# SPOKANE RIVER BASIN MODEL PROJECT

Volume IV - User's Manual for Steady-State Stream Model

by

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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.

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

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# SECTION I

## INTRODUCTION

The Steady-State Stream Model (DOSCI), documented herein, is an extensive modification of the program DOSAG-I [Reference 8], 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. Portions of DOSAG-I, as developed by the Texas Water Development Board in 1970, remain intact in DOSCI. Subroutines which are unchanged or only slightly modified include BLEND, CMIN, DOSAT, K2CAL, REINE, RMATC, SCAN and TRIBD. DOEQU, REPRE and RUNON have been extensively modified. Five newly added subroutines are named GETCON, NEWIN, PLOT, PLTSET, and SETOPT.

These modifications have given DOSCI the capability of modeling as many as sixteen quality constituents simultaneously. The algorithms used to model the quality constituents are described in detail in Volume I (Part III) of this report.

The format of the additional input required to execute DOSCI has been made consistent with the format of the input required to run DOSAG-I. Many input data cards required by DOSAG-I have been made optional by the incorporation of default values for the variables involved. Portions of this manual are taken from Reference [8], and the format of this manual has been made generally consistent with the format of Reference [8], subject to the constraints imposed by EPA documentation specifications.

DOSCI has been extensively tested on a wide variety of stream conditions on both the UNIVAC 1108 and the IBM 370/155. Run time is minimal and the chief use of the program is to give a rapid evaluation of a given set of stream conditions.

SECTION II

## MODE OF OPERATION

### PURPOSE

The purpose of this model is to calculate the concentrations of as many as sixteen water quality constituents in a particular stream system, including the biochemical oxygen demand and the dissolved oxygen concentration. If desired, the minimum dissolved oxygen concentration in the stream system may be checked against a pre-specified target level dissolved oxygen concentration. If the minimum dissolved oxygen level is below the target dissolved oxygen level, the program will compute the required amount of flow augmentation to bring the dissolved oxygen level up to the target level in the entire system. The user of the program specifys the locations within the stream system at which dilution water is available for flow augmentation. The program is designed to be run for varying climatic and hydrologic conditions during a twelve month period. Thus, it is possible to enter up to twelve different temperatures and corresponding discharges to each of the headwaters within the stream system being modeled.

The Steady-State Stream Model (DOSCI) is quite flexible and can be adapted to any stream system. One major restriction is that large impoundments such as reservoirs cannot be considered by this program. The output from a single run of the DOSCI dissolved oxygen simulation model will provide the user with a complete description of the dissolved oxygen resources of the stream system investigated, and the required dilution water needed to bring the system up to the target level dissolved oxygen concentration. An additional user option available with this program is the ability to find the dissolved oxygen distributions for varying levels of treatment (waste treatment plants) in the simulated river basin.

### RESTRICTIONS

1. Maximum number of headwater stretches = 10, and headwater stretch # must be $\leq$ 10
2. Maximum number of junctions = 20; jcts should be numbered in increasing order downstream to decrease program run time and output
3. Maximum total number of reaches = 100; maximum number of reaches per stretch = 20
4. Maximum number of stretches = 20
5. Maximum of twelve months of routing for temperature and headwater flows; a minimum of one month must be used.
6. Maximum number of dissolved oxygen targets = 4. A minimum of one dissolved oxygen target must be specified. This dissolved oxygen target may be entered as a negative number if no flow augmentation is desired.
7. Maximum of four degrees of waste treatment.

## SOLUTION TECHNIQUE

The algorithms used by DOSCI in the calculations of the various constituent concentrations in a stream system are described in detail in Part III of Volume I of this report. Briefly, given a stream reach, the procedure is as follows. All inflows to the head of the reach are mixed together and the resulting concentration for each constituent being modeled is calculated. In the simplest case the inflow to a reach is the outflow from the upstream reach. A reach may have as many as three inflows, however, as is the case for a reach located immediately below a junction and with a tributary inflow. In any case the resulting mixture is allowed to react for a time $\Delta t$ according to the quality equations where $\Delta t$ is the travel time through the reach. The process is then repeated for the next downstream reach. This process continues until the entire stream system has been modeled.

## MODEL USAGE

In order to use the DOSCI program, the user must take the stream system which he proposes to simulate and break it down into the elements which are used as input to the program. Figure 1 shows a schematic diagram of a typical river system which has been decomposed into the elements required to model it using DOSCI. There are essentially four major elements into which a system must be decomposed so that it can be modeled using this program. These elements are:

1. junctions - the confluence between two streams within the river basin being modeled,
2. stretches - the length of a river between junctions,
3. headwater stretches - the length of a river from its headwater to its first junction with another stream, and
4. reaches - the subunits which comprise a stretch (headwater or normal).

A new reach is designated at any point in the stretch where there is a significant change in the hydraulic, biologic, or physical characteristics of the channel, including the addition of a waste load, or the withdrawal of water from the stream.

After a stream has been represented schematically, it is necessary to specify the hydraulic and physical characteristics of each reach in the stream system. This step involves reading into the program various coefficients to describe all of the factors which are involved in the various reactions occurring among the quality constituents being modeled in the reach. It should be noted that this is some of the most important information required for the simulation process. The results obtained from the simulation of the dissolved oxygen resources within a river system, using DOSCI as a modeling medium, are only as accurate as the input data provided for the modeling process. It thus behooves the user to take great care in specifying the coefficients to be used in the program for simulating the stream system.

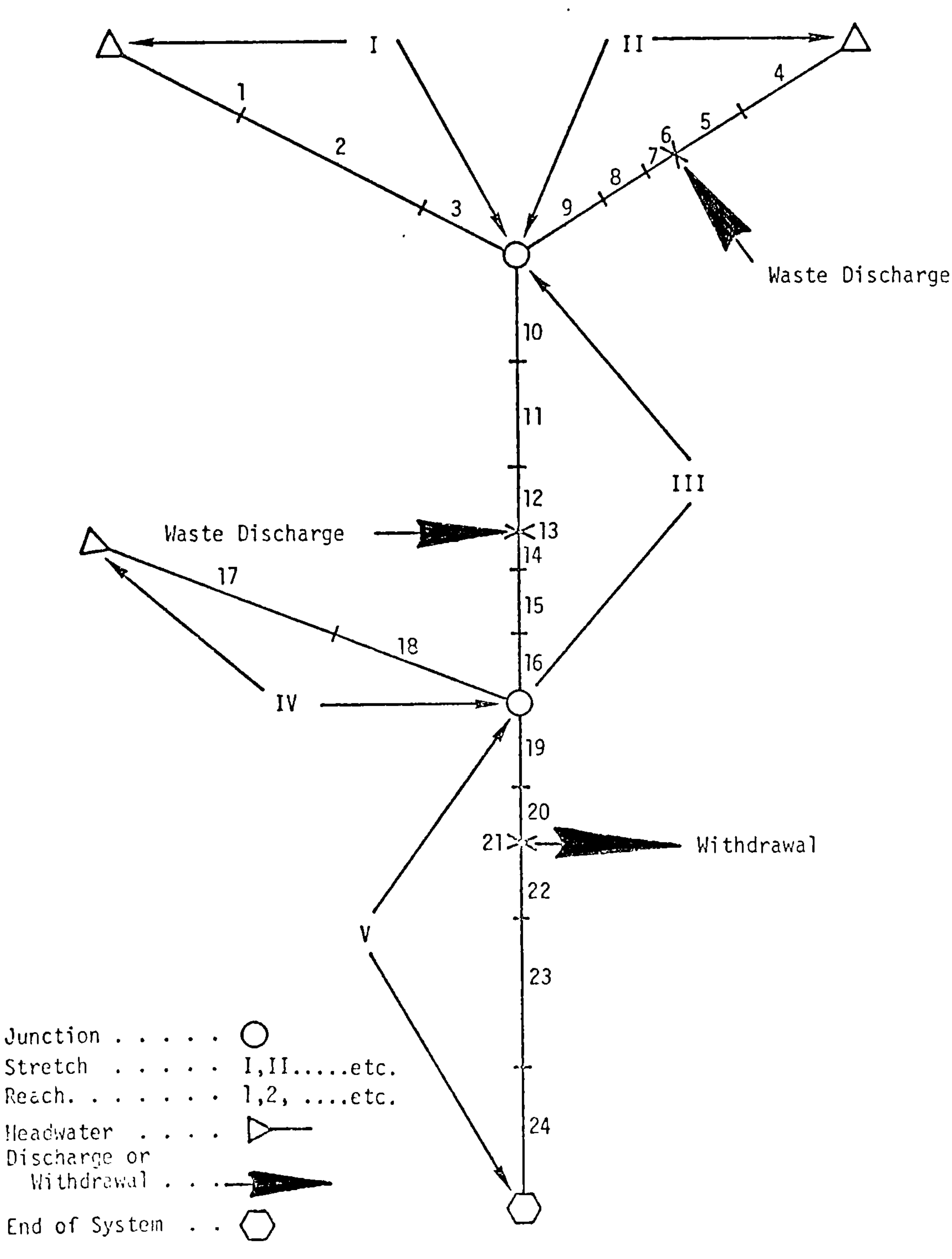



FIGURE 1. SCHEMATIC DIAGRAM OF A TYPICAL RIVER SYSTEM

Two equations are used to describe the hydraulic characteristics of each reach in the river system. The first equation represents the relationship between discharge and depth. It is assumed that both of these relationships can be represented by the following exponential equations:

$$V = A_1 Q^{B_1} \tag{1}$$

$$D = A_2 Q^{B_2} \tag{2}$$

where
$V$ = mean velocity in a reach (fps)
$Q$ = mean discharge in a reach (cfs)
$D$ = mean depth (feet)
$A_1, A_2, B_1, B_2$ = coefficients

The above regression coefficients are used as input data into the program. These coefficients must be developed from data obtained from the actual stream system. The most readily available data of this type are those collected by the U.S. Geological Survey at each of its streamflow gaging station sites. Data from other sources, but of the same type, in a given river basin, can also be very useful to the modeling process. If the type of data necessary to develop these relationships are not available for a given stream, it will be necessary to estimate these coefficients based on the known topography and physical characteristics of the stream. However, this method is subject to serious error and is not recommended unless absolutely necessary.

An extremely important factor in the dissolved oxygen modeling of a stream system is the reaeration coefficient, $K_2$, which is used in the calculation of the rate of diffusion of dissolved oxygen into the stream. There are five options available in this program for specifying the reaeration rate coefficient. One option is to read it in for each of the reaches in the stream system. The read-in values might be used if, for example, field surveys of the stream to be modeled have been made and values of the reaeration coefficient have been computed from the results of these. However, the reaeration coefficients determined from surveys of this type are only useful for the discharges measured during the survey period. A change in discharge in the stream would probably result in greatly different values for this coefficient. The program user may also choose to estimate $K_2$ values for each reach, based on the known physical and hydraulic characteristics of the stream being modeled. Obviously this method is very subjective and may involve large errors.

Several investigators have found that the reaeration coefficient, $K_2$, can be represented by a relationship as shown in Equation 3.

$$K_2 = \frac{A_3 V^{B_3}}{D^{C_3}} \tag{3}$$

where

$A_3, B_3, C_3$ = coefficients

This relationship postulates that the reaeration rate coefficient is directly proportional to the mean stream velocity and inversely proportional to the mean depth. It is based on two observed phenomena:

- increasing velocity and turbulence increases the surface renewal rate of dissolved oxygen and promotes mixing and dispersion of the oxygen throughout the depth of the stream, and

- increased depth decreases the rate of dispersion of dissolved oxygen throughout the water mass, thus resulting in lower quantities of oxygen being transferred from the atmosphere.

Several investigators have presented the necessary coefficients for use in Equation 3 to calculate the reaeration coefficient for any stream in which the mean velocity and mean depth are known. Table 1 presents these coefficients as determined by four investigators in both field and laboratory tests. The coefficients developed by Churchill in 1962 and by Langbein and Durum in 1967 are probably the best known for the computation of the reaeration rate coefficient for general model use.

If Equation 3 is preferred for the calculation of the reaeration rate coefficient, the appropriate coefficients in this equation are read into the program for every reach in which it is desired to calculate $K_2$ in this manner. A note of caution should be observed when using an equation of this form. Mean stream depths of less than one foot cause the reaeration coefficients predicted by the equation to be higher than are normally observed under actual field conditions. If the stream being modeled has significant areas in which the mean depth of flow is less than one foot, the user is advised to employ alternative methods for computing the reaeration coefficient in these areas.

Another technique for computing the reaeration coefficient, also available to the user of this program, is a direct proportionality between the reaeration coefficient and the stream discharge. This relationship is shown in Equation 4.

$$K_2 = A_4 Q^{B_4} \qquad (4)$$

A relationship of this type may be developed from data obtained from a field survey of a stream in which mean velocity and depth were not determined but discharge was known. The coefficients used in the discharge-reaeration coefficient equation must be computed from measured field data. Equation 4 is not generally applicable to most river systems, because many of the factors which effect the reaeration coefficient are not adequately described by a simple discharge-reaeration coefficient relationship.

TABLE 1.

COEFFICIENTS FOR COMPUTATION OF THE REAERATION COEFFICIENT

| Investigator | $A_3$ | $B_3$ | $C_3$ |
|---|---|---|---|
| Churchill, et al. (1962) | 5.026 | 0.969 | 1.673 |
| Langbein and Durum (1967) | 3.3 | 0.50 | 1.33 |
| O'Connor and Dobbins (1958) | 12.90 | 0.50 | 1.50 |
| Owens and Gibbs (1969) | 9.5 | 0.67 | 1.85 |

The fourth technique available for computing the reaeration coefficient for each reach is based on the investigation by Thackston and Krenkle. This technique was developed experimentally by determining the reaeration coefficient in laboratory channels, using as parameters the mean velocity, channel slope, and mean depth. Equation 5 shows the solution for the reaeration coefficient as developed by Thackston and Krenkle, and as is used in this program:

$$K_2 = .00125 \frac{g}{D} \sqrt{S_e} \left( 1 + \sqrt{\frac{V}{\sqrt{gD}}} \right) \tag{5}$$

where

$S_e$ = mean channel slope (feet/feet)

Use of this option requires that the program user specify a mean channel slope for each reach in the river system being modeled. Equation 5 indicates that the reaeration coefficient is proportional to the shear velocity developed within the stream. Thackston and Krenkle applied this equation to their laboratory data and showed that it gave a reasonably good description of the reaeration rate in the channel. However, only limited data were available to verify the predictive capability of this equation in an actual stream system. Studies at the Texas Water Development Board have indicated that Equation 5 may tend to give higher values for reaeration coefficients than are actually measured during the field evaluation of Texas streams.

The fifth technique available calculates $K_2$ by Equation 6.

$$K_2 = \frac{11.61\, V^{.969}}{D^{1.673}} A_5 \tag{6}$$

The program user may specify any of the five methods described above for the prediction of the reaeration rate coefficient for a given reach. The use of Equations 4, 5 and 6 for reaeration coefficient computation require the user to specify the appropriate coefficients for the equations. Equation 6 requires the program user to specify the mean channel slope for each reach for which this equation is to be used. The user may elect to use the same technique for calculating the reaeration coefficient for all reaches in the stream system or he may use a different method for each of the reaches in the system, depending upon the degree of knowledge obtained of the physical and hydraulic characteristics of each reach.

Waste discharges are entered into the system by specifying a separate reach at each location at which a discharge takes place. The reach specified should be of zero length and should be located at the site of the actual waste discharge in the prototype system. The user specifies the waste discharge volume in cubic feet per second, and the concentrations of all constituents in milligrams per liter. A provision is available in this program to reduce the treatment factor which is read into the program in percent. If the treatment factor is to be used, it is assumed that the concentrations of the waste, as read into the program, are actually the concentrations present in the raw wastewater prior to waste treatment. If the user desires to suppress this option, he inserts a treatment factor of 0.00. In effect, this means that the values specified for each waste treatment plant will not be changed in any manner by the model. (For a further discussion of the inflow treatment factor see the FILE F2 description in Table 2.

The model has provisions for withdrawing water at any location within the stream system. The water is withdrawn from the stream at the quality existing at the location of the withdrawal as determined by the model. The withdrawal is specified in the same manner as a waste input to the stream system. A separate reach of zero length is set up for each withdrawal in the system. A negative flow is specified on the waste and withdrawal input cards to indicate that water is being withdrawn from the system. The treatment factor values are not taken into consideration by the model for withdrawal.

The user of the DOSCI program has several options available which will enable him to simulate several different stream conditions in one computer run, without reading in additional data. The user of the program may read in up to four waste treatment factors. The program will calculate a new dissolved oxygen profile based on the organic load released from each plant after the treatment factor has been applied. This process is repeated for each of the treatment factors entered in the program. The user may also specify up to four dissolved oxygen target levels, which are the minimum permissable dissolved oxygen concentrations in the stream system. By specifying a positive dissolved oxygen target level, the user also indicates that he wishes the program to calculate the flow augmentation requirements, if any, needed to meet this target level. The other option available to the user is that up to twelve different temperatures and corresponding headwater flows may be specified, and the program will completely model the stream for each value. It should be noted that the input headwater temperature (FILE H) is used as the temperature in a given reach only if no temperature is specified for that reach (FILE J).

The above three options enable the program user, in a single run, to perform a large number of simulations of the stream system to determine the effects of various waste loadings, temperatures, and dissolved oxygen target levels on the dissolved oxygen concentration within the system.

The procedure used by DOSCI to determine augmentation requirements should be briefly mentioned. The model begins routing organic wastes and dissolved oxygen from the uppermost point in the stream system and proceeds downstream. As the simulation progresses downstream, reach by reach, the calculated dissolved oxygen concentration is checked against the target dissolved oxygen level specified by the user. When the model discovers a dissolved oxygen concentration below the target, it stops at this reach. The model then searches all of the upstream headwaters to see which headwaters have water available for flow augmentation purposes. The model then estimates, using a parabolic relationship between dissolved oxygen deficit and the target dissolved oxygen level, the quantity of water required for flow augmentation to increase the minimum dissolved oxygen concentration to the target level. The volume of water required is then divided equally among all of the headwaters from which water is available for augmentation. These new flows are then re-routed through the stream system. If the amount of augmentation was insufficient to raise the minimum dissolved oxygen concentration above the target level at the reach being investigated, the process is repeated until the target dissolved oxygen concentration is attained. After the target dissolved oxygen concentration has been satisfied, the program proceeds downstream until it comes to another dissolved oxygen concentration level below the target and then the process is repeated as before. The program is designed so that it can only augment from a headwater stretch, and the augmentation requirements are divided equally among all the headwater stretches which have augmentation availability. The flow augmentation option is suppressed by specifying a negative value for the target dissolved oxygen concentration.

## MODEL VERIFICATION AND SENSITIVITY

The DOSCI model was verified on five different stream regions in the Spokane Basin in the states of Washington and Idaho. These regions varied from deep, slow flowing streams such as the Spokane River above FDR Lake to shallow, steep streams such as the upper reaches of the South Fork of the Coeur d'Alene River. Two different simulation periods were chosen for each of the five regions. Quality constituents modeled included coliforms, zinc, chlorides, BOD, $NH_3$-N, $NO_2$-N, $NO_3$-N, $PO_4$-P and DO. Waste discharges modeled included urban sewers and mine processing outfalls. In general the simulated values of the constituent concentrations throughout the system matched the observed values very well. A sensitivity analysis was also performed, using one of the five regions as the study area. The results of the verification runs and the sensitivity analysis may be found in Volume I (Parts IV and V) of this report.

## SECTION III

## PROGRAM DESCRIPTION

The subroutines employed by DOSCI are described in this section. Flowcharts are provided for the new subroutines with the exception of the plotting routines. The nontrivial equations occur in subroutines K2CAL and GETCON. The equations used by K2CAL are described in Table 2 (File F-4). The equations used by GETCON are described in Volume I, Part III. The important local variables are described in Table 5. All subroutine interlinkages and simplified flowcharts for all subroutines are presented in Figure 2, which summarizes the modifications to the original flowchart in Reference [8].

### Main Program

The main program, with the help of subroutines NEWIN and PLTSET, reads and echo prints all input data. It sets the basin conditions to be considered, and calls the necessary subroutines for the modeling of the stream system. The main program repeats the modeling process for each of the options specified for program operation. Figure 2, which is based on Figure 4 of Reference [8], shows the general program subroutine interlinkages.

### Subroutine BLEND

This subroutine computes the discharges and the quality constituent concentrations entering a stretch immediately downstream from a junction. Discharges are computed by simple addition; constituent concentrations are computed by a mass balance at the junction.

### Subroutine CMIN

For each reach, this routine finds the sub-reach having the lowest dissolved oxygen concentration, and the river mile at which this concentration occurs.

### Subroutine DOEQU

When DOEQU is called to process a given reach the following procedure is followed. If the reach has length zero, the end conditions are set equal to the start conditions, the appropriate quantities are stored for future reference, and DOEQU returns control to the calling routine. If the reach length is not zero and only conservatives are being modeled, the concentrations of the conservatives are calculated at the end of the reach by a simple mass balance, the appropriate quantities are stored for future flow augmentation computations and printout, and control is returned to the calling routine. If the reach length is not zero and nonconservatives are being modeled, the reach is divided into ten equal subreaches and each subreach is then considered as follows. The velocity, depth,

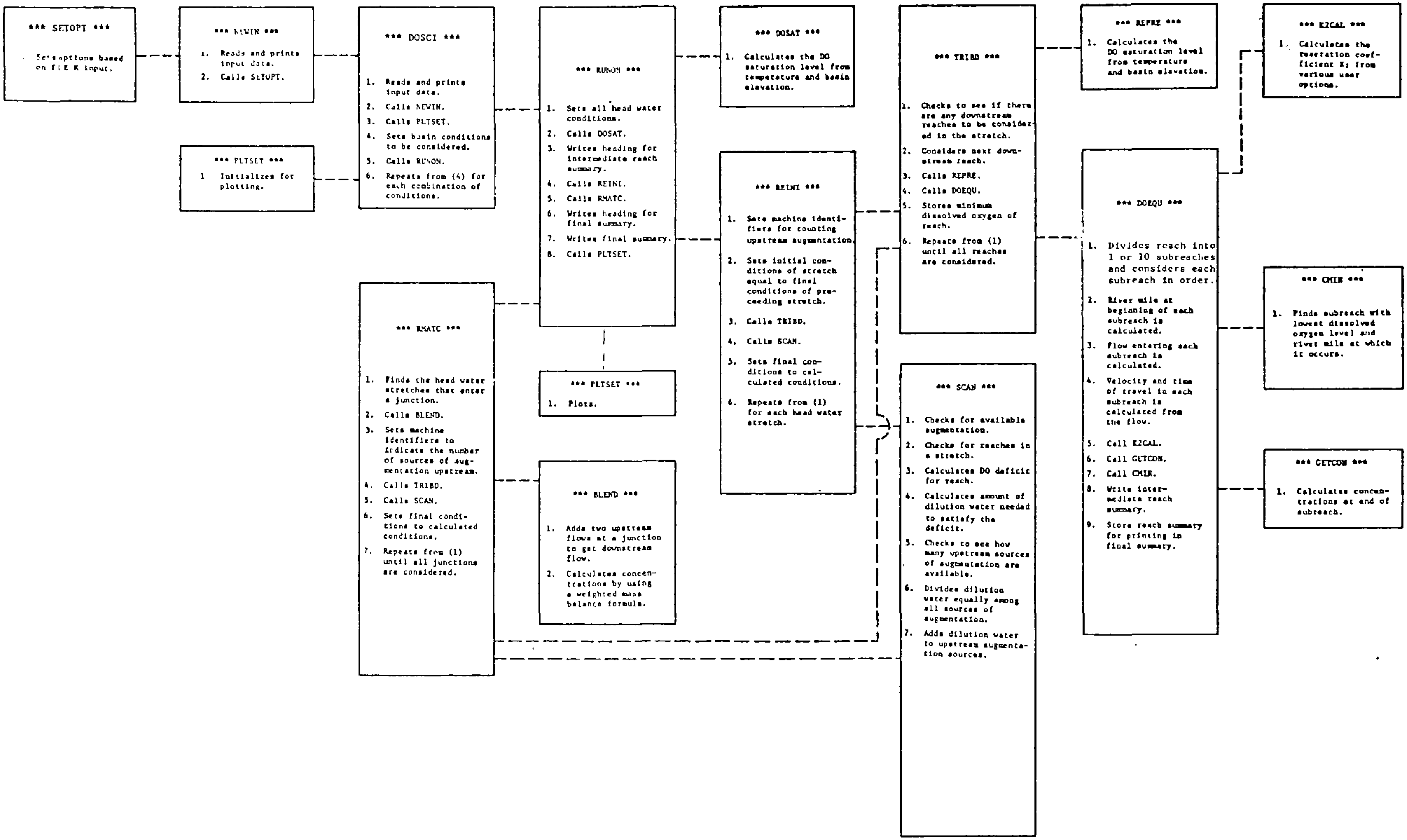



FIGURE 2. GENERAL PROGRAM FLOW DIAGRAM

and travel time for the subreach are computed, subroutine K2CAL is called to calculate $K_2$, and subroutine GETCON is called to compute the concentrations of the nonconservatives at the end of the subreach, given the concentrations at the beginning of the subreach. Any incremental flow is added, the concentrations are adjusted accordingly by a mass balance, and the procedure is repeated on the next subreach. When the last subreach is completed appropriate quantities are stored, and control is returned to the calling routine.

Subroutine DOSAT

This subroutine calculates the dissolved oxygen saturation concentration for each reach based on the temperature and elevation in that reach.

Subroutine GETCON

Subroutine GETCON is called by subroutine DOEQU to calculate the changes in concentrations which occur in a stream reach over a time interval $\Delta t$, where $\Delta t$ is the travel time through the reach. The algorithms used are explained in detail in Part III of Volume I. The inputs to GETCON include stream depth and velocity, average light intensity at the surface during $\Delta t$, and the appropriate system constants and reach variables, as well as the concentrations of all constituents at the beginning of $\Delta t$. A flow chart of subroutine GETCON is given in Figure 3. Equations referenced as A.NN may be found in Volume I, Part III.

Subroutine K2CAL

This subroutine calculates the reaeration rate coefficient for each reach in the river system being modeled. The technique used for calculating the reaeration coefficient is specified by the user in the input data (see Table 2, File F-4).

Subroutine NEWIN

This subroutine reads and echo prints the data input to FILE J and FILE K. Subroutine SETOPT is called to set various option flags based on the inputs to FILE K. A flowchart of subroutine NEWIN is given in Figure 4.

Subroutine PLOT

This subroutine is called to plot various quantities on the line printer. See the description of input FILE L for a list of the quantities which may be plotted.

Subroutine PLTSET

This subroutine has two uses. It is called to read and echo write FILE L input data. It is also the driver for subroutine PLOT and is used in this respect for plotting desired quantities.

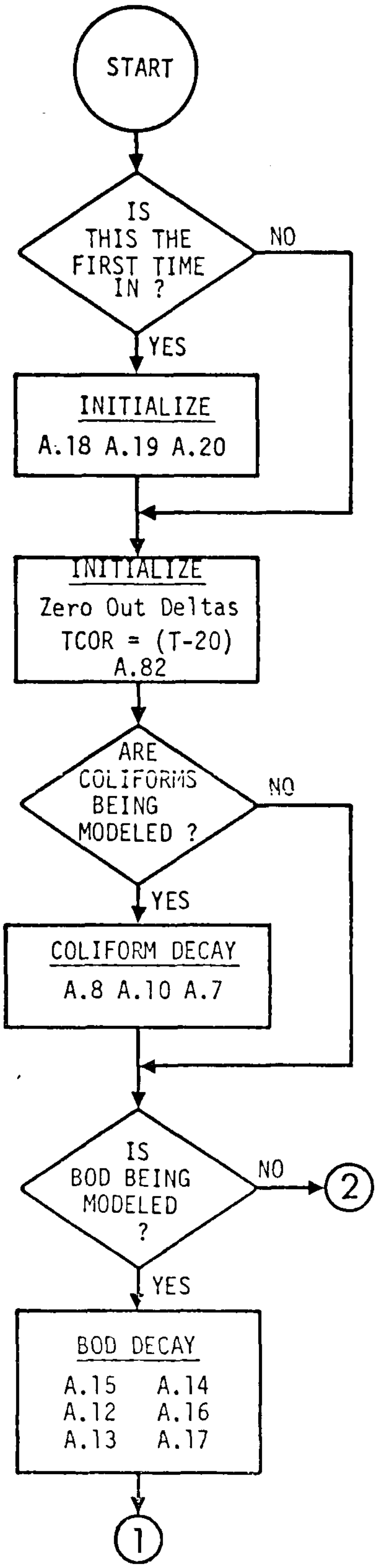



FIGURE 3. FLOWCHART - SUBROUTINE GETCON (Page 1)

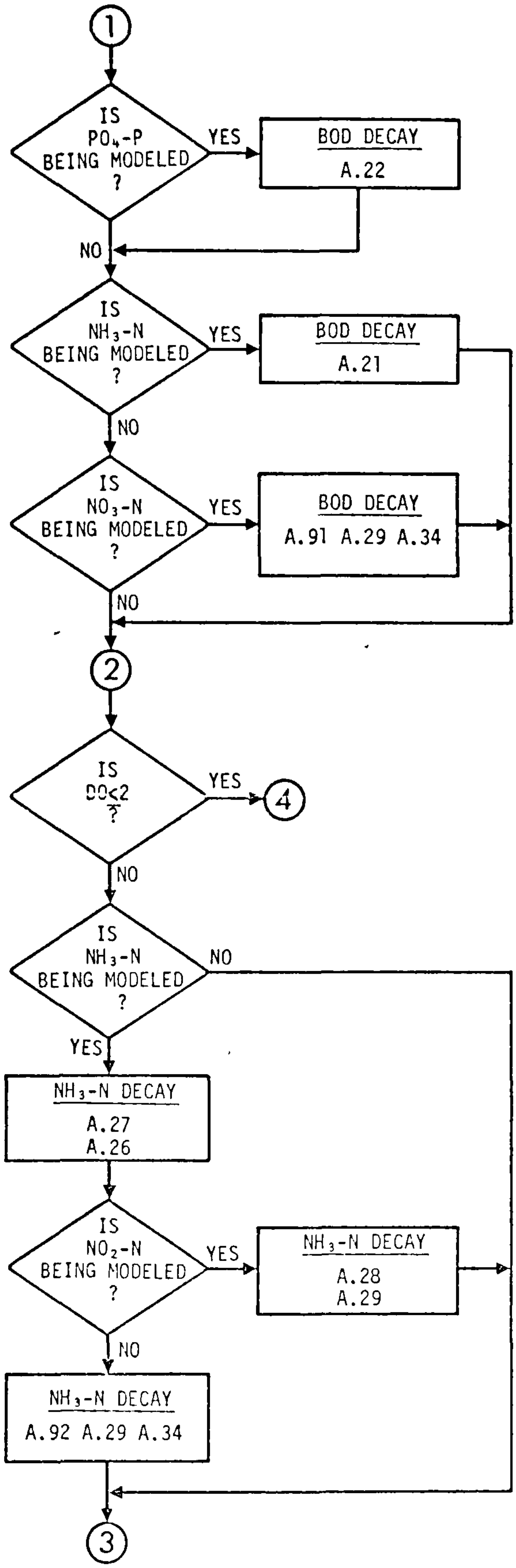



FIGURE 3.
FLOWCHART-SUBROUTINE GETCON (cont'd)

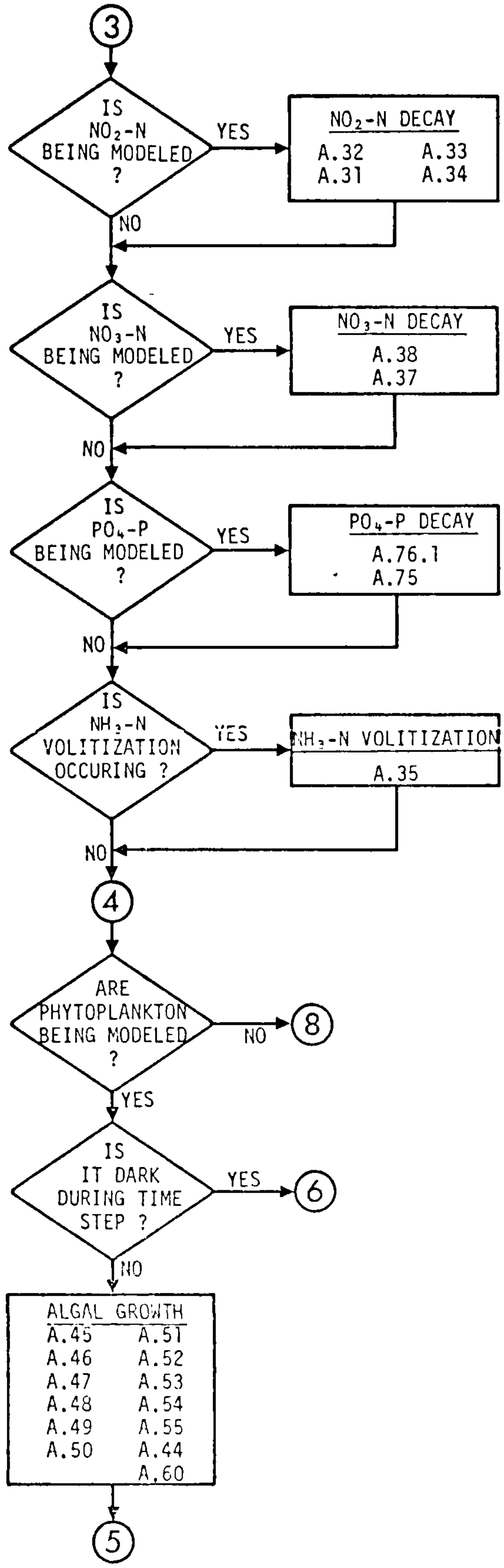



FIGURE 3.
FLOWCHART-SUBROUTINE GETCON (cont'd)

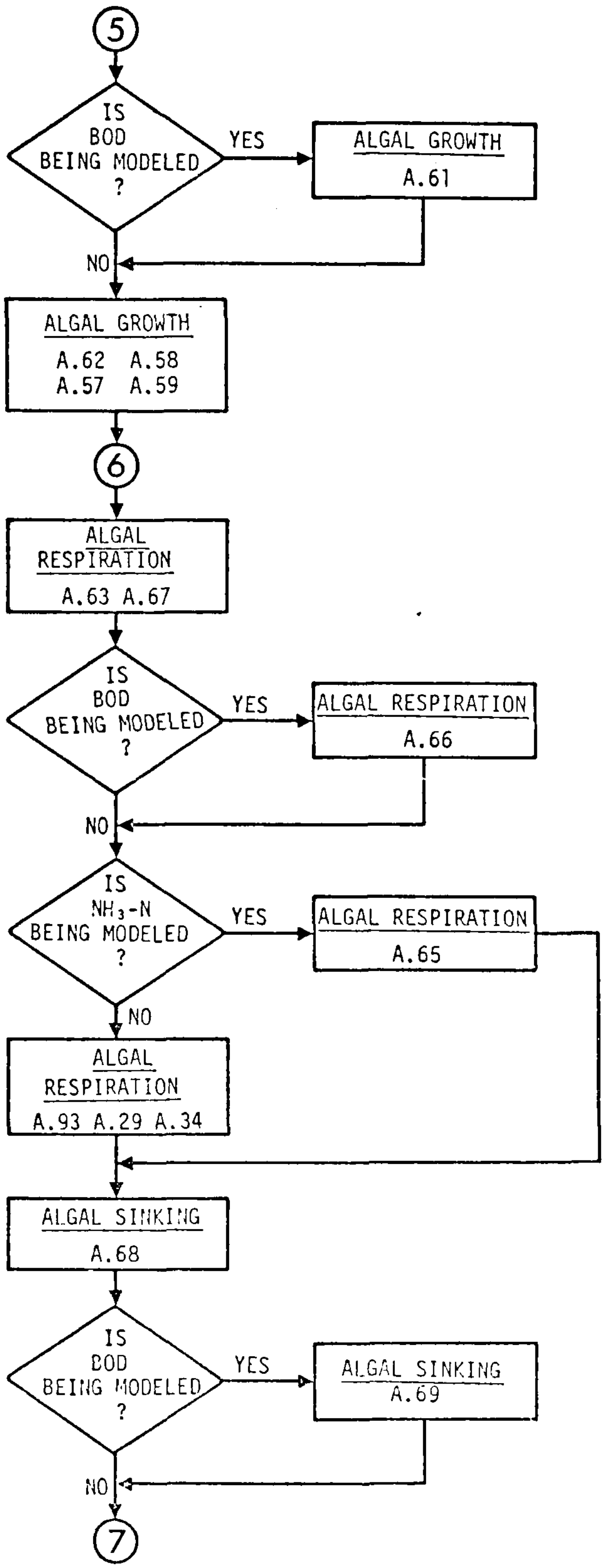



FIGURE 3.
FLOWCHART-SUBROUTINE GETCON (cont'd)

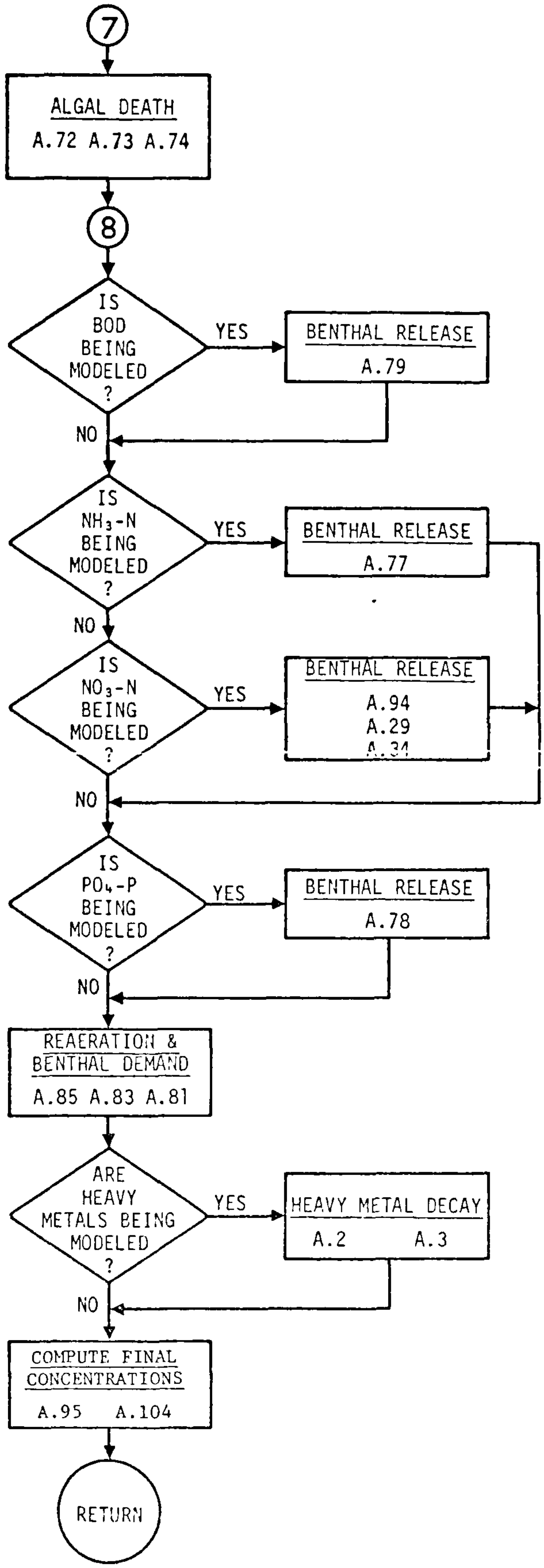



FIGURE 3.
FLOWCHART-SUBROUTINE GETCON (cont'd)

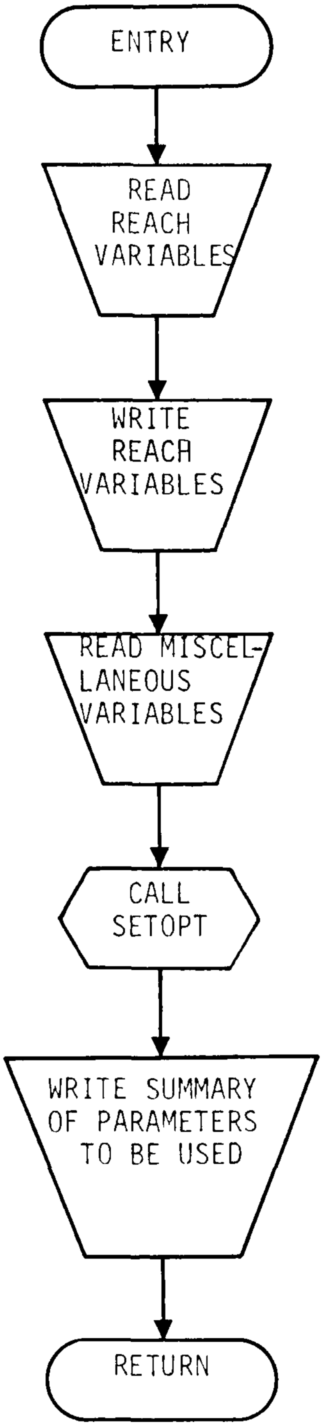



FIGURE 4. SUBROUTINE NEWIN

Subroutine REINI

This subroutine flags each headwater stretch to indicate whether water is available for flow augmentation. It also sets the initial conditions of a stretch equal to the final conditions of the preceeding stretch. After the calculations for each stretch are completed, including flow augmentation requirements (if any), this subroutine sets the final conditions for each stretch equal to the calculated conditions prior to printout. This procedure is repeated for each of the headwater stretches.

Subroutine REPRE

This subroutine calculates the concentrations at the head of a reach from the end conditions of the upstream reach and the concentrations of any tributary inflow using the mass balance technique. The treatment factor is applied to the inflow if required, i.e., if the DO level of the tributary inflow is input as a negative number (see footnote to FILE F-2 input data).

Subroutine RMATC

Subroutine RMATC identifies the headwater stretches as they enter a junction. As computations in the program progress downstream, RMATC stores and flags the headwater sources which are available for flow augmentation. This flagging operation is performed each time a junction within the river basin system is encountered.

Subroutine RUNON

This subroutine initializes the concentrations in each headwater of the system and calls DOSAT to calculate the DO saturation level in each reach. This subroutine also prints the headings for the intermediate and the final summaries, and prints out all of the information in the final summary after all calculations have been completed. Subroutine PLTSET is called to plot any quantities requested in FILE L.

Subroutine SCAN

Subroutine SCAN, operating on one stretch at a time, computes the flow augmentation required (if any) to meet the desired target dissolved oxygen concentration at all points in the stretch. It first checks for all available augmentation upstream of the stretch under consideration. The subroutine then determines the minimum dissolved oxygen level in each of the reaches in the stretch. It calculates and stores the dissolved oxygen concentration. It then estimates the quantity of dilution water required to satisfy the greatest deficit within the stretch. The required amount of dilution water is divided equally among all sources available for flow augmentation. SCAN then adds the dilution water to each of these upstream sources.

Subroutine SETOPT

This subroutine is called by subroutine NEWIN to set various option flags as required by the FILE K inputs. A listing of the constituents which are to be modeled is output. A flowchart of SETOPT is presented in Figure 5.

Subroutine TRIBD

This subroutine processes each reach in a stretch by calling REPRE to calculate conditions at the head of the reach and DOEQU to calculate the changes occurring throughout the reach. The minimum dissolved oxygen concentration in the reach is stored for use by flow augmentation calculations.

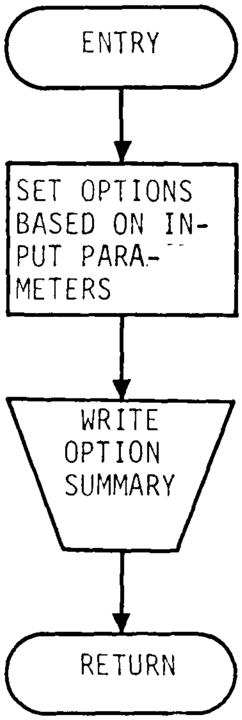



FIGURE 5. SUBROUTINE SETOPT

# SECTION IV

## INPUT REQUIREMENTS

The inputs required by DOSCI are described in this section in Table 2 and Table 3. Any variable which does not have a default value must be input. If a value of zero is desired for an input variable which has a non-zero default value, a small positive number (e.g., 0.00001) must be input. Restrictions on input data are discussed in Section II. Equations referenced as (A.NN) in Table 2 may be found in Part III of Volume I.

Figure 6 illustrates the physical arrangement of the DOSCI input deck. A typical DOSCI input deck is presented in Table 6.

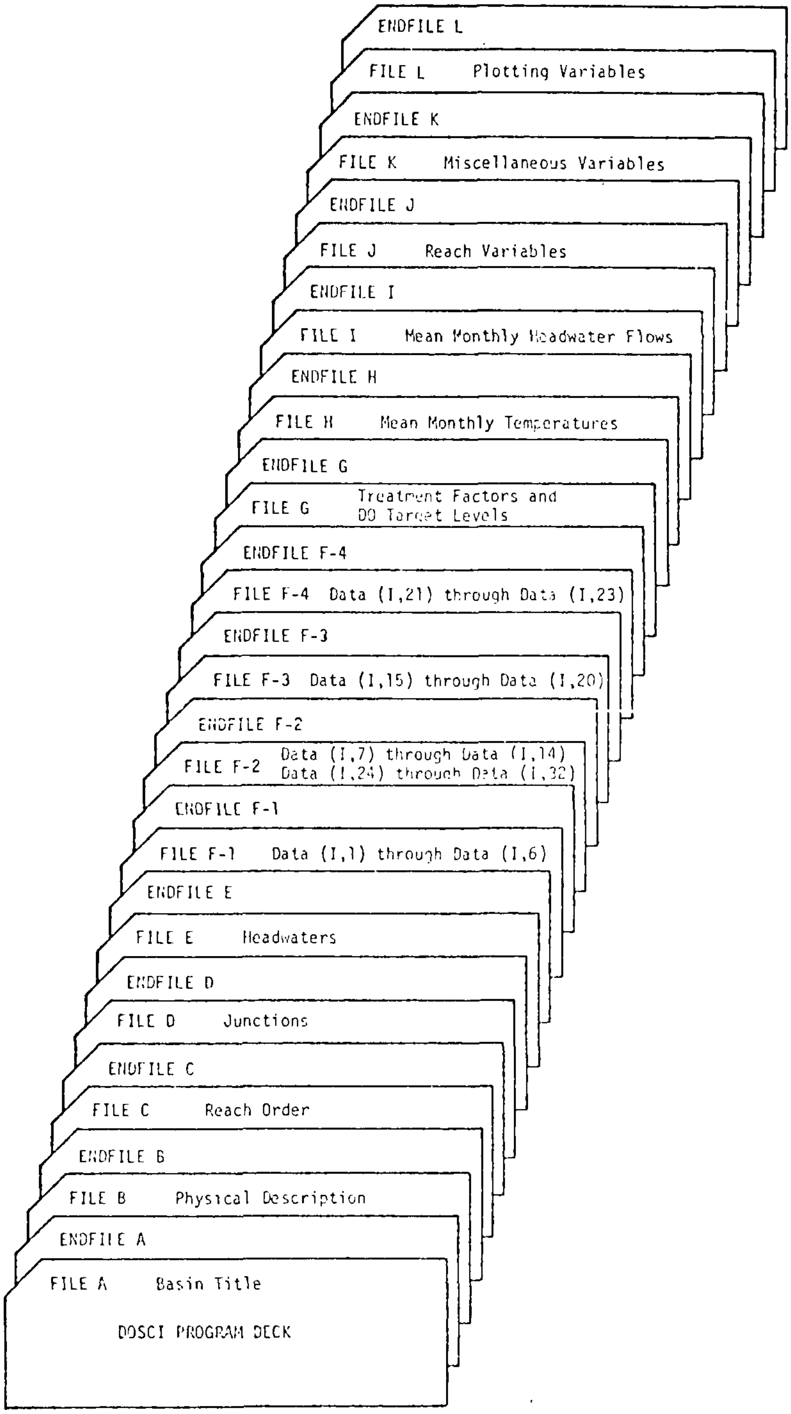



FIGURE 6. INPUT DATA ORGANIZATION

TABLE 2.

DOSCI INPUT

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File A - Run Title** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE A |
| | 9-72 | 18A4 | TITLE | | | Title for run |
| 2 | 1-8 | 2A4 | DUM | | | ENDFILE |
| | | | **File B - Physical Description** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE B |
| | 14-15 | I2 | NINIT | | | Number of headwater reaches (≤10) |
| | 25-26 | I2 | NJUNC | | 0 | Number of junctions (≤20) |
| | 35-36 | I2 | NREA | | | Number of reaches (≤99) |
| | 45-46 | I2 | NTRIB | | | Number of stretches (≤20) |
| | 55-56 | I2 | ICK | | 0 | 0 = intermediate summary and final summary<br>1 = final summary only |
| | 75-80 | F6.1 | ELEV | (FEET) | 0. | Mean elevation of the region |
| 2 | 1-8 | 2A4 | DUM | | | ENDFILE |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File C - Reach Ordering** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE C |
| | 12-13 | I2 | I | | | Stretch number ($\leq 20$) |
| | 21-80 | 20(I3) | (IORD(I,J), J=1,20) | | | Reaches in stretch I (upstream to downstream, no more than 20 reaches in a stretch) |
| 2-NTRIB | Each of the NTRIB stretches requires a card (same format as card #1) defining its reaches. | | | | | |
| NTRIB+1 | 1-8 | 2A4 | DUM | | | ENDFILE |
| | | | **File D - Junctions** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE D |
| | 22-23 | I2 | I | | | Junction number ($\leq 20$; junctions should be numbered in increasing order downstream) |
| | 30-31 | I2 | JUNC(I,1) | | | Upstream stretch for junction I |
| | 40-41 | I2 | JUNC(I,2) | | | Upstream stretch for junction I |
| | 50-51 | I2 | JUNC(I,3) | | | Downstream stretch for junction I |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|

### File D - Junctions

2-NJUNC Each of the NJUNC junctions requires a card (same format as card #1) defining its stretches.

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| NJUNC+1 | 1-8 | 2A4 | DUM | | | ENDFILE |

If there are no junctions, only the ENDFILE card is required.

### File E - Headwater Data

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 1 | 1-8 | 2A4 | DUM | | | FILE E |
| | 9-13 | I5 | I | | | Headwater stretch number (must be $\leq$10) |
| | 14-18 | I5 | LAUG(I) | | 0 | 0 = no augumentation<br>1 = augment flow if necessary |
| 2 | 1-10 | F10.4 | CONDZ(I,1) | (MG/L) | 0. | DO concentration in headwater I |
| | 11-20 | F10.4 | CONDZ(I,2) | (MG/L) | 0. | BOD concentration in headwater I |
| | 21-30 | F10.4 | CONDZ(I,3) | (MG/L) | 0. | $NH_3$-N concentration in headwater I |
| | 31-40 | F10.4 | CONDZ(I,4) | (MG/L) | 0. | $NO_2$-N concentration in headwater I |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File E - Headwater Data** | | | |
| 2 | 41-50 | F10.4 | CONDZ(I,5) | (MG/L) | 0. | $NO_3$-N concentration in headwater I |
| | 51-60 | F10.4 | CONDZ(I,6) | (MG/L) | 0. | $PO_4$-P concentration in headwater I |
| | 61-70 | F10.4 | CONDZ(I,7) | (MG/L) | 0. | CHLOR-A (phytoplankton) concentration in headwater I |
| | 71-80 | F10.4 | CONDZ(I,8) | (MPN/100) | 0. | COLIFORM concentration in headwater I |
| 3 | 1-10 | F10.4 | CONDZ(I,9) | (MG/L) | 0. | HEAVY METAL 1 concentration in headwater I |
| | 11-20 | F10.4 | CONDZ(I,10) | (MG/L) | 0. | HEAVY METAL 2 concentration in headwater I |
| | 21-30 | F10.4 | CONDZ(I,11) | (MG/L) | 0. | HEAVY METAL 3 concentration in headwater I |
| | 31-40 | F10.4 | CONDZ(I,12) | (MG/L) | 0. | TOTAL NITROGEN concentration in headwater I |
| | 41-50 | F10.4 | CONDZ(I,13) | (MG/L) | 0. | CHLORIDE concentration in headwater I |
| | 51-60 | F10.4 | CONDZ(I,14) | (MG/L) | 0. | HEAVY METAL 1 ION concentration headwater I (not used if PIHM1 $\neq$ 0, FILE K card 9) |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File E - Headwater Data** | | | |
| 3 | 61-70 | F10.4 | CONDZ(I,15) | (MG/L) | 0. | HEAVY METAL 2 ION concentration in headwater I (not used if PIHM2 $\neq$ 0, FILE K card 10) |
| | 71-80 | F10.4 | CONDZ(I,16) | (MG/L) | 0. | HEAVY METAL 3 ION concentration in headwater (not used if PIHM3 $\neq$ 0, FILE K, card 10) |

4-3*NINIT

Each of the NINIT headwaters requires 3 cards (same formats as cards #1, #2, #3) defining the concentrations of its constituents. Although no concentrations need be specified on the cards (in which case the default values apply), the cards must be included.

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 3*NINT+1 | 1-8 | 2A4 | DUM | | | ENDFILE |
| | | | **File F-1 Reach Data** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE F-1 |
| | 17-18 | I2 | I | | | Reach number ($\leq$99) |
| | 23-30 | F8.0 | DATA(I,1) | (MILES) | | Reach length |
| | 33-40 | F8.0 | DATA(I,2) | (MILES) | | River mile to head of reach |
| | 43-50 | F8.0 | DATA(I,3) | $(HOUR^{-1})$ | .008 | BOD decay coefficient |
| | 53-60 | F8.0 | DATA(I,4) | $(HOUR^{-1})$ | 0. | BOD settling coefficient |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File F-1 Reach Data** | | | |
| 1 | 63-70 | F8.0 | DATA(I,5) | | .255 | Coefficient on flow for velocity |
| | 73-80 | F8.0 | DATA(I,6) | | .414 | Exponent on flow for velocity |
| 2-NREA | | | | | | |
| Each of the NREA reaches requires a card (same format as card #1) defining the above data. | | | | | | |
| NREA+1 | 1-8 | 2A4 | DUM | | | ENDFILE |
| | | | **File F-2 Reach Data** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE F-2 |
| | 12-20 | I9 | I | | | Reach number ($\leq$99) |
| | 21-30 | F10.4 | DATA(I,7) | (CFS) | | Flow entering reach I (see F-2 note below) |
| 2 | 1-10 | F10.4 | DATA(I,8) | (MG/L) | 0. | DO concentration in flow for reach I |
| | 11-20 | F10.4 | DATA(1,9) | (MG/L) | 0. | BOD concentration in flow for reach I |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File F-2 Reach Data | | | |
| 2 | 21-30 | F10.4 | DATA(I,10) | (MG/L) | 0. | $NH_3$-N concentration in flow for reach I |
| | 31-40 | F10.4 | DATA(I,11) | (MG/L) | 0. | $NO_2$-N concentration in flow for reach I |
| | 41-50 | F10.4 | DATA(I,12) | (MG/L) | 0. | $NO_3$-N concentration in flow for reach I |
| | 51-60 | F10.4 | DATA(I,13) | (MG/L) | 0. | $PO_4$-P concentration in flow for reach I |
| | 61-70 | F10.4 | DATA(I,14) | (MG/L) | 0. | CHLOR-A(phytoplankton) concentration flow for reach I |
| | 71-80 | F10.4 | DATA(I,24) | (MPN/100) | 0. | COLIFORM concentration in flow for reach I |
| 3 | 1-10 | F10.4 | DATA(I,25) | (MG/L) | 0. | HEAVY METAL 1 concentration in flow for reach I |
| | 11-20 | F10.4 | DATA(I,26) | (MG/L) | 0. | HEAVY METAL 2 concentration in flow for reach I |
| | 21-30 | F10.4 | DATA(I,27) | (MG/L) | 0. | HEAVY METAL 3 concentration in flow for reach I |
| | 31-40 | F10.4 | DATA(I,28) | (MG/L) | 0. | TOTAL NITROGEN concentration in flow for reach I |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File F-2 Reach Data | | | |
| 3 | 41-50 | F10.4 | DATA(I,29) | (MG/L) | 0. | CHLORIDE concentration in flow for reach I |
| | 51-60 | F10.4 | DATA(I,30) | (MG/L) | 0. | HEAVY METAL 1 ION concentration in flow for reach I (not used if PIHMI ≠ 0, FILE K card 9) |
| | 61-70 | F10.4 | DATA(I,31) | (MG/L) | 0. | HEAVY METAL 2 ION concentration in flow for reach I (not used if PIHM2 ≠ 0, FILE K, card 10) |
| | 71-80 | F10.4 | DATA(I,32) | (MG/L) | 0. | HEAVY METAL 3 ION concentration in flow for reach I (not used if PIHM3 ≠ 0, FILE K, card 10) |

4-N

Each reach with a nonzero input or withdrawal requires 3 cards (same formats as cards #1, #2, #3) defining the above quantities. Although no concentrations need be specified on the cards (in which case the default values apply), the cards must be included.

The last card must be followed by the following:

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| N+1 | 1-8 | 2A4 | DUM | | | ENDFILE |

If no reach has a nonzero inflow, only the ENDFILE card is required.

TABLE 2. (Continued)

F-2 Note:

If the length of reach I is zero (card #1, File F-1) and the flow is positive, the reach is considered to be a point source. If the DO concentration is input as a negative number, the treatment factor (card #1, File G) is applied to all constituents being modeled and the DO concentration is treated as a positive quantity. If the DO is not input as a negative number, the treatment factor is not applied. If the length is zero and the flow is negative, the reach is considered to be a point withdrawal. The constituents are withdrawn from the system at the concentrations determined by the model.

If the length of the reach is positive and the flow is positive, the flow is added uniformly to the system over the reach length. This is accomplished by considering the flow to be divided evenly amongst ten equally spaced' point sources along the reach length. Each point source is then treated as described above.

Similarly, if the length is positive and the flow is negative, the flow is withdrawn uniformly over the reach length by considering ten equally spaced point withdrawals and treating each point withdrawal as described above.

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File F-3 Reach Data** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE F-3 |
| | 17-18 | I2 | I | | | Reach number ($\leq$99) |
| | 23-30 | F8.0 | DATA(I,15) | ($HOUR^{-1}$) | 0. | $K_2$ (reaeration) value for option #1 (see File F-4 for a definition of option values) |
| | 33-40 | F8.0 | DATA(I,16) | | 3.3 | Velocity coefficient for $K_2$ equation for option #2 |
| | 43-50 | F8.0 | DATA(I,17) | | 1.0 | Velocity exponent for $K_2$ equation for option #2 |
| | 53-60 | F8.0 | DATA(I,18) | | 1.33 | Depth exponent for $K_2$ equation for option #2 |
| | 63-70 | F8.0 | DATA(I,19) | | 0. | Flow coefficient for $K_2$ equation for option #3 |
| | 73-80 | F8.0 | DATA(I,20) | | 0. | Flow exponent for $K_2$ equation for option #3 |

2-N If the default values are not satisfactory for a given reach, a card (same format as card #1) must be included for that reach.

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File F-3 Reach Data** | | | |
| | | | If all default values are satisfactory, only the ENDFILE card is required. | | | |
| N+1 | 1-8 | 2A4 | DUM | | | ENDFILE |
| | | | **File F-4 Reach Data** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE F-4 |
| | 17-18 | I2 | I | | | Reach number ($\leq 99$) |
| | 25-26 | I2 | K2OPT(I) | | | Option for calculating reaeration constant $K_2$ (see F-4 note below) |
| | 31-50 | 5A4 | RIDENT | | | Reach identification |
| | 53-60 | F8.0 | DATA(I,21) | | .259 | Flow coefficient for depth equation |
| | 63-70 | F8.0 | DATA(I,22) | | .414 | Flow exponent for depth equation |
| | 73-80 | F8.0 | DATA(I,23) | | .0 | Channel slope for $K_2$ equation for option 4 |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | | | | **File F-4 Reach Data** |
| 2-NREA | Each of the NREA reaches requires a card (same format as card #1) defining the above data. | | | | | |
| NREA+1 | 1-8 | 2A4 | DUM | | | ENDFILE |

F-4 Note:

The reaeration constant $K_2$ is calculated as follows for reach I

Option #1 $\quad K_2 = \text{DATA(I,15)}$

Option #2

$$K_2 = \frac{A \cdot V^B}{D^C} \quad \frac{2.31}{24.}$$

where

$A$ = DATA(I,16)

$V$ = velocity (ft/sec)

$B$ = DATA(I,17)

$D$ = (ft)

$C$ = DATA(I,18)

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|

Option #3 $$K_2 = (A \cdot Q^B)\ (\frac{2.31}{24.})$$

where
A = DATA(I,19)
Q = flow (CFS)
B = DATA(I,20)

Option #4 $$K_2 = [10.8 \left(1 + \sqrt{\frac{V}{\sqrt{gD}}}\ \frac{1}{4}\right) \sqrt{S}\ (\frac{g}{D})]\ (\frac{2.31}{24.})$$

where
V = velocity (ft/sec)
g = gravity ($ft/sec^2$)
D = depth (ft)
S = DATA(I,23)

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|

Option #5

$$K_2 = \left(\frac{11.61\ V^{.969}}{24D^{1.673}}\right) A$$

where V = velocity (ft/sec)

D = depth (ft)

A = DOK2 (I) (see File J)

<u>File G - Treatment Factors and DO Levels</u>

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 1 | 1-8 | 2A4 | DUM | | | FILE G |
| | 11-15 | F5.0 | DOL(1) | (MG/L) | 0. | DO concentration level for 1st run (if the DO concentration falls below this level in any reach, augmentation will occur if allowed) |
| | 16-30 | 3F5.0 | (DOL(I), I=2,4 | (MG/L) | 0. | DO levels for 2nd, 3rd, and 4th runs (if DOL(I)=0, for I=2,3,4 run I will not be made) |
| | 31-35 | F5.0 | TRFAC(1) | | 0. | Fraction of constituents removed at treatment stations (see footnote to File F-2) for 1st case |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
| --- | --- | --- | --- | --- | --- | --- |
| | | | File G - Treatment Factors and DO Levels | | | |
| 1 | 36-50 | 3F5.0 | (TRFAC(I) I=2,4) | | 0. | Fractions of constituents removed for 2,3,4 (if TRFAC(I)=0, for I=2,3,4, case I will not be run) |
| 2 | 1-8 | 2A4 | DUM | | | ENDFILE |

If the default values are satisfactory, only the ENDFILE is required.

Run 1-Case 1, i.e., the DOL(1) - TRFAC(1) combination is always run. In addition, for any non-zero TRFAC(K),K=2,3,4, the DOL(1) - TRFAC(K) case is run. For I=2,3,4 if DOL(I)≠0, the DOL(I) - TRFAC(1) case is run plus the DOL(I) - TRFAC(K) cases for TRFAC(K)≠0, K=2,3,4. Hence a maximum of 16 cases may be run. The default values result in only the DOL(1) - TRFAC(1) case, i.e., no augmentation and no treatment.

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File H - Mean Monthly Temperatures** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE H |
| | 21-80 | 12F5.0 | (TEMMO(I), I=1,12) | (CENT°) | 0. | Mean monthly temperatures (Oct.-Sept.) for the system being modeled (if no temperature is assigned to a given reach in File J, the average is assigned to that reach |
| 2 | 1-8 | 2A4 | DUM | | | ENDFILE |

For each case executed (as defined in File G), a subcase is run for each TEMMO(I)≠0. Hence at least one TEMMO(I) must be nonzero.

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File I - Headwater Flows** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE I |
| | 12-13 | I2 | I | | | Headwater stretch number (≤10) |
| | 21-80 | 12F5.0 | (HWFLOW(I,J), J=1,12) | (CFS) | 0. | Average flow in headwater I for month J (Oct.-Sept.) (if TEMMO(K)≠0, HWFLOW(I,K) must be nonzero) |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File I - Headwater Flows** | | | |
| 2-NINIT | | | | | | |
| | Each headwater requires a card (same format as Card #1) defining the flows. | | | | | |
| NINIT+1 | 1-8 | 2A4 | DUM | | | ENDFILE |
| | | | **File J - Reach Variables** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE J |
| | 10-13 | I3 | I | | | Reach number ($\leq 99$) |
| | 14-19 | F6.0 | COLK(I) | ($HOUR^{-1}$) | .004 | Coliform reaction coefficient for reach I (A.7) |
| | 20-25 | F6.0 | NH3K(I) | ($HOUR^{-1}$) | .004 | $NH_3$ reaction coefficient for reach I (A.26) |
| | 26-31 | F6.0 | NO2K(I) | ($HOUR^{-1}$) | .015 | $NO_2$ reaction coefficient for reach I (A.31) |
| | 32-37 | F6.0 | NO3K(I) | ($HOUR^{-1}$) | .0014 | $NO_3$ reaction coefficient for reach I (A.37) |
| | 38-43 | F6.0 | PO4K(I) | ($HOUR^{-1}$) | .0009 | $PO_4$ settling coefficient for reach I (A.75) |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File J - Reach Variables | | | |
| | 44-49 | F6.0 | EXTK(I) | $(HOUR^{-1})$ | .04 | Extinction coefficient for reach I (A.51) |
| | 50-55 | F6.0 | DOK2(I) | $(HOUR^{-1})$ | 1. | $K_2$ coefficient for option 5 (see footnote to File F-4) |
| | 56-61 | F6.0 | HMIK(I) | $(HOUR^{-1})$ | .004 | Settling coefficient for HEAVY METAL 1 for reach I (A.2) |
| | 62-67 | F6.0 | HM3K(I) | $(HOUR^{-1})$ | 0. | Settling coefficient for HEAVY METAL 2 for reach I (A.2) |
| | 68-73 | F6.0 | HM3K(I) | $(HOUR^{-1})$ | 0. | Settling coefficient for HEAVY METAL 3 for reach I (A.2) |
| | 74-79 | F6.0 | TEMREA(I) | (CENT°) | File H value | Temperature in reach |

2-N If the default values are not satisfactory for a given reach, then a card (same format as card +1) defining the above variables must be input for that reach.

If all default values are satisfactory, only the ENDFILE card is required.

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| N+1 | 1-8 | 2A4 | DUM | | | ENDFILE |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File K - Miscellaneous Variables | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE K |
| | 10-20 | F10.4 | IO | (LANGLEYS/MIN) | | Average light intensity (A.53) |
| 2 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | I10 | IFN | | | PHYTOPLANKTON growth function option<br>0 = growth limited by $NO_3$-N concentration<br>1 = growth limited by $NH_3$-N concentration<br>2 = growth limited by maximum of $NH_3$-N and $NO_3$-N |
| | 21-30 | I10 | ICOL | | | COLIFORM option<br>0 = don't model COLIFORMS<br>1 = model COLIFORMS |
| | 31-40 | I10 | ICOMB | | | Constituent selection option (see Table 3) |
| 3 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | I10 | IHEAVY | | | Heavy metal option<br>0 = model no heavy metals or ions<br>N = model N heavy metals and their associated ions (N=1,2,3) |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File K - Miscellaneous Variables | | | |
| 3 | 21-30 | I10 | ITOTN | | | TOTAL NITROGEN option<br>0 = don't model TOTAL NITROGEN<br>1 = model TOTAL NITROGEN |
| | 31-40 | I10 | ICHLOR | | | CHLORIDE option<br>0 = don't model CHLORIDES<br>1 = model CHLORIDES |
| 4 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | I10 | INH | | 1 | $NH_3$ reaction order<br>1 = 1st order<br>2 = 2nd order |
| | 21-30 | I10 | IN2 | | 1 | $NO_2$ reaction order<br>1 = 1st order<br>2 = 2nd order |
| | 31-40 | I10 | IN3 | | 1 | $NO_3$ reaction order<br>1 = 1st order<br>2 = 2nd order |
| | 41-50 | I10 | IP | | 2 | $PO_4$ reaction order<br>1 = 1st order<br>2 = 2nd order |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File K - Miscellaneous Variables | | | |
| 5 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | F10.4 | THKCOL | | 1.07 | Temperature correction constant for (A.8) coliform (COL) reaction coefficient |
| | 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 (A.10) COL calculation |
| | 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 (A.27) $NH_3$-N decay coefficient |
| | 61-70 | F10.4 | VOLITK | | .01 | Exponent for $NH_3$-N volitization (A.35) |
| | 71-80 | F10.4 | THVOLK | | .17 | Temperature correction constant for (A.35) $NH_3$-N volitization |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | <u>File K - Miscellaneous Variables</u> | | | |
| 6 | 1-8 | 2A4 | DUM | | | FILE K |
| | 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 $O_2$/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 for GRMAX (A.45) |
| 7 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | F10.4 | CHMOA | (MG/L) | 20. | HM1 limit for phytoplankton growth (A.46) |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File K - Miscellanous Variables | | | |
| 7 | 21-30 | F10.4 | HMKA | | .01 | HM1 coefficient for phytoplankton (A.46) growth calculation |
| | 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) |
| 8 | 1-8 | 2A4 | DUM | | | FILE K |
| | 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 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | <u>File K - Miscellaneous Variables</u> | | | |
| 8 | 51-60 | F10.4 | ATD | | .001 | Phytoplankton toxic death coefficient for HM1 (A.73) |
| | 61-70 | F10.4 | BRRBOD | $(MG/M^2\text{-}HR)$ | 61. | BOD benthal release rate (A.79) |
| | 71-80 | F10.4 | BRRPO4 | $(MG/M^2\text{-}HR)$ | .125 | $PO_4$-P benthal release rate (A.78) |
| 9 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | F10.4 | BRRNH3 | $(MG/M^2\text{-}HR)$ | .108 | Nitrogen benthal release rate (A.77) |
| | 21-30 | F10.4 | BENOD | $(MG/M^2\text{-}HR)$ | 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 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File K - Miscellaneous Variables | | | |
| 10 | 1-8 | 2A4 | DUM | | | FILE K |
| | 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) |
| 11 | 1-8 | 2A4 | DUM | | | FILE K |
| | 11-20 | F10.4 | HMKA3 | | 0. | HM3 coefficient for phytoplankton growth calculation (A.46) |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File K - Miscellaneous Variables** | | | |
| 11 | 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) |
| | 1-8 | 2A4 | DUM | | | ENDFILE |

Although no values need be specified (in which case the default values apply), all 11 cards must be included.

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File L - Plot Variables** | | | |
| 1 | 1-8 | 2A4 | DUM | | | FILE L |
| | 11-15 | I5 | NR | | | Number of reaches for which quantities are to be plotted ($\leq$99) |
| | 16-20 | I5 | NIND | | | Number of quantities to be plotted per reach ($\leq$43) |

TABLE 2. (continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT VALUE | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File L - Plot Variables** | | | |
| 2-N | 1-8 | 2A4 | DUM | | | FILE L |
| | 11-80 | 14I5 | (INR(I),I=1, NR) | | | Reach number for which plots are wanted |
| | 14 reaches per card are input | | | | | |
| N-M | 1-8 | 2A4 | DUM | | | FILE L |
| | 11-80 | 14I5 | (INDS(I),I=1, NIND) | | | Quantities to be plotted<br>4 = flow at end of reach<br>5 = minimum DO in reach<br>7 = DO at reach end<br>11 = BOD at reach end<br>14 = DO at reach start<br>15 = BOD at reach start<br>16 = $NH_3$-N at reach start<br>17 = $NH_3$-N at reach end<br>18 = $NO_2$-N at reach start<br>19 = $NO_2$-N at reach end<br>20 = $NO_3$-N at reach start |
| | 14 quantities per card are input | | | | | |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT NAME | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | File L - Plot Variables | | | |
| N-M | | | | | | 21 = $NO_3$-N at reach end |
| | | | | | | 22 = $PO_4$-P at reach start |
| | | | | | | 23 = $PO_4$-P at reach end |
| | | | | | | 24 = phytoplankton at reach start |
| | | | | | | 25 = phytoplankton at reach end |
| | | | | | | 26 = coliform at reach start |
| | | | | | | 27 = coliform at reach end |
| | | | | | | 28 = HM1 at reach start |
| | | | | | | 29 = HM1 at reach end |
| | | | | | | 30 = HM2 at reach start |
| | | | | | | 31 = HM2 at reach end |
| | | | | | | 32 = HM3 at reach start |
| | | | | | | 33 = HM3 at reach end |
| | | | | | | 34 = total nitrogen at reach start |
| | | | | | | 35 = total nitrogen at reach end |

TABLE 2. (Continued)

| CARD # | CARD COLUMN | FORMAT | VARIABLE NAME | UNITS | DEFAULT NAME | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | **File L - Plot Variables** | | | |
| N-M | | | | | | 36 = chlorides at reach start |
| | | | | | | 37 = chlorides at reach end |
| | | | | | | 38 = HM1 ions at reach start |
| | | | | | | 39 = HM1 ions at reach end |
| | | | | | | 40 = HM2 ions at reach start |
| | | | | | | 41 = HM2 ions at reach end |
| | | | | | | 42 = HM3 ions at reach start |
| | | | | | | 43 = HM3 ions at reach end |
| M+1 | 1-8 | 2A4 | DUM | | | ENDFILE |

If no plots are required, only the ENDFILE card is needed.

TABLE 3.

DEFINITION OF CONSTITUENT SELECTION OPTION, ICOMB (FOR CARD 2 OF TABLE 2, FILE K)

| 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 V

## OUTPUT DESCRIPTION

The output generated by DOSCI is printer output and consists of the following:

1. All of the data input in File A through File F (see Table 2), appropriately labeled

2. A summary of the computed conditions in each reach including

   (a) reach length (mi)
   (b) river mile at head of reach
   (c) flow in reach (cfs)
   (d) minimum DO level in reach (mg/L)
   (e) river mile where minimum DO occurs
   (f) temperature of reach (°C)
   (g) concentrations at head and end of reach of all constituents being modeled
   (h) reaeration value for reach ($day^{-1}$)
   (i) travel time through reach (day)
   (j) velocity (fps), width (ft), depth (ft), and slope of reach

3. augmentation required

4. plots of requested concentrations versus river mile. Sample output is shown in Table 7.

SECTION VI

## DEFINITION OF PROGRAM VARIABLES

TABLE 4.
DESCRIPTION OF COMMON VARIABLES

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| COMMON/BLOCK1/ | | |
| CRMIN(IA) | Minimum DO concentration for reach IA | MG/L |
| DATA(IA,J) | | |
| J=1 | Length of reach IA | MILES |
| J=2 | River mile at head of reach | |
| J=3 | Decay coefficient for BOD in reach | $HOUR^{-1}$ |
| J=4 | Settling coefficient for BOD in reach | $HOUR^{-1}$ |
| J=5 | Flow coefficient to calculate velocity in reach | |
| J=6 | Flow exponent to calculate velocity in reach | |
| J=7 | Flow (incremental or point source) into reach | CFS |
| J=8 | DO concentration in inflow | MG/L |
| J=9 | BOD concentration in inflow | MG/L |
| J=10 | $NH_3$-N concentration in inflow | MG/L |
| J=11 | $NO_2$-N concentration in inflow | MG/L |
| J=12 | $NO_3$-N concentration in inflow | MG/L |
| J=13 | $PO_4$-P concentration in inflow | MG/L |
| J=14 | Algae concentration in inflow | MG/L |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| J=15 | Value for the reaeration coefficient $K_2$, if option 1 for calculating $K_2$ is used (base e) | $HOUR^{-1}$ |
| J=16 | Coefficient of velocity if option 2 is used for calculating $K_2$ | |
| J=17 | Exponent of velocity if option 2 is used for calculating $K_2$ | |
| J=18 | Exponent of depth if option 2 is used to calculate $K_2$ | |
| J=19 | Coefficient of discharge if option 3 is used to calculate $K_2$ | |
| J=20 | Exponent of discharge if option 3 is used to calculate $K_2$ | |
| J=21 | Coefficient of discharge to calculate the average depth of water for reach I | |
| J=22 | Exponent of discharge to calculate the average depth of water for reach I | |
| J=23 | Slope of channel if option 4 is used to calculate $K_2$ | |
| J=24 | Coliform concentration in inflow | MPN/100 ML |
| J=25 | HM1 concentration in inflow | MG/L |
| J=26 | HM2 concentration in inflow | MG/L |
| J=27 | HM3 concentration in inflow | MG/L |
| J=28 | N concentration in inflow | MG/L |
| J=29 | $Cl_2$ concentration in inflow | MG/L |
| J=30 | HM1 ion concentration in inflow | MG/L |
| J=31 | HM2 ion concentration in inflow | MG/L |
| J=32 | HM3 ion conentration in inflow | MG/L |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| FINIS(I,J) | | |
| J=1 | Reach I number | |
| J=2 | River mile to head of reach I | |
| J=3 | Length of reach I | MILES |
| J=4 | Total discharge leaving reach I | CFS |
| J=5 | Minimum dissolved oxygen concentration in reach I | MG/L |
| J=6 | River mile where minimum dissolved oxygen concentration occurs in reach I | |
| J=7 | Dissolved oxygen concentration at the end of reach I | MG/L |
| J=8 | Reaeration coefficient, $K_2$, value for reach I (base e) | $HOUR^{-1}$ |
| J=9 | Time of travel for reach I | DAYS |
| J=10 | Mean velocity in reach I | FPS |
| J=11 | BOD at the end of reach I | MG/L |
| J=12 | Not used | |
| J=13 | Depth of water in reach I | FEET |
| J=14 | Dissolved oxygen concentration at start of reach | MG/L |
| J=15 | BOD concentration at start of reach | MG/L |
| J=16 | $NH_3$-N concentration at start of reach | MG/L |
| J=17 | $NH_3$-N concentration at end of reach | MG/L |
| J=18 | $NO_2$-N concentration at start of reach | MG/L |
| J=19 | $NO_2$-N concentration at end of reach | MG/L |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| FINIS(I,J) | (Continued) | |
| J=20 | $NO_3$-N concentration at start of reach | MG/L |
| J=21 | $NO_3$-N concentration at end of reach | MG/L |
| J=22 | $PO_4$-P concentration at start of reach | MG/L |
| J=23 | $PO_4$-P concentration at end of reach | MG/L |
| J=24 | Algae concentration at start of reach | MG/L |
| J=25 | Algae concentration at end of reach | MG/L |
| J=26 | Coliform concentration at start of reach | MPN/100ML |
| J=27 | Coliform concentration at end of reach | MPN/100ML |
| J=28 | HM1 concentration at start of reach | MG/L |
| J=29 | HM1 concentration at end of reach | MG/L |
| J=30 | HM2 concentration at start of reach | MG/L |
| J=31 | HM2 concentration at end of reach | MG/L |
| J=32 | HM3 concentration at start of reach | MG/L |
| J=33 | HM3 concentration at end of reach | MG/L |
| J=34 | N concentration at start of reach | MG/L |
| J=35 | N concentration at end of reach | MG/L |
| J=36 | $Cl_2$ concentration at start of reach | MG/L |
| J=37 | $Cl_2$ concentration at end of reach | MG/L |
| J=38 | HM1 ion concentration at start of reach | MG/L |
| J=39 | HM1 ion concentration at end of reach | MG/L |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
| --- | --- | --- |
| FINIS(I,J) (continued) | | |
| J=40 | HM2 ion concentration at start of reach | MG/L |
| J=41 | HM2 ion concentration at end of reach | MG/L |
| J=42 | HM3 ion concentration at start of reach | MG/L |
| J=43 | HM3 ion concentration at end of reach | MG/L |
| J=44 | Internal flag used if total nitrogen concentration is greater than sum of components. | |
| RIDENT(IA,J) | | |
| J=1-5 | Reach identification for reach IA | |
| K2OPT(IA) | Option used for reaeration calculation for reach IA | |
| COMMON/BLOCK2/ | | |
| JNIT(IA) | Headwater identifier for flow augmentation calculations | |
| F(IA) | Not used | |
| C(I) | DO concentration in subreach I | MG/L |
| IONE(K) | Augmentation logic array | |
| G(I) | Not used | |
| TITLE(I) | Run title | |
| IORD(I,J) | | |
| J=1-20 | Reaches in stretch I | |
| JUNC(I,J) | | |
| J=1-3 | Stretches defining junction I | |
| INIT(I) | Headwater stretch identifier | |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| IAUG(I) | Augmentation logic array | |
| DOL(I) | Minimum permissable DO level | MG/L |
| TRFAC(I) | Treatment factors | |
| COMMON/BLOCK3/ | | |
| CONDZ(I,J) | | |
| J=1 | DO concentration in headwater I | MG/L |
| J=2 | BOD concentration in headwater I | MG/L |
| J=3 | $NH_3$-N concentration in headwater I | MG/L |
| J=4 | $NO_2$-N concentration in headwater I | MG/L |
| J=5 | $NO_3$-N concentration in headwater I | MG/L |
| J=6 | $PO_4$-P concentration in headwater I | MG/L |
| J=7 | Algae concentration in headwater I | MG/L |
| J=8 | Coliform concentration in headwater I | MPN/100ML |
| J=9 | HM1 concentration in headwater I | MG/L |
| J=10 | HM2 concentration in headwater I | MG/L |
| J=11 | HM3 concentration in headwater I | MG/L |
| J=12 | N concentration in headwater I | MG/L |
| J=13 | $Cl_2$ concentration in headwater I | MG/L |
| J=14 | HM1 ion concentration in headwater I | MG/L |
| J=15 | HM2 ion concentration in headwater I | MG/L |
| J=16 | HM3 ion concentration in headwater I | MG/L |
| CONDI(I,J) | | |
| J=1-16 | Concentrations at start of reach I, same constituents as CONDZ | MG/L |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| CONDE(I,J) J=1-16 | Concentrations at end of reach I, same constituents as CONDZ | MG/L |
| COMMON/BLOCK4/ | | |
| TEMMO(I) | Monthly mean stream temperature | °C |
| IDMCH(I,J) | Augmentation logic array | |
| HWFLOW(I,J) J=1-12 | Monthly flows in headwater I | CFS |
| TRFACN(I) | Not used | |
| SEASON(I) | I $\neq$ 0 means month I will be run | |
| COMMON/BLOCK5/ | | |
| JJ | Junction identifier for flow augmentation | |
| KK | Junction identifier for flow augmentation | |
| II | Junction identifier for flow augmentation | |
| B | Not used | |
| RMLOW | Location of minimum DO in a reach | RIVER MILE |
| MAX | Number of subreaches in a reach | |
| CLOW | Minimum DO in a reach | MG/L |
| NTRIB | Number of stretches in the system | |
| NREA | Number of reaches in the system | |
| NINIT | Number of headwaters in the system | |
| NJUNC | Number of junctions in the system | |
| ELEV | Basin elevation | FEET |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| DOLEV | DO target level | MG/L |
| TF | Treatment factor | |
| TEMP | Average temperature | °C |
| CSA | Saturation concentration for DO | MG/L |
| M | Flag to indicate end of computations for a stretch | |
| QUP | Total upstream flow entering a reach | CFS |
| FINL | Not used | |
| JA | Stretch subscript | |
| IA | Reach subscript | |
| ICK | Intermediate printout flag | |
| FINLN | Not used | |
| DELQ | Incremental flow used in subreach calculations | CFS |
| NI | Input unit | |
| NJ | Output unit | |
| $K_2$ | Reaeration coefficient | $HOUR^{-1}$ |
| VEL | Reach velocity | FT/SEC |
| NSEAS | Month of run | |
| NRUN | Run number | |
| TFN | Not used | |

TABLE 4. (Continued)

| FORTRAN NAME | DEFINITION | UNITS |
|---|---|---|
| COMMON/CONBEG | | |
| DO | Initial DO concentration for GETCON | MG/L |
| BOD | Initial BOD concentration for GETCON | MG/L |
| NH3 | Initial $NH_3$-N concentration for GETCON | MG/L |
| NO2 | Initial $NO_2$-N concentration for GETCON | MG/L |
| NO3 | Initial $NO_3$-N concentration GETCON | MG/L |
| PO4 | Initial $PO_4$-P concentration GETCON | MG/L |
| ALG | Initial algae concentration for GETCON | MG/L |
| COL | Initial coliform concentration for GETCON | MPN/100ML |
| HM1 | Initial HM1 concentration for GETCON | MG/L |
| HM2 | Initial HM2 concentration for GETCON | MG/L |
| HM3 | Initial HM3 concentration for GETCON | MG/L |
| HM | Initial HM concentration for GETCON | MG/L |
| TOTN | Initial N concentration for GETCON | MG/L |
| COMMON/CONEND | | |
| DOE | Final DO concentration from GETCON | MG/L |
| BODE | Final BOD concentration from GETCON | MG/L |
| NH3E | Final $NH_3$-N concentration from GETCON | MG/L |
| NO2E | Final $NO_2$-N concentration from GETCON | MG/L |
| NO3E | Final $NO_3$-N concentration from GETCON | MG/L |
| PO4E | Final $PO_4$-P concentration from GETCON | MG/L |

TABLE 4. (Continued)

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| ALGE | Final algae concentration from GETCON | MG/L |
| COLE | Final coliform concentration from GETCON | MPN/100ML |
| HM1E | Final HM1 concentration from GETCON | MG/L |
| HM2E | Final HM2 concentration from GETCON | MG/L |
| HM3E | Final HM3 concentration from GETCON | MG/L |
| HME | Final HM concentration from GETCON | MG/L |
| TOTNE | Final N concentration from GETCON | MG/L |
| COMMON/CONST/ | | |
| Variables in CONST are defined in FILE K input (see Table 2). | | |
| COMMON/RCHVAR/ | | |
| Variables in RCHVAR are defined in FILE J input (see Table 2). | | |
| COMMON/OPTION/ | | |
| IFN | Algae (phytoplankton) growth function option<br>0 = growth limited by $NO_3$-N concentration<br>1 = growth limited by $NH_3$-N concentration<br>2 = growth limited by maximum of $NH_3$-N and $NO_3$-N | |
| IK2 | $K_2$ selection option | |
| ICOL | 0 = don't model coliforms<br>1 = model coliforms | |
| ICOMB | Constituent selection option (see Table 3) | |
| INH3 | 0 = don't model $NH_3$-N;<br>1 = model $NH_3$-N | |

TABLE 4. (Continued)

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| $INO_2$ | 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 | =I means model I heavy metals | |
| ITOTN | 0 = don't model total nitrogen; 1 = model N | |
| ICHLOR | 0 = don't model $Cl_2$; 1 = model $Cl_2$ | |
| COMMON/OPT3 | | |
| IP | =I means model $PO_4$-P with I'th order reaction (I = 1 or 2) | |
| INH | =I means model $NH_3$-N with I'th order reaction (I = 1 or 2) | |
| IN2 | =I means model $NO_2$-N with I'th order reaction (I = 1 or 2) | |
| IN3 | =I means model $NO_3$-N with I'th order reaction (I = 1 or 2) | |

Local variables employed by DOSCI are described in Table 5 under their respective subroutine.

TABLE 5.

DESCRIPTION OF LOCAL VARIABLES

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| SUBROUTINE DOEQU | | |
| AVK2 | Average $K_2$ value for a reach | DAY-1 |
| DELQ | Flow in subreach | CFS |
| DELQ1 | Incremental flow into subreach | CFS |
| DEP | Depth of subreach | FEET |
| HSUM | Sum of subreach depths | FEET |
| TOTFLO | Total flow at end of reach | CFS |
| TRAV | Travel time through subreach | DAYS |
| TSUM | Travel time through reach | DAYS |
| VEL | Velocity in subreach | FPS |
| VSUM | Sum of subreach velocities | FPS |
| SUBROUTINE GETCON | | |
| ARR | Algal respiration rate | $HOUR^{-1}$ |
| 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 |

TABLE 5. (Continued)

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| SUBROUTINE GETCON (Continued) | | |
| 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 | |

TABLE 5. (Continued)

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| SUBROUTINE GETCON (Continued) | | |
| TCOR | Temperature correction term | °C |
| TT | Temperature | °C |
| SUBROUTINE NEWIN | | |
| TEMSET | Default temperature value | °C |
| XCK | Default coliform reaction coefficient | $HOUR^{-1}$ |
| XDOK | Default reaeration factor | |
| XEX | Default extinction coefficient | $FEET^{-1}$ |
| XNH | Default $NH_3$-N reaction coefficient | $HOUR^{-1}$ |
| XN2 | Default $NO_2$-N reaction coefficient | $HOUR^{-1}$ |
| XN3 | Default $NO_3$-N reaction coefficient | $HOUR^{-1}$ |
| XP | Default $PO_4$-P reaction coefficient | $HOUR^{-1}$ |
| SUBROUTINE PLOT | | |
| A | Dependent variable array to be plotted | |
| DX | Plot increment | |
| FMAX | Maximum value to be plotted | |
| FMIN | Minimum value to be plotted | |
| IPLOT | Print buffer for plotting | |
| LAB | Plot label | |
| N | Number of values to be plotted | |
| SMIN | Minimum grid limit | |
| SMAX | Maximum grid limit | |
| T | Independent variable array | |

TABLE 5. (Continued)

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| SUBROUTINE PLTSET | | |
| IFLAG | 0 = plot;<br>1 = read plot inputs | |
| INDS | Array of indices of quantities to be plotted | |
| INR | Array of reach numbers where plots are requested | |
| IOUT | 0 = plot;<br>1 = no more plots | |
| NIND | Number of quantities to be plotted | |
| NR | Number of reaches where plots are requested | |
| TITLE | Array of plot titles | |
| XPLT | Independent variable array passed to subroutine PLOT | |
| YPLT | Dependent variable array passed to subroutine PLOT | |
| SUBROUTINE REPRE | | |
| FAC | Treatment factor | |
| FACFLO | Incremental flow for subreaches | CFS |
| TOTFLO | Total flow for reach | CFS |
| VAR | Concentration of flow into subreach | MG/L |
| XMAX | Number of subreaches in reach | |
| SUBROUTINE RUNON | | |
| CHK | Velocity check parameter | $FT/SEC^2$ |
| IR | Reach number | |

TABLE 5. (Continued)

| VARIABLE | DEFINITION | UNITS |
|---|---|---|
| SUBROUTINE RUNON (Continued) | | |
| QAUG | Augmentation required | CFS |
| WIDM | Reach width | FEET |
| XSLOP | Reach slope | |
| SUBROUTINE SCAN | | |
| LL | Number of headwaters available for augmentation | |
| QADD | Total augmentation required | CFS |
| QPLUS | Augmentation required per headwater | CFS |
| Z | DO deficit | MG/L |

SECTION VII

## SAMPLE INPUT DECK

A listing of a sample input deck is provided in Table 6. The deck is for a DOSCI run simulating conditions in River Region 2 (Main Stem and South Fork of Coeur d'Alene River and Hangman Creek) during August, 1969. The region is divided into fifty two reaches. Numerous point source and infiltration flows are modeled. Three municipal outfalls are modeled. Many of the inflows are polluted due to the extensive mining activities in the area. Reaeration values are calculated by Option 2 (see Table 2 File F-4). Nominal values of all reaction coefficients are used with the exception of $NH_3$-N volitization, BOD benthal release, and benthal oxygen demand. Plots are produced for nine quantities in twenty two reaches. The resulting output is presented in Table 7.

TABLE 6. SAMPLE INPUT DECK

```
FILE A          SPOKANE RIVER REGION NUMBER 2    AUGUST,1969
ENDFILE A
FILE B          3          2          52          5          1                    2250.
ENDFILE B
FILE C          1          1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
FILE C          2          16 17 18 19 20 21 22
FILE C          3          23 24 25
FILE C          4          26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
FILE C          5          43 44 45 46 47 48 49 50 51 52
ENDFILE C
FILE D                     2          1          4          5
FILE D                     1          2          3          4
ENDFILE D
FILE E          1    0
    8.2         .8         .03        .006       .02        .05                    200.
    0.                                           0.
FILE E          2    0
    8.2         .8         .03        .006       .02        .05                    200.
    0.                                           0.
FILE E          3    0
    8.2         .8         .03        .006       .02        .05                    200.
    4.
ENDFILE E
FILE F=1             1     6.7        200.0                           .142
FILE F=1             2      .2        193.3                           .142
FILE F=1             3     0.0        193.1                           .142
FILE F=1             4     2.6        193.1                           .142
FILE F=1             5     0.0        190.5                           .142
FILE F=1             6     7.6        190.5                           .142
FILE F=1             7     0.0        182.9                           .142
FILE F=1             8     4.0        182.9                           .130
FILE F=1             9     0.0        178.9                           .130
FILE F=1            10     2.5        178.9                           .123
FILE F=1            11     0.0        176.4                           .146
FILE F=1            12     2.0        176.4                           .121
FILE F=1            13     0.0        172.4                           .155
FILE F=1            14     3.5        172.4                           .14
FILE F=1            15     1.1        168.9                           .14
FILE F=1            16     4.1         34.2                           .65
FILE F=1            17     0.0         30.1                           .5
FILE F=1            18     3.6         30.1                           .5
FILE F=1            19     0.0         26.5                           .5
FILE F=1            20     1.9         26.5                           .425
FILE F=1            21     0.0         24.6                           .5
FILE F=1            22     5.5         24.6                           .425
FILE F=1            23     2.4          6.4                           .52
FILE F=1            24     0.0          4.0                           .4
FILE F=1            25     4.0          4.0                           .52
FILE F=1            26     1.3         19.1                           .310
FILE F=1            27      .7         17.8                           .31
FILE F=1            28     0.0         17.1                           .31
FILE F=1            29     2.7         17.1                           .31
FILE F=1            30     0.0         14.4                           .31
FILE F=1            31     1.3         14.4                           .31
FILE F=1            32     0.0         13.2                           .31
FILE F=1            33     2.0         13.2                           .31
FILE F=1            34     0.0         11.2                           .31
FILE F=1            35     3.4         11.2                           .26
FILE F=1            36     0.0          7.8                           .31
FILE F=1            37      .9          7.8                           .26
```

TABLE 6. (cont'd)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FILE F=1 | 38 | 0.0 | 6.9 | | | .31 | |
| FILE F=1 | 39 | 1.9 | 6.9 | | | .21 | |
| FILE F=1 | 40 | 2.7 | 5.0 | | | .21 | |
| FILE F=1 | 41 | 0.0 | 2.3 | | | .21 | |
| FILE F=1 | 42 | 2.5 | 2.3 | | | .21 | |
| FILE F=1 | 43 | 3.6 | 167.8 | | | .1 | |
| FILE F=1 | 44 | 7.9 | 164.2 | | | .1 | |
| FILE F=1 | 45 | 0.0 | 156.3 | | | .071 | |
| FILE F=1 | 46 | 3.6 | 156.3 | | | .067 | |
| FILE F=1 | 47 | 0.0 | 152.7 | | | .071 | |
| FILE F=1 | 48 | 6.1 | 152.7 | | | .067 | |
| FILE F=1 | 49 | 0.0 | 146.6 | | | .071 | |
| FILE F=1 | 50 | 7.2 | 146.6 | | | .067 | |
| FILE F=1 | 51 | 0.0 | 139.4 | | | .071 | |
| FILE F=1 | 52 | 8.0 | 139.4 | | | .067 | |
| ENDFILE F=1 | | | | | | | |
| FILE F=2 | 2 | 4. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 3 | 36. | | | | | |
| 8.0 | 1.0 | | | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 5 | 18. | | | | | |
| 8.0 | 1.0 | | | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 6 | 12. | | | | | |
| 8.0 | 1.0 | | | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 7 | 4. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 8 | 4. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 9 | 36. | | | | | |
| 8.0 | 1.0 | | | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 11 | 18. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 12 | 4. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 13 | 60. | | | | | |
| 8.0 | 1.0 | | | .02 | .03 | 0. | 800. |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FILE F=2 | 14 | 4. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| | | | | 0.0 | | | |
| FILE F=2 | 16 | 6. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| | | | | 0.0 | | | |
| FILE F=2 | 17 | 6. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| | | | | 0.0 | | | |
| FILE F=2 | 18 | 6. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |
| | | | | 0.0 | | | |
| FILE F=2 | 19 | 6. | | | | | |
| 8.0 | 1.0 | .03 | .006 | .02 | .03 | 0. | 200. |

TABLE 6. (cont'd)

```
                                                      0.0
FILE F=2            20    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
                                                  0.0
FILE F=2            21    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
                                                  0.0
FILE F=2            22    6.
    8.0        1.0        .03        .006         .02         .03       0.        200.
                                                  0.0
FILE F=2            23    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
   3.                                             0.0
FILE F=2            24    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
   3.                                             0.0
FILE F=2            25    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
                                                  0.0
FILE F=2            26    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
    1.0                                           0.0
FILE F=2            28    6.
    8.0        1.0        .03        .006         .02         .03       0.        200.
    .8                                            30.
FILE F=2            30    .3
    1.         200.       .03        .006         .02         .03       0.      15000.
    .65                                           0.0
FILE F=2            32    .3
    1.         200.       .03        .006         .02         .03       0.      15000.
    .6                                            0.0
FILE F=2            34   38.
    8.0        1.0                                .02         .03       0.        200.
    .3
FILE F=2            35    3.
    8.0        1.0        .03        .006         .02         .03       0.        200.
    .3
FILE F=2            36    4.
    8.0        1.0        .03        .006         .02         .03       0.        200.
    .3                                            0.0
FILE F=2            38    .4
    1.         200.       .03        .006         .02         .03       0.      15000.
 100.
FILE F=2            39    7.
    8.0        1.0        .03        .006         .02         .03       0.        200.
 100.
FILE F=2            41    6.
    8.0   1.5             .03        .006         .02         .03       0.        200.
    5.1
FILE F=2            45    4.
    8.0        20.        .03        .006         .02         .03       0.        200.
    4.7
FILE F=2            47    4.
    8.0        20.        .03        .006         .02         .03       0.        200.
    1.6                                           0.0
FILE F=2            49    4.
    8.0        20.        .03        .006         .02         .03       0.        200.
    1.8                                           0.0
FILE F=2            51    4.
    8.0        20.        .03        .006         .02         .03       0.        200.
```

TABLE 6. (cont'd)

```
    2.6                                          0.0
ENDFILE F-2
FILE F-3          48                  2.5
FILE F-3          50                  2.5
FILE F-3          52                  2.5
ENDFILE F-3
FILE F-4           1        2      G4110 TO G4115            .137
FILE F-4           2        2      G4115 TO PRITCHARD C      .137
FILE F-4           3        2      PRITCHARD CREEK           .137
FILE F-4           4        2      PRITCHARD C TO BEAVR      .137
FILE F-4           5        2      BEAVER CREEK              .137
FILE F-4           6        2      BEAVER TO GRAHM CRK       .137
FILE F-4           7        2      GRAHM CREEK               .137
FILE F-4           8        2      GRAHM TO STEAMBOAT        .147
FILE F-4           9        2      STEAMBOAT CREEK           .147
FILE F-4          10        2      STEAMBOAT TO S-F-C        .155
FILE F-4          11        2      SMITH-FALL-COUGAR C       .131
FILE F-4          12        2      S-F-C TO N FORK           .162
FILE F-4          13        2      N FORK COEUR D'ALENE      .168
FILE F-4          14        2      N FORK TO G4130           .112
FILE F-4          15        2      G4130 TO S FRK CDAL       .112
FILE F-4          16        2      M34 TO DEADMAN            .140
FILE F-4          17        2      DEADMAN GULCH             .140
FILE F-4          18        2      DEAD TO HUNTER'S G        .154
FILE F-4          19        2      GOLD HUNTERS GULCH        .140
FILE F-4          20        2      GOLD TO SLAUGHTER         .154
FILE F-4          21        2      SLAUGHTERHOUSE CREEK      .140
FILE F-4          22        2      SLTHOUS TO CANYON C       .154
FILE F-4          23        2      M6.4 TO GEM OUTFALL       .21
FILE F-4          24        2      GEM OUTFALL               .140
FILE F-4          25        2      GEM OUTFALL TO S FRK      .21
FILE F-4          26        2      CANYON C TO G4131.5       .191
FILE F-4          27        2      G4131.5 TO LAKE CRK       .191
FILE F-4          28        2      LAKE CREEK                .191
FILE F-4          29        2      LAKE C TO SILVERTON       .191
FILE F-4          30        2      SILVERTON OUTFALL         .191
FILE F-4          31        2      OUTFALL TO OSBURN O       .191
FILE F-4          32        2      OSBURN OUTFALL            .191
FILE F-4          33        2      OUTFALL TO BIG CREEK      .191
FILE F-4          34        2      BIG CREEK                 .191
FILE F-4          35        2      BIG CREEK TO MILO C       .194
FILE F-4          36        2      MILO CREEK                .200
FILE F-4          37        2      MILO TO KELLOGG OUT       .200
FILE F-4          38        2      KELLOGG OUTFALL           .200
FILE F-4          39        2      OUT TO G4133              .215
FILE F-4          40        2      G4133 TO PINE CREEK       .222
FILE F-4          41        2      PINE CREEK                .270
FILE F-4          42        2      PINE C TO CDALN RIV       .236
FILE F-4          43        2      S FRK TO G4135            .153
FILE F-4          44        2      G4135 TO 4JULY CRK        .146
FILE F-4          45        2      4TH OF JULY CREEK         .600
FILE F-4          46        2      4JULY C TO ROSE CRK       .215
FILE F-4          47        2      ROSE CREEK                .600
FILE F-4          48        2      ROSE C TO KILLARNEY       .215
FILE F-4          49        2      KILLARNEY OUTLET          .600
FILE F-4          50        2      KILL O TO BLACK LAKE      .215
FILE F-4          51        2      BLACK LAKE OUTLET         .600
FILE F-4          52        2      OUT TO CDALENE LAKE       .215
ENDFILE F-4
ENDFILE G
```

TABLE 6. (cont'd)

```
FILE H                                                                                                         19.
ENDFILE H
FILE I           1                                                                                            117.
FILE I           2                                                                                              1.
FILE I           3                                                                                             13.
ENDFILE I
FILE J           1                                                                                                 19.7
FILE J           2                                                                                                 19.
FILE J           4                                                                                                 19.
FILE J           6                                                                                                 20.
FILE J           8                                                                                                 17.5
FILE J          10                                                                                                 18.5
FILE J          12                                                                                                 18.5
FILE J          14                                                                                                 19.
FILE J          15                                                                                                 19.
FILE J          16                                                                                                 16.4
FILE J          18                                                                                                 16.4
FILE J          20                                                                                                 16.4
FILE J          22                                                                                                 15.3
FILE J          23                                                                                                 17.
FILE J          25                                                                                                 17.
FILE J          26                                                                                                 18.3
FILE J          27                                                                                                 17.5
FILE J          29                                                                                                 16.
FILE J          31                                                                                                 16.
FILE J          33                                                                                                 18.
FILE J          35                                                                                                 16.7
FILE J          37                                                                                                 17.
FILE J          39                                                                                                 16.5
FILE J          40                                                                                                 17.3
FILE J          42                                                                                                 21.
FILE J          43                                                                                                 17.5
FILE J          44                                                                                                 16.7
FILE J          46                                                                                                 19.2
FILE J          48                                                                                                 19.2
FILE J          50                                                                                                 19.5
FILE J          52                                                                                                 20.
ENDFILE J
FILE K                                                       .
FILE K                       2               1               2
FILE K                       1               0               1
FILE K                       1               1               1               2
FILE K                                                                                         .1
FILE K
FILE K
FILE K                                                                                         .00001
FILE K            .01           .00001
FILE K
FILE K
ENDFILE K
FILE L             22      9
FILE L             52     50     48     46     44     43     15     14     10      8      6      1     42     40
FILE L             39     37     35     33     29     27     26     22
FILE L              7     11     17     19     21     23     27     29     37
ENDFILE L
##
```

# SECTION VIII

## SAMPLE OUTPUT

A listing of a sample DOSCI output is provided in Table 7. The output results from the input deck listed in Table 6 and is for the most part self explanatory. All input conditions are printed out. The three outfalls are point sources 30, 32, and 38. No augmentation is requested and no treatment factors are applied. DO, coliforms, BOD, $NH_3$-N, $NO_2$-N, $NO_3$-N, $PO_4$-P, zinc, and chlorides are modeled.

## TABLE 7. DOSCI OUTPUT

* * * FILE A - BASIN TITLE * * *

| CARD TYPE | NAME OF RIVER BASIN |
|---|---|
| FILE A | SPOKANE RIVER REGION NUMBER 2 AUGUST,1969 |

ENDFILE

* * * FILE B - PHYSICAL DESCRIPTION * * *

| CARD TYPE | NO. OF HEADWATERS MAX OF 10 | NO. OF JUNCTIONS MAX. OF 10 | NO. OF REACHES MAX OF 100 | NO. OF STRETCHES MAX OF 20 | INSERT 1 FOR FINAL SUMMARY ONLY | MEAN ELEV. (FT) |
|---|---|---|---|---|---|---|
| FILE B | 3 | 2 | 52 | 5 | 1 | 2250.0 |

ENDFILE

* * * FILE C - REACH ORDER * * *

| CARD TYPE | NO. OF STRETCH | ORDER OF ALL REACHES IN EACH STRETCH (UPSTREAM TO DOWNSTREAM) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FILE C | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | -0 | -0 | -0 | -0 | -0 |
| FILE C | 2 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 |
| FILE C | 3 | 23 | 24 | 25 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 |
| FILE C | 4 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | -0 | -0 | -0 |
| FILE C | 5 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 |

ENDFILE

* * * FILE D - JUNCTIONS * * *

| CARD TYPE | NO. OF JUNCTION | NO. OF UPSTREAM STRETCH | NO. OF UPSTREAM STRETCH | NO. OF DOWNSTREAM STRETCH |
|---|---|---|---|---|
| FILE D | 2 | 1 | 4 | 5 |
| FILE D | 1 | 2 | 3 | 4 |

ENDFILE

* * * FILE E - HEADWATERS * * *

| CARD TYPE | STCH NO | AUGM OPT | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | 1 | 0 | 8.20 | .80 | .0300 | .0060 | .0200 | .0500 | -.0000 | 200.0 | .00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| E | 2 | 0 | 8.20 | .80 | .0300 | .0060 | .0200 | .0500 | -.0000 | 200.0 | .00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| E | 3 | 0 | 8.20 | .80 | .0300 | .0060 | .0200 | .0500 | -.0000 | 200.0 | 4.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |

ENDFILE

* * * FILE F(1) - DATA(I,1) THRU DATA(I,6) * * *

| CARD TYPE | NO. OF | LENGTH OF REACH | RIVER MILE TO HEAD | BOD REACTION | BOD SETTLING | COEF. ON Q FOR | EXP. ON Q FOR |
|---|---|---|---|---|---|---|---|

# TABLE 7. DOSCI OUTPUT

* * * FILE A - BASIN TITLE * * *

| CARD TYPE | NAME OF RIVER BASIN |
|---|---|
| FILE A | SPOKANE RIVER REGION NUMBER 2 AUGUST,1969 |

ENDFILE

* * * FILE B - PHYSICAL DESCRIPTION * * *

| CARD TYPE | NO. OF HEADWATERS MAX OF 10 | NO. OF JUNCTIONS MAX OF 10 | NO. OF REACHES MAX OF 100 | NO. OF STRETCHES MAX OF 20 | INSERT 1 FOR FINAL SUMMARY ONLY | MEAN ELEV. (FT) |
|---|---|---|---|---|---|---|
| FILE B | 3 | 2 | 52 | 5 | 1 | 2250.0 |

ENDFILE

* * * FILE C - REACH ORDER * * *

CARD TYPE / NO. OF STRETCH / ORDER OF ALL REACHES IN EACH STRETCH (UPSTREAM TO DOWNSTREAM)

| CARD TYPE | NO. OF STRETCH | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FILE C | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | -0 | -0 | -0 | -0 | -0 |
| FILE C | 2 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 |
| FILE C | 3 | 23 | 24 | 25 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 |
| FILE C | 4 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | -0 | -0 | -0 |
| FILE C | 5 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 |

ENDFILE

* * * FILE D - JUNCTIONS * * *

| CARD TYPE | NO. OF JUNCTION | NO. OF UPSTREAM STRETCH | NO. OF UPSTREAM STRETCH | NO. OF DOWNSTREAM STRETCH |
|---|---|---|---|---|
| FILE D | 2 | 1 | 4 | 5 |
| FILE D | 1 | 2 | 3 | 4 |

ENDFILE

* * * FILE E - HEADWATERS * * *

| CARD TYPE | STCH NO | AUGM OPT | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | 1 | 0 | 8.20 | .80 | .0300 | .0060 | .0200 | .0500 | -.0000 | 200.0 | .00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| E | 2 | 0 | 8.20 | .80 | .0300 | .0060 | .0200 | .0500 | -.0000 | 200.0 | .00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| E | 3 | 0 | 8.20 | .80 | .0300 | .0060 | .0200 | .0500 | -.0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |

ENDFILE

* * * FILE F(1) - DATA(I,1) THRU DATA(I,6) * * *

| CARD TYPE | NO. OF | LENGTH OF REACH | RIVER MILE TO HEAD | BOD REACTION | BOD SETTLING | COEF. ON Q FOR | EXP. ON Q FOR |
|---|---|---|---|---|---|---|---|

| | | REACH | (MILES) | OF REACH | COEF. | COEF. | VELOCITY | VELOCITY |
|---|---|---|---|---|---|---|---|---|
| FILE | F-1 | 1 | 6.7 | 200.0 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 2 | .2 | 193.3 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 3 | .0 | 193.1 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 4 | 2.6 | 193.1 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 5 | .0 | 190.5 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 6 | 7.6 | 190.5 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 7 | .0 | 182.9 | .008 | -.000000 | .142 | .414 |
| FILE | F-1 | 8 | 4.0 | 182.9 | .008 | -.000000 | .130 | .414 |
| FILE | F-1 | 9 | .0 | 178.9 | .008 | -.000000 | .130 | .414 |
| FILE | F-1 | 10 | 2.5 | 178.9 | .008 | -.000000 | .123 | .414 |
| FILE | F-1 | 11 | .0 | 176.4 | .008 | -.000000 | .146 | .414 |
| FILE | F-1 | 12 | 2.0 | 176.4 | .008 | -.000000 | .121 | .414 |
| FILE | F-1 | 13 | .0 | 172.4 | .008 | -.000000 | .155 | .414 |
| FILE | F-1 | 14 | 3.5 | 172.4 | .008 | -.000000 | .140 | .414 |
| FILE | F-1 | 15 | 1.1 | 168.9 | .008 | -.000000 | .140 | .414 |
| FILE | F-1 | 16 | 4.1 | 34.2 | .008 | -.000000 | .650 | .414 |
| FILE | F-1 | 17 | .0 | 30.1 | .008 | -.000000 | .500 | .414 |
| FILE | F-1 | 18 | 3.6 | 30.1 | .008 | -.000000 | .500 | .414 |
| FILE | F-1 | 19 | .0 | 26.5 | .008 | -.000000 | .500 | .414 |
| FILE | F-1 | 20 | 1.9 | 26.5 | .008 | -.000000 | .425 | .414 |
| FILE | F-1 | 21 | .0 | 24.6 | .008 | -.000000 | .500 | .414 |
| FILE | F-1 | 22 | 5.5 | 24.6 | .008 | -.000000 | .425 | .414 |
| FILE | F-1 | 23 | 2.4 | 6.4 | .008 | -.000000 | .520 | .414 |
| FILE | F-1 | 24 | .0 | 4.0 | .008 | -.000000 | .400 | .414 |
| FILE | F-1 | 25 | 4.0 | 4.0 | .008 | -.000000 | .520 | .414 |
| FILE | F-1 | 26 | 1.3 | 19.1 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 27 | .7 | 17.8 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 28 | .0 | 17.1 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 29 | 2.7 | 17.1 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 30 | .0 | 14.4 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 31 | 1.3 | 14.4 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 32 | .0 | 13.2 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 33 | 2.0 | 13.2 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 34 | .0 | 11.2 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 35 | 3.4 | 11.2 | .008 | -.000000 | .260 | .414 |
| FILE | F-1 | 36 | .0 | 7.8 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 37 | .9 | 7.8 | .008 | -.000000 | .260 | .414 |
| FILE | F-1 | 38 | .0 | 6.9 | .008 | -.000000 | .310 | .414 |
| FILE | F-1 | 39 | 1.9 | 6.9 | .008 | -.000000 | .210 | .414 |
| FILE | F-1 | 40 | 2.7 | 5.0 | .008 | -.000000 | .210 | .414 |
| FILE | F-1 | 41 | .0 | 2.3 | .008 | -.000000 | .210 | .414 |
| FILE | F-1 | 42 | 2.3 | 2.3 | .008 | -.000000 | .210 | .414 |
| FILE | F-1 | 43 | 3.6 | 167.8 | .008 | -.000000 | .100 | .414 |
| FILE | F-1 | 44 | 7.9 | 164.2 | .008 | -.000000 | .100 | .414 |
| FILE | F-1 | 45 | .0 | 156.3 | .008 | -.000000 | .071 | .414 |
| FILE | F-1 | 46 | 3.6 | 156.3 | .008 | -.000000 | .067 | .414 |
| FILE | F-1 | 47 | .0 | 152.7 | .008 | -.000000 | .071 | .414 |
| FILE | F-1 | 48 | 6.1 | 152.7 | .008 | -.000000 | .067 | .414 |
| FILE | F-1 | 49 | .0 | 146.6 | .008 | -.000000 | .071 | .414 |
| FILE | F-1 | 50 | 7.2 | 146.6 | .008 | -.000000 | .067 | .414 |
| FILE | F-1 | 51 | .0 | 139.4 | .008 | -.000000 | .071 | .414 |
| FILE | F-1 | 52 | 8.0 | 139.4 | .008 | -.000000 | .067 | .414 |

ENDFILE

* * * FILE F(2) - DATA(I,7) THRU DATA(I,14),DATA(I,24)THRU DATA(I,32) * * *

| CARD TYPE | REACH NO | 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F-2 | 2 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 3 | 36.0 | 8.00 | 1.00 | -.0000 | -.0000 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 5 | 18.0 | 8.00 | 1.00 | -.0000 | -.0000 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 6 | 12.0 | 8.00 | 1.00 | -.0000 | -.0000 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 7 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 8 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 9 | 36.0 | 8.00 | 1.00 | -.0000 | -.0000 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 11 | 18.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 12 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 13 | 60.0 | 8.00 | 1.00 | -.0000 | -.0000 | .0200 | .0300 | .0000 | 800.0 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| F-2 | 14 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 16 | 6.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 17 | 6.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 18 | 6.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 19 | 6.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 20 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 21 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 22 | 6.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 23 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 5.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 24 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 5.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 25 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | -.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 26 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 1.00 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 28 | 6.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .80 | -.00 | -.00 | -.00 | 30.00 | -.00 | -.00 | -.00 |
| F-2 | 30 | .5 | 1.00 | 200.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 15000.0 | .65 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 32 | .3 | 1.00 | 200.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 15000.0 | .60 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 34 | 38.0 | 8.00 | 1.00 | -.0000 | -.0000 | .0200 | .0300 | .0000 | 200.0 | .30 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |
| F-2 | 35 | 5.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .30 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |
| F-2 | 36 | 4.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | .30 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 38 | .4 | 1.00 | 200.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 15000.0 | 100.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |
| F-2 | 39 | 7.0 | 8.00 | 1.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 100.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |
| F-2 | 41 | 6.0 | 8.00 | 1.50 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 5.10 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |
| F-2 | 45 | 4.0 | 8.00 | 20.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 4.70 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 | -.00 |
| F-2 | 47 | 4.0 | 8.00 | 20.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 1.60 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 49 | 4.0 | 8.00 | 20.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 1.80 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |
| F-2 | 51 | 4.0 | 8.00 | 20.00 | .0300 | .0060 | .0200 | .0300 | .0000 | 200.0 | 2.60 | -.00 | -.00 | -.00 | .00 | -.00 | -.00 | -.00 |

ENDFILE

* * * FILE F(3) - DATA(I,15) THRU DATA (I,20) * * *

| CARD TYPE | NO. OF REACH | VALUE FOR K2 OPTION-1 | COFF. ON V FOR K2 OPTION-2 | EXP. ON V FOR K2 OPTION-2 | EXP. ON D FOR K2 OPTION-2 | COEF. ON Q FOR K2 OPTION-3 | EXP. ON Q FOR K2 OPTION-3 |
|---|---|---|---|---|---|---|---|
| FILE F-3 | 1 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 2 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 4 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 6 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 8 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 10 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 12 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 14 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 15 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 16 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 18 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 20 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 22 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 23 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 25 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FILE F-3 | 26 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 27 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 29 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 31 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 33 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 35 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 37 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 39 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 40 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 42 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 43 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 44 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 46 | .000 | 3.300 | 1.000 | 1.330 | .000 | .000 |
| FILE F-3 | 48 | -.000 | 2.500 | 1.000 | 1.330 | -.000 | -.000 |
| FILE F-3 | 50 | -.000 | 2.500 | 1.000 | 1.330 | -.000 | -.000 |
| FILE F-3 | 52 | -.000 | 2.500 | 1.000 | 1.330 | -.000 | -.000 |

ENDFILE

* * * FILE F(4) - DATA(1,21) THRU DATA(1,23) * * *

| CARD TYPE | NO. OF REACH | OPTION FOR K2 | NAME OF REACH | COEF. ON Q FOR DEPTH | EXP. ON Q FOR DEPTH | CHANNEL SLOPE OPTION=4 |
|---|---|---|---|---|---|---|
| FILE F-4 | 1 | 2 | G4110 TO G4115 | .137 | .414 | -.000 |
| FILE F-4 | 2 | 2 | G4115 TO PRITCHARD C | .137 | .414 | -.000 |
| FILE F-4 | 3 | 2 | PRITCHARD CREEK | .137 | .414 | -.000 |
| FILE F-4 | 4 | 2 | PRITCHARD C TO BEAVR | .137 | .414 | -.000 |
| FILE F-4 | 5 | 2 | BEAVER CREEK | .137 | .414 | -.000 |
| FILE F-4 | 6 | 2 | BEAVER TO GRAHM CRK | .137 | .414 | -.000 |
| FILE F-4 | 7 | 2 | GRAHM CREEK | .137 | .414 | -.000 |
| FILE F-4 | 8 | 2 | GRAHM TO STEAMBOAT | .147 | .414 | -.000 |
| FILE F-4 | 9 | 2 | STEAMBOAT CREEK | .147 | .414 | -.000 |
| FILE F-4 | 10 | 2 | STEAMBOAT TO S-F-C | .155 | .414 | -.000 |
| FILE F-4 | 11 | 2 | SMITH-FALL-COUGAR C | .131 | .414 | -.000 |
| FILE F-4 | 12 | 2 | S-F-C TO N FORK | .162 | .414 | -.000 |
| FILE F-4 | 13 | 2 | N FORK COEUR DIALENE | .168 | .414 | -.000 |
| FILE F-4 | 14 | 2 | N FORK TO G4130 | .112 | .414 | -.000 |
| FILE F-4 | 15 | 2 | G4130 TO S FRK CDAL | .112 | .414 | -.000 |
| FILE F-4 | 16 | 2 | H34 TO DEADMAN | .140 | .414 | -.000 |
| FILE F-4 | 17 | 2 | DEADMAN GULCH | .140 | .414 | -.000 |
| FILE F-4 | 18 | 2 | DEAD TO HUNTERIS G | .154 | .414 | -.000 |
| FILE F-4 | 19 | 2 | GOLD HUNTERS GULCH | .140 | .414 | -.000 |
| FILE F-4 | 20 | 2 | GOLD TO SLAUGHTER | .154 | .414 | -.000 |
| FILE F-4 | 21 | 2 | SLAUGHTERHOUSE CREEK | .140 | .414 | -.000 |
| FILE F-4 | 22 | 2 | SLTHOUS TO CANYON C | .154 | .414 | -.000 |
| FILE F-4 | 23 | 2 | MF.J TO GEM OUTFALL | .210 | .414 | -.000 |
| FILE F-4 | 24 | 2 | GEM OUTFALL | .140 | .414 | -.000 |
| FILE F-4 | 25 | 2 | GEM OUTFALL TO S FRK | .210 | .414 | -.000 |
| FILE F-4 | 26 | 2 | CANYON C TO G4131.5 | .191 | .414 | -.000 |
| FILE F-4 | 27 | 2 | G4131.5 TO LAKE CRK | .191 | .414 | -.000 |
| FILE F-4 | 28 | 2 | LAKE CREEK | .191 | .414 | -.000 |
| FILE F-4 | 29 | 2 | LAKE C TO SILVERTON | .191 | .414 | -.000 |
| FILE F-4 | 30 | 2 | SILVERTON OUTFALL | .191 | .414 | -.000 |
| FILE F-4 | 31 | 2 | OUTFALL TO OSBURN O | .191 | .414 | -.000 |
| FILE F-4 | 32 | 2 | OSBURN OUTFALL | .191 | .414 | -.000 |
| FILE F-4 | 33 | 2 | OUTFALL TO BIG CREEK | .191 | .414 | -.000 |
| FILE F-4 | 34 | 2 | BIG CREEK | .191 | .414 | -.000 |
| FILE F-4 | 35 | 2 | BIG CREEK TO MILO C | .194 | .414 | -.000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FILE F-4 | 36 | 2 | MILO CREEK | .200 | .414 | -.000 |
| FILE F-4 | 37 | 2 | MILO TO KELLOGG OUT | .200 | .414 | -.000 |
| FILE F-4 | 38 | 2 | KELLOGG OUTFALL | .200 | .414 | -.000 |
| FILE F-4 | 39 | 2 | OUT TO G4133 | .215 | .414 | -.000 |
| FILE F-4 | 40 | 2 | G4133 TO PINE CREEK | .222 | .414 | -.000 |
| FILE F-4 | 41 | 2 | PINE CREEK | .270 | .414 | -.000 |
| FILE F-4 | 42 | 2 | PINE C TO CDALN RIV | .236 | .414 | -.000 |
| FILE F-4 | 43 | 2 | S FRK TO G4135 | .153 | .414 | -.000 |
| FILE F-4 | 44 | 2 | G4135 TO 4JULY CRK | .146 | .414 | -.000 |
| FILE F-4 | 45 | 2 | 4TH OF JULY CREEK | .600 | .414 | -.000 |
| FILE F-4 | 46 | 2 | 4JULY C TO ROSE CRK | .215 | .414 | -.000 |
| FILE F-4 | 47 | 2 | ROSE CREEK | .600 | .414 | -.000 |
| FILE F-4 | 48 | 2 | ROSE C TO KILLARNEY | .215 | .414 | -.000 |
| FILE F-4 | 49 | 2 | KILLARNEY OUTLET | .600 | .414 | -.000 |
| FILE F-4 | 50 | 2 | KILL O TO BLACK LAKE | .215 | .414 | -.000 |
| FILE F-4 | 51 | 2 | BLACK LAKE OUTLET | .600 | .414 | -.000 |
| FILE F-4 | 52 | 2 | OUT TO CDALENE LAKE | .215 | .414 | -.000 |

ENDFILE

* * * FILE G - BASIN CHARACTERISTICS * * *

| CARD TYPE | MINIMUM ALLOWABLE D.O. LEVEL (MG/L) | | | | FRACTION REMOVED BY TREATMENT | | | |
|---|---|---|---|---|---|---|---|---|
| FILE G | -.0 | -.0 | -.0 | -.0 | -.000 | -.000 | -.000 | -.000 |

ENDFILE

* * * FILE H - MEAN MONTHLY TEMPERATURES * * *

| CARD TYPE | STREAM TEMPERATURE IN DEGREES CENTIGRADE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
| FILE H | -.0 | -.0 | -.0 | -.0 | -.0 | -.0 | -.0 | -.0 | -.0 | -.0 | 19.0 | -.0 |

ENDFILE

* * * FILE I - MEAN MONTHLY HEADWATER FLOWS * * *

| CARD TYPE | NO. OF STRETCH | HEADWATER FLOWS IN CFS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
| FILE I | 1 | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | 117. | -0. |
| FILE I | 2 | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | 1. | -0. |
| FILE I | 3 | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | 13. | -0. |

ENDFILE

* * * FILE J - MORE REACH VARIABLES * * *

| CARD TYPE | REACH NUMBER | COLIFORM REACTION COEF | NH3 REACTION COEF | NO2 REACTION COEF | NO3 REACTION COEF | PO4 SETTLING COEF | EXTINCT COEF | K2 COEF FOR OPTION 5 | HEAVY MET 1 COEF | HEAVY MET 2 COEF | HEAVY MET 3 COEF | TEMPER (CENT DEG) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FILE J | 1 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.70 |
| FILE J | 2 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.00 |
| FILE J | 4 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.00 |
| FILE J | 6 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 20.00 |
| FILE J | 8 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.50 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FILE J | 10 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 18.50 |
| FILE J | 12 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 18.50 |
| FILE J | 14 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.00 |
| FILE J | 15 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.00 |
| FILE J | 16 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.40 |
| FILE J | 18 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.40 |
| FILE J | 20 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.40 |
| FILE J | 22 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 15.30 |
| FILE J | 23 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.00 |
| FILE J | 25 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.00 |
| FILE J | 26 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 18.30 |
| FILE J | 27 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.50 |
| FILE J | 29 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.00 |
| FILE J | 31 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.00 |
| FILE J | 33 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 15.00 |
| FILE J | 35 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.70 |
| FILE J | 37 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.00 |
| FILE J | 39 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.50 |
| FILE J | 40 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.30 |
| FILE J | 42 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 21.00 |
| FILE J | 43 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 17.50 |
| FILE J | 44 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 16.70 |
| FILE J | 46 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.20 |
| FILE J | 48 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.20 |
| FILE J | 50 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 19.50 |
| FILE J | 52 | .0040 | .0040 | .0150 | .0014 | .0009 | .0400 | 1.00 | .0040 | -.0000 | -.0000 | 20.00 |

ENDFILE

### * * * FILE K - 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)
CHLORIDES

| | |
|---|---|
| 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 = | .10000 |
| 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) = | .00001 |
| PHOSPHORUS BENTHAL RELEASE RATE (MG/SQUARE METER-HR) = | .12500 |
| TEMPERATURE CORRECTION CONSTANT FOR PO4 DECAY COEFFICIENT = | 1.08000 |
| NITROGEN BENTHAL RELEASE RATE (MG/SQUARE METER-HR) = | .01000 |
| BENTHAL OXYGEN DEMAND (MG/SQUARE METER-HR) = | .00001 |
| FRACTION OF HEAVY METAL 1 IN ION FORM = | -.00000 |

ENDFILE

* * * FILE K - 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)
CHLORIDES

| | |
|---|---|
| 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 = | .10000 |
| 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) = | .00201 |
| 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) = | .01000 |
| BENTHAL OXYGEN DEMAND (MG/SQUARE METER-HR) = | .00001 |
| FRACTION OF HEAVY METAL 1 IN ION FORM = | -.00000 |

ENDFILE

FILE L --- PLOT VARIABLES

```
QUANTITIES WILL BE PLOTTED FOR THE FOLLOWING REACHES
            52    50    48    46    44    43    15    14    10     8     6     1    42    40
            39    37    35    33    29    27    26    22


THE FOLLOWING QUANTITIES WILL BE PLOTTED

         DO AT REACH END (MG/L)
         BOD AT REACH END (MG/L)
         NH3 AT REACH END (MG/L)
         NO2 AT REACH END (MG/L)
         NO3 AT REACH END (MG/L)
         PO4 AT REACH END (MG/L)
         COL AT REACH END (MG/L)
         HM1 AT REACH END (MG/L)
         CL- AT REACH END (MG/L)
ENDFILE
```

* * * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2    AUGUST,1969

NUMBER OF RUN = 0
SEASON OF YR. = AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE =18.35

| NO. OF REACH | IDENTIFICATION OF REACH | RIVER MILE TO HEAD OF REACH | REACH LENGTH (MILES) | FLOW RATE (CFS) | D.O. MIN. (MG/L) | RIVER MILE AT MIN. D.O. | DISSOLVED OXYGEN AT START (MG/L) | DISSOLVED OXYGEN AT END (MG/L) | TEMP (CENT) |
|---|---|---|---|---|---|---|---|---|---|
| ..... | .................... | .......... | ....... | ..... | ..... | .......... | ........ | ...... | ...... |
| 1 | G4110 TO G4115 | 200.0 | 6.7 | 117.0 | 8.27 | 199.3 | 8.20 | 8.44 | 19.7 |
| 2 | G4115 TO PRITCHARD C | 193.3 | .2 | 121.0 | 8.44 | 193.1 | 8.44 | 8.44 | 19.0 |
| 4 | PRITCHARD C TO BEAVR | 193.1 | 2.6 | 157.0 | 8.36 | 192.8 | 8.34 | 8.49 | 19.0 |
| 6 | BEAVER TO GRAHM CRK | 190.5 | 7.6 | 187.0 | 8.39 | 182.9 | 8.44 | 8.39 | 20.0 |
| 8 | GRAHM TO STEAMBOAT | 182.9 | 4.0 | 195.0 | 8.44 | 182.5 | 8.38 | 8.70 | 17.5 |
| 10 | STEAMBOAT TO S-F-C | 178.9 | 2.5 | 231.0 | 8.60 | 178.6 | 8.59 | 8.62 | 18.5 |
| 12 | S-F-C TO N FORK | 176.4 | 2.0 | 253.0 | 8.58 | 176.2 | 8.58 | 8.60 | 18.5 |
| 14 | N FORK TO G4130 | 172.4 | 3.5 | 317.0 | 8.49 | 172.0 | 8.48 | 8.55 | 19.0 |
| 15 | G4130 TO S FRK COAL | 168.9 | 1.1 | 317.0 | 8.55 | 168.8 | 8.55 | 8.56 | 19.0 |
| 16 | M34 TO DEADMAN | 34.2 | 4.1 | 7.0 | 8.92 | 33.8 | 8.12 | 9.00 | 18.4 |
| 18 | DEAD TO HUNTERS G | 30.1 | 3.6 | 19.0 | 8.71 | 29.7 | 8.51 | 8.99 | 18.4 |
| 20 | GULD TO SLAUGHTER | 26.5 | 1.9 | 29.0 | 8.79 | 26.3 | 8.74 | 8.94 | 18.4 |
| 22 | SLTHOUS TO CANYON C | 24.6 | 5.5 | 39.0 | 8.97 | 24.1 | 8.81 | 9.23 | 15.3 |
| 23 | M6.4 TO GEM OUTFALL | 6.4 | 2.4 | 17.0 | 8.33 | 6.2 | 8.19 | 8.77 | 17.0 |
| 25 | GEM OUTFALL TO S FRK | 4.0 | 4.0 | 25.0 | 8.65 | 3.6 | 8.61 | 8.86 | 17.0 |
| 26 | CANYON C TO G4131.5 | 19.1 | 1.3 | 68.0 | 8.85 | 17.8 | 9.08 | 8.89 | 18.5 |
| 27 | G4131.5 TO LAKE CRK | 17.8 | .7 | 68.0 | 8.88 | 17.1 | 8.69 | 8.85 | 17.5 |
| 29 | LAKE C TO SILVERTON | 17.1 | 2.7 | 74.0 | 8.84 | 16.8 | 8.81 | 9.01 | 18.0 |
| 31 | OUTFALL TO OSBURN O | 14.4 | 1.3 | 74.3 | 8.99 | 14.3 | 8.98 | 9.03 | 18.0 |
| 33 | OUTFALL TO BIG CREEK | 13.2 | 2.0 | 74.6 | 8.66 | 11.2 | 9.00 | 8.86 | 18.0 |
| 35 | BIG CREEK TO MILO C | 11.2 | 3.4 | 115.6 | 8.61 | 10.9 | 8.57 | 8.81 | 18.7 |
| 37 | MILO TO KELLOGG OUT | 7.8 | .9 | 119.6 | 8.79 | 7.7 | 8.78 | 8.81 | 17.0 |
| 39 | OUT TO G4133 | 6.9 | 1.9 | 127.0 | 8.79 | 6.7 | 8.78 | 8.86 | 18.5 |
| 40 | G4133 TO PINE CREEK | 5.0 | 2.7 | 127.0 | 8.82 | 4.7 | 8.62 | 8.63 | 17.3 |
| 42 | PINE C TO COALN RIV | 2.3 | 2.3 | 133.0 | 8.54 | .0 | 8.79 | 8.54 | 21.0 |
| 43 | S FRK TO G4135 | 167.8 | 3.6 | 450.0 | 8.57 | 167.4 | 8.55 | 8.60 | 17.5 |
| 44 | G4135 TO 4JULY CRK | 164.2 | 7.9 | 450.0 | 8.72 | 163.4 | 8.58 | 8.90 | 18.7 |
| 46 | 4JULY C TO ROSE CRK | 156.3 | 3.6 | 454.0 | 8.72 | 152.7 | 8.69 | 8.72 | 19.2 |
| 48 | ROSE C TO KILLARNEY | 152.7 | 6.1 | 458.0 | 8.56 | 146.6 | 8.72 | 8.56 | 19.2 |
| 50 | KILL O TO BLACK LAKE | 146.6 | 7.2 | 462.0 | 8.43 | 139.4 | 8.56 | 8.43 | 19.5 |
| 52 | OUT TO COALENE LAKE | 139.4 | 8.0 | 466.0 | 8.31 | 131.4 | 8.42 | 8.31 | 20.0 |

## * * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2     AUGUST,1969

NUMBER OF RUN = 0
SEASON OF YR. = AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE =18.35

| NO. OF REACH | IDENTIFICATION OF REACH | RIVER MILE TO HEAD OF REACH | REACH LENGTH (MILES) | FLOW RATE (CFS) | D.O. MIN. (MG/L) | RIVER MILE AT MIN. D.O. | DISSOLVED OXYGEN AT START (MG/L) | DISSOLVED OXYGEN AT END (MG/L) | TEMP (CENT) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | G4110 TO G4115 | 200.0 | 6.7 | 117.0 | 8.27 | 199.3 | 6.20 | 8.44 | 19.7 |
| 2 | G4115 TO PRITCHARD C | 193.3 | .2 | 121.0 | 8.44 | 193.1 | 8.44 | 8.44 | 19.0 |
| 4 | PRITCHARD C TO BEAVR | 193.1 | 2.6 | 157.0 | 8.36 | 192.8 | 8.34 | 8.49 | 19.0 |
| 6 | BEAVER TO GRAHM CRK | 190.5 | 7.6 | 187.0 | 8.39 | 182.9 | 8.44 | 8.39 | 20.0 |
| 8 | GRAHM TO STEAMBOAT | 182.9 | 4.0 | 195.0 | 8.44 | 182.5 | 6.38 | 8.70 | 17.5 |
| 10 | STEAMBOAT TO S-F-C | 178.9 | 2.5 | 231.0 | 8.60 | 178.6 | 6.59 | 8.62 | 16.5 |
| 12 | S-F-C TO N FORK | 176.4 | 2.0 | 253.0 | 8.58 | 176.2 | 8.58 | 8.60 | 18.5 |
| 14 | N FORK TO G4130 | 172.4 | 3.5 | 317.0 | 8.49 | 172.0 | 6.48 | 8.55 | 19.0 |
| 15 | G4130 TO S FRK CDAL | 168.9 | 1.1 | 317.0 | 8.55 | 168.8 | 8.55 | 8.56 | 19.0 |
| 16 | M34 TO DEADMAN | 34.2 | 4.1 | 7.0 | 8.92 | 33.8 | 8.12 | 9.00 | 16.4 |
| 18 | DEAD TO HUNTER'S G | 30.1 | 3.6 | 19.0 | 8.71 | 29.7 | 6.51 | 8.99 | 16.4 |
| 20 | GOLD TO SLAUGHTER | 26.5 | 1.9 | 29.0 | 8.79 | 26.3 | 8.74 | 8.94 | 16.4 |
| 22 | SLTHOUS TO CANYON C | 24.6 | 5.5 | 39.0 | 8.97 | 24.1 | 6.81 | 9.23 | 15.3 |
| 23 | M6.4 TO GEM OUTFALL | 6.4 | 2.4 | 17.0 | 8.33 | 6.2 | 8.19 | 8.77 | 17.0 |
| 25 | GEM OUTFALL TO S FRK | 4.0 | 4.0 | 25.0 | 8.65 | 3.6 | 8.61 | 8.86 | 17.0 |
| 26 | CANYON C TO G4131.5 | 19.1 | 1.3 | 68.0 | 8.85 | 17.8 | 9.09 | 8.89 | 16.5 |
| 27 | G4131.5 TO LAKE CRK | 17.8 | .7 | 68.0 | 8.88 | 17.1 | 6.09 | 8.85 | 17.5 |
| 29 | LAKE C TO SILVERTON | 17.1 | 2.7 | 74.0 | 8.84 | 16.8 | 8.61 | 9.01 | 16.0 |
| 31 | OUTFALL TO OSBURN O | 14.4 | 1.3 | 74.3 | 8.99 | 14.3 | 8.98 | 9.03 | 16.0 |
| 33 | OUTFALL TO BIG CREEK | 13.2 | 2.0 | 74.6 | 8.66 | 11.2 | 9.00 | 8.86 | 18.0 |
| 35 | BIG CREEK TO MILO C | 11.2 | 3.4 | 115.6 | 8.61 | 10.9 | 8.57 | 8.81 | 16.7 |
| 37 | MILO TO KELLOGG OUT | 7.8 | .9 | 119.6 | 6.79 | 7.7 | 6.78 | 8.81 | 17.0 |
| 39 | OUT TO G4133 | 6.9 | 1.9 | 127.0 | 6.75 | 6.7 | 6.78 | 8.82 | 16.5 |
| 40 | G4133 TO PINE CREEK | 5.0 | 2.7 | 127.0 | 6.82 | 4.7 | 8.62 | 8.83 | 17.3 |
| 42 | PINE C TO COALN RIV | 2.3 | 2.3 | 133.0 | 6.54 | .0 | 8.79 | 8.54 | 21.0 |
| 43 | S FRK TO G4135 | 167.8 | 3.6 | 450.0 | 6.57 | 167.4 | 8.55 | 8.66 | 17.5 |
| 44 | G4135 TO 4JULY CRK | 164.2 | 7.9 | 450.0 | 6.72 | 163.4 | 6.58 | 8.90 | 16.7 |
| 46 | 4JULY C TO ROSE CRK | 156.3 | 3.6 | 454.0 | 6.72 | 152.7 | 8.69 | 8.72 | 19.2 |
| 48 | ROSE C TO KILLARNEY | 152.7 | 6.1 | 458.0 | 6.56 | 146.6 | 6.72 | 8.56 | 19.2 |
| 50 | KILL O TO BLACK LAKE | 146.6 | 7.2 | 462.0 | 6.43 | 139.4 | 6.56 | 6.43 | 19.5 |
| 52 | OUT TO COALENE LAKE | 139.4 | 8.0 | 466.0 | 6.31 | 131.4 | 8.42 | 6.31 | 20.0 |

# * * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2    AUGUST,1969

NUMBER OF RUN = 0
SEASON OF YR. = AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE =18.39

| NO. OF REACH | IDENTIFICATION OF REACH | BOD CONCENTRATION AT START (MG/L) | BOD CONCENTRATION AT END (MG/L) | REAERATION VALUE (BASE E) | TRAVEL TIME (DAYS) | MEAN VELOCITY (FT/SEC) | MEAN DEPTH (FT) | MEAN WIDTH (FT) | MEAN SLOPE (BASED ON MANNING=.04) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | G4110 TO G4115 | .80 | .74 | .33 | .402 | 1.02 | .96 | 116.61 | .000766 |
| 2 | G4115 TO PRITCHARD C | .74 | .75 | .32 | .012 | 1.03 | .99 | 116.75 | .000770 |
| 4 | PRITCHARD C TO BEAVR | .80 | .76 | .31 | .138 | 1.15 | 1.11 | 122.66 | .000851 |
| 6 | BEAVER TO GRAHM CRK | .81 | .76 | .31 | .380 | 1.22 | 1.18 | 129.57 | .000665 |
| 8 | GRAHM TO STEAMBOAT | .77 | .74 | .25 | .213 | 1.15 | 1.30 | 130.51 | .000671 |
| 10 | STEAMBOAT TO S-F-C | .78 | .77 | .22 | .131 | 1.17 | 1.48 | 135.75 | .000568 |
| 12 | S-F-C TO N FORK | .78 | .77 | .20 | .103 | 1.19 | 1.60 | 132.92 | .000549 |
| 14 | N FORK TO G4130 | .82 | .80 | .37 | .141 | 1.52 | 1.21 | 172.54 | .001260 |
| 15 | G4130 TO S FRK COAL | .80 | .79 | .37 | .044 | 1.52 | 1.22 | 171.73 | .001262 |
| 16 | M34 TO DEADMAN | .87 | .95 | 2.22 | .223 | 1.16 | .25 | 24.13 | .006172 |
| 18 | DEAD TO HUNTERS C | .98 | .96 | 1.23 | .139 | 1.59 | .49 | 24.53 | .004711 |
| 20 | GOLD TO SLAUGHTER | .97 | .97 | .98 | .070 | 1.67 | .60 | 20.76 | .003928 |
| 22 | SLTHOUS TO CANYON C | .97 | .95 | .92 | .179 | 1.68 | .66 | 30.66 | .004249 |
| 23 | M6.4 TO GEM OUTFALL | .81 | .84 | .87 | .092 | 1.60 | .65 | 16.38 | .005307 |
| 25 | GEM OUTFALL TO S FRK | .87 | .87 | .82 | .128 | 1.91 | .77 | 16.96 | .005717 |
| 26 | CANYON C TO G4131.5 | .92 | .92 | .49 | .045 | 1.76 | 1.08 | 35.68 | .002003 |
| 27 | G4131.5 TO LAKE CRK | .92 | .91 | .46 | .024 | 1.78 | 1.10 | 34.90 | .002018 |
| 29 | LAKE C TO SILVERTON | .92 | .91 | .46 | .090 | 1.64 | 1.13 | 35.01 | .002054 |
| 31 | OUTFALL TO OSBURN O | 1.71 | 1.70 | .45 | .045 | 1.84 | 1.14 | 35.03 | .002068 |
| 33 | OUTFALL TO BIG CREEK | 2.50 | 2.47 | .48 | .066 | 1.65 | 1.14 | 35.46 | .002070 |
| 35 | BIG CREEK TO MILO C | 1.97 | 1.91 | .56 | .112 | 1.85 | 1.38 | 45.32 | .001604 |
| 37 | MILO TO KELLOGG OUT | 1.88 | 1.87 | .35 | .029 | 1.88 | 1.45 | 43.79 | .001560 |
| 39 | OUT TO G4133 | 2.53 | 2.42 | .25 | .075 | 1.54 | 1.56 | 52.13 | .000933 |
| 40 | G4133 TO PINE CREEK | 2.42 | 2.38 | .24 | .106 | 1.56 | 1.66 | 64.35 | .000910 |
| 42 | PINE C TO COALD RIV | 2.34 | 2.30 | .24 | .088 | 1.59 | 1.79 | 45.79 | .000840 |
| 43 | S FRK TO G4135 | 1.24 | 1.20 | .15 | .175 | 1.25 | 1.92 | 135.42 | .000475 |
| 44 | G4135 TO 4JULY CRK | 1.20 | 1.13 | .17 | .385 | 1.25 | 1.83 | 195.82 | .000506 |
| 46 | 4JULY C TO ROSE CRK | 1.29 | 1.23 | .07 | .261 | .84 | 2.71 | 196.84 | .000136 |
| 48 | ROSE C TO KILLARNEY | 1.40 | 1.28 | .05 | .440 | .65 | 2.72 | 199.16 | .000136 |
| 50 | KILL O TO BLACK LAKE | 1.45 | 1.31 | .05 | .518 | .65 | 2.73 | 199.40 | .000137 |
| 52 | OUT TO COALENE LAKE | 1.47 | 1.31 | .05 | .573 | .85 | 2.74 | 199.73 | .000137 |

*** * * * * F I N A L   S U M M A R Y * * * * ***

SPOKANE RIVER REGION NUMBER 2    AUGUST,1969

NUMBER OF RUN = 0
SEASON OF YR. = AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE =18.35

| NO. OF REACH | IDENTIFICATION OF REACH | NH3-N CONCENTRATION AT START (MG/L) | NH3-N CONCENTRATION AT END (MG/L) | NO2-N CONCENTRATION AT START (MG/L) | NO2-N CONCENTRATION AT END (MG/L) | NO3-N CONCENTRATION AT START (MG/L) | NO3-N CONCENTRATION AT END (MG/L) | PO4-P CONCENTRATION AT START (MG/L) | PO4-P CONCENTRATION AT END (MG/L) |
|---|---|---|---|---|---|---|---|---|---|
| ..... | .................. | ....... | ....... | ....... | ....... | ....... | ....... | ....... | ....... |
| 1 | G4110 TO G4115 | .030 | .012 | .006 | .006 | .020 | .021 | .050 | .054 |
| 2 | G4115 TO PRITCHARD C | .012 | .013 | .006 | .006 | .021 | .021 | .054 | .054 |
| 4 | PRITCHARD C TO BEAVR | .010 | .008 | .005 | .004 | .020 | .021 | .048 | .049 |
| 6 | BEAVER TO GRAHM CRK | .007 | .004 | .004 | .003 | .020 | .021 | .047 | .050 |
| 8 | GRAHM TO STEAMBOAT | .004 | .004 | .004 | .003 | .021 | .021 | .049 | .051 |
| 10 | STEAMBOAT TO S-F-C | .004 | .003 | .003 | .003 | .021 | .021 | .047 | .048 |
| 12 | S-F-C TO N FORK | .005 | .005 | .003 | .003 | .021 | .021 | .047 | .047 |
| 14 | N FORK TO G4130 | .004 | .004 | .002 | .002 | .021 | .021 | .044 | .045 |
| 15 | G4130 TO S FRK COAL | .004 | .004 | .002 | .002 | .021 | .021 | .045 | .045 |
| 16 | M34 TO DEADMAN | .030 | .026 | .006 | .006 | .020 | .020 | .042 | .038 |
| 18 | DEAD TO HUNTERS G | .028 | .025 | .006 | .006 | .020 | .020 | .034 | .035 |
| 20 | GOLD TO SLAUGHTER | .026 | .025 | .006 | .006 | .020 | .020 | .034 | .035 |
| 22 | SLTHOUS TO CANYON C | .026 | .022 | .006 | .006 | .020 | .020 | .034 | .036 |
| 23 | MO.4 TO GEM OUTFALL | .030 | .027 | .006 | .006 | .020 | .020 | .049 | .047 |
| 25 | GEM OUTFALL TO S FRK | .028 | .024 | .006 | .006 | .020 | .020 | .043 | .043 |
| 26 | CANYON C TO G4131.5 | .023 | .022 | .006 | .006 | .020 | .020 | .039 | .039 |
| 27 | G4131.5 TO LAKE CRK | .022 | .021 | .006 | .006 | .020 | .020 | .039 | .039 |
| 29 | LAKE C TO SILVERTON | .022 | .020 | .006 | .006 | .020 | .020 | .038 | .039 |
| 31 | OUTFALL TO OSBURN O | .020 | .019 | .006 | .006 | .020 | .020 | .039 | .039 |
| 33 | OUTFALL T BIG CREEK | .019 | .018 | .006 | .006 | .020 | .021 | .039 | .040 |
| 35 | BIG CREEK TO MILO C | .012 | .012 | .004 | .004 | .020 | .020 | .037 | .037 |
| 37 | MILO TO KELLOGG OUT | .012 | .012 | .004 | .004 | .020 | .020 | .037 | .037 |
| 39 | OUT TO G4133 | .012 | .013 | .004 | .004 | .020 | .020 | .037 | .037 |
| 40 | G4133 TO PINE CREEK | .013 | .012 | .004 | .004 | .020 | .020 | .037 | .038 |
| 42 | PINE C TO COALN RIV | .013 | .011 | .004 | .004 | .020 | .021 | .038 | .039 |
| 43 | S FRK TO G4135 | .006 | .005 | .003 | .003 | .021 | .021 | .043 | .044 |
| 44 | G4135 TO 4JULY CRK | .005 | .005 | .003 | .003 | .021 | .021 | .044 | .047 |
| 46 | 4JULY C TO ROSE CRK | .005 | .004 | .003 | .003 | .021 | .021 | .047 | .048 |
| 48 | ROSE C TO KILLARNEY | .005 | .004 | .003 | .002 | .021 | .021 | .048 | .050 |
| 50 | KILL O TO BLACK LAKE | .004 | .004 | .002 | .002 | .021 | .021 | .050 | .052 |
| 52 | OUT TO COALENE LAKE | .004 | .003 | .002 | .002 | .021 | .021 | .052 | .055 |

# * * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2     AUGUST,1969

NUMBER OF RUN =      0
SEASON OF YR. =   AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE  =18.35

| NO. OF REACH | IDENTIFICATION OF REACH | ALGAE CONCENTRATION AT START (MG/L) | ALGAE CONCENTRATION AT END (MG/L) | COLIF CONCENTRATION AT START (MPN/100) | COLIF CONCENTRATION AT END (MPN/100) | MET-1 CONCENTRATION AT START (MG/L) | MET-1 CONCENTRATION AT END (MG/L) | MET-2 CONCENTRATION AT START (MG/L) | MET-2 CONCENTRATION AT END (MG/L) |
|---|---|---|---|---|---|---|---|---|---|
| ..... | .................. | ....... | ....... | ....... | ....... | ....... | ....... | ....... | ....... |
| 1 | G4110 TO G4115 | .000 | .000 | 200.0 | 192.6 | .000 | .000 | .000 | .000 |
| 2 | G4115 TO PRITCHARD C | .000 | .000 | 192.6 | 192.6 | .000 | .000 | .000 | .000 |
| 4 | PRITCHARD C TO BEAVR | .000 | .000 | 194.3 | 191.9 | .000 | .000 | .000 | .000 |
| 6 | BEAVER TO GRAHM CRK | .000 | .000 | 192.8 | 166.5 | .000 | .000 | .000 | .000 |
| 8 | GRAHM TO STEAMBOAT | .000 | .000 | 186.8 | 183.9 | .000 | .000 | .000 | .000 |
| 10 | STEAMBOAT TO S-F-C | .000 | .000 | 186.4 | 184.3 | .000 | .000 | .000 | .000 |
| 12 | S-F-C TO N FORK | .000 | .000 | 185.5 | 184.0 | .000 | .000 | .000 | .000 |
| 14 | N FORK TO G4130 | .000 | .000 | 302.0 | 297.1 | .000 | .000 | .000 | .000 |
| 15 | G4130 TO S FRK CDAL | .000 | .000 | 297.1 | 295.9 | .000 | .000 | .000 | .000 |
| 16 | M34 TO DEADMAN | .000 | .000 | 200.0 | 198.1 | .000 | .000 | .000 | .000 |
| 18 | DEAD TO HUNTER'S G | .000 | .000 | 199.0 | 197.5 | .000 | .000 | .000 | .000 |
| 20 | GULD TO SLAUGHTER | .000 | .000 | 198.2 | 197.4 | .000 | .000 | .000 | .000 |
| 22 | SLTHOUS TO CANYON C | .000 | .000 | 197.8 | 195.8 | .000 | .000 | .000 | .000 |
| 23 | M6.4 TO GEM OUTFALL | .000 | .000 | 200.0 | 198.7 | 3.970 | 3.735 | .000 | .000 |
| 25 | GEM OUTFALL TO S FRK | .000 | .000 | 199.0 | 197.3 | 3.527 | 2.983 | .000 | .000 |
| 26 | CANYON C TO G4131.5 | .000 | .000 | 196.4 | 195.8 | 1.164 | 1.150 | .000 | .000 |
| 27 | G4131.5 TO LAKE CRK | .000 | .000 | 195.8 | 195.5 | 1.150 | 1.148 | .000 | .000 |
| 29 | LAKE C TO SILVERTON | .000 | .000 | 195.8 | 194.6 | 1.120 | 1.110 | .000 | .000 |
| 31 | OUTFALL TO OSHMAN D | .000 | .000 | 254.3 | 253.5 | 1.106 | 1.104 | .000 | .000 |
| 33 | OUTFALL TO BIG CREEK | .000 | .000 | 312.8 | 311.1 | 1.102 | 1.095 | .000 | .000 |
| 35 | BIG CREEK TO MILO C | .000 | .000 | 273.4 | 269.4 | .625 | .604 | .000 | .000 |
| 37 | MILO TO KELLOGG OUT | .000 | .000 | 267.1 | 266.5 | .787 | .785 | .000 | .000 |
| 39 | OUT TO G4133 | .000 | .000 | 314.9 | 307.5 | 1.689 | 6.537 | .000 | .000 |
| 40 | G4133 TO PINE CREEK | .000 | .000 | 307.5 | 304.9 | 6.537 | 6.471 | .000 | .000 |
| 42 | PINE C TO CDALN RIV | .000 | .000 | 300.1 | 297.4 | 6.409 | 6.355 | .000 | .000 |
| 43 | S FRK TO G4135 | .000 | .000 | 296.3 | 292.2 | 1.878 | 1.847 | .000 | .000 |
| 44 | G4135 TO 4JULY CRK | .000 | .000 | 292.2 | 263.6 | 1.847 | 1.780 | .000 | .000 |
| 46 | 4JULY C TO ROSE CRK | .000 | .000 | 282.9 | 276.3 | 1.806 | 1.761 | .000 | .000 |
| 48 | ROSE C TO KILLARNEY | .000 | .000 | 275.6 | 264.8 | 1.759 | 1.687 | .000 | .000 |
| 50 | KILL D TO BLACK LAKE | .000 | .000 | 264.2 | 251.8 | 1.686 | 1.606 | .000 | .000 |
| 52 | OUT TO CDALENE LAKE | .000 | .000 | 251.4 | 237.9 | 1.614 | 1.520 | .000 | .000 |

* * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2    AUGUST,1969

NUMBER OF RUN =    0
SEASON OF YR. =  AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE  =18.35

| NO. OF REACH | IDENTIFICATION OF REACH | MET-3 CONCENTRATION AT START (MG/L) | AT END (MG/L) | TOT N CONCENTRATION AT START (MG/L) | AT END (MG/L) | CL- CONCENTRATION AT START (MG/L) | AT END (MG/L) | ION-1 CONCENTRATION AT START (MG/L) | AT END (MG/L) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | G4110 TO G4115 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 2 | G4115 TO PRITCHARD C | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 4 | PRITCHARD C TO BEAVR | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 6 | BEAVER TO GRAHM CRK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 8 | GRAHM TO STEAMBOAT | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 10 | STEAMBOAT TO S-F-C | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 12 | S-F-C TO N FORK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 14 | N FORK TO G4130 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 15 | G4130 TO S FRK CDAL | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 16 | M34 TO DEADMAN | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 18 | DEAD TO HUNTER'S G | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 20 | GOLD TO SLAUGHTER | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 22 | SLTHOUS TO CANYON C | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 23 | M6.4 TO GEM OUTFALL | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 25 | GEM OUTFALL TO S FRK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 26 | CANYON C TO G4131.5 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 27 | G4131.5 TO LAKE CRK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 29 | LAKE C TO SILVERTON | .000 | .000 | .000 | .000 | 2.432 | 2.432 | .000 | .000 |
| 31 | OUTFALL TO OSBURN O | .000 | .000 | .000 | .000 | 2.423 | 2.423 | .000 | .000 |
| 33 | OUTFALL TO BIG CREEK | .000 | .000 | .000 | .000 | 2.413 | 2.413 | .000 | .000 |
| 35 | BIG CREEK TO MILO C | .000 | .000 | .000 | .000 | 1.594 | 1.557 | .000 | .000 |
| 37 | MILO TO KELLOGG OUT | .000 | .000 | .000 | .000 | 1.595 | 1.595 | .000 | .000 |
| 39 | OUT TO G4133 | .000 | .000 | .000 | .000 | 1.491 | 1.417 | .000 | .000 |
| 40 | G4133 TO PINE CREEK | .000 | .000 | .000 | .000 | 1.417 | 1.417 | .000 | .000 |
| 42 | PINE C TO CDALN RIV | .000 | .000 | .000 | .000 | 1.353 | 1.353 | .000 | .000 |
| 43 | S FRK TO G4135 | .000 | .000 | .000 | .000 | .400 | .400 | .000 | .000 |
| 44 | G4135 TO 4JULY CRK | .000 | .000 | .000 | .000 | .400 | .400 | .000 | .000 |
| 46 | 4JULY C TO ROSE CRK | .000 | .000 | .000 | .000 | .396 | .396 | .000 | .000 |
| 48 | ROSE C TO KILLARNEY | .000 | .000 | .000 | .000 | .393 | .393 | .000 | .000 |
| 50 | KILL O TO BLACK LAKE | .000 | .000 | .000 | .000 | .390 | .390 | .000 | .000 |
| 52 | OUT TO CDALENE LAKE | .000 | .000 | .000 | .000 | .386 | .386 | .000 | .000 |

* * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2    AUGUST,1969

NUMBER OF RUN =     0
SEASON OF YR. =   AUG

TARGET D.O. LEVEL = -.00
MEAN TEMPERATURE  =18.35

| NO. OF REACH | IDENTIFICATION OF REACH | MET-3 CONCENTRATION AT START (MG/L) | MET-3 CONCENTRATION AT END (MG/L) | TOT N CONCENTRATION AT START (MG/L) | TOT N CONCENTRATION AT END (MG/L) | CL- CONCENTRATION AT START (MG/L) | CL- CONCENTRATION AT END (MG/L) | ION-1 CONCENTRATION AT START (MG/L) | ION-1 CONCENTRATION AT END (MG/L) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | G4110 TO G4115 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 2 | G4115 TO PRITCHARD C | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 4 | PRITCHARD C TO BEAVR | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 6 | BEAVER TO GRAHM CRK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 8 | GRAHM TO STEAMBOAT | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 10 | STEAMBOAT TO S-F-C | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 12 | S-F-C TO N FORK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 14 | N FORK TO G4130 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 15 | G4130 TO S FRK COAL | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 16 | M34 TO DEADMAN | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 18 | DEAD TO HUNTERS G | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 20 | GOLD TO SLAUGHTER | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 22 | SLTHOUS TO CANYON C | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 23 | M6.4 TO GEM OUTFALL | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 25 | GEM OUTFALL TO S FRK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 26 | CANYON C TO G4131.5 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 27 | G4131.5 TO LAKE CRK | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| 29 | LAKE C TO SILVERTON | .000 | .000 | .000 | .000 | 2.432 | 2.432 | .000 | .000 |
| 31 | OUTFALL TO OSBURN O | .000 | .000 | .000 | .000 | 2.423 | 2.423 | .000 | .000 |
| 33 | OUTFALL TO BIG CREEK | .000 | .000 | .000 | .000 | 2.413 | 2.413 | .000 | .000 |
| 35 | BIG CREEK TO MILO C | .000 | .000 | .000 | .000 | 1.594 | 1.557 | .000 | .000 |
| 37 | MILO TO KELLOGG OUT | .000 | .000 | .000 | .000 | 1.505 | 1.505 | .000 | .000 |
| 39 | OUT TO G4133 | .000 | .000 | .000 | .000 | 1.491 | 1.417 | .000 | .000 |
| 40 | G4133 TO PINE CREEK | .000 | .000 | .000 | .000 | 1.417 | 1.417 | .000 | .000 |
| 42 | PINE C TO CDALN RIV | .000 | .000 | .000 | .000 | 1.353 | 1.353 | .000 | .000 |
| 43 | S FRK TO G4135 | .000 | .000 | .000 | .000 | .400 | .400 | .000 | .000 |
| 44 | G4135 TO 4JULY CRK | .000 | .000 | .000 | .000 | .400 | .400 | .000 | .000 |
| 46 | 4JULY C TO ROSE CRK | .000 | .000 | .000 | .000 | .396 | .396 | .000 | .000 |
| 48 | ROSE C TO KILLARNEY | .000 | .000 | .000 | .000 | .393 | .393 | .000 | .000 |
| 50 | KILL O TO BLACK LAKE | .000 | .000 | .000 | .000 | .390 | .390 | .000 | .000 |
| 52 | OUT TO CDALENE LAKE | .000 | .000 | .000 | .000 | .386 | .386 | .000 | .000 |

* * * * * F I N A L   S U M M A R Y * * * * *

SPOKANE RIVER REGION NUMBER 2    AUGUST,1969

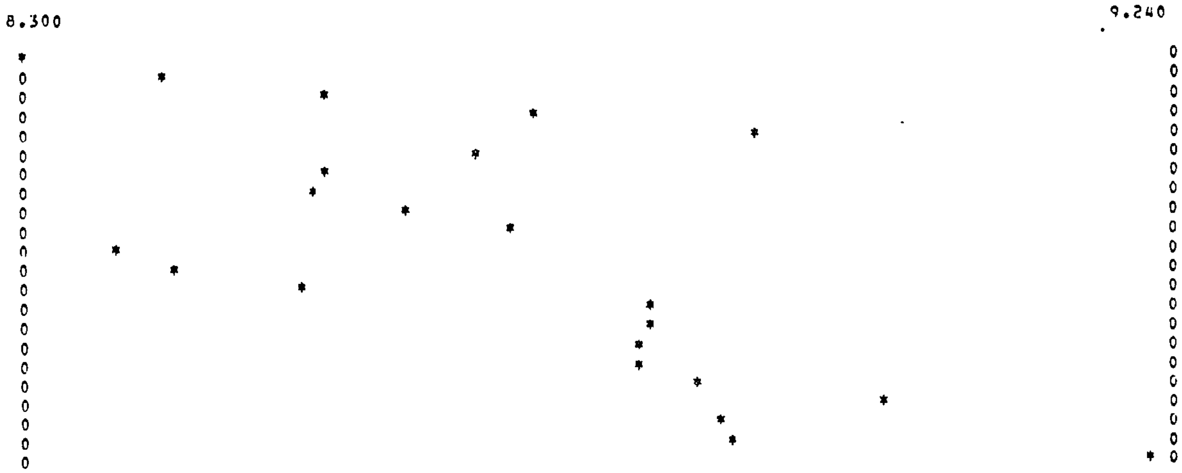
NUMBER OF RUN =   0    TARGET D.O. LEVEL = -.00
SEASON OF YR. =  AUG    MEAN TEMPERATURE =18.35

| NO. OF HEADWATER | NO. OF STRETCH | INITIAL FLOW (CFS) | FINAL FLOW (CFS) | AUGMENTATION REQUIRED (CFS) |
|---|---|---|---|---|
| 1 | 1 | 117.0 | 117.0 | .0 |
| 2 | 2 | 1.0 | 1.0 | .0 |
| 3 | 3 | 13.0 | 13.0 | .0 |

95

DO AT REACH END (MG/L)

| REACH | DEP. VAR. |
|---|---|
| 52 | .83071+01 |
| 50 | .84282+01 |
| 48 | .85608+01 |
| 46 | .87233+01 |
| 44 | .89029+01 |
| 43 | .86774+01 |
| 15 | .85555+01 |
| 14 | .85456+01 |
| 10 | .86237+01 |
| 8 | .87046+01 |
| 6 | .83936+01 |
| 1 | .84402+01 |
| 42 | .85433+01 |
| 40 | .88256+01 |
| 39 | .88232+01 |
| 37 | .88126+01 |
| 35 | .88108+01 |
| 33 | .88582+01 |
| 29 | .90129+01 |
| 27 | .88773+01 |
| 26 | .88865+01 |
| 22 | .92301+01 |

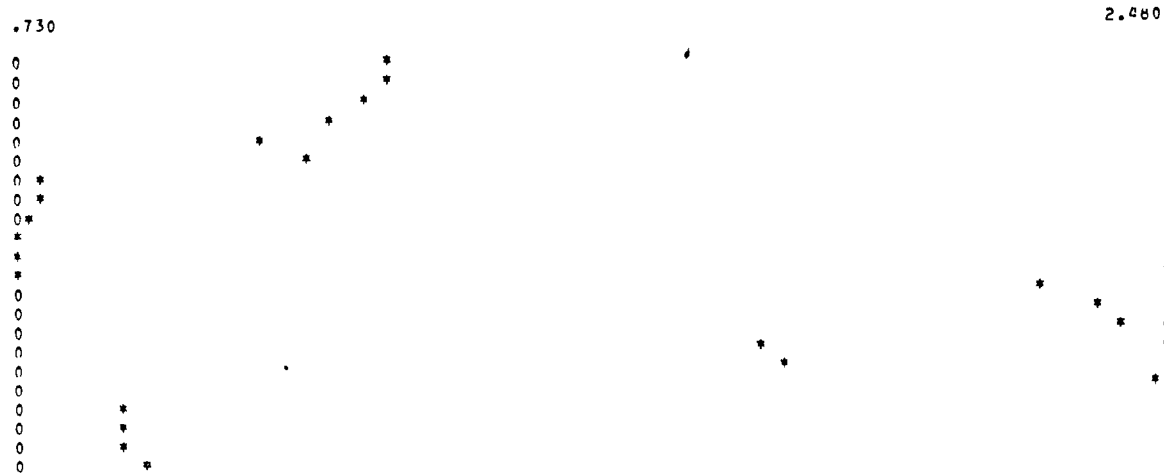


DO AT REACH END (MG/L)

| REACH | DEP. VAR. | 8.300 — 9.240 |
|---|---|---|
| 52 | .83071+01 | |
| 50 | .84282+01 | |
| 48 | .85608+01 | |
| 46 | .87233+01 | |
| 44 | .89029+01 | |
| 43 | .86774+01 | |
| 15 | .85555+01 | |
| 14 | .85456+01 | |
| 10 | .86237+01 | |
| 8 | .87046+01 | |
| 6 | .83936+01 | |
| 1 | .84402+01 | |
| 42 | .85433+01 | |
| 40 | .88256+01 | |
| 39 | .88232+01 | |
| 37 | .88126+01 | |
| 35 | .88108+01 | |
| 33 | .88582+01 | |
| 29 | .90129+01 | |
| 27 | .88773+01 | |
| 26 | .88865+01 | |
| 22 | .92301+01 | |

BOD AT REACH END (MG/L)

| REACH | DEP. VAR. |
| --- | --- |
| 52 | .13092+01 |
| 50 | .13078+01 |
| 48 | .12836+01 |
| 46 | .12313+01 |
| 44 | .11275+01 |
| 43 | .11991+01 |
| 15 | .79061-00 |
| 14 | .79657-00 |
| 10 | .76552-00 |
| 8 | .74397-00 |
| 6 | .76094-00 |
| 1 | .73945-00 |
| 42 | .22961+01 |
| 40 | .23796+01 |
| 39 | .24219+01 |
| 37 | .18747+01 |
| 35 | .19142+01 |
| 33 | .24702+01 |
| 29 | .90885-00 |
| 27 | .91440-00 |
| 26 | .91812-00 |
| 22 | .95208-00 |

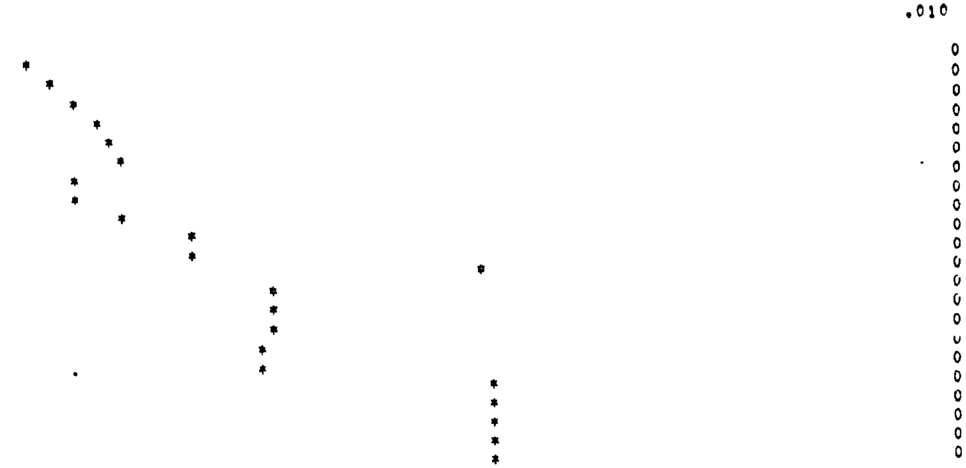


NH3 AT REACH END (MG/L)

| REACH | DEP. VAR. |
|---|---|
| 52 | .34514-02 |
| 50 | .36645-02 |
| 48 | .38792-02 |
| 46 | .42857-02 |
| 44 | .48183-02 |
| 43 | .53851-02 |
| 15 | .37953-02 |
| 14 | .39359-02 |
| 10 | .33101-02 |
| 8 | .42412-02 |
| 6 | .37473-02 |
| 1 | .12402-01 |
| 42 | .10666-01 |
| 40 | .11795-01 |
| 39 | .12556-01 |
| 37 | .11684-01 |
| 35 | [illegible] |
| 33 | [illegible] |

NO2 AT REACH END (MG/L)

| REACH | DEP. VAR. | .000 |
|---|---|---|
| 52 | .20347-02 | 0 |
| 50 | .27425-02 | 0 |
| 48 | .24449-02 | 0 |
| 46 | .26245-02 | 0 |
| 44 | .27207-02 | 0 |
| 43 | .28646-02 | 0 |
| 15 | .24107-02 | 0 |
| 14 | .24308-02 | 0 |
| 10 | .28034-02 | 0 |
| 8 | .34136-02 | 0 |
| 6 | .34466-02 | 0 |
| 1 | .59321-02 | 0 |
| 42 | .41812-02 | 0 |
| 40 | .41338-02 | 0 |
| 39 | .41600-02 | 0 |
| 37 | .40625-02 | 0 |
| 35 | .40028-02 | 0 |
| 33 | .60002-02 | 0 |
| 29 | .60296-02 | 0 |
| 27 | .60432-02 | 0 |
| 26 | .60454-02 | 0 |
| 22 | .60477-02 | 0 |



NO3 AT REACH END (MG/L)

```
REACH    DEP. VAR.       .020                                              .030

  52    .20958-01        0       *                                          0
  50    .20927-01        0       *                                          0
  48    .20860-01        0      *                                           0
  46    .20775-01        0     *                                            0
  44    .20714-01        0     *                                            0
  43    .20616-01        0    *                                             0
  15    .20567-01        0   *                                              0
  14    .20560-01        0   *                                              0
  10    .20695-01        0    *                                             0
   8    .20774-01        0     *                                            0
   6    .20707-01        0     *                                            0
   1    .20576-01        0   *                                              0
  42    .20552-01        0   *                                              0
  40    .20496-01        0  *                                               0
  39    .20427-01        0  *                                               0
  37    .20407-01        0  *                                               0
  35    .20403-01        0  *                                               0
  33    .20524-01        0   *                                              0
  29    .20401-01        0  *                                               0
  27    .20334-01        0 *                                                0
  26    .20305-01        0 *                                                0
  22    .20305-01        0 *                                                0
```

NO3 AT REACH END (MG/L)

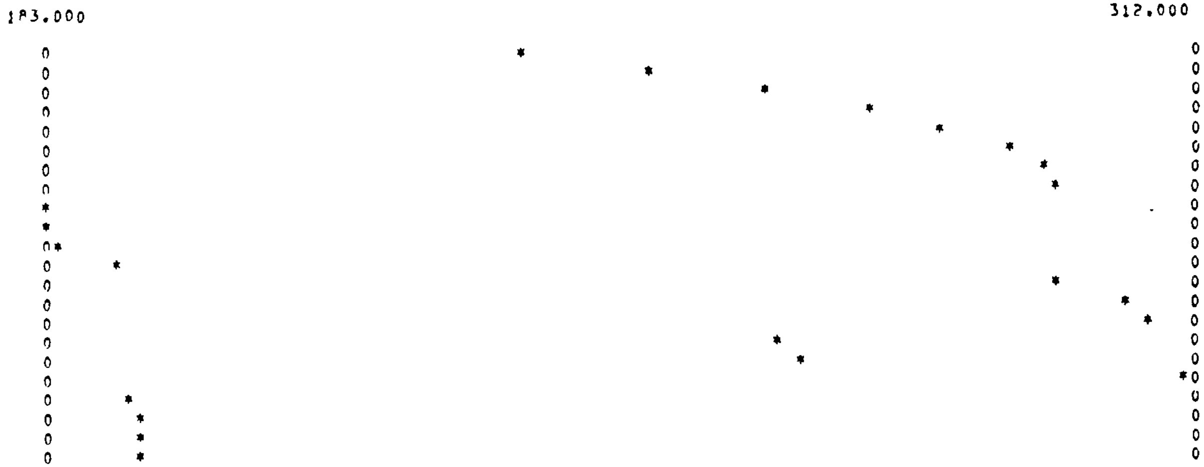
| REACH | DEP. VAR. | .020 | .030 |
|---|---|---|---|
| 52 | .20958-01 | 0 * | 0 |
| 50 | .20927-01 | 0 * | 0 |
| 48 | .20860-01 | 0 * | 0 |
| 46 | .20775-01 | 0 * | 0 |
| 44 | .20714-01 | 0 * | 0 |
| 43 | .20616-01 | 0 * | 0 |
| 15 | .20567-01 | 0 * | 0 |
| 14 | .20560-01 | 0 * | 0 |
| 10 | .20693-01 | 0 * | 0 |
| 8 | .20774-01 | 0 * | 0 |
| 6 | .20707-01 | 0 * | 0 |
| 1 | .20576-01 | 0 * | 0 |
| 42 | .20552-01 | 0 * | 0 |
| 40 | .20496-01 | 0 * | 0 |
| 39 | .20427-01 | 0 * | 0 |
| 37 | .20407-01 | 0 * | 0 |
| 35 | .20403-01 | 0 * | 0 |
| 33 | .20524-01 | 0 * | 0 |
| 29 | .20401-01 | 0 * | 0 |
| 27 | .20334-01 | 0 * | 0 |
| 26 | .20305-01 | 0 * | 0 |
| 22 | .20305-01 | 0 * | 0 |

PO4 AT REACH END (MG/L)

| REACH | DEP. VAR. |
|---|---|
| 52 | .54524-01 |
| 50 | .52016-01 |
| 48 | .49770-01 |
| 46 | .47884-01 |
| 44 | .46834-01 |
| 43 | .44478-01 |
| 15 | .45469-01 |
| 14 | .45085-01 |
| 10 | .48276-01 |
| 8 | .50534-01 |
| 6 | .49640-01 |
| 1 | .54247-01 |
| 42 | .38582-01 |
| 40 | .38286-01 |
| 39 | .37483-01 |
| 37 | .37335-01 |
| 35 | .37346-01 |
| 33 | .39935-01 |
| 29 | .38699-01 |
| 27 | .38784-01 |
| 26 | .38553-01 |
| 22 | .35926-01 |

COL AT REACH END (MG/L)

| REACH | DEP. VAR. |
|---|---|
| 52 | .23791+03 |
| 50 | .25182+03 |
| 48 | .26479+03 |
| 46 | .27627+03 |
| 44 | .28364+03 |
| 43 | .29215+03 |
| 15 | .29588+03 |
| 14 | .29706+03 |
| 10 | .18431+03 |
| 8 | .18390+03 |
| 6 | .18651+03 |
| 1 | .19259+03 |
| 42 | .29743+03 |
| 40 | .30488+03 |
| 39 | .30747+03 |
| 37 | .26645+03 |
| 35 | .26438+03 |
| 33 | .31110+03 |
| 29 | .19455+03 |
| 27 | .19547+03 |
| 26 | .19585+03 |
| 22 | .19579+03 |



COL AT REACH END (MG/L)

| REACH | DEP. VAR. |
|---|---|
| 52 | .23791+03 |
| 50 | .25182+03 |
| 48 | .26479+03 |
| 46 | .27627+03 |
| 44 | .28364+03 |
| 43 | .29215+03 |
| 15 | .29580+03 |
| 14 | .29706+03 |
| 10 | .18431+03 |
| 8 | .18390+03 |
| 6 | .18651+03 |
| 1 | .19259+03 |
| 42 | .29743+03 |
| 40 | .30488+03 |
| 39 | .30747+03 |
| 37 | .26645+03 |
| 35 | .26938+03 |
| 33 | .31110+03 |
| 29 | .19455+03 |
| 27 | .19547+03 |
| 26 | .19585+03 |
| 22 | .19579+03 |

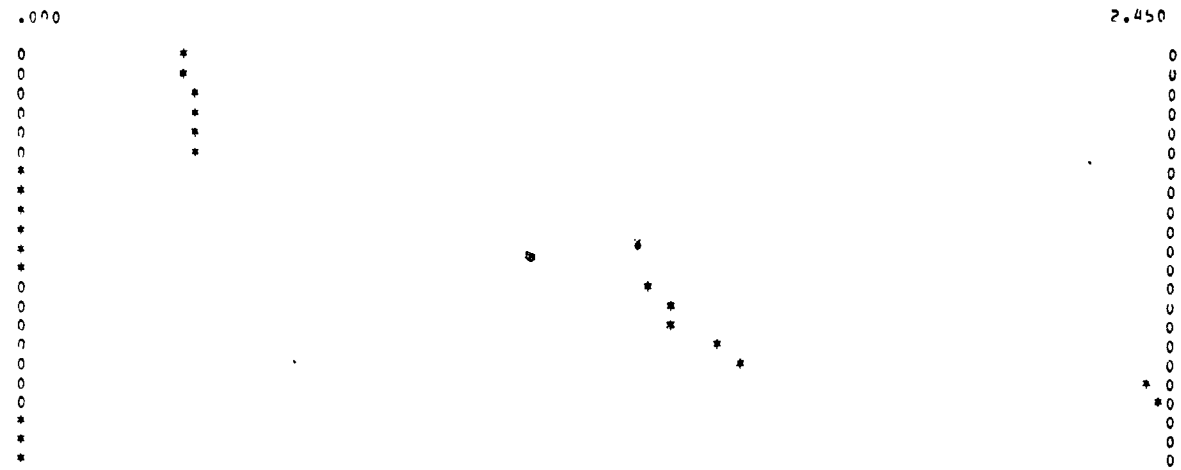
HM1 AT REACH END (MG/L)

Scale: .000 to 6.600

| REACH | DEP. VAR. |
|---|---|
| 52 | .15278+01 |
| 50 | .16057+01 |
| 48 | .16856+01 |
| 46 | .17609+01 |
| 44 | .17798+01 |
| 43 | .18468+01 |
| 15 | .00000 |
| 14 | .00000 |
| 10 | .00000 |
| 8 | .00000 |
| 6 | .00000 |
| 1 | .00000 |
| 42 | .63547+01 |
| 40 | .64707+01 |
| 39 | .65367+01 |
| 37 | .78504-00 |
| 35 | .60410-00 |
| 33 | .10946+01 |
| 29 | .11100+01 |
| 27 | .11478+01 |
| 26 | .11505+01 |
| 22 | .00000 |

CL- AT REACH END (MG/L)

| REACH | DEP. VAR. |
|---|---|
| 52 | .38627-00 |
| 50 | .38961-00 |
| 48 | .39301-00 |
| 46 | .39648-00 |
| 44 | .40000-00 |
| 43 | .40000-00 |
| 15 | .00000 |
| 14 | .00000 |
| 10 | .00000 |
| 8 | .00000 |
| 6 | .00000 |
| 1 | .00000 |
| 42 | .13534+01 |
| 40 | .14173+01 |
| 39 | .14173+01 |
| 37 | .15050+01 |
| 35 | .15571+01 |
| 33 | .24129+01 |
| 29 | .24324+01 |
| 27 | .00000 |
| 26 | .00000 |
| 22 | .00000 |



# SECTION IX

## PROGRAM LISTING

## TYPICAL JCL

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

```
//  EXEC FORTGCL,REGION=160K
//FORT.SYSLIN DD UNIT=SYSDA,SPACE=(CYL,(5,5)),
//DSN=&LOADSET,DISP=(MOD,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//FORT.SYSIN DD *

          DOSCI FORTRAN SOURCE DECK INSERTED HERE

/*
//LKED.SYSLMOD DD DSN=CN1752.ZAS.DOSAG(DOSCI),
//   UNIT=2314,VOL=SER=WYLBO2,SPACE=(1024,(140,10,1),RLSE),DISP=(,KEEP)
// EXEC PGM=DOSCI,REGION=160K
//STEPLIB DD DSN=CN1752.ZAS.DOSAG,UNIT=2314,
//VOL=SER=WYLBO2,DISP=SHR
//FT06F001  DD  SYSOUT=A
//FT05F001  DD  *

          DOSCI DATA DECK INSERTED HERE

/*
//
```

```
      SUBROUTINE BLEND
      COMMON/BLOCK5/JJ,KK,II
      COMMON/BLOCK3/CONDZ(10,20),CONDI(20,20),CONDE(20,20)
      COMMON/MISC/IO,CALCK2,NFLOW,NCON
C
C                                        STEP-1
C                                        ADD TWO UPSTREAM FLOWS AT A
C                                        JUNCTION TO GET DOWNSTREAM
C                                        FLOW.
C
      CONDI(KK,NFLOW)=CONDE(JJ,NFLOW)+CONDE(II,NFLOW)
C
C                                        STEP-2
C                                        CALCULATE DOWNSTREAM BOD AND
C                                        D.O. BY USING A WEIGHTED MASS
C                                        BALANCE FORMULA.
C
      DO 3 I=1,NCON
      CONDI(KK,I)=((CONDE(JJ,NFLOW)*CONDE(JJ,I))+(CONDE(II,NFLOW)*CONDE
     *(II,I)))/CONDI(KK,NFLOW)
    3 CONTINUE
C
C                                        STEP-3
C                                        RETURN TO CALLER (R M A T C)
C
      RETURN
      END
      SUBROUTINE CMIN
      COMMON/BLOCK2/JNIT(20),F(10),C(11)
      COMMON/BLOCK5/JJ(4),RMLOW,MAX,CLOW
C
C                                        STEP-1
C                                        FIND SUBREACH WITH LOWEST
C                                        DISSOLVED OXYGEN LEVEL AND
C                                        RIVER MILE AT WHICH IT OCCURS.
C
      RMLOW=F(1)
      CLOW=C(1)
      IF(MAX.EQ.1) RETURN
      DO 1 I=2,MAX
      IF(C(I).GE.CLOW) GO TO 1
      CLOW=C(I)
      RMLOW=F(I)
    1 CONTINUE
C
C                                        STEP-2
C                                        RETURN TO CALLER (D O E Q U).
C
      RETURN
      END
      SUBROUTINE DOEQU
      COMMON/MISC/IO,CALCK2,NFLOW,NCON
      REAL IO
      COMMON/BLOCK5/JJ(4),RMLOW,MAX,CLOW,NTRIB(10),QUP,FINL(3),IA,
     *ICK,FINLK(3),NJ,K2,VEL
      REAL K2
      COMMON/BLOCK1/CRMIN(100),DATA(100,40),FINIS(100,50),RIDENT
     *(100,5),K2OPT(100)
      COMMON/BLOCK2/JNIT(20),F(10),C(11)
      COMMON/RCHVAR/CCLK(600),DOK2(100)
```

```
      COMMON/TEMPER/TEMPAV,TEMREA(100)
      COMMON/WORK1/XCONI(20)/WORK2/XCONE(20)
      COMMON/CONREG/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
      COMMON/OPTION/IFN,IK2,ICOL,ICOMB
      COMMON/OPT2/IHEAVY,ITOTN
      REAL NH3,NO2,NO3,NH3E,NO2E,NO3E
      DIMENSION ARIN(1),AROUT(1)
      EQUIVALENCE (ARIN,DO),(AROUT,DOE)
      DATA BLNK,ASTER/' ','*'/
      MAX=10
      IF(ICOMB.EQ.18)  MAX=1
      XMAX=MAX
      DELQ1=DATA(IA,7)/XMAX
C     IF THE REACH LENGTH IS ZERO, SET END CONDITIONS TO START CONDITION
      IF(DATA(IA,1).NE.0.)  GO TO 70
      DO 60 I=1,NCON
60    XCONE(I)=XCONI(I)
      GO TO 30
70    CONTINUE
      VSUM=0.
      TSUM=0.
      HSUM=0.
      AVK2=0.
      DO 20 I=1,MAX
      Z=I
      F(I)=DATA(IA,2)-DATA(IA,1)*Z/XMAX
      DELQ=QUP+DATA(IA,7)*Z/XMAX
      VEL=DATA(IA,5)*DELQ**DATA(IA,6)
      DEP=DATA(IA,21)*DELQ**DATA(IA,22)
      TRAV=DATA(IA,1)/XMAX/(VEL*16.36)
      IF(ICOMB.EQ.18)  GO TO 22
      CALL K2CAL(DEP)
      IF(K2OPT(IA).NE.5) DOK2(IA)=K2*1.0159**(TEMREA(IA)-20.)
      IK2=0
      IF(K2OPT(IA).EQ.5)  IK2=1
      TOTFLO=DELQ
      IF(I.NE.1)  GO TO 6
      DO 17 LM=1,11
17    ARIN(LM)=XCONI(LM)
      HM=0.
      DO 5 K=1,3
5     HM=HM+XCONI(8+K)
6     CONTINUE
      CALL GETCON(IO,TRAV*24.,IA,DEP,VEL)
      C(I)=DOE
      AK2=DOK2(IA)
      IF(K2OPT(IA).EQ.5) AK2=CALCK2
22    CONTINUE
      HSUM=HSUM+DEP
      VSUM=VSUM+VEL
      TSUM=TSUM+TRAV
      IF(ICOMB.EQ.18)  GO TO 21
      AVK2=AVK2+AK2
      DO 10 K=1,15
10    ARIN(K)=AROUT(K)
      IF(I.EQ.MAX)  GO TO 20
      DO 15 IL=1,7
15    ARIN(IL)=(ARIN(IL)*DELQ+DELQ1*DATA(IA,7+IL))/(DELQ+DELQ1)
      DO 16 IL=8,11
```

```
 16   ARIN(IL)=(ARIN(IL)*DELQ+DELQ1*DATA(IA,16+IL))/(DELQ1+DELQ)
 20   CONTINUE
      CALL CMIN
      IF(ICK.EQ.0) WRITE(NJ,100) IA,DATA(IA,2),TOTFLO,CLOW,RMLOW,
     *XCONI(1),DOE,XCONI(2),BODE
      DO 18 LM=1,11
 18   XCONE(LM)=AROUT(LM)
 21   CONTINUE
 C    DILUTE THE CONSERVATIVES
      DO 32 LM=12,NCON
 32   XCONE(LM)=(QUP*XCONE(LM)+DATA(IA,7)*DATA(IA,16+LM))/(QUP+DATA(IA,7
     *))
 30   CONTINUE
      FINIS(IA, 1)=IA
      FINIS(IA, 2)=DATA(IA,2)
      FINIS(IA, 3)=DATA(IA,1)
      FINIS(IA, 4)=QUP+DATA(IA,7)
      FINIS(IA, 5)=CLOW
      FINIS(IA, 6)=RMLOW
      FINIS(IA, 7)=XCONE(1)
      FINIS(IA, 8)=AVK2/XMAX
      FINIS(IA, 9)=TSUM
      FINIS(IA,10)=VSUM/XMAX
      FINIS(IA,11)=XCONE(2)
      FINIS(IA,12)=0.
      FINIS(IA,13)=HSUM/XMAX
      FINIS(IA,14)=XCONI(1)
      FINIS(IA,15)=XCONI(2)
      FINIS(IA,44)=BLNK
      IF(TOTNE.GT.XCONE(12).AND.ITOTN.EQ.1) FINIS(IA,44)=ASTER
      IND=14
      DO 40 K=3,NCON
      IND=IND+2
      FINIS(IA,IND)=XCONI(K)
 40   FINIS(IA,IND+1)=XCONE(K)
      RETURN
 100  FORMAT(I10,F11.1,F9.1,F7.2,F10.1,F10.2,F9.2,F9.2,F9.2)
      END
      COMMON/BLOCK1/CRMIN(100),DATA(100,40),FINIS(100,50),RIDENT(100,5),
     *K2OPT(100)
      COMMON/BLOCK2/JNIT(20),F(10),C(11),IONE(20),G(50),TITLE(20),
     *JORD(20,20),JUNC(20,3),INIT(10),IAUG(20),DOL(10),TRFAC(10)
      COMMON/BLOCK3/CONDZ(10,20),CONDI(20,20),CONDE(20,20)
      COMMON/BLOCK4/TEMPO(12),IOMCH(20,10),HWFLOW(10,12),TRFACN(10),
     *SEASON(12)
      COMMON/BLOCK5/JJ,KK,II,B,RMLOW,MAX,CLOW,NTRIB,NREA,NINIT,NJUNC,
     *ELEV,DOLEV,TF,TEMP,CSAT,M,QUP,FINL,FINC,JA,IA,ICK,FINLN,DELQ,
     *NI,NJ,K2,VEL,NSEAS,NRUN,TEN
      COMMON/CONBEG/COL,BOD,NH3,NO2,NO3,PO4,ALG,DO,HM
      COMMON/CONEND/COLE,BODE,NH3E,NO2E,NO3E,PO4E,ALGE,DOE
      COMMON/WORK1/WRK(20)
      COMMON/WORK2/WRK2(20)
      DIMENSION AR3(1),IR5(1),ARCON(1)
      EQUIVALENCE (AR3,CONDZ),(IR5,JJ),(ARCON,THKCOL)
      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
      COMMON/RCNVAR/COLK(100),BODK(100),BODKS(100),NH3K(100),NO2K(100),
     *EX1K(100),DOK2(100),HM1K(100),HM2K(100),HM3K(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/MISC/IO,CALCK2,NFLOW,NCON,TOTFLO
      REAL NOREFR
      REAL NH3,NO2,NO3,MPO4,M1NO3
      REAL M2NO3,MNH3,ML,NR,NH3K,NO2K,IO
      REAL NH3E,NO2E,NO3E
      DIMENSION AMONTH(12)
      REAL  K2
      DATA AMONTH/3HOCT,3HNOV,3HDEC,3HJAN,3HFEB,3HMAR,3HAPR,3HMAY,
     *             3HJUN,3HJUL,3HAUG,3HSEP/
      DATA ENDF/4HENDF/
      DATA LAB1,LAB2/'FILE',' F=3'/
      DATA LAB3,LAB4/'FILE',' G  '/
      DO 2020 I=1,12
      SEASON(I)=AMONTH(I)
 2020 CONTINUE
C     ZERO OUT QUANTITIES
      DO 101 I=1, 9600
101   CRMIN(I)=0.0
      DO 102 I=1,641
102   JNIT(I)=0
      DO 103 I=1,1000
103   AR3(I)=0.0
      DO 104 I=1,342
104   TEMMO(I)=0.
      DO 106 I=1,100
      TEMREA(I)=0.0
106   K2OPT(I)=0
      DO 107 I=1,32
107   IR5(I)=0 .
      DO 108 I=1,43
108   ARCON(I)=0.0
      DO 109 I=1,700
109   COLK(I)=0.0
      DO 110 I=1,20
      WRK2(I)=0.
110   WRK(I)=0.
      NI=5
      NJ=6
      NFLOW=20
      NCON=16
      WRITE (6,2055)
 2055 FORMAT (1H1)
C
C                                             STEP-1
C                                             READ AND ECHO WRITE ALL INPUT
C                                             DATA (FILE-A THRU FILE-I).
C
      WRITE (NJ,901)
  901 FORMAT (39X,32H* * * FILE A - BASIN TITLE * * *,//)
      WRITE (NJ,601)
  601 FORMAT (15X,40HCARD                                    NAME,
     *             40H OF                                    ./,
     *         15X,40HTYPE                                   RIVER ,
     *             40HBASIN                                        ,/)
   41 READ (NI,1) DUM1,DUM2,(TITLE(I),I=1,18)
      WRITE (NJ,757) DUM1,DUM2,(TITLE(I),I=1,18)
    1 FORMAT (20A4)
```

```
  737 FORMAT (15X,20A4)
  801 FORMAT (1H0,15X,20A4,//)
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,902)
  902 FORMAT (35X,41H* * * FILE B - PHYSICAL DESCRIPTION * * *,//)
      WRITE (NJ,602)
  602 FORMAT (15X,40HCARD                 NO. OF    NO. OF    NO. ,
     *               40HOF     NO. OF     INSERT 1          MEAN ,/,
     *       15X,40HTYPE              HEADWATERS JUNCTIONS  REAC,
     *               40HHES  STRETCHES FOR FINAL            ELEV.,/,
     *       15X,40H                  MAX OF 10 MAX OF 10 MAX O,
     *               40HF 100 MAX OF 20 SUMMARY ONLY        (FT)/)
      READ (NI,26) DUM1,DUM2,MINIT,NJUNC,NREA,NTRIB,ICK,ELEV
   26 FORMAT (2A4,5X,I2,5X,4(4X,I2,4X),14X,F6.0)
      WRITE (NJ,804) DUM1,DUM2,MINIT,NJUNC,NREA,NTRIB,ICK,ELEV
  804 FORMAT (15X,2A4,2X,5(5X,I5),14X,F6.1)
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,904)
  904 FORMAT (39X,32H* * * FILE C - REACH ORDER * * *,//)
      WRITE (NJ,603)
  603 FORMAT (15X,40HCARD        NO. OF                  ORDER OF,
     *               40H ALL REACHES IN EACH STRETCH              ,/,
     *       15X,40HTYPE         STRETCH                      (U,
     *               40HPSTREAM TO DOWNSTREAM)                    ,/)
      DO 10 K=1,NTRIB
      READ (NI,3) DUM1,DUM2,I,(IORD(I,J),J=1,20)
    3 FORMAT (2A4,3X,I2,7X,20(1X,I2))
      WRITE (NJ,805) DUM1,DUM2,I,(IORD(I,J),J=1,20)
  805 FORMAT (15X,2A4,2X,I5,5X,20(1X,I2))
   10 CONTINUE
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      IF(NJUNC.EQ.0) GO TO 97
      WRITE (NJ,905)
  905 FORMAT (40X,30H* * * FILE D - JUNCTIONS * * *,//)
      WRITE (NJ,604)
  604 FORMAT (15X,40HCARD                      NO.     NO. OF    ,
     *               40H NO. OF    NO. OF                         ,/,
     *       15X,40HTYPE                       OF      UPSTREAM  ,
     *               40HUPSTREAM  DOWNSTREAM                      ,/,
     *       15X,40H                       JUNCTION   STRETCH  ,
     *               40H STRETCH   STRETCH                        ,/)
      DO 11 K=1,NJUNC
      READ (NI,33) DUM1,DUM2,I,(JUNC(I,J),J=1,3)
   33 FORMAT (2A4,13X,I2,2X,3(4X,I2,4X))
      WRITE (NJ,806) DUM1,DUM2,I,(JUNC(I,J),J=1,3)
  806 FORMAT (15X,2A4,12X,I5,3(5X,I5))
   11 CONTINUE
 97   CONTINUE
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,906)
  906 FORMAT (40X,31H* * * FILE E - HEADWATERS * * *,//)
      WRITE (NJ,605)
 605  FORMAT(' CARD  STCH  AUGM   DO   BOD    NH3-N   NO2-N  NO3-N PO4-P
```

```
     *  PHYTO  COLIFORMS  HM1    HM2    HM3   TOT N   CHLOR  HMI1   HMI2
     *   HMI3'/ ' TYPE    NO    OPT  (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 12 K=1,NINIT
      READ(NI,27) DUM1,DUM2,I,IAUG(I),(CONDZ(I,J),J=1,16)
      INIT(K)=I
27    FORMAT(2A4,I5,I5/8F10.4/8F10.4)
      WRITE(NJ,807)        DUM2,I,IAUG(I),(CONDZ(I,J),J=1,16)
807   FORMAT(1X,A4,2I5,2F8.2,5F7.4,F9.1,F8.2,7F7.2)
12    CONTINUE
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,907)
  907 FORMAT (31X,43H* * * FILE F(1) - DATA(I,1) THRU DATA(I,6) ,
     *               5H* * *,//)
      WRITE (NJ,606)
  606 FORMAT (15X,40HCARD                    NO.  LENGTH OF RIVER M,
     *FILE    BOD       BOD      COEF.      EXP.'/,
     *         15X,40HTYPE                  OF      REACH    TO HEA,
     *               41HD   REACTION  SETTLING ON Q FOR  ON Q FOR,/,
     *         15X,40H                      REACH  (MILES)  OF REAC,
     *               41HH      COEF.      COEF.   VELOCITY  VELOCITY,/)
      DO 100 K=1,NREA
      READ (NI,105) DUM1,DUM2,I,(DATA(I,J),J=1,6)
C     DATA(I,3) IS CARBONACEOUS REACTION COEFFICIENT
C     DATA(I,4) IS CARBONACEOUS SETTLING COEFFICIENT
C     DATA(I,5) IS Q COEFFICIENT FOR VELOCITY
C     DATA(I,6) IS Q EXPONENT FOR VELOCITY
      IF(DATA(I,3).EQ.0.)  DATA(I,3)=.2/24.
      IF(DATA(I,5).EQ.0.)  DATA(I,5)=.15*1.7
      IF(DATA(I,6).EQ.0.)  DATA(I,6)=.414
  105 FORMAT (2A4,8X,I2,2X,6(2X,F8.0))
      WRITE (NJ,808) DUM1,DUM2,I,(DATA(I,J),J=1,6)
808   FORMAT(15X,2A4,7X,I7,F8.1,F10.1,F10.3,F10.6,F10.3,F10.3)
  100 CONTINUE
      DO 141 K=1,100.
      BODK(K)=DATA(K,3)
141   BODKS(K)=DATA(K,4)
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,908)
908   FORMAT(31X,'* * * FILE F(2) - DATA(I,7) THRU DATA(I,14),DATA(I,24)
     *THRU DATA(I,32) * * *'/)
      WRITE (NJ,607)
607   FORMAT(' CARD REACH  FLOW    DO      BOD     NH3-N    NO2-N NO3-N PO4-P
     *  PHYTO  COLIFORMS  HM1    HM2    HM3   TOT N   CHLOR  HMI1   HMI2
     *   HMI3'/ ' TYPE    NO   (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 150 K=1,NREA
      READ(NI,127) DUM1,DUM2,I,STOR
127   FORMAT(2A4,3X,I9,F10.4)
C     INPUT ONLY REACHES WITH NONZERO FLOWS
      IF(DUM1.EQ.ENDF)  GO TO 151
      DATA(I,7)=STOR
      READ(NI,128) (DATA(I,J),J=8,14),(DATA(I,J),J=24,32)
128   FORMAT(8F10.4/8F10.4)
      WRITE(NJ,818) DUM2,I,(DATA(I,J),J=7,14),(DATA(I,J),J=24,32)
```

```
 818  FORMAT(1X,A4,I5,F6.1,F8.2,F7.2,5F7.4,F10.1,8F7.2)
  150 CONTINUE
      READ (NI,1) DUM1,DUM2
 151  CONTINUE
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,909)
  909 FORMAT (30X,46H* * * FILE F(3) - DATA(I,15) THRU DATA (I,20) ,
     *             5H* * *,//)
      WRITE (NJ,608)
  608 FORMAT (15X,40HCARD                        NO.    VALUE   COEF. O,
     *            41HN    EXP. ON   EXP. ON  COEF. ON   EXP. ON,/,
     *        15X,40HTYPE                        OF     FOR K2   V FOR K,
     *            41H2  V FOR K2  D FOR K2  Q FOR K2  Q FOR K2,/,
     *        15X,40H                          REACH  OPTION-1 OPTION-,
     *            41H2  OPTION-2  OPTION-2  OPTION-3  OPTION-3,/)
      DO 160 K=1,NREA
      READ (NI,170) DUM1,DUM2,I,(DATA(I,J),J=15,20)
      IF(DUM1.EQ.ENDF)  GO TO 153
  170 FORMAT (2A4,8X,I2,2X,6(2X,F8.0))
  810 FORMAT (15X,2A4,7X,I5,6(2X,F8.3))
  160 CONTINUE
      READ (NI,1) DUM1,DUM2
 153  CONTINUE
      DO 161 K=1,NREA
      IF(DATA(K,1).EQ.0.)  GO TO 161
      IF(DATA(K,16).EQ.0.)  DATA(K,16)=3.3
      IF(DATA(K,17).EQ.0.)  DATA(K,17)=1.0
      IF(DATA(K,18).EQ.0.)  DATA(K,18)=1.33
      WRITE(NJ,810) LAB1,LAB2,K,(DATA(K,J),J=15,20)
 161  CONTINUE
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,910)
  910 FORMAT (30X,45H* * * FILE F(4) - DATA(I,21) THRU DATA(I,23) ,
     *             5H* * *,//)
      WRITE (NJ,609)
  609 FORMAT (15X,40HCARD                        NO.  OPTION       NA,
     *            40HME                     COEF.    EXP.    CHANNEL,/,
     *        15X,40HTYPE                        OF      FOR          O,
     *            40HF                  ON Q FOR  ON G FOR   SLOPE ,/,
     *        15X,40H                          REACH    K2         REA,
     *            41HCH                   DEPTH     DEPTH   OPTION-4,/)
      DO 230 K=1,NREA
      READ (NI,240) DUM1,DUM2,I,K2OPT(I),(RIDENT(I,J),J=1,5),
     *                 (DATA(I,J),J=21,23)
C     DATA(I,21) IS COEFFICIENT ON Q FOR DEPTH
C     DATA(I,22) IS EXPONENT ON Q FOR DEPTH
      IF(DATA(I,21).EQ.0.)  DATA(I,21)=.44/1.7
      IF(DATA(I,22).EQ.0.)  DATA(I,22)=.414
  240 FORMAT (2A4,8X,I2,6X,I2,4X,5A4,3(2X,F8.0))
      WRITE (NJ,811) DUM1,DUM2,I,K2OPT(I),(RIDENT(I,J),J=1,5),
     *                  (DATA(I,J),J=21,23)
  811 FORMAT (15X,2A4,7X,I5,4X,I2,4X,5A4,3(2X,F8.3))
  230 CONTINUE
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,911)
  911 FORMAT (34X,42H* * * FILE G - BASIN CHARACTERISTICS * * *,//)
      WRITE (NJ,610)
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  610 FORMAT (15X,40HCARD                    MINIMUM ALLOWABLE        ,
     *'     FRACTION REMOVED BY TREATMENT'/,
     *          15X,40HTYPE                  D.O. LEVEL (MG/L)        ,
     *//)
      READ(NI,5) DUM1,DUM2,(DOL(I),I=1,4),(TRFAC(I),I=1,4)
 5    FORMAT(2A4,2X,8F5.0)
      WRITE(NJ,812) LAB3,LAB4,(DOL(I),I=1,4),(TRFAC(I),I=1,4)
 812  FORMAT(15X,2A4,7X,4F5.1,5X,4F10.3)
      IF(DUM1.NE.ENDF) READ(NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,912)
  912 FORMAT (32X,46H* * * FILE H = MEAN MONTHLY TEMPERATURES * * *,//)
      WRITE (NJ,611)
  611 FORMAT (15X,40HCARD                                  STREAM TEM,
     *          40HPERATURE IN DEGREES CENTIGRADE            ,/,
     *          15X,40HTYPE                    OCT  NOV  DEC  JAN,
     *          40H  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP,/)
      READ (NI,6) DUM1,DUM2,(TEMMO(I),I=1,12)
    6 FORMAT (2A4,12X,12F5.0)
      WRITE (NJ,813) DUM1,DUM2,(TEMMO(I),I=1,12)
  813 FORMAT (15X,2A4,12X,12F5.1)
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      WRITE (NJ,913)
  913 FORMAT (31X,44H* * * FILE I = MEAN MONTHLY HEADWATER FLOWS ,
     *          5H* * *,//)
      WRITE (NJ,612)
  612 FORMAT (15X,40HCARD        NO. OF                        ,
     *          40HHEADWATER FLOWS IN CFS                    ,/,
     *          15X,40HTYPE       STRETCH    OCT  NOV  DEC  JAN,
     *          40H  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP,/)
      DO 250 K=1,NINIT
      READ (NI,260) DUM1,DUM2,I,(HWFLOW(I,J),J=1,12)
  260 FORMAT (2A4,3X,I2,7X,12F5.0)
      WRITE (NJ,270) DUM1,DUM2,I,(HWFLOW(I,J),J=1,12)
 270  FORMAT(15X,2A4,2X,I5,5X,12F5.0)
  250 CONTINUE
      READ (NI,1) DUM1,DUM2
      WRITE (NJ,801) DUM1,DUM2
      IF (DUM1.NE.ENDF) GO TO 777
      CALL NEWIN
      CALL PLTSET(FINIS,1)
C     SET THE APPROPRIATE HEAVY METAL ION CONCENTRATIONS
      DO 253 K=1,NREA
      IF(DATA(K,25).NE.0.  .AND.  DATA(K,30).EQ.0.)  DATA(K,30)=
     *PIHM1*DATA(K,25)
      IF(DATA(K,26).NE.0.  .AND.  DATA(K,31).EQ.0.)  DATA(K,31)=
     *PIHM2*DATA(K,26)
      IF(DATA(K,27).NE.0.  .AND.  DATA(K,32).EQ.0.)  DATA(K,32)=
     *PIHM3*DATA(K,27)
 253  CONTINUE
      DO 254 K=1,NINIT
      IF(CONDZ(K,9).NE.0.  .AND.  CONDZ(K,14).EQ.0.)  CONDZ(K,14)=
     *PIHM1*CONDZ(K,9)
      IF(CONDZ(K,10).NE.0.  .AND.  CONDZ(K,15).EQ.0.)  CONDZ(K,15)=
     *PIHM2*CONDZ(K,10)
      IF(CONDZ(K,11).EQ.0.  .AND.  CONDZ(K,16).EQ.0.)  CONDZ(K,16)=
     *PIHM3*CONDZ(K,11)
 254  CONTINUE
```

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C      CHECK TO INSURE THAT THE BOD-N EXCEEDS THE ALGAL-N
       BODWT=BODC*12./BODPC
       BODNWR=BODN*14./BODWT
       BODPWR=32./BODWT
       DO 256 K=1,NREA
       BODNX=DATA(K,9)*BODNWR/BODOQ
       ALGN=DATA(K,14)*BODNWR/(APR*BODPWR)
       IF(BODNX.GE.ALGN)  GO TO 256
       WRITE(NJ,779) BODNX,ALGN,K
  779  FORMAT(' ***BOD NITROGEN =',F10.6,' AND ALGAL NITROGEN =',F10.6,
      *' IN REACH',I5,' ***')
  256  CONTINUE
       NRUN=0
C
C                                               STEP-2
C                                               SET BASIN CONDITIONS TO BE
C                                               CONSIDERED (TARGET D.O. LEVEL,
C                                               TREATMENT EFF., AND TEMPERATURE).
C
       DO 13 I=1,4
       IF(DOL(I).EQ.0.   .AND.  I.GT.1)  GO TO 13
    20 DOLEV=DOL(I)
       DO 14 J=1,4
       TF=TRFAC(J)/100.
       IF(J.GT.1   .AND.  TF.EQ.0.)  GO TO 14
       DO 15 K=1,12
       IF (TEMMO(K))22,15,22
  22   CONTINUE
       VAR=0.
       DO 23 LL=1,NREA
       IF(TEMREA(LL).EQ.0.)  TEMREA(LL)=TEMMO(K)
  23   VAR=VAR+TEMREA(LL)
       TEMPAV=VAR/NREA
       NSEAS=K
       DO 24 L=1,10
       CONDZ(L,NFLOW)=HWFLOW(L,K)
    24 CONTINUE
       IF(ICK.EQ.1   .OR.  ICOMB.EQ.18)  GO TO 3336
  3335 WRITE (NJ,2055)
       WRITE (NJ,334)
   334 FORMAT (26X,49H* * * * * I N T E R M E D I A T E   S U M M A R Y,
      *            10H * * * * *,//)
       WRITE (NJ,8011) (TITLE(L),L=1,18)
  8011 FORMAT (19X,18A4,//)
       NRUN=NRUN+1
       WRITE(NJ,335) NRUN,DOLEV,TF,TFN,SEASON(NSEAS),TEMPAV
   335 FORMAT (15X,15HNUMBER OF RUN =,  I5,36X,19HTARGET D.O. LEVEL =,
      *             F5.2,/,
      *        15X,15HTREATMENT (C) =,F5.2,36X,19HTREATMENT (N)     =,
      *             F5.2,/,
      *        15X,17HSEASON OF YR. =  ,A3,36X,19HMEAN TEMPERATURE  =,
      *             F5.2,//)
C
C                                               STEP-3
C                                               CALL  R U N O N
C
  3336 CALL RUNON
C
C                                               STEP-4
C                                               REPEAT STEP-2 THRU STEP-3
C                                               UNTIL ALL COMBINATIONS OF
```

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C                                             BASIN CONDITIONS HAVE BEEN
C                                             ANALYZED.
C
   15 CONTINUE
   14 CONTINUE
   13 CONTINUE
      GO TO 7777
  777 WRITE (NJ,778)
  778 FORMAT (1H1,21X,34H* * * * * * * * * * * * * * * * ,
     *                   33H* * * * - * * * * * * * * * * *,//,
     *               22X,34H* E X E C U T I O N   W A S   T E ,
     *                   33HR M I N A T E D   B E C A U S E *,//,
     *               22X, 1H*,31X,3HO F,31X,1H*,//,
     *               22X,34H*                E R R O R S   I N   ,
     *                   33HI N P U T   D A T A              *,//,
     *               22X,34H* * * * * * * * * * * * * * * * ,
     *                   33H* * * * * * * * * * * * * * * *)
      GO TO 9999
 7777 CONTINUE
 9999 CONTINUE
      STOP
      END
      SUBROUTINE DOSAT
      COMMON/BLOCK5/JJ(8),NREA,NINIT,NJUNC,ELEV
      COMMON/TEMPER/TEMPAV,TEMREA(100),SATREA(100)
C
C                                             STEP-1
C                                             CALCULATE THE D.O. SATURATION
C                                             LEVEL FROM TEMPERATURE AND
C                                             BASIN ELEVATION.
C
      DO 1 I=1,NREA
      TEMP=TEMREA(I)
      CSAT=(14.62-(.3898*TEMP)+(.006969*TEMP**2)-(.00005897*TEMP**3))*(
     *     (1.0-(0.00000697*ELEV))**5.167)
    1 SATREA(I)=CSAT
C
C                                             STEP-2
C                                             RETURN TO CALLER (R U N O N).
C
      RETURN
      END
      SUBROUTINE GETCON(IO,DELT,IND,DEPTH,VEL)
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     IND IS THE INDEX OF THE STREAM REACH
C     DEPTH IS THE AVERAGE DEPTH OF THE REACH IN FEET
C     VEL IS THE AVERAGE VELOCITY OF THE REACH IN FT/SEC
C
      COMMON/MISC/BLANK,CALCK2
      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,AHOD,AHM,CHMOC,THKNH3,VOLITK,THVOLK,RODC,
     *BODN,RODPC,BODOQ,NOREFR,GRMAX,THGRMX,CHMOA,HMKA,MPO4,M1NO3,M2NO3,
     *MNH3,ML,APR,NR,ASR,AND,ATD,BRRBOD,BRRPO4,BRRNH3,BENOD
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     *,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,MNH3,IO,NR,IBAR,ML,K2A20
      REAL NO3K
      REAL NOPFFR
      COMMON/OPTION/IFN,IK2,ICOL,ICOMB,INH3,INO2,INO3,IPO4,IALG,IFIRST
      COMMON/OPTS/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     DLBODD 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     DPO4BR IS CHANGE IN PO4-P
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
      IBUG=0
      IFIRST=0
      BODWT=BODC*12./BODPC
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          BODNWR=BODN*14./BODWT
          BODPWR=32./BODWT
          FAC1=BODOQ*NOREFR/(APR*BODPWR)
    8     CONTINUE
          IF(IBUG.EQ.1) WRITE(NOUT,1023) IND,IO,DELT,DEPTH,VEL,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.
          TCOR=TEMREA(IND)-20.
          FAC2=3.28*DELT/(DEPTH*1000.)
          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.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.)
          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)/BODOQ
          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
      XTEMP=NO3K(IND)*THNO3K**TCOR*DELT
      IF(IN3.EQ.1) DNO3DS=NO3*(EXP(-XTEMP)-1.)
      IF(IN3.EQ.2) DNO3DS=(-XTEMP*NO3**2)/(1.+XTEMP*NO3)
   33 CONTINUE
      IF(IPO4.EQ.0)  GO TO 34
C
C     DECAY (SETTLING) OF PO4
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
      DNH3=(-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.
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                IF(HM3.GT.CHMOA3) FHM3=EXP(-HMKA3*(HM3-CHMOA3))
                FHM=AMIN1(FHM1,FHM2,FHM3)
                FP=(PO4/(MPO4+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
                XK=EXTK(IND)+.00457*ALG
                IBAR=(IO*(1.-EXP(-XK*DEPTH))/(XK*DEPTH))*(24./9.)
                DU=ALOG(100.)/XK
                IF(DU.LT.DEPTH) IBAR=.215*IO*24./9.
                FL=IBAR/(ML+IBAR)
                FLIM=AMIN1(FP,FN,FL)
                GRLIM=GRMAXT*FHM*FLIM
                DELA=ALG*GRLIM*DU*9.*DELT/(DEPTH*24.)
                IF(IBUG.EQ.1) WRITE(NOUT,1015) XK,IBAR,DU,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
                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*TEMRFA(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
      DALSNK=-ASR*ALG*DELT/DEPTH
      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
      XK=DOK2(IND)
      IF(IK2.EQ.0)  GO TO 100
      K2A20=(11.61*VEL**.969*DEPTH**(-1.673))/24.
      XK=DOK2(IND)*K2A20*1.047**TCOR
      CALCK2=XK
  100 CONTINUE
      DOD=(SATREA(IND)-DO)*(1.-EXP(-XK*DELT))
      OGIVE=OGIVE+DOD
      DOBEN=-BENOD*FAC2
      ONEED=ONEED+DOBEN
      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
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      DNO3H3=DNO3H3*OFAC
      DNO2=DNO2*OFAC
      DNO302=DNO302*OFAC
      DARES=DARES*OFAC
      DPO4AR=DPO4AR*OFAC
      DNO3AR=DNO3AR*OFAC
      DPO4BR=DPO4BR*OFAC
      DNO3BR=DNO3BR*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
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+DNO302+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/BODOQ
      IF(IBUG.EQ.1) WRITE(NOUT,1024) IND,COLE,BODE,NH3E,NO2E,NO3E,PO4E,
     *ALGE,DOE,HM1E,HM2E,HM3E,TOTNE
      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,DNO302,ONEED=',4E16.8)
 1013 FORMAT(' XTEMP,DNH3V=',2E16.8)
 1014 FORMAT(' FHM,FP,FNO3,FNH3,FN=',5E16.8)
 1015 FORMAT(' XK,IBAR,DU,FL,GRLIM,DELA=',6E16.8)
 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,DALND,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,VELOCI
     *TY=',4F12.4/
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     *' COL,BOD,NH3,NO2,NO3=',5E16.8/
     *' PO4,ALG,DO=',3E16.8/
     *' 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)
      END
      SUBROUTINE K2CAL(H)
      COMMON/BLOCK1/CRMIN(100),DATA(100,40),FINIS(100,50),RIDENT(100,5),
     *K2OPT(100)
      COMMON/BLOCK5/JJ(21),IA,ICK(2),DELQ,NI(2),K2,VEL
      REAL  K2
C
C                                                STEP-1
C                                                CALCULATE THE REAERATION
C                                                COEFFICIENT FROM VARIOUS USER
C                                                OPTIONS.
C
      IOPT=K2OPT(IA)
      IF(IOPT.EQ.5) RETURN
      GO TO (1,2,3,4), IOPT
    1 K2=DATA(IA,15)
      GO TO 100
    2 K2=DATA(IA,16)*(VEL**DATA(IA,17))/(H**DATA(IA,18))*2.31
      GO TO 100
3     K2=DATA(IA,19)*(DELQ**DATA(IA,20))*2.31
      GO TO 100
    4 K2=10.8*(1+((VEL/SQRT(32.17*H))**.5))*SQRT(DATA(IA,23)*32.17/
     *    H)*2.31
  100 CONTINUE
C
C                                                STEP-2
      K2=K2/24.
C                                                RETURN TO CALLER (D O E Q U).
C
      RETURN
      END
      SUBROUTINE NEWIN
      COMMON/CONST/THKCOL,ABOD,AHM,CHMOC,THKNH3,VOLITK,THVOLK,BODC,
     *BODN,BODPC,BODOD,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/BLOCK1/CRMIN(100),DATA(100,40)
      COMMON/BLOCK4/TEMMO(1)
      DIMENSION ARCON(1)
      EQUIVALENCE (ARCON,THKCOL)
      COMMON/MISC/IO
      DATA NI,NJ/5,6/
      DATA ENDF/'ENDF'/
      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/BLOCK5/JJ(8),NREA
      DATA LAB1,LAB2/'FILE','  J  '/
      REAL NOREFR
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      REAL NO3K
      REAL MPO4,M1NO3
      REAL M2NO3,MNH3,ML,NR,NH3K,NO2K,IO
      DIMENSION DEFALT(30)
      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,.0014,.004,.004,.015,.04,
     *1./
      WRITE(NJ,111)
111   FORMAT(31X,'* * * FILE J - MORE REACH VARIABLES * * *',//)
      WRITE(NJ,112)
112   FORMAT(' CARD   REACH    COLIFORM      NH3',8X,'NO2',8X,'NO3',8X,
     *'PO4',6X,'EXTINCT   K2 COEF     HEAVY    HEAVY    HEAVY    TEMPER'/
     *' TYPE    NUMBER    ',4('REACTION',3X),'SETTLING     COEF',7X,'FOR',
     *6X,'MET 1    MET 2    MET 3    (CENT'/
     *19X,5('COEF',7X),8X,'OPTION 5    COEF      COEF      COEF',4X,'DEG)'/)
      DO 113 K=1,NREA
      READ(MI,213) DUM1,DUM2,I,COLK(I),NH3K(I),NO2K(I),NO3K(I),PO4K(I),
     *EXTK(I),DOK2(I),
     *HM1K(I),HM2K(I),HM3K(I),TEMREA(I)
213   FORMAT(2A4,2X,I3,11F6.0)
      IF(DUM1.NE.ENDF)  GO TO 113
117   CONTINUE
      TEMSET=0.
      DO 30 IK=1,12
      IF(TEMMO(IK).EQ.0.)  GO TO 30
      TEMSET=TEMMO(IK)
      GO TO 31
30    CONTINUE
31    CONTINUE
      DO 300 IK=1,NREA
      IF(DATA(IK,1).EQ.0.)  GO TO 300
      IF(TEMREA(IK).EQ.0.)  TEMREA(IK)=TEMSET
      IF(PO4K(IK).EQ.0.)  PO4K(IK)=XP
      IF(NO3K(IK).EQ.0.)  NO3K(IK)=XN3
      IF(COLK(IK).EQ.0.)  COLK(IK)=XCK
      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) LAB1,LAB2,IK,COLK(IK),NH3K(IK),NO2K(IK),NO3K(IK),
     *PO4K(IK),EXTK(IK),
     *DOK2(IK),HM1K(IK),HM2K(IK),HM3K(IK),TEMREA(IK)
217   FORMAT(1X,2A4,I4,F10.4,F11.4,F11.4,F11.4,F11.4,F11.4,F11.2,
     *F9.4,F8.4,F8.4,F8.2)
300   CONTINUE
      WRITE(NJ,2) DUM1,DUM2
2     FORMAT(1X,2A4)
      GO TO 116
113   CONTINUE
      READ(NI,1) DUM1,DUM2
1     FORMAT(2A4)
      IF(DUM1.EQ.ENDF) GO TO 117
      GO TO 777
116   CONTINUE
      WRITE(NJ,1211)
1211  FORMAT(1H1)
      WRITE(NJ,121)
121   FORMAT(31X,'* * * FILE K - MISCELLANEOUS VARIABLES * * *',//)
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      READ(NI,123) DUM2,DUM2,IO
      READ(NI,122) DUM1,DUM2,IFN    ,ICOL,ICOMB
      READ(NI,122) DUM1,DUM2,IHEAVY,ITOTN,ICHLOR
      READ(NI,122) DUM1,DUM2,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(2A4,2X,7I10)
      READ(NI,123) DUM1,DUM2,(ARCON(I),I=1,45)
123   FORMAT(2A4,2X,7F10.4/(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
      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,1000) IO
      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
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      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
1002  FORMAT(' CONSTITUENT SELECTION OPTION =',64X,I5)
1001  FORMAT(' PHYTOPLANKTON GROWTH FUNCTION OPTION =',56X,I5)
1000  FORMAT(' AVERAGE LIGHT INTENSITY (LANGLEYS/MIN) =',55X,F10.5)
1003  FORMAT(' COLIFORM OPTION =',78X,I5)
1004  FORMAT(' TEMPERATURE CORRECTION CONSTANT FOR COLIFORM REACTION COE
     *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
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     *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) =',48X,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)
      READ(NI,123) DUM1,DUM2
      IF(DUM1.EQ.ENDF) WRITE(NJ,2) DUM1,DUM2
      IF(DUM1.NE.ENDF)  GO TO 777
      RETURN
777   WRITE(NJ,778)
778   FORMAT(' DATA CARD ERROR')
      STOP
      END
      SUBROUTINE PLOT(N,A,T,LAB)
      DIMENSION FINCR(12),A(1),ICHAR(3),T(1),IPLOT(100)
      INTEGER T
      DIMENSION LAB(6)
      DATA FINCR/.01,.05,.1,.25,.5,1.,2.,3.,4.,5.,10.,100./
      DATA ICHAR/' ','*','0'/
      ILAST=100
      FMIN=1.E10
      FMAX=-1.E10
      DO 1 I=1,N
      IF(A(I).LT.FMIN) FMIN=A(I)
      IF(A(I).GT.FMAX) FMAX=A(I)
    1 CONTINUE
      DX=(FMAX-FMIN)/40.
```

```
      DO 10 J=1,12
      K=J
      IF(FINCR(J).GT.DX) GO TO 11
   10 CONTINUE
   11 IF(K.EQ.1) K=2
      DX=FINCR(K-1)
      IMIN=FMIN/DX
      IMAX=FMAX/DX+1
      SMIN=IMIN*DX
      SMAX=IMAX*DX
      WRITE(6,600) LAB
  600 FORMAT(1H1,40X,6A4)
      WRITE(6,601) SMIN,SMAX
  601 FORMAT(/,'      REACH     DEP. VAR.',F10.3,85X,F10.3/)
      DO 30 J=1,N
      DO 20 IP=2,ILAST
   20 IPLOT(IP)=ICHAR(1)
      IPLOT(1)=ICHAR(3)
      IPLOT(ILAST)=ICHAR(3)
      IP=(A(J)-SMIN)*ILAST/(SMAX-SMIN)
      IF(IP.LE.0) IP=1
      IF(IP.GT.ILAST) IP=ILAST
      IPLOT(IP)=ICHAR(2)
      WRITE(6,602) T(J),A(J),IPLOT
  602 FORMAT(1H ,I10,E12.5,7X,100A1)
   30 CONTINUE
      RETURN
      END
      SUBROUTINE PLTSET(D,IFLAG)
      DATA ENDF/'ENDF'/
      DIMENSION D(100,1)
      DIMENSION INR(100),INDS(43),XPLT(100),YPLT(100)
      INTEGER XPLT
      DIMENSION TITLE(6,43),T1(60),T2(60),T3(60),T4(60),T5(18)
       DIMENSION TI(258)
      EQUIVALENCE (TI,TITLE)
       EQUIVALENCE (TI,T1),(TI(61),T2),(TI(121),T3),(TI(181),T4),(TI(241
     *),T5)
      DATA T1/
     *'REAC','H NU','MBER','    ','    ','    ',
     *'RIV ','MILE','TO R','EACH','HEAD','    ',
     *'REAC','H LE','NGTH','    ','    ','    ',
     *'FLOW',' AT ','END ','OF R','EACH','-CFS',
     *'MINI','MUM ','DO I','N RE','ACH ','    ',
     *'MINI','MUM ','DO M','ILE ','    ','    ',
     *'DO A','T RE','ACH ','END ','(MG/','L)  ',
     *'K2 F','OR R','EACH','    ','    ','    ',
     *'TRAV','EL T','IME ','    ','    ','    ',
     *'MEAN',' VEL','OCIT','Y   ','    ','    '/
      DATA T2/
     *'BOD ','AT R','EACH',' END',' (MG','/L) ',
     *'    ','    ','    ','    ','    ','    ',
     *'MEAN',' DEP','TH  ','    ','    ','    ',
     *'DO A','T RE','ACH ','STAR','T (M','G/L)',
     *'BOD ','AT R','EACH',' STA','RT(M','G/L)',
     *'NH3 ','AT R','EACH',' STA','RT(M','G/L)',
     *'NH3 ','AT R','EACH',' END',' (MG','/L) ',
     *'NO2 ','AT R','EACH',' STA','RT(M','G/L)',
     *'NO2 ','AT R','EACH',' END',' (MG','/L) ',
     *'NO3 ','AT R','EACH',' STA','RT(M','G/L)'/
      DATA T3/
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```
     *'NO3 ','AT R','EACH',' END',' (MG','/L) ',
     *'PO4 ','AT R','EACH',' STA','RT(M','G/L)',
     *'PO4 ','AT R','EACH',' END',' (MG','/L) ',
     *'ALG ','AT R','EACH',' STA','RT(M','G/L)',
     *'ALG ','AT R','EACH',' END',' (MG','/L) ',
     *'COL ','AT R','EACH',' STA','RT(M','G/L)',
     *'COL ','AT R','EACH',' END',' (MG','/L) ',
     *'HM1 ','AT R','EACH',' STA','RT(M','G/L)',
     *'HM1 ','AT R','EACH',' END',' (MG','/L) ',
     *'HM2 ','AT R','EACH',' STA','RT(M','G/L)'/
      DATA T4/
     *'HM2 ','AT R','EACH',' END',' (MG','/L) ',
     *'HM3 ','AT R','EACH',' STA','RT(M','G/L)',
     *'HM3 ','AT R','EACH',' END',' (MG','/L) ',
     *'TON ','AT R','EACH',' STA','RT(M','G/L)',
     *'TON ','AT R','EACH',' END',' (MG','/L) ',
     *'CL- ','AT R','EACH',' STA','RT(M','G/L)',
     *'CL- ','AT R','EACH',' END',' (MG','/L) ',
     *'MI1 ','AT R','EACH',' STA','RT(M','G/L)',
     *'MI1 ','AT R','EACH',' END',' (MG','/L) ',
     *'MI2 ','AT R','EACH',' STA','RT(M','G/L)'/
      DATA T5/
     *'MI2 ','AT R','EACH',' END',' (MG','/L) ',
     *'MI3 ','AT R','EACH',' STA','RT(M','G/L)',
     *'MI3 ','AT R','EACH',' END',' (MG','/L) '/
      IN=5
      NJ=6
      IF(IFLAG.EQ.0)  GO TO 20
      READ(IN,101) DUM1,DUM2,NR,NIND
      IOUT=0
      IF(DUM1.EQ.ENDF) IOUT=1
      IF(DUM1.EQ.ENDF)  RETURN
      READ(IN,100) (INR(I),I=1,NR)
      READ(IN,100) (INDS(I),I=1,NIND)
      READ(IN,101) DUM1,DUM2
      IF(DUM1.NE.ENDF)  GO TO 40
      WRITE(NJ,104)
      WRITE(NJ,105)  (INR(I),I=1,NR)
      WRITE(NJ,106)
      DO 60 I=1,NIND
      IND2=INDS(I)
60    WRITE(NJ,107)  (TITLE(J,IND2),J=1,6)
      WRITE(NJ,102) DUM1,DUM2
      RETURN
40    WRITE(NJ,103)
      STOP
20    CONTINUE
      IF(IOUT.EQ.1) RETURN
      DO 10 I=1,NIND
      IND2=INDS(I)
      DO 5 J=1,NR
      IND1=INR(J)
      XPLT(J)=IND1
5     YPLT(J)=D(IND1,IND2)
10    CALL PLOT(NR,YPLT,XPLT,TITLE(1,IND2))
      RETURN
100   FORMAT(10X,14I5)
101   FORMAT(2A4,2X,2I5)
102   FORMAT(1X,2A4)
103   FORMAT(' DATA CARD ERROR IN FILE L')
104   FORMAT(1H1,///40X,'FILE L --- PLOT VARIABLES'/)
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105   FORMAT(' QUANTITIES WILL BE PLOTTED FOR THE FOLLOWING REACHES'/
     *(10X,14I5))
106   FORMAT(//' THE FOLLOWING QUANTITIES WILL BE PLOTTED'/)
107   FORMAT(10X,6A4)
      END
      SUBROUTINE REINI
      COMMON/BLOCK2/JNIT(591),INIT(10),IAUG(20)
      COMMON/BLOCK4/TEMPO(12),IDMCH(20,10)
      COMMON/BLOCK5/JJ(9 ),MINIT,NJUNC(6),M,QUP,FINL(2),JA
      COMMON/BLOCK3/COND/(10,20),CONDI(20,20),CONDE(20,20)
      COMMON/WORK1/XCONI(20)
      COMMON/WORK2/XCONE(20)
      COMMON/MISC/IO,CALCK2,NFLOW,NCON
C
C                                        STEP-1
C                                        SET MACHINE IDENTIFIERS FOR
C                                        COUNTING UPSTREAM AUGMENTATION.
C
      DO 1 I=1,NINIT
      JA=INIT(I)
      IF(IAUG (JA))2,2,3
3     IDMCH (JA,1)=JA
      IDMCH (JA,2)=0
      GO TO 4
2     IDMCH (JA,1)=0
C
C                                        STEP-2
C
4     CONTINUE
      QUP=CONDI(JA,NFLOW)
      DO 10 K=1,NCON
10    XCONE(K)=CONDI(JA,K)
C
C                                        STEP-3
C                                        CALL  T R I B D
C
      CALL TRIBD
C
C                                        STEP-4
C                                        CALL  S C A N
C
      CALL SCAN
C
C                                        STEP-5
C                                        SET FINAL CONDITIONS TO
C                                        CALCULATED CONDITIONS
C
      CONDE(JA,NFLOW)=QUP
      DO 20 K=1,NCON
20    CONDE(JA,K)=XCONE(K)
C
C                                        STEP-6
C                                        REPEAT STEP-1 THRU STEP-5 FOR
C                                        EACH HEADWATER STRETCH.
C
      IF(M)1,1,5
1     CONTINUE
C
C                                        STEP-7
C                                        RETURN TO CALLER (R U N O N).
C
```

```
5       RETURN
        END
        SUBROUTINE REPRE
C       DATA(IA,7) IS INCREMENTAL FLOW IF REACH LENGTH IS NONZERO.
C       IT IS A POINT SOURCE(OR WITHDRAWAL) IF THE REACH LENGTH IS ZERO.
C       IF THE TREATMENT FACTOR IS TO BE APPLIED, THE DO CONCENTRATION
C       IS INPUT AS A NEGATIVE NUMBER.
        COMMON/WORK1/XCONI(20)
        COMMON/WORK2/XCONE(20)
        COMMON/BLOCK1/CRMIN(100),DATA(100,40)
        COMMON/BLOCK5/JJ(13),TF,TEMP(3),QUP,FINL(3),IA
        COMMON/MISC/IO,CALCK2,NFLOW,NCON,TOTFLO
        COMMON/OPTION/IFN(3),ICOMB
C       SET UP INITIAL CONDITIONS IN REACH IA
        XMAX=1.
        IF(DATA(IA,1).NE.0.)  XMAX=10.
        IF(ICOMB.EQ.18) XMAX=1
        FACFLO=DATA(IA,7)/XMAX
        TOTFLO=QUP+FACFLO
        FAC=1.
        IF(DATA(IA,1).NE.0.)  GO TO 5
        IF(DATA(IA,8).LT.0.)  FAC=1.-TF
        IF(DATA(IA,8).LT.0.)  DATA(IA,8)=-DATA(IA,8)
5       CONTINUE
        DO 10 I=1,NCON
        IF(DATA(IA,7).GE.0.) GO TO 15
        VAR=XCONE(I)
        GO TO 10
15      IF(I.LT.8)  VAR=DATA(IA,7+I)*FAC
        IF(I.GE.8)  VAR=DATA(IA,16+I)*FAC
10      XCONI(I)=(XCONE(I)*QUP+FACFLO*VAR)/TOTFLO
        RETURN
        END
        SUBROUTINE RMATC
        COMMON/BLOCK2/JNIT(20),F(21),IONE(20),G(470),JUNC(20,3),INIT(10),
       *IAUG(20)
        COMMON/BLOCK3/CONDZ(10,20),CONDI(20,20),CONDE(20,20)
        COMMON/BLOCK4/TEMMO(12),IDMCH(20,10)
        COMMON/BLOCK5/JJ,KK,II,B(4),NTRIB,NREA,NINIT,NJUNC,ELEV(5),M,QUP,
       *FINL(2),JA
        COMMON/WORK1/XCONI(20)/WORK2/XCONE(20)
        COMMON/MISC/IO,CALCK2,NFLOW,NCON,TOTFLO
C
C                                                  STEP-1
C                                                  FIND THE HEADWATER STRETCHES
C                                                  THAT ENTER A JUNCTION.
C
        DO 1 I=1,20
1       IONE(I)=0
        IF(NJUNC)333,333,334
333     IONE(1)=1
334     DO 2 I=1,20
2       JNIT(I)=0
        IINIT=NINIT
        DO 3 I=1,IINIT
        JNIT(I)=INIT(I)
        J=INIT(I)
3       IONE(J)=1
16      DO 4 I=1,NJUNC
        DO 5 J=1,IINIT
        IF(JUNC(I,1)-JNIT(J))5,6,5
```

```
    5       CONTINUE
            GO TO 4
    6       DO 7 J=1,IINIT
            IF(JUNC(I,2)-JNIT(J))7,8,7
    7       CONTINUE
            GO TO 4
    8       II=JUNC(I,1)
            JJ=JUNC(I,2)
            KK=JUNC(I,3)
            JA=KK
            IF(IAUG(JJ).EQ.1   .OR.   IAUG(KK).EQ.1)  IAUG(KK)=1
    C
    C                                             STEP-2
    C                                             CALL  B L E N D
    C
            CALL BLEND
            QUP=CONDI(KK,NFLOW)
            DO 20 J=1,NCON
    20      XCONE(J)=CONDI(KK,J)
    C
    C                                             STEP-3
    C                                             SET MACHINE IDENTIFIERS TO
    C                                             INDICATE THE NUMBER OF SOURCES
    C                                             OF AUGMENTATION UPSTREAM.
    C
            L=1
            LL=1
    13      IF(IDMCH (JJ,L))9,9,10
    10      IDMCH (KK,L)=IDMCH (JJ,L)
            L=L+1
            GO TO 13
    9       IF(IDMCH (II,LL))11,11,12
    12      IDMCH (KK,L)=IDMCH (II,LL)
            LL=LL+1
            L=L+1
            GO TO 9
    11      IDMCH (KK,L)=0
    C
    C                                             STEP-4
    C                                             CALL  T R I B D
    C
            CALL TRIBD
    C
    C                                             STEP-5
    C                                             CALL  S C A N
    C
            CALL SCAN
    C
    C                                             STEP-6
    C                                             SET FINAL CONDITIONS EQUAL
    C                                             TO CALCULATED CONDITIONS
    C
            CONDE(JA,NFLOW)=QUP
            DO 30 J=1,NCON
    30      CONDE(JA,J)=XCONE(J)
    C
    C                                             STEP-7
    C                                             REPEAT STEP-1 THRU STEP-6
    C                                             UNTIL ALL JUNCTIONS HAVE BEEN
    C                                             CONSIDERED.
    C
```

```
      IF(M)14,14,15
14    IONE(KK)=1
      IINIT=IINIT+1
      JNIT(IINIT)=KK
4     CONTINUE
      DO 17 I=1,NTRIB
      IF(IONE(I))16,16,17
17    CONTINUE
C
C                                                STEP-8
C                                                RETURN TO CALLER (R U N O N).
C
15    RETURN
      END
      SUBROUTINE RUNON
      COMMON/BLOCK1/CRMIN(4100),FINIS(100,50),RIDENT(100,5)
      COMMON/BLOCK2/JNIT(111),TITLE(20),IORD(20,20),JUNC(20,3),INIT(10)
      COMMON/BLOCK3/CONDZ(10,20),CONDI(20,20),CONDE(20,20)
      COMMON/BLOCK4/TEMMO(342),SEASON(12)
      COMMON/BLOCK5/JJ(8),NREA,MINIT,NJUNC(2),DOLEV,TF,TEMP,CSAT,M,QUP(5
     *),ICK,FINLN(3),NJ,K2(2),NSEAS,NRUN,TFN
      COMMON/TEMPER/TEMPAV,TEMREA(100),SATREA(100)
      COMMON/MISC/IO(2),NFLOW
      COMMON/OPTION/IFN,IK2,ICOL,ICOMB,INH3,INO2,INO3,IPO4,IALG
      COMMON/OPT2/IHEAVY,ITOTN,ICHLOR
      DATA ASTER/'*'/
C
C                                                STEP-1
C                                                SET ALL HEADWATER CONDITIONS
C                                                EQUAL TO ZERO.
C
      DO 1 I=1,10
      DO 1 J=1,20
1     CONDI(I,J)=CONDZ (I,J)
C
C                                                STEP-2
C                                                CALL  D O S A T
C
      CALL DOSAT
C
3     M=0
      IF(ICK.EQ.1  .OR.  ICOMB.EQ.18)  GO TO 3333
C
C                                                STEP-4
C                                                WRITE HEADING FOR INTERMEDIATE
C                                                REACH SUMMARY.
C
 3335 WRITE (NJ,388)
  388 FORMAT (1H0)
      WRITE (NJ,333)
  333 FORMAT ( 7X,48H NO.  RIVER MILE  FLOW    D.O.  RIVER MILE  DISS,
     *          'OLVED OXYGEN       BOD',/,
     *          7X,48H OF       TO HEAD    RATE     MIN.    AT MIN.   AT S,
     *          'TART  AT END  AT START  AT END',/,
     *          7X,48HREACH  OF REACH   (CFS)  (MG/L)    D.O.     (MG,
     *          '/L)   (MG/L)   (MG/L)   (MG/L)',/,
     *          7X,48H..... .........   .....  ...... ..........  ....'
     *          '....  ......  ........  .......',/)
C
C                                                STEP-5
C                                                CALL R E I N I
```

```
C
 3333 CALL PEINI
      IF(M)4,4,3
C
C                                         STEP-6
C                                         CALL  R M A T C
C
4     CALL RMATC
      IF(M)5,5,3
C
C                                         STEP-7
C                                         WRITE HEADING FOR FINAL
C                                         SUMMARY.
C
    5 WRITE (NJ,2055)
 2055 FORMAT (1H1)
      WRITE (NJ,24)
   24 FORMAT (33X,45H* * * * * F I N A L   S U M M A R Y * * * * *,//)
      WRITE (NJ,336) (TITLE(I),I=1,18)
  336 FORMAT (19X,18A4,//)
      WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
  335 FORMAT (15X,15HNUMBER OF RUN =,  I5,36X,19HTARGET D.O. LEVEL =,
     *              F5.2,/,
     *         15X,17HSEASON OF YR. =  ,A3,36X,19HMEAN TEMPERATURE  =,
     *              F5.2,//)
      WRITE (NJ,25)
   25 FORMAT (10X,45H NO.      IDENTIFICATION    RIVER MILE  REACH ,
     *50H  FLOW    D.O.  RIVER MILE  DISSOLVED OXYGEN  TEMP,/,
     *         10X,45H OF                  OF           TO HEAD   LENGTH ,
     *             ' RATE     MIN.    AT MIN.    AT START  AT END (CENT)'/
     *         10X,45HREACH                REACH          OF REACH  (MILES),
     *             45H  (CFS)   (MG/L)    D.O.       (MG/L)    (MG/L) :/,
     *         10X,45H..... .................... ........... .......'
     *'  .....  ..... ..........  ........  ...... ......'/)
C
C                                         STEP-8
C                                         WRITE FINAL SUMMARY.
C
      DO 88 I=1,NREA
      IF(FINIS(I,3).EQ.0.)  GO TO 88
      IR=FINIS(I,1)
      WRITE (NJ,28) IR,(RIDENT(I,J),J=1,5),(FINIS(I,J),J=2,6),
     *   FINIS(I,14),FINIS(I,7),TEMREA(I)
   88 CONTINUE
   28 FORMAT (10X,I3,3X,5A4,2X,F7.1,4X,F5.1,1X,F7.1,2X,F5.2,3X,F7.1,
     *   5X,F5.2,4X,F5.2,F6.1)
      WRITE (NJ,2055)
      WRITE (NJ,24)
      WRITE (NJ,336) (TITLE(I),I=1,18)
      WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
      WRITE (NJ,30)
30    FORMAT(11X,'NO.     IDENTIFICATION          BOD CONCENTRATION  REAERA
     *TION  TRAVEL     MEAN      MEAN   MEAN  MEAN SLOPE'/
     *11X,'OF              OF                  AT START   AT END    VALUE
     *TIME   VELOCITY  DEPTH  WIDTH  (BASED ON'/
     *10X,'REACH            REACH              (MG/L)     (MG/L)    (BASE E)
     * (DAYS) (FT/SEC)  (FT)    (FT)   MANNING=.04)'/
     *10X,'.....  ..................  .......  .......   ........
     *....... ......   ...... ......  ............'/)
      DO 89 I=1,NREA
      IF(FINIS(I,3).EQ.0.)  GO TO 89
```

```
      IR=FINIS(I,1)
      WIDM=FINIS(I,4)/(FINIS(I,10)*FINIS(I,13))
      XSLOP=(.04*FINIS(I,10)/(1.49*FINIS(I,13)**.6666))**2
      WRITE (NJ,32) IR,(RIDENT(I,J),J=1,5),FINIS(I,15),FINIS(I,11),
     * (FINIS(I,J),J=8,10),
     *FINIS(I,13),WIDM,XSLOP
      CHK=FINIS(I,10)**2/FINIS(I,13)
      IF(CHK.GT.32.)  WRITE(NJ,400) CHK,IR
400   FORMAT(' ***VELOCITY SQUARED OVER DEPTH =',F10.3,' IN REACH',I5,'
     ****')
   89 CONTINUE
32    FORMAT(8X,I5,5X,5A4,1X,F7.2,F10.2,F10.2,F10.3,2F9.2,F7.2,F12.6)
      IF(INH3.EQ.0  .AND.  INO2.EQ.0  .AND.  INO3.EQ.0  .AND.
     *  IPO4.EQ.0)  GO TO 2051
      WRITE(NJ,2055)
      WRITE(NJ,24)
      WRITE(NJ,336)  (TITLE(I),I=1,18)
      WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
      WRITE(NJ,200)
      DO 210 I=1,NREA
      IF(FINIS(I,3).EQ.0.)  GO TO 210
      IR=FINIS(I,1)
      WRITE(NJ,205) IR,(RIDENT(I,J),J=1,5),(FINIS(I,J),J=16,23)
210   CONTINUE
205   FORMAT(I13,5X,5A4,1X,4(F7.3,5X,F7.3,2X))
2051  CONTINUE
      IF(IALG.EQ.0  .AND.  ICOL.EQ.0  .AND.  IHEAVY.EQ.0)  GO TO 2201
      IF(ICOMB.EQ.18)  GO TO 2201
      WRITE(NJ,2055)
      WRITE(NJ,24)
      WRITE(NJ,336)  (TITLE(I),I=1,18)
      WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
      WRITE(NJ,201)
      DO 220 I=1,NREA
      IF(FINIS(I,3).EQ.0.)  GO TO 220
      IR=FINIS(I,1)
      WRITE(NJ,206) IR,(RIDENT(I,J),J=1,5),(FINIS(I,J),J=24,31)
206   FORMAT(I13,5X,5A4,1X,F7.3,5X,F7.3,F9.1,3X,F9.1,2X,2(F7.3,5X,F7.3,
     *2X))
220   CONTINUE
2201  CONTINUE
      IF(IHEAVY.EQ.0  .AND.  ITOTN.EQ.0  .AND.  ICHLOR.EQ.0)  GO TO 2301
      WRITE(NJ,2055)
      WRITE(NJ,24)
      WRITE(NJ,336)  (TITLE(I),I=1,18)
      WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
      WRITE(NJ,202)
      IAS=0
      DO 230 I=1,NREA
      IF(FINIS(I,3).EQ.0.)  GO TO 230
      IR=FINIS(I,1)
      WRITE(NJ,207) IR,(RIDENT(I,J),J=1,5),FINIS(I,32),FINIS(I,33),
     *FINIS(I,34),FINIS(I,44),(FINIS(I,J),J=35,39)
207   FORMAT(I13,5X,5A4,1X,F7.3,5X,F7.3,2X,F7.3,2X,A1,2X,F7.3,2X,
     *F7.3,5X,F7.3,2X,F7.3,5X,F7.3)
      IF(FINIS(I,44).EQ.ASTER) IAS=1
230   CONTINUE
      IF(IAS.EQ.1) WRITE(NJ,208)
208   FORMAT(/' * INDICATES SUM TOTAL OF THE NITROGEN IN CONSTITUENTS BE
     *ING MODELED EXCEEDS THE TOTAL NITROGEN BEING MODELED AS A CONSERVA
     *TIVE.')
```

```
      2301 CONTINUE
           IF(IHEAVY.LT.2)  GO TO 2401
           WRITE(NJ,2055)
           WRITE(NJ,24)
           WRITE(NJ,336)  (TITLE(I),I=1,18)
           WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
           WRITE(NJ,203)
           DO 240 I=1,NREA
           IF(FINIS(I,3).EQ.0.)  GO TO 240
           IR=FINIS(I,1)
           WRITE(NJ,205) IR,(RIDENT(I,J),J=1,5),(FINIS(I,J),J=40,43)
       240 CONTINUE
      2401 CONTINUE
           WRITE (NJ,2055)
           WRITE (NJ,24)
           WRITE (NJ,336) (TITLE(I),I=1,18)
           WRITE(NJ,335) NRUN,DOLEV,SEASON(NSEAS),TEMPAV
           WRITE (NJ,55)
        55 FORMAT (31X,48H   NO.        NO.     INITIAL  FINAL   AUGMENTATION,/,
          *          31X,48H    OF          OF          FLOW    FLOW    REQUIRED  ,/,
          *          31X,48HHEADWATER  STRETCH   (CFS)   (CFS)     (CFS)    ,/,
          *          31X,48H.........  .......  .......  .....  ............,/)
           DO 100 I=1,NINIT
           K = INIT(I)
           QAUG=CONDI(K,NFLOW)-CONDZ(K,NFLOW)
           WRITE(NJ,56) I,INIT(I),CONDZ(K,NFLOW),CONDI(K,NFLOW),QAUG
        56 FORMAT (31X,I5,5X,I5,4X,F7.1,1X,F7.1,3X,F7.1)
       100 CONTINUE
      C
      C                                           STEP-9
      C                                           RETURN TO CALLER (D O S A G).
      C
      C    PLOT DESIRED QUANTITIES FROM FINIS ARRAY.
           CALL PLTSET(FINIS,0)
           RETURN
      200  FORMAT(11X,'NO.         IDENTIFICATION     NH3-N CONCENTRATION  NO2-
          *N CONCENTRATION  NO3-N CONCENTRATION  PO4-P CONCENTRATION'/
          *11X,'OF                OF               AT START      AT END  AT START
          *  AT END  AT START     AT END  AT START     AT END'/
          *10X,'REACH              REACH           (MG/L)        (MG/L)   (MG/L)
          *   (MG/L)  (MG/L)       (MG/L)  (MG/L)       (MG/L)'/
          *10X,'.....  ..................  .......        .......  .......
          *  .......  .......       .......  .......      .......'/)
      201  FORMAT(11X,'NO.         IDENTIFICATION     ALGAE CONCENTRATION  COLI
          *F CONCENTRATION  MET-1 CONCENTRATION  MET-2 CONCENTRATION'/
          *11X,'OF                OF               AT START      AT END  AT START
          *  AT END  AT START     AT END  AT START     AT END'/
          *10X,'REACH              REACH           (MG/L)        (MG/L)  (MPN/100)
          * (MPN/100) (MG/L)       (MG/L)  (MG/L)       (MG/L)'/
          *10X,'.....  ..................  .......        .......  .......
          *  .......  .......       .......  .......      .......'/)
      202  FORMAT(11X,'NO.         IDENTIFICATION     MET-3 CONCENTRATION  TOT
          *N CONCENTRATION   CL-  CONCENTRATION  ION-1 CONCENTRATION'/
          *11X,'OF                OF               AT START      AT END  AT START
          *  AT END  AT START     AT END  AT START     AT END'/
          *10X,'REACH              REACH           (MG/L)        (MG/L)   (MG/L)
          *   (MG/L)  (MG/L)       (MG/L)  (MG/L)       (MG/L)'/
          *10X,'.....  ..................  .......        .......  .......
          *  .......  .......       .......  .......      .......'/)
      203  FORMAT(11X,'NO.         IDENTIFICATION     ION-2 CONCENTRATION  ION-
          *3 CONCENTRATION'/
```

```
      *11X,'OF                 OF                 AT START      AT END   AT START
      *  AT END'/
      *10X,'REACH              REACH               (MG/L)        (MG/L)   (MG/L)
      *    (MG/L)'/
      *10X,'.....   ...................   .......       .......  .......
      *  .......'/)
       END
       SUBROUTINE SCAN
       COMMON/BLOCK1/CRMIN(100)
       COMMON/BLOCK2/JNIT(131),IORD(20,20),JUNC(70),IAUG(20)
       COMMON/BLOCK3/CONDZ(10,20),CONDI(20,20)
       COMMON/BLOCK4/TEMMO(12),IDMCH(20,10)
       COMMON/BLOCK5/JJ(12),DOLEV,TF(3),M,QUP,FINL(2),JA,IA
C
C                                               STEP-1
C                                               CHECK FOR AVAILABLE
C                                               AUGMENTATION.
C
       I=0
       IF(IAUG(JA))1,1,2
2      I=I+1
C
C                                               STEP-2
C                                               CHECK FOR REACHES IN A
C                                               STRETCH.
C
       IF(IORD(JA,I))1,1,3
3      IA=IORD(JA,I)
C
C                                               STEP-3
C                                               CALCULATE D.O. DEFICIT FOR
C                                               REACH.
C
       Z=DOLEV -CRMIN(IA)
       IF(Z) 2,2,5
C
C                                               STEP-4
C                                               CALCULATE AMOUNT OF DILUTION
C                                               WATER NEEDED TO SATISFY THE
C                                               DEFICIT.
C
     5 QADD=QUP*(Z/DOLEV + 0.25*(Z/DOLEV)**2)
C
C                                               STEP-5
C                                               CHECK TO SEE HOW MANY UPSTREAM
C                                               SOURCES OF AUGMENTATION ARE
C                                               AVAILABLE.
C
       L=1
       LL=0
       M=1
7      IF(IDMCH (JA,L))1,8,6
6      LL=LL+1
       L=L+1
       GO TO 7
8      M=LL
C
C                                               STEP-6
C                                               DIVIDE DILUTION WATER EQUALLY
C                                               AMONG ALL SOURCES OF
C                                               AUGMENTATION.
```

```
C
      QPLUS=QADD/W
      L=1
   10 IF(IDMCH (JA,L))1,1,9
C
C                                         STEP-7
C                                         ADD DILUTION WATER TO UPSTREAM
C                                         AUGMENTATION SOURCES.
C
    9 IB=IDMCH (JA,L)
      CONDI(IB,4)=CONDI(IB,4)+QPLUS
      L = L + 1
      GO TO 10
C
C                                         STEP-8
C                                         RETURN TO CALLER (R M A T C)
C                                         OR (R E I N I).
C
    1 RETURN
      END
      SUBROUTINE SETOPT
      COMMON/OPTION/IFN,IK2,ICOL,ICOMB,INH3,INO2,INO3,IPO4,IALG,IFIRST
      COMMON/OPT2/IHEAVY,ITOIN,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 TRIBD
             COMMON/BLOCK1/CRMIN(100),DATA(100,40)
             COMMON/BLOCK2/JNIT(61),G(50),TITLE(20),IORD(20,20)
             COMMON/BLOCK3/CONDZ(10,20),CONDI(20,20)
             COMMON/BLOCK5/JJ(6),CLOW,NTRIB(10),GUP,FINL(2),JA,IA
       C
       C                                       STEP-1
       C                                       CHECK TO SEE IF THERE ARE ANY
       C                                       DOWNSTREAM REACHES TO BE
       C                                       CONSIDERED IN THE STRETCH.
       C
             I=1
       2     IF(IORD(JA,I))1,1,3
       C
       C                                       STEP-2
```

```
C                                                   CONSIDER NEXT DOWNSTREAM
C                                                   REACH.
C
3       IA=IORD(JA,I)
C
C                                                   STEP-3
C                                                   CALL  R E P R E
C
        CALL REPRE
C
C                                                   STEP-4
C                                                   CALL  D O E Q U
C
        CALL DOEQU
        QUP=QUP+DATA(IA,7)
        IF(QUP) 10,10,20
C
C                                                   STEP-5
C                                                   STORE MINIMUM DISSOLVED OXYGEN
C                                                   OF REACH.
C
     10 CRMIN(IA)=CONDI(JA,1)
        GO TO 30
     20 CRMIN(IA)=CLOW
     30 CONTINUE
        I=I+1
C
C                                                   STEP-6
C                                                   REPEAT STEP-1 THRU STEP-5
C                                                   UNTIL ALL REACHES HAVE BEEN
C                                                   CONSIDERED.
C
        GO TO 2
C
C                                                   STEP-7
C                                                   RETURN TO CALLER (R E I N I)
C                                                   OR (R M A T C).
C
1       RETURN
        END
```

## SECTION X

## REFERENCES

1. Churchill, M.A., Elmore, H.L., and Buckingham, R.A., "The Prediction of Stream Reaeration Rates," Journal, Sanitary Engineering Division, A.S.C.E., vol. 7, 1962.

2. Eckenfelder, W.W. and O'Connor, D.J., Biological Waste Treatment, Pergamon Press, London, 1962.

3. Langbien, W.B. and Durum, W.H., "The Aeration Capacity of Streams," U.S.G.S. Circular No. 542, U.S. Department of the Interior, Washington, D.C., 1967.

4. O'Connor, D.J. and Dobbins, W.E., "Mechanism of Reaeration in Natural Streams," Transactions, A.S.C.E., vol. 123, New York, 1958.

5. O'Connor, D.J., "An Analysis of the Dissolved Oxygen Variation in a Flowing Stream," paper presented at Symposium on Advances in Biological Waste Treatment, University of Texas at Austin, Austin, Texas, 1966.

6. Owens, M., Edwards, R.W., and Gibbs, J.W., "Some Reaeration Studies in Streams," Inter. Journal of Air and Water Pollution Res., vol. 8, 1964.

7. Streeter, H.W. and Phelps, E.B., "A Study of the Pollution and Natural Purification of the Ohio River," Bulletin 146, U.S. Public Health Services, 1925, reprinted 1958.

8. "DOSAG-I Simulation of Water Quality in Streams and Canals. Program Documentation and Users Manual," Texas Water Development Board, Austin, Texas, 1970.

SECTION XI

## ABBREVIATIONS

| | |
|---|---|
| ASCE | American Society of Civil Engineers |
| EPA | Environmental Protection Agency |
| SCI | Systems Control, Incorporated |
| USGS | United States Geological Survey |
| BOD | biochemical oxygen demand (5-day) |
| $CL_2$ | chloride |
| Cent° | centigrade degrees |
| cfs | cubic feet per second |
| cms | cubic meters per second |
| deg | degrees |
| DO | dissolved oxygen |
| °F | Farenheit degrees |
| ft | feet |
| g | acceleration due to gravity |
| 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 |
| min | minutes |
| 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

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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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