAL PRINTED OUTPUT

  147 IF( NSD .GT. 0 ) READ(5,511) ( IDOUT(J), J = 1, NSD )

C ** LOCATE OUTLETS IN THIS SEGMENT

      DO 159 J = 1, NOUTS
      DO 157 K = 1, MAXP
      IF( ELOUT(J) .GT. ZMID(K) ) GO TO 157
      NOU(J) = K
      GO TO 159
```

```
  157 CONTINUE
  159 CONTINUE

C ** WRITE OUT SYSTEM INFORMATION NOW AVAILABLE

  163 MAX = INTP * 48
      DO 165 J = 1, MAXP, MAX
      IGO = J
      IEND = IGO + MAX -1
      IF( IEND .GT. MAXP ) IEND = MAXP
      NPAGE = NPAGE + 1
      WRITE(6,601) CMENT
      WRITE(6,607) (K,Z(K),AREA(K),VOL(K),DVOL(K),T(K),
     A  K = IGO, IEND, INTP )
  165 CONTINUE

      RETURN

      ENTRY PRNT(M,MM)

C ** CONVERT TO DEG F AND CALCULATE ADVECTION RATIOS

      QVIN = 0.0
      DO 213 J = 1, NUME
      TF(J) = 1.8 * TFX(J) + 32.0
      TA = 1.0 / DVOL(J)
      IF( J .EQ. NUME ) TA = 1.0 / VTOP
      QVOT = QHI(J) + QVIN - QHO(J)
      VH(J) = DELT * AMAX1(QHI(J),QHO(J) ) * TA
      VZ(J) = DELT * AMAX1(ABS(QVIN),ABS(QVOT)) * TA
      QVIN = QVOT
  213 CONTINUE

C ** WRITE SIMULATION OUTPUT

      NPAGE = NPAGE + 1
      WRITE(6,601) CMENT
      WRITE(6,653) M,MM
      WRITE(6,643) RESEL, AT, DZT, TFX(NUME), QI, EVA, QOUT, EVAP,
     A      ELTC, TIN(M), DST(M), Z(IMIX), RESTM(M), TSPEC(M)
      WRITE(6,645)      QNS, QNA, QW, QE, QC
      WRITE(6,649)(J, NOU(J), ELOUT(J), QOT(M,J), TOUT(M,J), DRODZ(J),
     A  J = 1, NOUTS )
  214 MAX = INTP * 48
      DO 215 J = 1, NUME, MAX
      IGO = J
      IEND = IGO + MAX - 1
      IF( IEND .GT. NUME ) IEND = NUME
      NPAGE = NPAGE + 1
      WRITE(6,601) CMENT
      WRITE(6,653) M,MM
      WRITE(6,654)
      WRITE(6,655) ( K, Z(K), TFX(K), TF(K), QHO(K), QHI(K), TDOT(K),
     A  DC(K), VZ(K), VH(K), K = IGO, IEND, INTP )
  215 CONTINUE
      CALL QPRINT(M,MM,NUME)
      CALL CURVE(TFX(1),Z(1),NUME,1,M)
      DO 219 J = NUMP, MAXP
      TFX(J) = TFX(NUME)
      Z(J) = Z(J-1) + SDZ
  219 CONTINUE
```

```
                RETURN


      C ** INPUT FORMAT STATEMENTS

        501 FORMAT( 20A4 )
        503 FORMAT( 2I10, 6E10.0 )
        504 FORMAT( 8E10.0 )
        505 FORMAT( 16I5 )
        507 FORMAT( 4( I10, E10.0 ) )
      509   FORMAT(I10,2E10.0,I10)
        511 FORMAT( 16I5 )

      C ** OUTPUT FORMAT STATEMENTS

      601    FORMAT(1H1,35X,'DEEP RESERVOIR MODEL'//(25X,20A4))

        603 FORMAT ( /// 21X, 9HFIRST DAY I10 / 21X, 9HFINAL DAY I10 //
           A  21X, 9HNORMAL DZ F10.3 / 20X, 10HMAXIMUM EL F10.1 )

        604 FORMAT( // 22X, 8HEX DEPTH 1PE15.3 /
           A  18X, 12HEVAP COEFF A  E15.3 /
           B  18X, 12HEVAP COEFF B E15.3 /
           C  22X, 8HMIN STAB 0PF15.3 // 20X, 10HSW EX COEF E15.3 )

        605 FORMAT( //  20X,10HSEG NUMBER I10 /
           A  22X, 8HTEMP PTS I10 / 22X, 8HDAYS OUT I10 /
           B  19X, 11HOUTPUT FREQ I10 / 17X, 13HVERT PRT FREQ I10 /
           C  22X, 8HTAPE OUT I10 /  19X, 11HNUM OUTLETS I10 /
           D  20X, 10HREPEAT XEQ  I10 / 16X, 14HXEQ OUTPUT INT  I10 /
           E  19X, 11HOBS PER DAY  I10 )

        606 FORMAT( // 24X, 36HOUTLET       ELEVATION      EFF WIDTH  /
           A  ( I30, 1P2E15.3 ) )

        607 FORMAT(  / 13X,  62HNO      ELEVATION       SEC AREA       CULM VO
           *L       DELTA VOL  ,6X,'TEMP(C)'//(I15,0PF15.1,1P4E15.3))

        609 FORMAT(  // 17X, 13HAREA COEFF C1 1PE15.3 / 17X, 13HAREA COEFF C2
           A  E15.3 / 17X, 13HAREA COEFF C3 E15.3 )

        643 FORMAT( // 14X, 26HGENERAL SYSTEM INFORMATION //
           A  21X, 19HRESERVOIR ELEVATION F10.2, 2H M 17X,
           B  16HSURFACE AIR TEMP F12.2, 6H DEG C /
           C  25X, 15HSURFACE ELEMENT F10.2, 2H M 15X,
           D  18HSURFACE WATER TEMP  F12.2,  6H DEG C  /
           E  21X, 19HTOTAL SYSTEM INFLOW F10.1, 4H CMS 13X,
           F  18HEVAPORIZATION RATE  1PE12.2, 4H CMS   /
           G  20X,   20HTOTAL SYSTEM OUTFLOW 0PF10.1, 4H CMS 13X,
           H  18HCULM EVAPORIZATION  F12.3, 2H M /
           K  24X, 16HELEV THERMOCLINE F10.1, 2H M   ,
           L  15X, 18HINFLOW TEMPERATURE F12.2, 6H DEG C /
           M  25X, 15HDOWNSTREAM TEMP  0PF10.2, 6H DEG C, 12X,
           N  17HLOWEST MIXED ELEV  F12.1, 2H M  /
           O  26X, 14HRETENTION TIME  F10.1,  5H DAYS ,
           P  16X, 14HOBJECTIVE TEMP F12.2,    6H DEG C  )

        645 FORMAT( /// 18X, 22HSURFACE HEAT EXCHANGES  //
           A  37X, 3HQNS 1PE13.3,8H KC/M2/S  /
           B  37X, 3HQNA, E13.3, 8H KC/M2/S /38X, 2HQW, E13.3, 8H KC/M2/S  /
           C  38X, 2HQE, E13.3, 8H KC/M2/S / 38X, 2HQC, E13.3, 8H KC/M2/S )
```

```
      649 FORMAT( /// 25X, 15HSYSTEM OUTFLOWS  // 33X, 57HNO       ELEM
         AELEV       FLOW       TEMP        DEN GRAD  /
         B  ( 25X, 2I10, 0PF10.1, 2F10.2, 1PE15.3 ) )

      653 FORMAT( /  25X, 36HSUMMARY OF OUTPUT FOR SIMULATION DAY  I5 ,
         A  5X, 18HEXECUTION INTERVAL IS )

      654 FORMAT(   / 8X, 120HNO        ELEVATION     TEMP DEG C     TEMP DEG
         1F        HORZ OUT          HORZ IN     RATE OF CHG       DIFF COEF    V
         2AR   HAR  /  )

      655 FORMAT( I10, 0PF15.1, 4F15.4, 1P2E15.3, 0PF7.2, F6.2 )

      659 FORMAT( /// 10X, 13HERROR IN FILE I4, 20H   THE FILE RANGE IS I4,
         A  4H  TO  I4  )

      663 FORMAT( /// 17X, 13HCRITICAL STAB 1PE15.3 /
         A  17X, 13HLOW GRAD COEF E15.3 / 21X, 9HINTERCEPT E15.3 /
         B  22X, 8HEXPONENT E15.3    /
         C  18X, 12HREACH LENGTH  1PE15.3 )

          END
          SUBROUTINE SUBH2

          COMMON/NDV/ A, B, IDAY, ITAPE, IYR, LAT, LDAY, LOG, NOBS, PTEMP,
         A  RESEL, SRO, SSO, NGO, NINT

          COMMON DATA(2920,7),ALPHA(20),INDEX(7)

          EQUIVALENCE (DATA(1,1),AP(1)), (DATA(1,2),CLD(1),ET(1) ),
         A  (DATA(1,3),WS(1)),(DATA(1,4),DBT(1)), (DATA(1,5),WBT(1),DPT(1) ,
         B  EA(1)),   (DATA(1,6),QS(1),QNS(1)),(DATA(1,7),QAT(1),WC(1) )

          REAL AP(2920), CLD(2920), WS(2920), DBT(2920), WBT(2920),
         A  DPT(2920), QS(2920), QAT(2920), QNS(2920), WC(2920), EA(2920),
         B  ET(2920)

          REAL  LAT, LOG, MU, LAMBDA

          REAL ALPH(6), BETA(6), ATWO(4), BTWO(4), DUST(4,2)

          DATA ALPH / 5.70,4.00,0.757,-5.41,-15.29,-30.43/,
         A  BETA/ 0.620,0.842,1.107,1.459,1.898,2.449/,
         B  ATWO/ 1.18,2.20,0.95,0.35 / ,
         C  BTWO /-0.77,-0.97,-0.75,-0.45/,
         D  DUST /0.06,0.06,0.05,0.07,0.08,0.10,0.07,0.08 /

          VPS(THA) = 2.1718E8 * EXP( -4157.0 / ( THA + 239.09 ) )

          IQUIT = 0

    C ** CHECK ON ATMOSPHERIC PRESSURE

          IF( INDEX(1) .GT. 0 ) GO TO 103
          TEMP = 1013.0 * 10.0 ** ( -5.25E-5 * RESEL )
          DO 101 J = NGO, NINT
          AP(J) = TEMP
      101 CONTINUE

    C ** GENERAL INPUT DATA CHECKS
```

```
      103 DO 105 J = 2, 4
          IF( INDEX(J) .LE. 0 ) IQUIT = 1
      105 CONTINUE
          IF( INDEX(5) + INDEX(6) .LE. 0 ) IQUIT = 1
          IF( IQUIT .LE. 0 ) GO TO 109
          WRITE(6,671)
          STOP

      109 IF( INDEX(6) .GT. 0 ) GO TO 117

    C ** WET BULB IS AVAILABLE

          DO 113 J = NGO, NINT
          EA(J) = VPS( WBT(J) ) - AP(J) * ( DBT(J) - WBT(J) ) *
         A  ( 6.6E-4 + 7.59E-7 * WBT(J) )
          WC(J) = 0.86 * ( 1.26E-5 * ( DBT(J) + 273.0 ) ** 2 ) ** 8.33
      113 CONTINUE
          GO TO 121

    C ** DEW POINT AVAILABLE

      117 DO 119 J = NGO, NINT
          EA(J) = VPS( DPT(J) )
          WC(J) = 0.86 * EXP( 0.111 + 0.0614 * DPT(J) )
      119 CONTINUE

    C ** SOLAR RADIATION CALCULATIONS

    C ** CALCULATE SOME CONSTANTS

      121 NHRS = 24 / NOBS
          HRS = FLOAT( NHRS )
          SRO = SRO / 57.3
          SSO = SSO / 57.3
          CONE = 3.14159 * LAT / 180.0
          TC = FLOAT( ( IFIX(LOG) / 15 ) * 15 )
          TC = ( LOG - TC ) / 15.0


    C ** ENTER MAIN CALCULATION LOOP

          LL = 0
      125 DO 135 L = IDAY, LDAY
          LL = LL + 1
          KK = L / 92 + 1

    C ** SET UP DAILY VALUES

          R = 1.0 + 0.017 * COS( 1.72E-2 * FLOAT( 181 - L ) )
          DEL = 0.409 * COS( 1.72E-2 * FLOAT( 172 - L ) )
          CTWO = SIN(CONE) * SIN(DEL)
          CTRI = COS(CONE) * COS(DEL)
          HSR = - 3.82 * ARCOS( ( SIN(SRO) - CTWO ) / CTRI ) + TC
          HSS = 3.82 * ARCOS( ( SIN(SSO) - CTWO ) / CTRI ) + TC
          TIME = -12.0
          QONE = 0.0
          RONE = 0.0
          NN = NOBS * ( LL - 1 )

    C ** ENTER INTERVAL LOOP
```

```
      DO 133 K = 1, NOBS
      SUMQ = 0.0
      RSUM = 0.0
      N = NN + K
      M = 1
      IF( CLD(N) .LT. 0.1 ) GO TO 127
      M = 2 + INT( ( CLD(N) - 0.101 ) / 0.40 )
  127 CS = 1.0 - 0.65*CLD(N) ** 2

C ** ENTER HOUR LOOP

      DO 131 J = 1, NHRS
      TIME = TIME + 1.0
      IF( TIME .LE. HSR .OR. TIME .GE. HSS )   GO TO 131
      AL = ARSIN( SIN(CONE) * SIN(DEL) + COS(CONE) * COS(DEL) *
     A  COS( 0.262 * TIME ) )
      IF( AL .LE. 0.0 .OR. AL .GE. 1.57 ) GO TO 131
      TEMP = AP(N) / 1013.0
      CM =  TEMP / ( SIN(AL) +  0.15 * ( 57.3 * AL + 3.885 ) **
     A  ( -1.253 ) )
      TEMP = 0.17 * EXP( -0.88 * CM ) + 0.129
      AI = EXP( - ( 0.465 + 0.134 * WC(N) ) * TEMP * CM )
      TEMP = 0.421 * EXP( -0.721 * CM ) + 0.179
      AII = EXP( - ( 0.465 + 0.134 * WC(N) ) * TEMP * CM )
      QO = 0.33 * SIN(AL) / R ** 2
      RSO = ATWO(1) * ( 57.3 * AL ) ** BTWO(1)
      RFO = ATWO(M) * ( 57.3 * AL ) ** BTWO(M)
      IF( RFO .GT. 1.0 ) RFO = 1.00
      MM = 1
      IF( CM .GT. 1.5 ) MM = 2
      TEMP = AII + 0.5 * ( 1.0 -AI - DUST(KK,MM) )
      TEMP = TEMP / ( 1.0 - 0.5 * RSO * ( 1.0 - AI + DUST(KK,MM) ))
      QTWO = QO * TEMP * CS
      SUMQ = SUMQ + 0.5 * ( QONE + QTWO )
      RTWO = QTWO * ( 1.0 - RFO )
      RSUM = RSUM + 0.5*( RONE + RTWO )
      QONE = QTWO
      RONE = RTWO
  131 CONTINUE
      RTEMP = 0.0
      IF( SUMQ .GT. 0.0 ) RTEMP = RSUM / SUMQ
      IF( INDEX(7) .LE. 0 ) QS(N) = SUMQ / HRS
      QNS(N) = RTEMP * QS(N)
  133 CONTINUE
  135 CONTINUE

C ** NET ATMOSPHERIC


      DO 149 J = NGO, NINT
      QAT(J) = 1.233E-16 * ( 1.0 + 0.17 * CLD(J) ** 2 )
     A  * ( DBT(J) + 273.0 ) ** 6
  149 CONTINUE

C** CALCULATE EQULIBRIUM TEMPFRATURES

      DO 169 J = NGO, NINT
      N = IFIX( PTEMP ) / 5 + 1
      TA = 5.95E5 * ( A + B * WS(J) )
      LAMBDA = 1.17E-3 + TA * ( BETA(N) + 6.1E-4 * AP(J) )
```

```
          MU = 0.6 * QNS(J) + QAT(J) - 7.36E-2 - TA *
         A  ( ALPH(N) - EA(J) - 6.1E-4 * AP(J) * DBT(J) )
          ET(J) = MU / LAMBDA
          PTEMP = ET(J)
          IF( PTEMP .LT. 0.0 ) PTEMP = 0.0
          IF( PTEMP .GT. 29.9 ) PTEMP = 29.9
      169 CONTINUE

    C ** WRITE OUTPUTS

      173 DO 171 K = NGO, NINT, 50
          MAX = K + 49
          IF( MAX .GT. NINT ) MAX = NINT
          WRITE(6,601)
          WRITE(6,651)(J, QNS(J), QAT(J), AP(J), DBT(J),  EA(J) ,
         A  WS(J), ET(J), J = K, MAX )
      171 CONTINUE

          IF( ITAPE .LE. 0 )  RETURN

          DO 175 J = NGO, NINT
          AP(J) = 6.1E-4 * AP(J)
      175 CONTINUE
          WRITE(ITAPE) IYR,IDAY,LDAY,NOBS
          DO 177 J = NGO, NINT
          WRITE(ITAPE) QNS(J),QAT(J),AP(J),DBT(J),EA(J),WS(J)
      177 CONTINUE
          END FILE ITAPE
          REWIND ITAPE
          RETURN

    601   FORMAT(1H1,30X,'METEOROLOGIC DATA'/)

      651 FORMAT(3X, 93HNO     NET SOLAR     NET ATMOS     AT PRESS     DRY BL
         1UB            EA           WIND         EQ TEMP
         *  //(I5,7F13.5))


      671 FORMAT( // 20X, 37HSOME NECESSARY PARAMETERS ARE MISSING  //
         A  22X, 17H** PROGRAM HALTED  )

          END
          SUBROUTINE SUBC

          COMMON/ABLK/ ABAR(200), AREA(200), DC(200), DENS(200), DHI(200),
         A  DVOL(200), DZ(200), DZI(200), QHI(200), QHO(200), T(200),
         B  TDOT(200), TFX(200), THI(200), VOL(200), Z(200), ZMID(200)

          COMMON/BBLK/ A, AT, BB, EV, NAVG, QC, QE, QN, QNA, GNS, QW

          COMMON/CBLK/ DST(365), POOL(365), QIN(365), RESTM(365), TIN(365)

          COMMON/DBLK/ DRODZ(5), ELOUT(5), NOU(5), QOT(365,3), TOUT(365,3),
         A  TSPEC(365), WOT(5)

          COMMON/FBLK/ EUP(5), QUP(5), TUP(5),WUP(5), IDOUT(50), QORO(365)

          COMMON/NDV/ A1, A2, A3, DELT, DGIN, DTBY2, DZT, EDMAX, ELTC, EVA,
         A  EVAP, EXCO, GMAX, GMIN, GSWM, IAT, IBT, IDAY, IMIX, INTP, IONE,
         B  IPRT, ITAPE, ITWO, IVAL, LDAY, MAXE, MAXP, NLFTS, NOBS, NOUTS,
         C  NTC, NREP, NSD, NSEG, NUM, NUME, NUMP, NUSI, NTRIBS, NXEQ, QI,
```

```
      D  QOUT, RESEL, RLEN, SDZ, SHEAT, STABLE, VONE, VSUM, VTOP, INT,
      E  C1, C2, C3
       COMMON/DBUG/IBUG
       COMMON/TEMPER/TEMPAV,TEMLEV(100)
       COMMON CINFLO(365,16),CLAK(100,16),COTFLO(365,16),AV(200),B(200),
      *FEE(200),P(200),S(200,3),SN(200)
       COMMON/LAK/KCON,DU,E1,E2,NOWDAY,XSDZ,XDZTOP,XATOP,XVTOP,NHOUR
       COMMON/LAK2/DZTOP2,ATOP2,VTOP2
       DIMENSION XTEMP(16)


       RO(TA) = 1000.0 - (((TA - 3.98 ) ** 2*( TA + 283.0 ) ) /
      A  ( 503.57 * ( TA + 67.26 ) ) )
       AF(X) = C1 + C2 * X + C3 * X ** 2
       VF(X) = C1 * X +( C2 / 2.0 ) * X ** 2 + ( C3 / 3.0 ) * X ** 3

C ** CALCULATE SOME MISCELLANEOUS QUANTITIES

       IBUG=0
       TA = 1.0 / SDZ
       DO 105 J = 1, MAXE
       DZI(J) = TA
       TEX(J) = T(J)
       ABAR(J) = 0.5 * ( AREA(J) + AREA(J+1) )
   105 CONTINUE
       DELT = 3600.0 * FLOAT( 24 / NXEQ )
       DTBY2 = 0.5 * DELT
       EVAP = 0.0
       IMIX = 1
       IF(T(MAXE)-T(1).GT. .1)  IMIX=MAXE
       NHOB = 24 / NOBS
       NHXQ = 24 / NXEQ
       NAVG = ( NHXQ - 1 ) / NHOB + 1

C ** INITIAL OUTPUT TAPE WRITE

       IF( ITAPE .LE. 0 ) GO TO 119
       WRITE(ITAPE) IDAY, LDAY, SDZ, NOUTS

C *****  ENTER DAILY INTERVAL LOOP  *****

   119 DO 279 L = IDAY, LDAY
       IF(L.EQ.174) STOP
       IF(IBUG.EQ.1)  WRITE(6,1002) L
 1002  FORMAT(/' ******DAY NUMBER',I5,' ******'/)
       RESEL = POOL(L)
       TSPEC(L) = TIN(L)
       QI = QIN(L)
       NOWDAY=L

C ** SURFACE ELEMENT PROPERTIES

       NUME = POOL(L) / SDZ + 1.0
       IF( POOL(L) - Z(NUME) .LT. 0.75 * SDZ ) NUME = NUME - 1
       NUMP = NUME + 1
       NUM = NUME - 1
       NULL = NUM  - 1
       ATOP = AF( POOL(L) )
       VSUM = VF( POOL(L) )
       VTOP = VSUM - VOL(NUME)
       DZT = POOL(L) - Z(NUME)
```

```
      DZTOP = 0.5 * ( SDZ + DZT )
C     PASS VARIABLES TO SUBROUTINE LAKCON
      XSDZ=SDZ
      XDZTOP=DZTOP
      XATOP=ATOP
      XVTOP=VTOP
      LP1=L+1
      IF(L.EQ.LDAY) LP1=L
      ATOP2=AF(POOL(LP1))
      VTOP2=VF(POOL(LP1))-VOL(NUME)
      DZTOP2=POOL(LP1)-Z(NUME)
      DZTOP2=.5*(SDZ+DZTOP2)

C ***** ENTER EXECUTION INTERVAL LOOP  *****

      DO 271 M = 1, NXEQ
      NHOUR=M*24/NXEQ
      DO 163 J = 1, MAXE
      AV(J) = 0.0
      QHI(J) = 0.0
      QHO(J) = 0.0
      FEE(J) = 0.0
      SW(J) = 0.0
  163 CONTINUE
      NH = ( M - 1 ) * NHXQ
      IF( MOD(NH,NHOB) .EQ. 0 ) CALL SUBD( TFX(NUME) + DELT *TDOT(NUME))
  164 EVAP = EVAP + EV * DELT
      EVA = EV * ATOP

C ** CALCULATE THE DENSITY PROFILE

      DO 165 J = 1, NUME
      DENS(J) = RO( TFX(J) )
  165 CONTINUE
      DENS(NUMP) = DENS(NUME)

C ** LOCATE THERMOCLINE

      NTC = NUME
      TA = 0.0
      DO 169 J = 1, NUM
      TB = DZI(J) * ( TFX(J+1) - TFX(J) )
      IF( TB .LT. TA ) GO TO 169
      NTC = J
      TA = TB
  169 CONTINUE
      ELTC = Z(NTC)

C ** CALCULATE THE DIFFUSION COEFFICIENT

      DO 175 J = 1, NUM
      DC(J+1) = A1
      TA =(2.0   * DZI(J) * ( DENS(J) - DENS(J+1) ))/ ( DENS(J)
     A  + DENS(J+1) )
      IF( TA .LE. GSWH ) GO TO 175
      DC(J+1) = A2 * TA ** A3
  175 CONTINUE
      DC(1) = 0.0
      DC(NUMP) = 0.0

C ** CALCULATE RATE OF HORIZONTAL ENERGY INPUT
```

```
      CALL SUBH( L, FEE, 200 )
      CALL SUBE(M,L)

C ** CALCULATE RATE OF SOLAR ENERGY INPUT

  211 TA = RESEL - 0.3
      TB = RESEL - EDMAX
      DO 213 J = 1, NUME
      K = NUMP - J
      IF( Z(K) .LT. TB ) GO TO 215
      SW(K) = EXP( EXCO * ( Z(K) - TA ) )
  213 CONTINUE
  215 QSW = 0.6 * QNS
      DO 219 J = K, NUM
      SW(J) = AHAR(J) * QSW * ( SW(J+1) - SW(J) )
  219 CONTINUE
      SW(NUME) =  ATOP * QSW * ( 1.0 - SW(NUME) )

C ** CALCULATE RATE OF SURFACE ENERGY INPUT

      SHEAT=  QN - 0.6 * QNS - QE - QC

C ** ESTIMATE INITIAL RATE OF TEMPERATURE CHANGE

      IF( L .NE. IDAY ) GO TO 220
      IF( M .NE. 1 ) GO TO 220
      T(NUMP) = T(NUME)
      VERT = 0.0
      TA = 0.0
      DO 197 J = 1, NUME
      TD = DZI(J)
      IF( J .EQ. NUM  ) TD = 1.0 / DZTOP
      TB = AREA(J+1) * DC(J+1) * TD * ( T(J) - T(J+1) )
      TC = TA - TB + FEE(J) - QHO(J) * DENS(J) * T(J) + SW(J)
      TA = TB
      K = J - 1
      IF( VERT ) 191, 193, 192
  191 K = J
  192 TC = TC + VERT * T(K) * DENS(K)
  193 K = J
      VERT = VERT + QHI(J) - QHO(J)
      IF( VERT ) 194, 196, 195
  194 K = J + 1
  195 TC = TC - VERT * T(K) * DENS(K)
  196 TD = DVOL(J)
      IF( J .EQ. NUME) TD = VTOP
      TDOT(J) = TC / ( DENS(J) * TD )
  197 CONTINUE
      GO TO 301

C ** FORM SOLUTION MATRICES

  220 DO 221 J = 1, NUME
      P(J) = FEE(J) + SW(J)
  221 CONTINUE
      P(NUME) = P(NUME) + SHEAT * ATOP
      DO 225 J = 1, NUME
      B(J) = T(J) + DTBY2 * TDOT(J)
  225 CONTINUE
```

```
      TA = 0.0
      QV1 = 0.0
      DO 229 J = 1, NUM
      QV2 = QV1 + QHI(J) - QHO(J)
      TD = DZI(J)
      IF( J .EQ. NUM ) TD = 1.0 / DZTOP
      TB = AREA(J+1) * DC(J+1) * TD
      S(J,1) = - TA
      IF( QV1 .GT. 0.0 ) S(J,1) = - ( TA + QV1 * DENS(J-1) )
      S(J,3) = - TB
      IF( QV2 .LT. 0.0 ) S(J,3) = - ( TB - QV2 * DENS(J+1) )
      TC = QHO(J)
      IF( QV1 .LT. 0.0 ) TC = TC - QV1
      IF( QV2 .GT. 0.0 ) TC = TC + QV2
      S(J,2) = TA + TB + TC * DENS(J)
      QV1 = QV2
      TA = TB
  229 CONTINUE
      S(NUME,1) = - TA
      IF( QV1 .GT. 0.0 ) S(NUME,1) = - ( TA + QV1 * DENS(NUM) )
      QV2 = QV1 + QHI(NUME) - QHO(NUME)
      TC = QHO(NUME) + QV2
      IF( QV1 .LT. 0.0 ) TC = TC - QV1
      S(NUME,2) = TA + TC * DENS(NUME)
      S(NUME,3) = 0.0
      P(1) = P(1) - ( S(1,2) * B(1) + S(1,3) * B(2) )
      DO 235 J = 2, NUME
      P(J) = P(J) - ( S(J,1) * B(J-1) + S(J,2) * B(J) + S(J,3) *
     A  B(J+1) )
  235 CONTINUE
      DO 239 J = 1, NUME
      S(J,1)  = DTBY2 * S(J,1)
      TA = DVOL(J)
      IF( J .EQ. NUME ) TA = VTOP
      S(J,2) = DTBY2 * S(J,2) + DENS(J) * TA
      S(J,3) = DTBY2 * S(J,3)
  239 CONTINUE

C ** SOLVE FOR FINAL TEMPERATURES


      P(1) = P(1) / S(1,2)
      S(1,3) = S(1,3) / S(1,2)
      DO 245 J = 2, NUME
      TA = S(J,2) - S(J,1) * S(J-1,3)
      P(J) = ( P(J) - S(J,1) * P(J-1) ) / TA
      S(J,3) = S(J,3) / TA
  245 CONTINUE
      TDOT(NUME) = P(NUME)
      T(NUME) = B(NUME) + DTBY2 * TDOT(NUME)
      DO 251 J = 2, NUME
      N = NUMP - J
      TDOT(N) = P(N) - S(N,3) * TDOT(N+1)
      T(N) = B(N) + DTBY2 * TDOT(N)
  251 CONTINUE
      T(NUMP) = T(NUME)

C  ****  SMOOTH THE PROFILE

      TFX(1) = T(1)
      TFX(NUME) = T(NUME)
```

```
      DO 253 J = 2, NUM
      TFX(J) = 0.25 * ( T(J-1) + 2.0 * T(J) + T(J+1) )
  253 CONTINUE
      DO 254 J = 1, NUME
      T(J) = TFX(J)
  254 CONTINUE

C ** MIX THE RESERVOIR AS REQUIRED
      IF(IBUG.EQ.1)
     *WRITE(6,1000) NUME,(T(LJ),LJ=1,NUMP)
 1000 FORMAT(' SUBC--NUME =',I5/(20F6.2))

      IMIX = NUME
      GTEM = GMIN
      IF( L .LT. 75 ) GTEM = -1.0E-3
  256 DO 257 J = 1, NULL
      NN = J
      GRAD = ( T(J+1) - T(J) ) * DZI(J)
      IF( GRAD .GT. GTEM .AND. GRAD .LT. GMAX ) GO TO 257
      GO TO 258
  257 CONTINUE
      NN = NUM
      GRAD = ( T(NUME) - T(NUM) ) / DZTOP
      IF( GRAD .GT. GTEM .AND. GRAD .LT. GMAX ) GO TO 301
  258 IMIX = NN
      GTEM = -1.0E-3
      TA = VTOP * T(NUME)
      DO 259 J = IMIX, NUM
      TA = TA + DVOL(J) * T(J)
  259 CONTINUE
      TA = TA / ( VSUM - VOL(IMIX) )
      DO 260 J = IMIX, NUME
      T(J) = TA
      TFX(J) = TA
  260 CONTINUE
      IF(IBUG.EQ.1) WRITE(6,1003) IMIX,NUME,(T(JL),JL=IMIX,NUME)
 1003 FORMAT(' TEMP HAS BEEN CHANGED FROM',I5,' TO',I5/(20F6.2))
      GO TO 256

C ** UPDATE FOR ELEMENT INCREASE

  301 DO 302 J = NUME, MAXE
      T(J) = T(NUME)
      TDOT(J) = TDOT(NUME)
      TFX(J) = T(NUME)
  302 CONTINUE
      IF(IBUG.EQ.1) WRITE(6,1001) L,M,IMIX,MAXE
 1001 FORMAT(' SUBC--DAY,STEP,IMIX,MAXE=',4I10)

C ** CALCULATE DOWNSTREAM TEMPERATURE

      TA = 0.0
      DO 265 J = 1, NOUTS
      TA = TA + QOT(L,J)  * TOUT(L,J)
  265 CONTINUE
      DST(L) = TA / QOUT
      RESTM(L) = VSUM /(AMAX1(QI,QOUT) * 8.64E4 )
      DO 400 JL=1,MAXE
  400 TEMLEV(JL)=TFX(JL)
C     MIX ALL LEVELS FROM IMIX TO NUME
      VOLMIX=0.
```

```
      DO 420 JL=1,KCON
420   XTEMP(JL)=0.
      DO 430 JL=IMIX,NUME
      XX=DVOL(JL)
      IF(JL.EQ.NUME) XX=VTOP
      VOLMIX=VOLMIX+XX
      DO 440 JK=1,KCON
440   XTEMP(JK)=XTEMP(JK)+CLAK(JL,JK)*XX
430   CONTINUE
      DO 450 JL=1,KCON
450   XTEMP(JL)=XTEMP(JL)/VOLMIX
      DO 460 JK=IMIX,NUME
      DO 460 JL=1,KCON
460   CLAK(JK,JL)=XTEMP(JL)
      IF(IBUG.EQ.1) WRITE(6,1004) IMIX,NUME,XTEMP
1004  FORMAT(' SUBC-IMIX,NUME,XTEMP=',2I10/7F8.4,F8.1,8F8.4)
      CALL LAKCON

C ** CHECK FOR OUTPUT INTERVAL

      IA = 0
      IF( M .NE. IVAL ) GO TO 271
      IF( MOD(L,IPRT) .EQ. 0 .OR. L .EQ. IDAY ) IA = 1
      DO 263 J = 1, NSD
      IF( IDOUT(J) .EQ. L ) IA = 1
  263 CONTINUE
  267 IF( IA .GT. 0 ) CALL PRNT(L,M)
      IF( ITAPE .GT. 0 ) WRITE(ITAPE) L, NUME, ( TFX(J), J = 1, NUME )
  271 CONTINUE
C     CALCULATE OUTFLOW CONCENTRATIONS FOR DAY L
      FLOOUT=0.
      DO 520 JL=1,KCON
520   XTEMP(JL)=0.
      DO 530 JL=1,NUME
      IF(QHO(JL).EQ.0.)  GO TO 530
      FLOOUT=FLOOUT+QHO(JL)
      DO 540 JK=1,KCON
540   XTEMP(JK)=XTEMP(JK)+QHO(JL)*CLAK(JL,JK)
530   CONTINUE
      DO 550 JL=1,KCON
550   COTFLO(L,JL)=XTEMP(JL)/FLOOUT
  279 CONTINUE
      WRITE(6,621)(J, DST(J), J = IDAY, LDAY )
621   FORMAT(1H1,//30X,'OUTFLOW TEMPERATURES (CENTIGRADE)'//
     *7('    DAY    TEMP ')/(7(I7,F8.2)))
      WRITE(6,909)
909   FORMAT(1H1,//35X,'LAKE OUTFLOW CONCENTRATIONS',//)
      WRITE(6,608)
      DO 303 I=IDAY,LDAY
303   WRITE(6,819) I,QOT(I,1),(COTFLO(I,LJ),LJ=1,KCON)
819   FORMAT(I8,F8.2,F8.2,F7.2,5F7.4,F10.1,8F7.3)
608   FORMAT('     DAY     FLOW    DO     BOD     NH3-N   NO2-N NO3-N PO4-P
     *  PHYTO  COLIFORMS  HM1     HM2     HM3    TOT N    CHLOR  HMI1    HMI2
     *    HMI3'/ ' NUMBER       (CFS) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
     *G/L) (MG/L) (MPN/100) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (MG/L) (M
     *G/L) (MG/L)'/)
      IF( ITAPE .LE. 0 ) RETURN
      WRITE(ITAPE) ( TSPEC(J), J = IDAY, LDAY )
      WRITE(ITAPE) ( ( QOT(J,K),K = 1, NOUTS ), J = IDAY, LDAY )
      WRITE(ITAPE) ( ( TOUT(J,K),K = 1, NOUTS), J = IDAY, LDAY )
      WRITE(ITAPE)  ((COTFLO(J,K),K=1,KCON),J=IDAY,LDAY)
```

```
      END FILE ITAPE
      RETURN
      END
      SUBROUTINE SUBD( TA )

      COMMON/BBLK/ A, AT, BB, EV, NAVG, QC, QE, QN, QNA, QNS, QW
      COMMON/NDV/ A1, A2, A3, DELT, DQIN, DTBY2, DZT, EDMAX, ELTC, EVA,
     A  EVAP, EXCO, GMAX, GMIN, GSWM, IAT, IBT, IDAY, IMIX, INTP, IONE,
     B  IPRT, ITAPE, ITWO, IVAL, LDAY, MAXE, MAXP, NLEIS, NOBS, NOUTS,
     C  NTC, NREP, NSD, NSEG, NUM, NUME, NUMP, NUSI, NTRIES, NXEQ, QI,
     D  QOUT, RESEL, RLEN, SDZ, SHEAT, STABLE, VONE, VSUM, VTOP, INT,
     E  C1, C2, C3

      REAL DATA(8,6)

C ** CALCULATE HV, ROS, ES

      HV = 597.0 - 0.57 * TA
      ROS = 1000.0 - ((( TA - 3.98 ) ** 2*( TA + 283.0 ) ) /
     A  ( 503.57 * ( TA + 67.26 ) ) )
      ES = 2.1718E8* EXP( -4157.0 / ( TA + 239.09 ) )

C ** READ WEATHER RECORD FROM UNIT 9

      DO 103 J = 1, NAVG
      READ(INT) ( DATA(J,K), K = 1, 6 )
  103 CONTINUE

C ** AVERAGE INPUT DATA AS REQUIRED

      IF( NAVG .LE. 1 ) GO TO 115
      TC = 1.0 / FLOAT( NAVG )
      DO 109 K = 1, 6
      TB = 0.0
      DO 107 J = 1, NAVG
      TB = TB + DATA(J,K)
  107 CONTINUE
      DATA(1,K) = TC * TB
  109 CONTINUE
  115 QNS = DATA(1,1)
      QNA = DATA(1,2)
      AT = DATA(1,4)
      EA = DATA(1,5)
      WS = DATA(1,6)

C ** CALCULATE QE, QC, AND QW

      EV = ( WS * BB + A ) * ( ES - EA )
      IF( EV .LT. 0.0 ) EV = 0.0
      QE = ROS * HV * EV
      RB = DATA(1,3) * ( TA - AT ) / ( ES - EA )
      QC = QE * RB
      QW = 7.36E-2 + 1.17E-3 * TA
      QN = QNS + QNA - QW
      RETURN
      END
      SUBROUTINE SUBE( M, L )

      COMMON/ABLK/ ABAR(200), AREA(200), DC(200), DENS(200), CHI(200),
     A  DVOL(200), DZ(200), DZI(200), QHI(200), QHO(200), T(200),
     B  TDOT(200), TEX(200), THI(200), VOL(200), Z(200), ZMID(200)
```

```
      COMMON/CBLK/ DST(365), POOL(365), QIN(365), RESTM(365), TIN(365)

      COMMON/DBLK/ DRODZ(5), ELOUT(5), NOU(5), QOT(365,3), TOUT(365,3),
     A  TSPEC(365), WOT(5)
     *,ISRNOU(3)

      COMMON/FBLK/ EUP(5), QUP(5), TUP(5),WUP(5), IDOUT(50), QORD(365)

      COMMON/NDV/ A1, A2, A3, DELT, DQIN, DTRY2, DZT, EDMAX, ELTC, EVA,
     A  EVAP, EXCO, GMAX, GMIN, GSWM, IAT, IBT, IDAY, IMIX, INTP, IONE,
     B  IPRT, ITAPE, ITWO, IVAL, LDAY, MAXE, MAXP, NLETS, NOBS, NOUTS,
     C  NTC, NREP, NSO, NSEG, NUM, NUME, NUMP, NUSI, NTRIBS, NXEQ, QI,
     D  QOUT, RESEL, RLEN, SDZ, SHEAT, STABLE, VONE, VSUM, VTOP, INT,
     E  C1, C2, C3
      COMMON/DBUG/IBUG

      REAL TQMO(200)

C ****  SUM TOTAL OUTFLOW

      QOUT = 0.0
      QSPL=0.
      DO 101 J = 1, NOUTS
      QOUT = QOUT + QOT(L,J)
      QOT(L,J) = 0.0
  101 CONTINUE
      IF(IBUG.EQ.1)  WRITE(6,1000) L,QOUT
 1000 FORMAT(' ENTERING SUBE ON DAY ',I6,'  QOUT =',E20.8)

      DO 10 J=1,NOUTS
      IF(ISRNOU(J).EQ.0)  GO TO 2
      NOU(J)=NUME
      ELOUT(J)=Z(NUME)
      GO TO 10
 2    CONTINUE
      DO 5 JL=1,NUME
      IF(ELOUT(J).GT.Z(JL))  GO TO 5
      NOU(J)=JL
      GO TO 10
 5    CONTINUE
      NOU(J)=NUME
 10   CONTINUE

C ****  ESTIMATE TEMP AND FIND HIGHEST OUTLET

      MAX = NOUTS
      DO 104 J = 1, MAX
      TOUT(L,J) = 0.0
      K = NOU(J)
      TOUT(L,J) = TFX(K)
      IF( L.EQ. IDAY ) GO TO 104
      IF( QOT(L-1,J) .GT. 0.0 ) TOUT(L,J) = TOUT(L-1,J)
  104 CONTINUE
      IF( MOD(NSEG,2) .EQ. 0 ) GO TO 107
C     IF NOT OPERATING TO MEET OBJECTIVE, DISTRIBUTE EVENLY.
      DO 11 JL=1,NOUTS
 11   QOT(L,JL)=QOUT/NOUTS
      GO TO 121

C ****  OPERATE TO MEET OBJECTIVE
```

```
      107 TOBJ = ( QOUT  * TSPEC(L) - QSPL * TOUT(L,NOUTS) ) /
     A  ( QOUT - QSPL )
          MAX = NOUTS - 1
          IF( TOBJ .GT. TOUT(L,1) ) GO TO 109
          QOT(L,1) = QOUT - QSPL
          GO TO 121
      109 IF( TOBJ .LT. TOUT(L,MAX) ) GO TO 111
          QOT(L,MAX) = QOUT - QSPL
          GO TO 121
      111 DO 112 J = 2, MAX
          IF( TOUT(L,J) .LT. TOBJ ) GO TO 112
          NLO = J - 1
          GO TO 113
      112 CONTINUE
          NLO = MAX
      113 QOT(L,NLO) = ( QOUT - QSPL ) * ( TOUT(L,MAX) - TOBJ ) /
     A  ( TOUT(L,MAX) - TOUT(L,NLO) )
          IF( MAX .EQ. NLO ) GO TO 121
          QOT(L,MAX) = QOUT - QOT(L,NLO) - QSPL

C ** ENTER MAIN DISTRIBUTION LOOP

      121 DO 299 J = 1, NOUTS
          N = NOU(J)
          DRODZ(J) = 0.0
          IF( QOT(L,J) .GT. 0.0 ) GO TO 122
          GO TO 299
      122 DO 123 K = 1, NUME
          TQHO(K) = 0.0
      123 CONTINUE
          UNITQ = QOT(L,J) / NOT(J)
          QDEB = QOT(L,J)
          ICRAY = 0
          JMIN = 1
          JMAX = NUME
          IF(IBUG.EQ.1)  WRITE(6,1001) IMIX
 1001     FORMAT(' IMIX =',I5)
          IF( IMIX .LT. N - 2 ) GO TO 205

C ** NOT MIXED  **  USE DEBLERS CRITERIA

          MAX = N + 7
          IF( MAX .GT. NUME ) MAX = NUME
      124 TA = - BETA(N-7,MAX,DENS,200)
          DRODZ(J) = TA
          IF( TA .GT. 0.0 ) GO TO 131

C ** NEGATIVE OR ZERO DENSITY GRADIENT

          NLO = N
          NUP = N
      125 IF( NLO .GT. 1 ) NLO = NLO -1
          IF( NUP .LT. NUM ) NUP = NUP + 1
          TA = ( DENS(NLO) - DENS(NUP) ) / ( ZMID(NUP) - ZMID(NLO) )
          IF( TA .GT. 0.0 ) GO TO 131
           IF( NLO .LE. 1 .AND. NUP .GE. NUM ) GO TO 147
          GO TO 125

C ** CALCULATE WITHDRAWAL DEPTH

```

```
  131 IF( N .NE. 1 .AND. N .NE. NUME .AND. ICRAY .EQ. 0 ) UNITQ =
     A  0.5 * UNITQ
      IF(IBUG.EQ.1) WRITE(6,1005) TA
 1005 FORMAT(' TA FOR DT =',E20.8)
      DT = SQRT( 42.0 * UNITQ / TA ** 0.5 )
      IF( ICRAY .GT. 0 ) GO TO 139
      TA = ZMID(N) + DT
      IF( TA .GT. Z(NUME) ) GO TO 139
      DO 135 K = 1, NUME
      JMAX = NUME - K
      IF( Z(JMAX) .LT. TA ) GO TO 139
  135 CONTINUE
  139 TA = ZMID(N) - DT
      IF( TA .LT. Z(2) ) GO TO 147
      DO 143 K = 3, NUMP
      IF( Z(K) .LT. TA ) GO TO 143
      JMIN = K - 1
      GO TO 147
  143 CONTINUE
      JMIN = NUME

C ** DISTRIBUTE OUTFLOWS

 147  CONTINUE
      TA = VOL(JMAX+1) - VOL(JMIN)
      IF( JMAX .GE. NUME ) TA = VSUM - VOL(JMIN)
      TA = QDEB / TA
  157 DO 163 K = JMIN, JMAX
      TQHO(K) = TA * DVOL(K)
      IF( K .EQ. NUME ) TQHO(K) = TA * VTOP
      QHO(K) = QHO(K) + TQHO(K)
  163 CONTINUE
      IF(IBUG.EQ.1) WRITE(6,1002) JMIN,JMAX,ICRAY,DT,UNITQ
 1002 FORMAT(' JMIN,JMAX,ICRAY,DT,UNITQ =',3I5,2E20.8)
      GO TO 225

C ** CONVECTIVE MIXED OUTFLOW      **********

  205 IF( IMIX .LE. 2 ) GO TO 147
      TA = DENS(1) - DENS(IMIX)
      IF( TA .LE. 0.0 ) GO TO 147
      QDEB = 0.0
      TC = 0.1505
      IF( N .EQ. NUME ) TC = 0.0742
  209 DT = RESEL - Z(IMIX)
      QCRIT = TC * DT * SQRT( DT * TA )
  211 QCRAY = QOT(L,J)
      IF(IBUG.EQ.1) WRITE(6,1006) QCRIT,QCRAY
 1006 FORMAT(' QCRIT,QCRAY AT STATEMENT 211 =',2E16.8)
      IF( QCRIT .GE. UNITQ ) GO TO 215
      QCRAY = QOT(L,J) * QCRIT / UNITQ
      QDEB =  QOT(L,J) - QCRAY
      ICRAY = 1
      UNITQ = QDEB / WOT(J)
      IF(IBUG.EQ.1) WRITE(6,1007) QCRAY,QDEB,UNITQ
 1007 FORMAT(' ICRAY=1,QCRAY,QDEB,UNITQ=',3E16.8)
  215 TA = QCRAY / ( VSUM - VOL(IMIX) )
      DO 219 K = IMIX, NUM
      TQHO(K) = TA * DVOL(K)
      QHO(K) = QHO(K) + TQHO(K)
  219 CONTINUE
```

```
      TQHO(NUME) = TA * VTOP
      QHO(NUME) = QHO(NUME) + TQHO(NUME)
      IF( ICRAY .LE. 0 ) GO TO 225
      JMAX = IMIX - 1
      N = IMIX - 1
      MAX = JMAX
      GO TO 124

C ** CALCULATE OUTFLOW TEMPERATURE

  225 TA = 0.0
      TB = 0.0
      DO 229 K = 1, NUME
      TA = TA + TQHO(K) * TFX(K)
      TB = TB + TQHO(K)
  229 CONTINUE
      TOUT(L,J) = TA / TB
  299 CONTINUE
      RETURN
      END
      SUBROUTINE SUBG(NP, DATA, N )

      COMMON/ABLK/ ABAR(200), AREA(200), DC(200), DENS(200), DHI(200),
     A  DVOL(200), DZ(200), DZI(200), QHI(200), QHO(200), T(200),
     B  TDOT(200), TFX(200), THI(200), VOL(200), Z(200), ZMID(200)

      REAL DATA(N)

C ** DEFINE END POINTS

      DH = 0.0
      M = 1
      DO 104 J = 2, NP
      NLO = M + 1
      DO 101 K = NLO, N
      IF( DATA(K) .EQ. 0.0 ) GO TO 101
      DH = ( DATA(K) - DATA(M) ) / ( Z(K) - Z(M) )
      M = K
      GO TO 102
  101 CONTINUE

C ** INTERPOLATE BETWEEN POINTS

  102 DO 103 K = NLO, M
      DATA(K) = DATA(K-1) + DH * DZ(K-1)
  103 CONTINUE
  104 CONTINUE
      RETURN
      END
      SUBROUTINE SUBH( L, FEE, M )

      COMMON/ABLK/ ABAR(200), AREA(200), DC(200), DENS(200), DHI(200),
     A  DVOL(200), DZ(200), DZI(200), QHI(200), QHO(200), T(200),
     B  TDOT(200), TFX(200), THI(200), VOL(200), Z(200), ZMID(200)

      COMMON/CBLK/ DST(365), POOL(365), QIN(365), RESTM(365), TIN(365)

      COMMON/DBLK/ DRODZ(5), ELOUT(5), NOU(5), QOT(365,3), TOUT(365,3),
     A  TSPEC(365), WOT(5)

      COMMON/FBLK/ EUP(5), QUP(5), TUP(5),WUP(5), IDOUT(50), QORO(365)
```

```
      COMMON/NDV/ A1, A2, A3, DELT, DQIN, DTRY2, DZT, EDMAX, ELTC, EVA,
     A  EVAP, EXCO, GMAX, GMIN, GSWH, IAT, IBT, IDAY, IMIX, INTP, IONE,
     B  IPRT, ITAPE, ITWO, IVAL, LDAY, MAXE, MAXP, NLETS, NOBS, NOUTS,
     C  NTC, NREP, NSD, NSEG, NUM, NUME, NUMP, NUST, NTRIBS, NXEQ, QI,
     D  QOUT, RESEL, RLEN, SDZ, SHEAT, STABLE, VONE, VSUM, VTOP, INT,
     E  C1, C2, C3
      COMMON/DBUG/IBUG

      REAL FEE(M)

      RO(TA) = 1000.0 - (((TA - 3.98 ) ** 2*( TA + 283.0 ). ) /
     A  ( 503.57 * ( TA + 67.26 ) ) )

      JMIN = 1
      JMAX = NUME

C ** FIND ENTRY LEVEL

      RUP = RO( TIN(L) )
      DO 109 J = 1, NUME
      N = J
       IF( RUP .GE. DENS(J) ) GO TO 113
  109 CONTINUE

C ** CHECK REGIONS

  113 IF( N .LT. IMIX .OR. IMIX + 4 .GT. NUME ) GO TO 119
      JMIN = IMIX
      TA = QI * DELT
      IF( VSUM - VOL(IMIX) .GT. TA ) GO TO 129
      DO 115 J = 1, NUME
      JMIN = NUMP -J
      IF( VSUM - VOL(JMIN) .GT. TA ) GO TO 129
  115 CONTINUE
      GO TO 129

C ** ESTABLISH THE DENSITY GRADIENT

  119 MAX = N + 7
      IF( MAX .GT. NUME ) MAX = NUME
      TA = - BETA(N-7,MAX,DENS,200)
      IF( TA .GT. 0.0 ) GO TO 127
      NLO = N
      NUP = N
  123 IF( NLO .GT. 1 ) NLO = NLO - 1
      IF( NUP .LT. NUM ) NUP = NUP + 1
      TA = ( DENS(NLO) - DENS(NUP) ) / ( ZMID(NUP) - ZMID(NLO) )
      IF( TA .GT. 0.0 ) GO TO 127
      IF( NLO .LE. 1 .AND. NUP .GE. NUM ) GO TO 129
      GO TO 123

C ** CALCULATE WITHDRAWALS

  127 TA = SQRT( TA )
      DENOM=AREA(N)
      IF(DENOM.EQ.0.) DENOM=AREA(N+1)
      UNITQ=.5*QI*RLEN/DENOM
      DT = SQRT( 42.0 * UNITQ / TA )
      IFLO = DT / SDZ
      IF( 2 * IFLO .GE. NUM ) GO TO 129
```

```
      JMAX = N + IFLO
      IF( JMAX .GT. NUME ) JMAX = NUME
      JMIN = N - IFLO
      IF( JMIN .LT. 1 ) JMIN = 1
      IF( JMAX .EQ. NUME ) JMIN = NUMP - 2 * IFLO
      IF( JMIN .EQ. 1 ) JMAX = 2 * IFLO
      IF(JMIN.EQ.NUMP .AND. JMAX.EQ.NUME) JMIN=NUME
      IF(JMIN.EQ.1  .AND.  JMAX.EQ.0) JMAX=1
  129 TA = VOL(JMAX+1) - VOL(JMIN)
      IF( JMAX .GE. NUME ) TA = VSUM - VOL(JMIN)
      TB = QI / TA
      IF(IBUG.EQ.1) WRITE(6,1000) L,N,IMIX,TA,UNITQ,DT,IFLO,JMIN,JMAX
 1000 FORMAT(//' SUBH--DAY=',I5,'  N,IMIX=',2I5/' TA,UNITQ,DT,IFLO,JMIN,
     *JMAX =',3E16.8,3I10/)
      DO 131 J = JMIN, JMAX
      TV = DVOL(J)
      IF( J .EQ. NUME ) TV = VTOP
      TC = TB * TV
      QHI(J) = QHI(J) + TC
      FEE(J) = FEE(J) + TC * RUP * TIN(L)
  131 CONTINUE
  135 CONTINUE

      RETURN

      END
      SUBROUTINE SUN(NDAY)
      COMMON/PASS/TOTL,SR,SS
      COMMON/BBLK/A(8),QNA,QNS
      COMMON/NDV/A1(40),NXEQ
      COMMON/MISC/XLAT,NDAY1
      COMMON/DBUG/IBUG
      DATA F1,F2,F3,F4/.409279,.0172142,7.63944,3.81972/
      TOTL=(QNA+QNS)*8640.
      DAY=NDAY
      D=F1*COS(F2*(172.-DAY))
      HSS=ARCOS(-TAN(D)*TAN(XLAT))
      HRS=F3*HSS
      SS=F4*HSS+12.
      SR=24.-SS
      IF(IBUG.EQ.1) WRITE(6,1000) NXEQ,NDAY,NDAY1,QNA,QNS,SS,SR
 1000 FORMAT(' SUN-NXEQ,NDAY,NDAY1,QNA,QNS,SS,SR=',3I6,4E16.8)
      RETURN
      END
      COMMON/DBUG/IBUG
C     IF IBUG = 1 VARIOUS DEBUG PRINTOUT IS PRODUCED
      IBUG=1
      IBUG=0
C     CALL BAL TO GENERATE FLOW DATA
      CALL BAL
C     GENERATE MIFP DATA
      CALL SUBA
      CALL SUBB2
C     EXECUTE TSIP
      CALL SUBB
      CALL NEWIN
      CALL SUBC
      STOP
      END
```

SECTION XII

REFERENCES

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4. "Mathematical Models for the Net Rate of Heat Transfer Through the Air-Water Interface of a Flowing Stream," L.A. Roesner, Ph.D. Thesis, University of Washington, March, 1969.

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SECTION XIII
ABBREVIATIONS

CEMIF	Corps of Engineers Meteorologic Input File
CETSIP	Corps of Engineers Thermally Stratefied Impoundment Program
DRM	Deep Reservoir Model
EPA	Environmental Protection Agency
SCI	Systems Control, Incorporated

BOD	biochemical oxygen demand (5-day)
CL_2	chloride
°C	centigrade degrees
cfs	cubic feet per second
cms	cubic meters per second
deg	degrees
DO	dissolved oxygen
°F	Farenheit degrees
ft	feet
HM	heavy metal
HM1	heavy metal one
HM2	heavy metal two
HM3	heavy metal three
hr	hour
JCL	job control language
m	meters
mb	millibars
mg	milligrams
ml	milliliter
MPN	most probable number
N	nitrogen
NH_3-N	ammonia nitrogen
NO_2-N	nitrite nitrogen
NO_3-N	nitrate nitrogen
PO_4-P	phosphate phosporus
sec	seconds

SELECTED WATER
RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

W

Spokane River Basin Model Project

October, 1974

Finnemore, E. John; and Shepherd, John L.

Systems Control, Inc.
Palo Alto, California

68-01-0756

Environmental Protection Agency

Set of six volumes: Volume I - Final Report, Volume II - Data Report, Volume III - Verification Report, Volume IV - User's Manual for Steady-state Stream Model, Volume V - User's Manual for Dynamic Stream Model, Volume VI - User's Manual for Stratified Reservoir Model.

Three existing mathematical models, capable of representing water quality in rivers and lakes, have been modified and adapted to the Spokane River Basin in Washington and Idaho. The resulting models were named the Steady-state Stream Model, the Dynamic Stream Model, and the Stratified Reservoir Model. They are capable of predicting water quality levels resulting from alternative basinwide wastewater management schemes, and are designed to assist EPA, State, and local planning organizations to evaluate water quality management strategies and to establish priorities and schedules for investments in abatement facilities in the basin. Physical data and historical hydrologic, water quality and meteorologic data were collected, assessed and used for the model calibrations and verifications. The modified models are all capable of simulating the behavior of various subsets of up to sixteen different water quality constituents. Sensitivity analyses were conducted with all three models to determine the relative importance of a number of individual model parameters. The models were provided to the EPA as computer source card decks in FORTRAN IV language, with accompanying data decks. All development work on, and applications made with, these models were fully documented so as to permit their easy utilization and duplication of historical simulations by other potential users. A user's manual with a complete program listing was prepared for each model.

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