Computer Program Documentation

USER'S MANUAL

ONE-DIMENSIONAL STEADY-STATE STREAM WATER-QUALITY MODEL

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 79-45

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The model formulation is based on a steady-state assumption which requires constant flow rate of waste and stream discharges and associated parameters. To achieve a problem solution, each reach of a stream system is broken into a given number of subreaches, generally defined by locations of waste or tributary inflow points. All waste constituents are assumed to be completely mixed within any cross section.

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UNITED STATES DEPARTMENT OF THE INTERIOR

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Multiply Inch-Pound units	By	To obtain metric units
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
foot per second (ft/s)	2447	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

ONE-DIMENSIONAL STEADY-STATE STREAM WATER-QUALITY MODEL

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ABSTRACT

A computer program, based on a one-dimensional mathematical model which predicts the stream water-quality response characteristics from waste source inputs, is described and documented. Variables predicted include dissolved oxygen, biochemical oxygen demand, nitrogen forms, total and fecal-coliform bacteria, orthophosphate-phosphorus, and various conservative substances. The model is based primarily on the well known Streeter-Phelps oxygen-sag equation. Special options of the program include the capability of handling nonpoint source waste inputs and anoxic conditions.

The model formulation is based on a steady-state assumption which requires constant flow rate of waste and stream discharges and associated parameters. To achieve a problem solution, each reach of a stream system is broken into a given number of subreaches, generally defined by locations of waste or tributary inflow points. All waste constituents are assumed to be completely mixed within any cross section.

INTRODUCTION

This report describes a computer program for a steady-state stream water-quality model which predicts stream biochemical characteristics and conservative constituent concentrations from waste source inputs. The program is developed using the basic Streeter-Phelps (1925) equation as a basis. The formulation is based on a one-dimensional analysis and constant stream and waste flows.

In modeling the water quality of a stream reach, the program user can break the reach into as many subreaches as desired. Summary results from the model are broken into tabulations at fixed distance intervals (miles) downstream. For given subreaches the user is allowed to specify waste or tributary inflow at the start of the subreach and (or) linear runoff (nonpoint flow) along the subreach.

The original program framework is based upon a dissolved-oxygen (DO) model developed by Shindala (1972). Additional features added to the original model include computations for: (1) Conservative constituents, (2) linear runoff, (3) nitrogen components, (4) anoxic stream conditions, (5) total and fecal-coliform bacteria, and (6) orthophosphate-phosphorus. Program output includes line-printer plots and various line-printer output tabulations. Some editing of the input data is also included.

A preliminary application of the program described in this manual involved a waste assimilation capacity study in Arkansas (Jennings and Bryant, 1973). More recent applications involving nitrogen components have been done on the Yampa River in Colorado (Bauer and others, 1978) and the Chattahoochee River in Georgia (J. E. Miller and M. E. Jennings, 1978). The user is advised to consult with the staff of the U.S. Geological Survey at the Gulf Coast Hydroscience Center (GCHC), NSTL Station, Mississippi, concerning field data-collection programs required to provide input.

Future revisions are expected to reflect improvements in calculation methods or modeling techniques. Therefore, assistance of the GCHC staff in using the program is recommended.

MODEL OBJECTIVES

The model described in this manual is intended to be used in any one-dimensional, stream water-quality modeling situation in which the assumption of steady-state flows and waste inputs is acceptable. To satisfy the steady-state flow assumption, it is not necessary that stream flows be constant throughout the stream system; however, at each point in the stream system, the flow pattern must be constant for at least the time-of-travel through the system. Such assumptions are acceptable in many situations--particularly when the focus is on critical water-quality sequences associated with water-quality planning options. Often this will be a low flow period in which almost all waste inputs and flows can be considered at steady-state. Thus, critical conditions are based on critical hydrologic occurrences. Usually, projections can then be made using conditions that are based on the recurrence probability of the critical hydrologic event such as the 7-day low flow exceeded on the average once in ten years. When steady-state assumptions cannot be met for a given problem, unsteady transport models such as Bauer and Bennett (1976) are recommended.

As in the case of any water-quality model, the model described in this report must be properly calibrated and verified, using an adequate data base, prior to simulation for water-quality planning use. This requires at least two data collection periods, preferably at low-flow or critical water-quality conditions. As noted by Bauer, Steele, and Anderson (1978), data for water-quality modeling should be collected during different seasons of a year. Data collected, however, during a critical low-flow condition, can be sufficient to calibrate a model (Hines and others, 1975).

BASIS FOR MODEL DEVELOPMENT

A synopsis of the development of equations is given in this section. The conservation of mass equation for this model takes the form:

$$\frac{\partial C}{\partial t} = -\frac{1}{A}\frac{\partial (QC)}{\partial x} \pm \Sigma S \qquad (1)$$

Rate of change of the constituent with time.	Rate of change of the constituent mass flow rate in the x direction.	Source or sink terms in the system.

where

C = conservative or nonconservative constituent concentration;
t = time;
A = stream cross-sectional area;
Q = streamflow;
x = stream downstream distance and direction coordinate; and
S = system source or sink terms effects (Note: for conservative constituents, the sum of S is zero).

Equation 1 is a fundamental modeling equation used to describe the stream transport of many water-quality constituents. It does not account for dispersion. Figure 1 illustrates the use of the equation for an incremental length of a stream reach.

In this manual, various kinds of reaction coefficients are used. Each reaction coefficient is described when presented. Further explanation can be obtained from the reference cited for that constituent.

The term "linear runoff" is used in this manual to describe a nonpoint source of flow and wastes into the stream. When used, it indicates streamflow or waste inputs per foot of stream length.

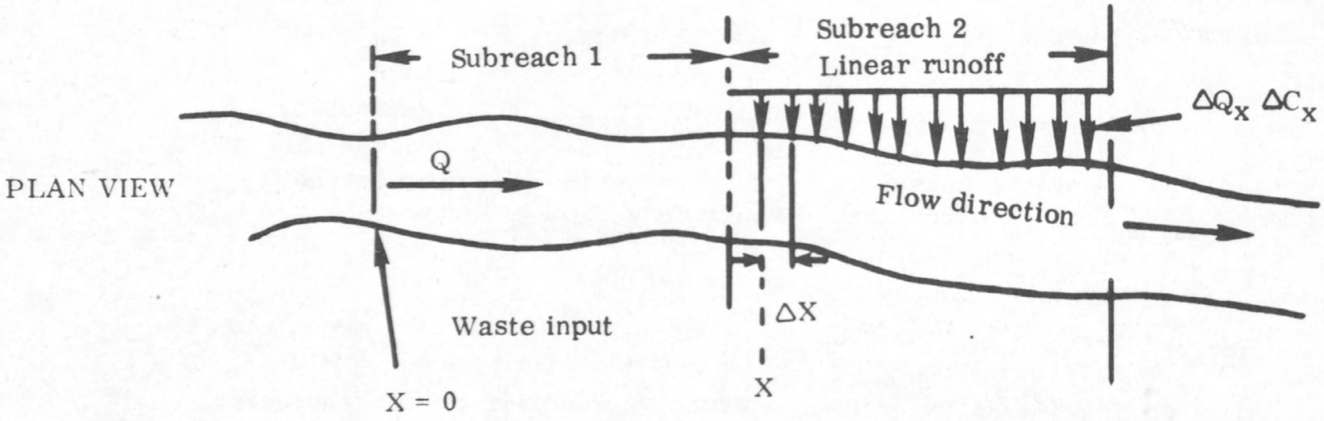
Biochemical Oxygen Demand

The application of equation 1 to biochemical oxygen demand (BOD) modeling in streams results in the following:

$$\frac{dL}{dt} = -\frac{1}{A}\frac{d(QL)}{dx} - K_r L, \qquad (2)$$

where K_r is the stream decay rate and L is the ultimate BOD concentration in the stream. Ultimate BOD is the total DO consumed in the BOD bottle when all material, oxidizable by microbial degradation, has been oxidized--as described by Jennings and Bauer (1976). Biochemical oxygen demand may refer to either carbonaceous BOD (CBOD) or nitrogenous BOD (NBOD) effects. At steady-state conditions, $\frac{dL}{dt} = 0$; therefore,

$$U\frac{dL}{dx} = -K_r L. \qquad (3)$$



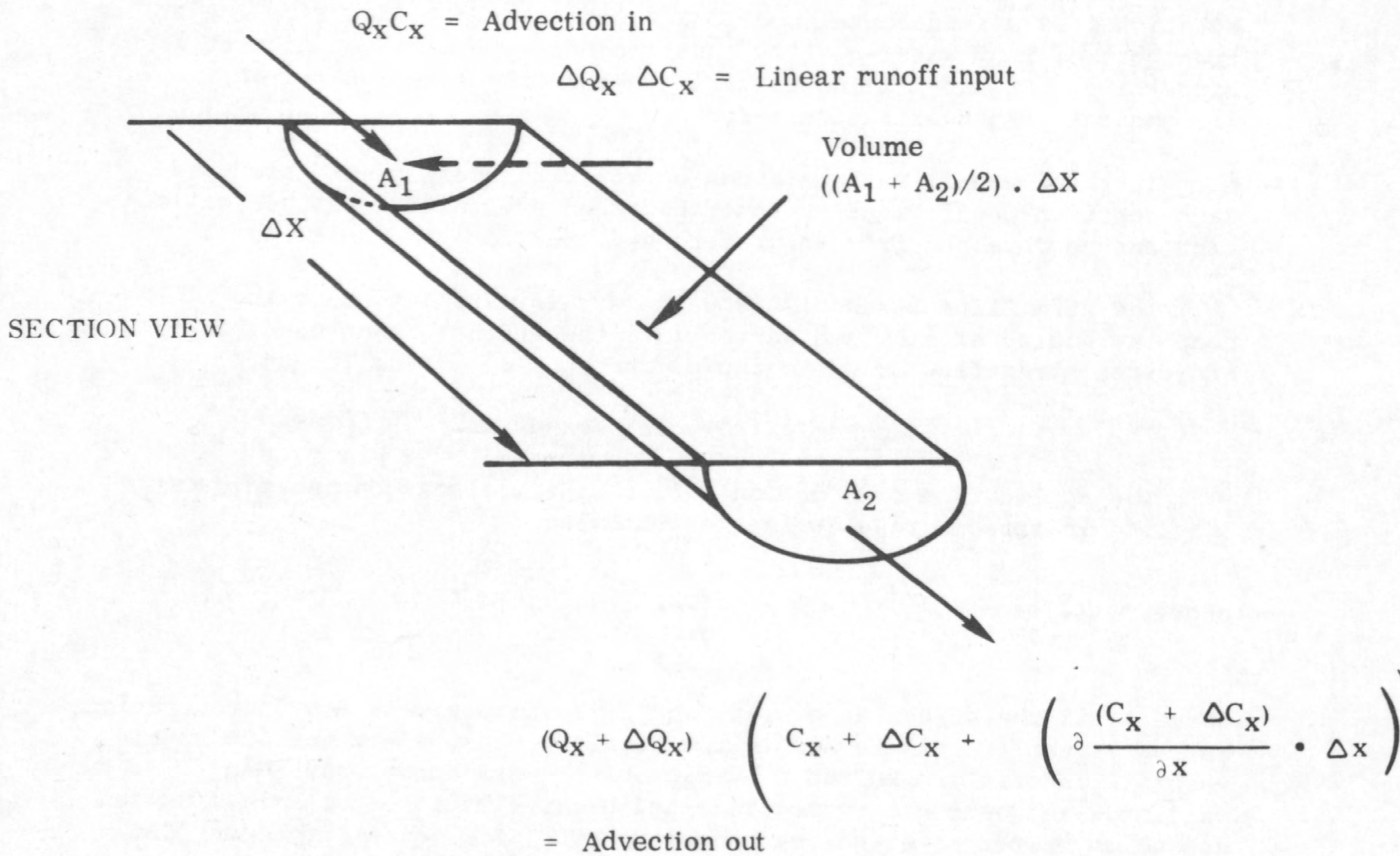


Figure 1.--Material balance for an elemental volume of a stream reach.

Integrating using boundary conditions, $L = L_o$ at $x = 0$,

$$L = L_o e^{-K_r \left(\frac{x}{U}\right)}, \tag{4}$$

where

L_o = ultimate CBOD or NBOD (N_o) concentration at some initial time t_o;
L^o = ultimate CBOD or NBOD (N^o) concentration some time t later than t_o;
K_r = stream decay rate for CBOD and the same as the deoxygenation rate for NBOD (K_n);
U = mean stream velocity = Q/A; and
e = the base of natural logarithms, approximated by 2.72.

A procedure for determining K_r using semi-log logarithmic plots of observed BOD values versus time of travel is described by Thomann (1972). An explanation and example illustrating this procedure is given in attachment F. This procedure can be used for any constituent which is modeled using equation 2. In this model reaction coefficients for CBOD, NBOD, organic-nitrogen, total-coliform bacteria and fecal-coliform bacteria can be determined using this procedure.

Nitrogen Constituents

Nitrogen can be modeled either as the lumped parameter NBOD or by modeling the nitrification cycle. This cycle should be modeled when the prediction of concentrations of the nitrogen constituents is required or when a detailed analysis of the effect of nitrogenous wastes on the dissolved oxygen concentration of the stream is desired.

Figure 2 illustrates the dominant reactions involved in the nitrogen cycle. This is a complex cycle involving many transformations; however, given the proper conditions, the most significant changes are the forward sequential reactions of organic-nitrogen to nitrate-nitrogen. This process is called nitrification.

A set of first-order differential equations for the nitrogen cycle components, illustrated in figure 2 and developed by Thomann, O'Connor, and DiToro (1971), is listed below:

$$\frac{dN_1}{dt} = -K_{11}N_1 + W_1(x) \tag{5}$$

$$\frac{dN_2}{dt} = -K_{22}N_2 + K_{12}N_1 + W_2(x) \tag{6}$$

$$\frac{dN_3}{dt} = -K_{33}N_3 + K_{23}N_2 + W_3(x) \tag{7}$$

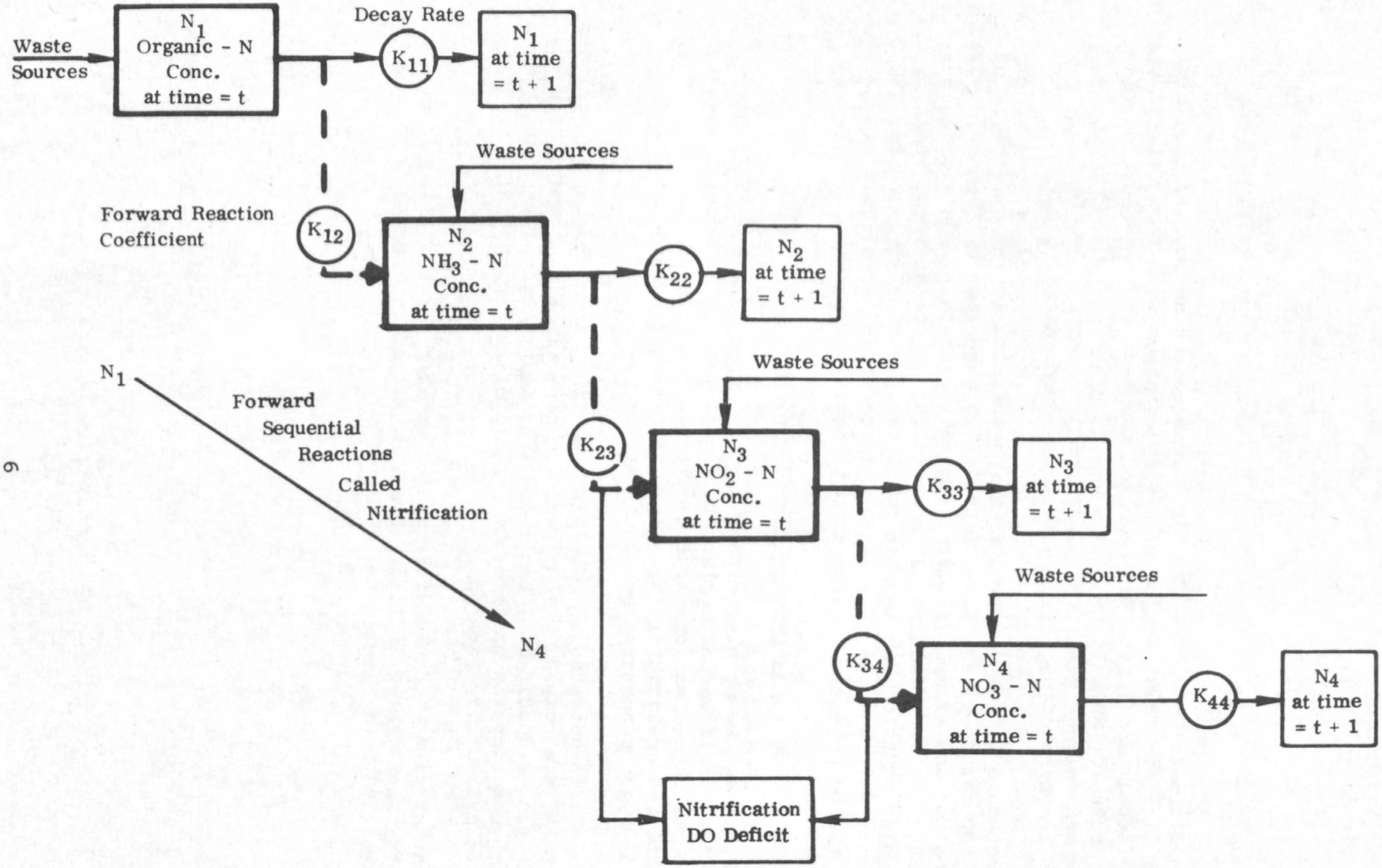


Figure 2.--Model representation of the nitrification cycle.

$$\frac{dN_4}{dt} = -K_{44}N_4 + K_{34}N_3 + W_4\ (x) \tag{8}$$

where

t	= traveltime = $\frac{x}{U}$;
N_1	= organic-nitrogen concentration;
N_2	= ammonia-nitrogen concentration;
N_3	= nitrite-nitrogen concentration;
N_4	= nitrate-nitrogen concentration;
K_{11}, K_{22}, K_{33}, K_{44}	= decay rates (see fig. 2);
K_{12}, K_{23}, K_{34}	= forward reaction coefficients (see fig. 2); and
W_1, W_2, W_3, W_4	= input discharge and waste concentration added to mass balance at each input to the stream.

Substituting the solution of the preceeding equation into the next sequential equation and solving results in the following:

$$N_1 = N_{10}e^{-K_{11}t} \tag{9}$$

$$N_2 = A_n e^{-K_{11}t} + B_n e^{-K_{22}t} \tag{10}$$

$$N_3 = C_n e^{-K_{11}t} + D_n e^{-K_{22}t} + E_n e^{-K_{33}t} \tag{11}$$

$$N_4 = F_n e^{-K_{11}t} + G_n e^{-K_{22}t} + H_n e^{-K_{33}t} + I_n e^{-K_{44}t} \tag{12}$$

where

$$A_n = \frac{K_{12}\ N_{10}}{K_{22} - K_{11}}$$

$$B_n = N_{20} - A_n$$

$$C_n = \frac{A_n K_{23}}{K_{33} - K_{11}}$$

$$D_n = \frac{N_{20} K_{23}}{K_{33} - K_{22}} - \frac{A_n K_{23}}{K_{33} - K_{22}}$$

$$E_n = N_{30} - \frac{N_{20} K_{23}}{K_{33} - K_{22}} - C_n + \frac{A_n K_{23}}{K_{33} - K_{22}}$$

$$F_n = \frac{C_n K_{34}}{K_{44} - K_{11}}$$

$$G_n = \frac{K_{23} K_{34} B_n}{(K_{33} - K_{22})(K_{44} - K_{22})}$$

$$H_n = \frac{K_{34}}{K_{44} - K_{33}} \left(-N_{30} + C_n + \frac{K_{23} B_n}{K_{33} - K_{22}} \right)$$

$$I_n = N_{40} - F_n - G_n - H_n$$

$N_{10}, N_{20}, N_{30}, N_{40}$ = nitrogen constituent concentrations at the preceding time step; and

$t, N_1, N_2, N_3, N_4, K_{11}, K_{22}, K_{33}, K_{44}, K_{12}, K_{23}, K_{34}$, and e are as previously defined.

Nitrogen cycle modeling provides the capability to determine the effects of the discharge of nitrogenous compounds and nitrogen cycle transformations. This is a coupled sequential reaction involving the decay of organic-nitrogen and ammonia-nitrogen through nitrite-nitrogen to nitrate-nitrogen. In these reactions one form of nitrogen is converted to another form of nitrogen. For example, organic-nitrogen is converted to ammonia-nitrogen. In this model the coupling of the concentration and forward reaction of each N form with the next sequential nitrogen form is determined by the forward reaction coefficient. Under proper conditions (adequate oxygen, phosphates and an alkaline environment), the most significant reactions are the forward sequential reactions of organic-nitrogen to nitrate-nitrogen; however, there are other possible reactions. These include plant utilization of ammonia-nitrogen, nitrate reduction of nitrite-nitrogen and nitrate-nitrogen, and the escape as gas of nonionized ammonia-nitrogen.

To provide a capability to handle the plant utilization, nitrate reduction, and other sinks in the system, two reaction coefficients are used for organic-nitrogen, ammonia-nitrogen, and nitrite-nitrogen (see fig. 2). These are the forward reaction coefficients and decay rates. Decay rates describe the total rate of decay of the nitrogen form. The forward reaction coefficients describe the rate that one form of nitrogen decays sequentially forward to the next form. Thus, the decay rate must always be equal to or greater than the forward reaction coefficient. Usually both reaction coefficients, for each form of nitrogen, will be equal. After initial calibration runs have been attempted, changes may be made if nitrogen sinks are suspected. A procedure for calibrating the nitrogen constituent model is given in the Discussion of Model Application. The present model structure does not take into account the escape of nonionized ammonia-nitrogen. In cases of high water temperatures (greater than 20°C) and high pH values (greater than 8.0), the amount of nitrogen loss, by this effect, can be estimated (Willingham, 1976).

Dissolved Oxygen

The application of equation 1 to dissolved-oxygen (DO) modeling in streams results in the following equation describing DO sources and sinks:

$$0 = -\frac{1}{A} d \frac{(QD)}{dx} - K_a D + K_d L + K_n N - P + R + B \qquad (13)$$

where

D = DO deficit defined as the difference between saturated DO concentration (Cs) and the observed DO concentration (C);

K_a = atmospheric reaeration rate;

K_d = deoxygenation rate for CBOD;

L = ultimate CBOD concentration;

K_n = deoxygenation rate for NBOD;

N = NBOD concentration;

P = mean daily photosynthetic DO production;

R = oxygen utilized by respiration;

B = oxygen used by the stream-bottom deposits;
and A, Q, x, and e are as previously defined.

When nitrification is modeled instead of NBOD, the term in the above equation (eq. 13) for NBOD deoxygenation ($K_n N$) is the following:

$$3.43\ K_{23}\ N_2 + 1.14\ K_{34}\ N_3 \tag{13a}$$

where N_2, N_3, K_{23}, and K_{34} are as previously defined. This equation was presented by Thomann, O'Connor, and DiToro (1971) and describes the effects of ammonia-nitrogen and nitrite-nitrogen transformations. Integrating (eq. 13), the dissolved-oxygen deficit becomes the sum of the following components:

$$D_o e^{-K_a \frac{x}{U}} \quad \text{- initial DO deficit}$$

$$\frac{K_d L_o}{K_a - K_r}\left(e^{-K_r \frac{x}{U}} - e^{-K_a \frac{x}{U}}\right) \quad \text{- deficit due to oxidation of CBOD}$$

$$\frac{K_n N_o}{K_a - K_n}\left(e^{-K_n \frac{x}{U}} - e^{-K_a \frac{x}{U}}\right) \quad \text{- deficit due to oxidation of NBOD}$$

$$\frac{R}{K_a}\left(1 - e^{-K_a \frac{x}{U}}\right) \quad \text{- deficit due to plant respiration}$$

$$\frac{B}{K_a}\left(1 - e^{-K_a \frac{x}{U}}\right) \quad \text{- deficit due to bottom deposits}$$

$$-\ \frac{P}{K_a}\left(1 - e^{-K_a \frac{x}{U}}\right) \quad \text{- deficit due to mean daily photosynthetic production} \tag{14}$$

where

D_o = DO deficit at some initial time t_o;

$\frac{x}{U}$ = traveltime down the stream = t;

B = BNT/DEPTH (.3048), BNT is the areal oxygen demand per unit mean depth expressed in meters. The mean depth is given to the program in units of feet and then converted to meters;

R = C_a (.025), the algae respiration effect is approximated by multiplying chlorophyll a concentration, C_a, by 0.025 (Shindala, 1972); and K_a, e, K_d, L_o, K_r, K_n, N_o, R, B, and P are as previously defined.

When nitrification is modeled instead of NBOD, the deficit (D_n integrating eq. 13a as a term in eq. 13) due to nitrogen constituent concentration changes is:

$$D_n = 3.43\, K_{23} \left[\frac{A_n\left(e^{-K_{11}\frac{x}{U}} - e^{-K_a\frac{x}{U}}\right)}{K_a - K_{11}} + \frac{B_n\left(e^{-K_{22}\frac{x}{U}} - e^{-K_a\frac{x}{U}}\right)}{K_a - K_{22}} \right]$$
$$+ 1.14\, K_{34} \left[\frac{C_n\left(e^{-K_{11}\frac{x}{U}} - e^{-K_a\frac{x}{U}}\right)}{K_a - K_{11}} + \frac{D_n\left(e^{-K_{22}\frac{x}{U}} - e^{-K_a\frac{x}{U}}\right)}{K_a - K_{22}} + \frac{E_n\left(e^{-K_{33}\frac{x}{U}} - e^{-K_a\frac{x}{U}}\right)}{K_a - K_{33}} \right] \quad (15)$$

where K_{11}, K_{22}, K_{33}, K_{23}, K_{34}, K_a, A_n, B_n, C_n, D_n, E_n, $\frac{x}{U}$, and e are as previously defined. An explanation of when to use the nitrification model instead of the NBOD model is given under Nitrogen Constituents. For an explanation of the effect of nitrogen transformations on dissolved oxygen, see Thomann, O'Connor, and DiToro (1971).

A FORTRAN computer program (Jennings and Bauer, 1976) is available for computation of K_d, K_n, and BOD values based on laboratory DO depletion data. In addition, an analyses presented by Stephens and Jennings (1976) is available to calculate estimates of mean daily photosynthetic DO production and respiration from diurnal DO and related field data for applicable subreaches. If this analysis is used, the results, called 24-hour community metabolism, can be used as P. Since this analysis includes respiration effects, R would be set equal to zero. It is important to define the magnitude of P and R when there is a significant diurnal DO variation or a large algae population in the study reach.

The stream reaeration rate is computed by the program using an equation developed by Bennett and Rathbun (1972). The basic relationship is:

$$K_a = (8.76U^{0.607}/H^{1.689})(2.303) \quad (16)$$

where

K_a = reaeration rate in units of 1/day;

U = mean stream velocity, in feet per second, supplied from mean discharge and cross-sectional area data or the subreach length divided by the subreach traveltime;

H = mean depth in feet; and

2.303 = conversion factor from base 10 to base e.

Anoxic Conditions

In streams where significant waste loading exists, the DO concentration may drop to zero. If an anoxic condition is approached (DO concentration less than 0.1 mg/L), the program automatically computes the length of the anoxic zone and the CBOD concentration at the downstream end of the zone using equations developed by Bell (1973). The basic equations are as follows:

$$L_b = \frac{K_a D_c - K_n N - R + P - B}{K_d} \quad (17)$$

and

$$(T_b - T_a) = \frac{L_a - L_b}{K_a D_c - K_n N - R + P - B} \quad (18)$$

where

L_b = remaining CBOD concentration at the end of anoxic zone;

L_a = CBOD concentration at the start of the anoxic zone;

$(T_b - T_a)$ = total traveltime or length of the anoxic zone (T_b is the traveltime at the end, and T_a is the traveltime at the beginning of the anoxic zone);

D_c = maximum DO deficit equal to the saturated DO concentration; and K_a, K_n, N, R, P, B, and K_d are as previously defined.

When anoxic conditions are computed, care must be taken to insure reasonable results. For example, when the DO in a stream is lowered to 2.0 mg/L or lower, nitrification begins to slow down. Thus, if NBOD is large and is decreasing the DO concentrations to zero at a rapid rate, the K_n should be reduced in these possible anoxic subreaches to account for the much slower nitrification rate. This can maintain DO concentrations above zero which, in many cases, may be more reasonable.

Total and Fecal-Coliform Bacteria

The application of equation 1 to coliform bacteria modeling in streams, presented by Mahloch (1973), results in the same derivation shown for BOD (eq. 2). The resulting equation is:

$$N_C = N_{CO} e^{-K_C \frac{x}{U}} \tag{19}$$

where

N_{CO} = coliform bacteria concentration at some initial time t_o;

N_C = coliform bacteria concentration at some time t later than t_o;

K_C = stream coliform bacteria die-off rates (These rates can be estimated using the procedure described in attachment F.); and $\frac{x}{U}$ and e are as previously defined.

Orthophosphate-Phosphorus

The application of equation 1 to orthophosphate-phosphorus modeling in streams, presented by Willis, Anderson, and Dracup (1975), results in the following:

$$\frac{dN_P}{dx} = -K_{P1} N_P - K_{P2} C_a \tag{20}$$

where

N_P = orthophosphate-phosphorus concentration;

K_{P1} = orthophosphate-phosphorus stream bottom deposit uptake rate;

C_a = chlorophyll a concentration;

K_{P2} = orthophosphate-phosphorus chlorophyll a uptake rate; and

x = is as previously defined.

The solution to this equation, adapted from the above reference, as presented is:

$$N_P = N_{PO} e^{-K_{P1} \frac{x}{U}} - K_{P2} C_a (1 - e^{-K_{P2} \frac{x}{U}}) \quad (21)$$

where

N_{PO} = orthophosphate-phosphorus concentration at some initial time t_o; and N_P, K_{P1}, C_a, K_{P2}, $\frac{x}{U}$, and e are as previously defined.

Conservative Constituents

Conservative constituent concentrations (maximum of three) are computed using the mass balance equation shown below.

$$C_c = \frac{C_o Q_o + C_T Q_T}{Q_o + Q_T} \quad (22)$$

where

C_c = stream concentration of conservative constituent;

C_o = stream concentration of conservative constituent upstream of tributary;

C_T = tributary concentration of constituent;

Q_o = streamflow; and

Q_T = tributary flow.

Linear Runoff

Linear runoff is added to the mass balance in the stream using equation 22. For this application of equation 22, C_T is the added waste concentration of the linearly incremented runoff, and Q_T is the linearly incremented flow rate over the distance, x, for each time step.

Temperature Correction of Reaction Coefficients

Reaction coefficients in the model are corrected for water temperatures other than 20°C using the following equations (Shindala, 1972):

$K_T = K_{20}(1.047)^{T-20}$ CBOD decay rate (23)

CBOD deoxygenation rate

$$K_T = K_{20}(1.09)^{T-20} \quad (24)$$

NBOD deoxygenation rate
Organic-nitrogen forward reaction coefficient
Organic-nitrogen decay rate
Ammonia-nitrogen forward reaction coefficient
Ammonia-nitrogen decay rate
Nitrite-nitrogen forward reaction coefficient
Nitrite-nitrogen decay rate
Nitrate-nitrogen decay rate
Orthophosphate-phosphorus stream bottom deposit uptake rate
Chlorophyl a uptake rate

$$K_T = K_{20}(1.065)^{T-20} \quad (25)$$

Benthic deposit demand

$$K_T = K_{20}(1.021)^{T-20} \quad (26)$$

Reaeration rate

where

K_T = temperature corrected reaction coefficient;

K_{20} = reaction coefficient at 20°C; and

T = temperature.

For stream temperatures less than 15°C or greater than 30°C temperature corrected reaction coefficients, using the above equations, should be carefully checked to insure the use of reasonable values. If the computed reaction coefficients are not reasonable, the user should adjust the coefficients to produce desired temperature corrected coefficients. At temperatures near or below 10°C, nitrification no longer occurs at a significant rate (Thomann and others, 1971). At these stream temperatures, nitrification reaction rates should be adjusted to reflect the very slow rate.

GENERAL MODEL OPERATION

To apply the model the stream must be divided into a given number of subreaches. The number of subreaches and boundaries are set by the program user. Criteria for dividing a stream are as follows:

1. Individual point waste flow or tributary inputs require the start of a subreach for each source. Subreaches should be set up so the discharges enter the stream at the upstream end.

2. Linear runoff data is also defined by subreach boundaries.

3. Major changes in hydraulic characteristics, stream temperature, or reaction coefficient values require a subreach division.

4. Possible additional future inputs or changes along the stream to be used in the study can be indicated also by subreaches.

There are several types of data required for each subreach to adequately define model parameters. Special data considerations for each subreach include:

1. Estimate the reaction rate coefficients for the model parameters, for example K_R for a BOD.

2. Check estimated reaeration rates for each subreach obtained by the Bennett-Rathbun reaeration formula. Use other formulae if the values are much higher or lower than expected (see Bennett and Rathbun, 1972). An inert gas tracer measurement determination of reaeration rates should be made if practical (see Rathbun and others, 1976).

3. Inspect each subreach for occurrences of unexpected phenomenas. For example, a large chemical oxygen demand or a toxic waste discharge will require special consideration before the model can be applied. In some cases, for large toxic discharges, the model described in this report should not be used.

General program computation steps are the following:

1. Read input data, initialize variables, and set computation options.

2. Print initial output tables from input data.

3. Compute CBOD, NBOD, coliform, and so forth, concentrations at given x distance increments for each subreach.

4. Print and plot subreach results and observed data.

5. Compute conservative concentrations at given x distance increment for each subreach.

6. Print and plot subreach results.

The program loops through the calculations once every calculation interval, DXPNT. DXPNT is input on card type 2. Because of possible computation errors that can occur, it is important that extreme values of DXPNT are not used. A reasonable range is from .05 miles to 5.0 miles. To avoid exceeding certain arrays in the program, the number of calculation intervals (total length of stream modeled divided by DXPNT) cannot exceed 950.

The major DO, BOD, nitrification, total and fecal-coliform bacteria, and orthophosphate-phosphorus computations of the program are solved within a major interative loop (1 to NSEG, where NSEG is the number of subreaches for a tributary or main stem) in subroutines NITBOD and NITRIF. Each subreach has some specified length, and for each subreach the program gives results at DXPNT increments. Within the program, the initial concentrations for each subreach are updated to the downstream computed value of the previous subreach after each computation cycle. The program then computes the next downstream value after incrementing x, an amount, DXPNT. Traveltime (t) for these computations, DELTT, is computed as the stream traveltime over the distance DXPNT. Since the program is based on a downstream river mileage convention, the distance incrementation is by subtraction rather than addition.

The initial DO deficit (DDO) is updated to the computed downstream deficit value (DD) after each computation cycle. This is done in the same manner as discussed above. The reaeration rate is computed for each printing interval as the program advances through a subreach computation. If desired, the program user may specify an average reach value for the reaeration rate by specifying a subreach mean reaeration rate (AAKAT field of card 52 of input--see Model Options). If AAKAT is specified, it is not corrected for temperature. Tracer techniques for determining stream reaeration are available (see Rathbun and others, 1976) and are recommended.

After computing the DO concentration, the program tests the DO concentration. If it is less than 0.1 mg/L, the routine calls subroutine "ANEROB." For the first entry, the subroutine computes the length of time for the anoxic zone. For successive incremental computation points, the DO concentration is set to zero. After the established traveltime (eq. 18) is exceeded for the anoxic zone, the program returns to a normal processing format.

Linear runoff is specified in the program as a total incoming flow and average concentrations for the length of the subreach. When linear runoff data is specified for the current subreach, mass balance computations are made at each calculation interval, DXPNT. The amount of flow added for a given calculation interval is computed by dividing the runoff flow amount by the number of printing intervals in the runoff subreach. These calculations are made in either subroutine NITBOD or subroutine NITRIF.

MODEL OPTIONS

The program provides six major options. These options are specified on card type 2 by setting the option variable to the specified value as described below.

Option 1: Reaeration rates are calculated using the Bennett and Rathbun (1972) equation. However, if another equation is found to be more applicable to the modeling situation or if a tracer study has been done to determine reaeration rates, these values can be input to the model. This is done by specifying the option variable, ICODE = 1 and inputing values for AAKAT (Card type 52) for each subreach.

Option 2: Linear runoff can be specified for the model. This is done by setting the option variable, IRUNOF = 1 and supplying linear runoff data (card type A) for the subreaches where runoff occurs.

Option 3: From 1 to 3 conservative constituents can be modeled. This is done by specifying the option variable, NCONSV = 1, 2, or 3 and supplying the appropriate data.

Option 4: Traveltimes are calculated using an average stream velocity for each subreach. However, if dye tracer traveltime data is available, it can be used in the model. This is done by specifying the option variable, ITTIFO = 1 and inputing the traveltime data (Card type 51) for each subreach.

Option 5: Nitrogenous BOD can be modeled using the lumped variable NBOD or by modeling the nitrogen cycle. The nitrification cycle is modeled by specifying the option variable, IMODEL = 1 and furnishing the required data.

Option 6: Total and fecal-coliform bacteria can be modeled. This is done by specifying the option variable, ICOLOP = 1 and supplying the required input data.

DATA REQUIREMENTS

Both hydrologic data and waste inflow data must be collected. Data is usually collected over a period of a day or two and at a given time interval to obtain approximate diurnal variation for most of the constituents to be sampled. Stream and waste flows should approximate steady-state conditions for the sample period. Ideally, data for the model should be collected during different seasons of the year, since water-quality characteristics and flows vary considerably over a yearly cycle (Hines and others, 1975). However, calibration and verification data sets usually have to be collected during the critical water-quality period most similar to the anticipated water-qualtiy period for which projections will be made. At least two independent data collection periods are required to calibrate and verify the model.

Data Description

Mean depth and velocity of each subreach - Collected at selected sites along the stream study reach. Adequate number of cross sections should be made to define the mean depth and velocities. Data are used to determine subreach traveltime, estimate reaeration coefficients, and estimate bottom deposits DO deficit values.

Mean cross-sectional area and flow of each subreach	- Collected at selected sites to define subreach flow and mean cross-sectional area.
Dissolved-oxygen concentrations at each site	- Collected at main-stream, tributary, and waste source inflow sites to help define both the measured and computed DO profiles in the stream study reach.
Conservative constituent concentrations and specific conductance, stream ultimate CBOD, NBOD, organic-nitrogen, ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen, fecal and total-coliform bacteria, and orthophosphate-phosphorus samples at each site	- Collected at main-stream, tributary, and waste source inflow sites.
Algal respiration, benthic and photosynthetic data, and chlorophyll a concentrations	- Special data collected at representative sites along main study reach to evaluate constants *R*, *B*, and *P*.
Stream temperature	- Collected at main-stream tributary and waste source inflow sites. Used to temperature-adjust rate constants and to calculate DO saturation values.

DATA INPUT SPECIFICATION

Input to this program is by cards. See attachments C and D for a schematic and examples of card input for the model.

Description	Variable	Columns	Format
Card type 1 - (required) - Any alphanumeric information can be used as a title.			
a. Card type = 1		1	I1
b. Title (alphanumeric)	TITLE	2-77	19A4
Card type 2 - Initial conditions and options (default = 0) (required).			
a. Card type = 2		1	I1
b. Number of subreaches (maximum of 50) for tributary or main stem being modeled	NSEG	3-4	I2
c. Subreach number of main stem where tributary enters. Set to zero for main stem calculations.	JSEG	5-6	I2
d. Option 1 = 0 or blank; compute reaeration rate (AKAT) = 1; read AAKAT (card type 51, card sequence 2, columns 25-29)	ICODE	7	I1
e. Option 2 = 1; tributary or main stem includes linear runoff (card type A) = 0 or blank; no linear runoff	IRUNOF	9	I1
f. Option 3 = 1,2,3; number of sets of conservative data (maximum of 3) to be modeled = 0 or blank; conservative data not included.	NCONSV	10	I1
g. Option 4 = 1; read subreach traveltime data (card type 5, card sequence 1, item S) = 0; traveltime computed from mean subreach discharge, cross-sectional area and length	ITTIFO	11	I1

Description	Variable	Columns	Format
h. Option 5 = 1; nitrogen cycle computation (sequential reaction mode) = 0 or blank; nitrogenous BOD computation	IMODEL	12	I1
i. Option 6 = 1; compute total and fecal-coliform bacteria concentration for tributary or main stem	ICOLOP	13	I1
j. Starting upstream point river mileage (use downstream river mileage convention - decreasing downstream)	XSTRT	14-19	F6.2
k. Calculation interval of results (mi)	DXPNT	20-23	F4.0
l. Initial ultimate CBOD concentration at starting location (mg/L) (reach background conditions upstream from starting location)	BDC	24-27	F4.0
m. Initial ultimate NBOD concentration at starting location (mg/L) (reach background conditions upstream from starting location)	BDN	28-31	F4.0
n. Initial organic-nitrogen concentration (mg/L) (upstream from starting location)	ORGNST	32-35	F4.0
o. Initial ammonia-nitrogen concentration (mg/L) (upstream from starting location)	AMONST	36-39	F4.0
p. Initial nitrite-nitrogen concentration (mg/L) (upstream from starting location)	STNO2	40-43	F4.0
q. Initial nitrate-nitrogen concentration (mg/L) (upstream from starting location)	STNO3	44-47	F4.0
r. Initial DO concentration (mg/L) (upstream from starting location)	DO	48-51	F4.0
s. Initial streamflow (ft^3/s) (flow rate upstream from starting location)	QUPS	52-56	F5.0
t. Initial upstream fecal coliform concentration (colonies/100 mL; program multiplies value given by 1000) (upstream from starting location)	STCOLI	57-60	F4.0

Description	Variable	Columns	Format
u. Initial upstream total coliform concentration (colonies/100 mL; program multiplies value given by 1000) (upstream from starting location)	STCOLT	61-64	F4.0
v. Initial conservative 1 (C1) concentration (mg/L) (background condition upstream from starting location; leave blank if conservatives are not included).	CIUPST	65-70	F6.0
w. Initial conservative 2 (C2) concentration (mg/L) (reach background condition upstream from starting location; leave blank if conserva tives are not included).	C2UPST	71-76	F6.0
x. Initial conservative 3 (C3) concentration (mg/L) (reach background condition upstream from starting location; leave blank if conservatives are not included).	C3UPST	77-80	F4.0
a. Card type = 2		1	I1
b. Card sequence = 2		2	I1
c. Initial orthophosphates concentration (mg/L)	PO4	3-8	F6.0
d. Barometric Pressure (inches of mercury)	BP	9-14	F6.0

Card type I - (required) Three cards type I are used to define the conservative constituent titles printed in initial values table on page one of output (card 1, card 2, card 3). (Leave heading fields blank if conservatives are not to be modeled. Give only once for the first reach card section).

CARD 1

Description	Variable	Columns	Format
a. Card type = I		1	A1
b. Initial C1 description	PTINIT	2-41	10A4

Card 2

Description	Variable	Columns	Format
a. Card type = I		1	A1
b. Initial C2 description	PTINIT	2-41	10A4

Description	Variable	Columns	Format
CARD 3			
a. Card type = I		1	A1
b. Initial C3 description	PTINIT	2-41	10A4

Card type P - Conservative tabular line printer output headings (required) (Leave heading fields blank if conservatives are not to be modeled. Give only once for the first reach card section).

TITLES			
a. Card type = P		1	A1
b. C1 heading for output	PTC1	2-9	2A4
c. C2 heading for output	PTC2	12-19	2A4
d. C3 heading for output	PTC3	22-29	2A4

Card type 3 - Observed data for each reach being modeled (optional input). These data do not necessarily occur at subreach divisions.
(Note: For partial observed data location (one or more of the observed data samples missing), leave the missing data items card fields blank.)
(Maximum of 200 points).

a. Card type = 3		1	I1
b. Observed river mile location (downstream river mile convention)(mi)	OBSMI	3-8	F6.0
c. Observed stream DO concentration (mg/L)	OBSDO	9-15	F7.0
d. Observed stream organic-nitrogen concentration (mg/L)	OBSORG	16-22	F7.0
e. Observed stream ammonia-nitrogen concentration (mg/L)	OBSAMN	23-29	F7.0
f. Observed stream nitrite-nitrogen concentration (mg/L)	OBSNO2	30-36	F7.0
g. Observed stream nitrate-nitrogen concentration (mg/L)	OBSNO3	37-43	F7.0
h. Observed stream fecal-coliform bacteria concentration (colonies/100 mL)	OBSCOL	44-50	F7.0

Description	Variable	Columns	Format
i. Observed stream total-coliform bacteria concentration (colonies/100 mL)	OBSCOT	51-57	F7.0
j. Observed stream conservative constituent concentration (Cl)(mg/L)	OBSC1	58-64	F7.0
k. Observed stream conservative constituent concentration (C2)(mg/L)	OBSC2	65-71	F7.0
l. Observed stream conservative constituent concentration (C3)(mg/L)	OBSC3	72-78	F7.0
Card type = 3		1	I1
Card sequence = 2		2	I1
a. Observed stream ultimate CBOD (mg/L)	OCBODU	3-8	F6.0
b. Observed stream ultimate NBOD (mg/L)	ONBODU	9-15	F7.0
c. Observed stream orthophosphate-phosphorus (mg/L)	OBSPO4	16-22	F7.0
Card type 4 - Point source data.			
a. Card type = 4		1	I1
b. Card sequence = 1		2	I1
c. Ultimate CBOD concentration of waste or tributary (mg/L) (should be left blank if specified in lb/day under "1 WBOCU")	BODCU	3-8	F6.0
d. Direct discharge of ultimate CBOD (lb/day) (should only apply to treatment effluent; leave blank if specified in (mg/L) under "BODCU")	WBODCU	9-14	F6.0
e. Ultimate NBOD discharge concentration of waste or tributary (mg/L) (should be left blank if specified in lb/day below under "WBODN")	BODN	15-20	F6.0
f. Organic-nitrogen discharge concentration of waste or tributary (mg/L) - should be left blank if specified in lb/day below under "ORGNLB"	ORGNTB	21-26	F6.0

Description	Variable	Columns	Format
g. Ammonia-nitrogen discharge concentration of waste or tributary (mg/L) - should be left blank if specified in lb/day below under "AMONLB"	AMONTB	27-32	F6.0
h. Nitrite-nitrogen discharge concentration of waste or tributary (mg/L) - should be left blank if specified in lb/day below under "LBNO2"	TBNO2	33-38	F6.0
i. Nitrate-nitrogen discharge concentration of waste or tributary (mg/L) - should be left blank if specified in lb/day below under "LBNO3"	TBNO3	39-44	F6.0
j. Direct discharge of NBOD (lb/day) (should only apply to treatment plant effluent; leave blank if specified in mg/L under "BODN")	WBODN	45-50	F6.0
k. Direct discharge of organic-nitrogen (lb/day) - should only apply to treatment plant effluent; leave blank if specified in mg/L above under "ORGNTB"	ORGNLB	51-56	F6.0
l. Direct discharge of ammonia-nitrogen (lb/day) - should only apply to treatment plant effluent; leave blank if specified in mg/L above under "AMONTB"	AMONLB	57-62	F6.0
m. Direct discharge of nitrite-nitrogen (lb/day) - should only apply to treatment plant effluent; leave blank if specified in mg/L above under "TBNO2"	LBNO2	63-68	F6.0
n. Direct discharge of nitrate-nitrogen (lb/day) - should only apply to treatment plant effluent; leave blank if specified in mg/L above under "TBNO3"	LBNO3	69-74	F6.0
a. Card type = 4		1	I1
b. Card sequence = 2		2	I1
c. DO of inflow source (mg/L) (point source or waste tributary: applies to "BODCU" and "BODN")	DOD	3-8	F6.0

Description	Variable	Columns	Format
d. Mean temperature of point source waste or tributary (°C)	TEMPTR	9-14	F6.0
e. Benthic deposit demand [(g/m^2)/day] (given as an average value for subreach)	BN	15-20	F6.0
f. Chlorophyll a concentration (μg/L) (average concentration for subreach; used by model to determine plant respiration effects; leave blank if not to be considered)	CHLA	21-26	F6.0
g. Average daily photosynthetic dissolved-oxygen production [(mg/L)/day] (average condition for subreach; leave blank if not to be considered)	PNET	27-32	F6.0
h. Conservative 1 (C1) concentration of point source waste or tributary (mg/L) (leave blank if conservatives are not included)	C1	33-38	F6.0
i. Conservative 2 (C2) concentration of point source waste or tributary (mg/L) (leave blank if conservatives are not included)	C2	39-44	F6.0
j. Conservative 3 (C3) concentration of point source waste or tributary (mg/L) (leave blank if conservatives are not included)	C3	45-50	F6.0
k. Orthophosphate-phosphorus concentration for point source waste or tributary (mg/L) (should be left blank if specified in lb/day under "WPO4CU")	PO4CU	51-56	F6.0
l. Direct discharge of orthophosphate-phosphorus (lb/day) (leave blank if specified in (mg/L) under "PO4CU")	WPO4CU	57-62	F6.0

Card type 5 - Point source waste or tributary flow rate and reaction coefficient data (required)

a. Card type = 5		1	I1
b. Card sequence = 1		2	I1

Description	Variable	Columns	Format
c. Flow rate of waste or tributary (ft^3/s) (value specified can be negative in the case of a diversion)	Q	3-7	F5.0
d. Mean depth of stream for subreach downstream of waste or tributary inflow (ft).	DEPTH	8-12	F5.0
e. Mean cross-sectional area of stream for subreach downstream of waste or tributary inflow (ft^2)	AREA	13-17	F5.0
f. Mean temperature of stream for subreach downstream of waste or tributary inflow (°C)	TEMP	18-20	F3.0
g. Mile at which subreach ends (mi) (river mile location at start of next subreach)	XSEG	21-26	F6.0
h. Average CBOD decay rate for the subreach (1/day). (Expressed as an average subreach instream decay rate)	AKR	27-30	F4.0
i. Average CBOD deoxygenation rate for the subreach (1/day) (expressed as a bottle time decay rate in some cases equal to "AKR" given above)	AKD	31-34	F4.0
j. Average deoxygenation rate for NBOD (1/day) (average NBOD decay rate for subreach)	AKN	35-38	F4.0
k. Average organic-nitrogen forward reaction coefficient for subreach (1/day) expressed as an average subreach instream decay rate	AKORGN	39-42	F4.0
l. Average ammonia-nitrogen forward reaction coefficient for the subreach (1/day) expressed as an average subreach instream decay rate	AKAMON	43-46	F4.0
m. Average nitrite-nitrogen forward reaction coefficient for the subreach (1/day) expressed as an average subreach instream rate	AKNO2	47-50	F4.0

Description	Variable	Columns	Format
n. Average nitrate-nitrogen decay rate for the subreach (1/day) expressed as an average subreach instream rate	AKNO3	51-54	F4.0
o. Fecal-coliform bacteria point source concentration of waste or tributary (colonies/100 mL; program multiplies value given by 1000)	COLITR	55-60	F6.0
p. Total-coliform bacteria point source concentration of waste or tributary (colonies/100 mL; program multiplies value given by 1000)	COLTTR	61-66	F6.0
q. Average fecal-coliform bacteria die-off rate for the subreach (1/day)	COLDIE	67-70	F4.0
r. Average total-coliform bacteria die-off rate for the subreach (1/day)	TOTDIE	71-74	F4.0
s. Subreach mean traveltime for flow condition to be modeled (specified in hours and decimal fraction thereof) Leave blank if ITTIFO = 0 or blank (card type 2, col. 11)	TTSUBR	75-80	F6.0
a. Card type = 5		1	I1
b. Card sequence = 2		2	I1
c. Coefficient (1) for stream bottom deposit uptake rate (1/day) in orthophosphate-phosphorus equation	KPO41	3-7	F5.0
d. Coefficient (2) for orthophosphate-phosphorus chlorophyll a uptake rate (1/day) term in orthophosphate calculation	KPO42	8-12	F5.0
e. Average organic-nitrogen decay rate for subreach (1/day) expressed as an instream decay rate	SKORGN	13-16	F4.0
f. Average ammonia-nitrogen decay rate for the subreach (1/day) expressed as an instream decay rate	SKAMON	17-20	F4.0

Description	Variable	Columns	Format
g. Average nitrite-nitrogen decay rate for the subreach (1/day) expressed as an instream rate	SKNO2	21-24	F4.0
h. Average reaeration rate for the subreach (1/day) - leave blank if ICODE = 0 or blank	AAKAT	25-29	F5.0

Card type A - Linear runoff data for each subreach (maximum number of subreaches is 50) (optional). If given, "IRUNOF" card type 2 should be set to 1, include linear runoff cards for all subreaches in reach being modeled. If no linear runoff exists for some subreaches, punch card type "A" and "A2" for each of these subreaches and leave the rest of the card blank.

a. Card type = A		1	A1
b. CBOD concentration of runoff (mg/L)	LNBODC	3-7	F5.0
c. NBOD concentration of runoff (mg/L) (leave blank if IMODEL = 1)	LNBODN	8-13	F6.0
d. Organic-nitrogen concentration of runoff (mg/L) - leave blank if IMODEL = 0 or blank	LNORGN	14-19	F6.0
e. Ammonia-nitrogen concentration of runoff (mg/L) - leave blank if IMODEL = 0 or blank	LNAMON	20-25	F6.0
f. Nitrate-nitrogen concentration of runoff (mg/L) - leave blank if IMODEL = 0 or blank	LNNO2	26-31	F6.0
g. Nitrate-nitrogen concentration of runoff (mg/L) - leave blank if IMODEL = 0 or blank	LNNO3	32-37	F6.0
h. DO concentration of runoff (mg/L)	LNDO	38-43	F6.0
i. Fecal-coliform bacteria concentration of runoff (colonies/100 mL; program multiplies value given by 1000)	LNCOLI	44-49	F6.0
j. Total-coliform bacteria concentration of runoff (colonies/100 mL; program multiplies value given by 1000)	LNCOLT	50-55	F6.0
k. Conservative 1 (Cl) concentration of runoff (mg/L) (leave blank if conservative not modeled)	LNC1	56-61	F6.0

Description	Variable	Columns	Format
l. Conservative 2 (C2) concentration of runoff (mg/L) (leave blank if conservative not modeled)	LNC2	62-67	F6.0
m. Conservative 3 (C3) concentration of runoff (mg/L) (leave blank if conservative not modeled)	LNC3	68-73	F6.0
n. Total runoff in flow amount for subreach (ft^3/s)	LNQ	74-79	F6.0
a. Card type = A		1	I1
b. Card sequence = 2		2	I1
c. Orthophosphate concentration of runoff (mg/L)	LNPO4	3-7	F5.0

Card type 6 - Reach description data (printout purposes only) (required). Give this data only once for the first reach card section.

Description	Variable	Columns	Format
a. Card type = 6		1	I1
b. Reach number (give as an ascending number sequenced in order subreaches are to be modeled)		2-4	I3
c. Alphabetic code subreach channel description; use following:		5-6	A2

A - Rocky bottom - pool riffle - light vegetation
B - Rocky bottom - pool riffle - medium vegetation
C - Rocky bottom - pool riffle - heavy vegetation
D - Rocky bottom - channel control - light vegetation
E - Rocky bottom - channel control - medium vegetation
F - Rocky bottom - channel control - heavy vegetation
G - Mud bottom - pool riffle - light vegetation
H - Mud bottom - pool riffle - medium vegetation
I - Mud bottom - pool riffle - heavy vegetation
J - Mud bottom - channel control - light vegetation
K - Mud bottom - channel control - medium vegetation
L - Mud bottom - channel control - heavy vegetation

(Note: The code description table is given in the model output below the reach description listing.)

Description	Variable	Columns	Format
d. Name or title of reach (give in order of subreach-modeling sequence)		7-26	5A4

Description	Variable	Columns	Format
e. Begin mile of subreach		27-34	F8.0
f. End mile of subreach		35-42	F8.0

Card type 7 - Point source waste and minor tributary data (printout purposes only) (required). Give this data only once for the initial reach card section.

a. Card type = 7		1	I1
b. Card sequence = 1		2	I1
c. Subreach number (punch in ascending order in which subreaches are modeled; there should be "NSEG" (card type 2) subreach cards)		3-5	I3
d. Month of which sample collected		6-7	A2
e. Year of which sample collected		8-9	A2
f. Code to indicate agency responsible for collection and analysis of sample (such as U.S. Geological Survey; Environmental Protection Agency) (see card type K below; match alphabetic codes with that used in card type K)		10-11	A2
g. Name or title of point source waste or minor tributary		12-31	5A4
h. Mile location on reach where waste or tributary enters stream		32-37	F6.0
i. Mean flow rate of waste or tributary (ft^3/s)		38-43	F6.0
j. Ultimate CBOD concentration of waste or tributary (mg/L)		44-49	F6.0
k. Ultimate NBOD concentration of waste or tributary (mg/L)		50-55	F6.0
l. DO concentration of waste or tributary (mg/L)		56-60	F5.0
m. Mean temperature of waste or tributary (°C)		61-64	F4.0

Description	Variable	Columns	Format
n. Mean conservative 1 (C1) concentration of waste or tributary (mg/L) (leave blank if conservatives are not to be modeled)		65-70	F6.0
o. Mean conservative 2 (C2) concentration of waste or tributary (mg/L) (leave blank if conservatives are not to be modeled)		71-76	F6.0
p. Mean conservative 3 (C3) concentration of waste or tributary (mg/L) (leave blank if conservatives are not to be modeled)		77-80	F4.0
a. Card type = 7		1	I1
b. Card sequence = 2		2	I1
c. Organic-nitrogen concentration of waste or tributary (mg/L)		3-8	F6.0
d. Ammonia-nitrogen concentration of waste or tributary (mg/L)		9-14	F6.0
e. Nitrite-nitrogen concentration of waste or tributary (mg/L)		15-20	F6.0
f. Nitrate-nitrogen concentration of waste or tributary (mg/L)		21-26	F6.0
g. Fecal-coliform bacteria concentration of waste or tributary (colonies/100 mL)		27-34	F8.0
h. Total-coliform bacteria concentration of waste or tributary (colonies/100 mL)		35-42	F8.0

Card type K - Key: Source of waste data listed under card type 7.

Description	Variable	Columns	Format
a. Card type = K		1	I1
b. Alphabetic SOURCE CODE of data collection agency noted on columns 2-77 (serves as explanation for codes on card type 7, columns 9 and 10)	SCODE	2	A1
c. Title of agency for source code listed under column 2 (Note: A tabular output key is given for agencies responsible for data collection and analysis.)	TTLKEY	3-77	19A4

Description	Variable	Columns	Format
Card type 8 - Average subreach streamflow data for the major tributaries and main stem reach. (List values for each reach to be modeled; include data only once for the initial subreach card input section.)			
a. Card type = 8		1	I1
b. Subreach number (include as an ascending number sequenced in order subreaches are to be modeled)		2-4	I3
c. Average subreach discharges (ft^3/s) (same sequence as subreach number, columns 2-4)		5-14	F10.0
d. Average subreach depth (ft) (same sequence as subreach number, columns 2-4)		15-24	F10.0
e. Average subreach velocity (ft/s) (same sequence as subreach number, columns 2-4)		25-34	F10.0
f. Average subreach width (ft) (same sequence as subreach number, columns 2-4)		35-44	F10.0

PROGRAM RUN PREPARATION

Two examples of program deck setups are given in attachment D: one example illustrates a hypothetical problem with several different program options; the other example, for the Chattahoochee River near Atlanta, Ga., illustrates the nitrogen cycle option. A schematic representation of the first card input example is illustrated in figure 3. A general schematic of the deck setup is given in attachment C and indicates the general card sequence for the two example deck setups. The present version of the program requires approximately 210,000 bytes of core storage on IBM 360 or 370 equipment.[1/] A typical program computation run, as illustrated in the output examples, attachment E, requires approximately 7 seconds of IBM 370/165 CPU time.

In preparing the data for the program, as shown in attachment D, the major tributary reaches must be coded before the river main stem reach. The model similarly computes constituent concentrations for the major tributaries first, stores the necessary results, and then computes the main stem reach last. Card types 6, 7, 8, I, P, and K are given only once--for the first major tributary or main stem reach to be modeled. Following is a list of the maximum number of various data items which can be handled within the present model framework:

(1) twenty major tributary reaches;

(2) fifty point sources for each major tributary or main stem reach (point source waste or minor tributary inflow);

(3) two hundred observed measurements for each constituent for each major tributary or main stem reach;

(4) three conservative constituents; and

(5) nine hundred fifty calculation intervals (DXPNT divided by total stream length).

The program does include editing of the card input data by the use of subroutine "REREAD." This subroutine is written in IBM assembly language and is not included as part of the source deck listing. Because of the differences of assembly languages between computer installations, this card editing capability, subroutine "READCD," may have to be rewritten before using it on other installations. Other mathematical and special purpose library subroutines which were used in the model should be available on most computer installations.

[1/] The use of brand names in this report are for identification purposes only and does not imply endorsement by the U.S. Geological Survey.

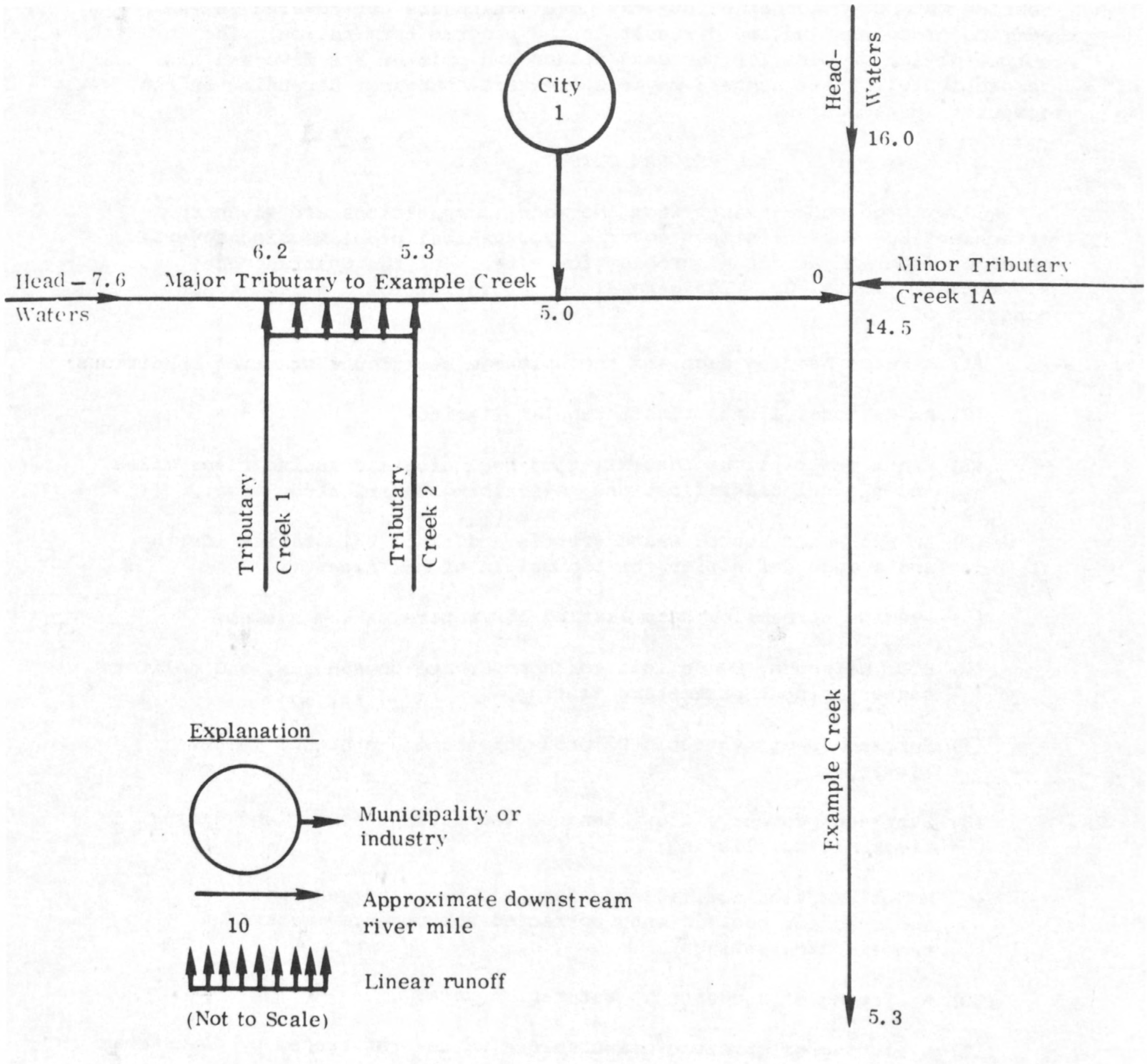


Figure 3.--Model representation of card input example 1--a hypothetical example.

There are numerous printable error messages available from subroutine "READCD." Other errors may occur which are not covered in the editing procedure and could result in the program termination. The output device numbers for the card reader and printer are five and six, respectively. These numbers may also require changing, depending on the computer installation.

PROGRAM OUTPUT

Example output listings from two model computations are given in attachment E. These listings cover a hypothetical problem using several model options and an actual problem for a reach of the Chattahoochee River near Atlanta, Ga. The general output format for a stream reach consists of:

(1) A reach heading page and the upstream background starting conditions;

(2) An optional linear runoff tabular listing;

(3) Reach descriptions consisting of beginning and ending river miles and channel classifications, describing entire study area;

(4) An all point source waste sources and minor tributaries listing and a code definition for the origin of the data;

(5) Average streamflow data listing for entire stream system;

(6) BOD, nitrogen, DO deficit, orthophosphate-phosphorus, and coliform bacteria input parameters listing;

(7) Subreach photosynthetic DO production and benthic DO demands listing;

(8) Subreach geometry, flow changes, water temperature, and ending river mileage listing;

(9) Model reaction coefficients for 20°C water temperature and reaction coefficients corrected for observed water temperature listings;

(10) A listing of subreach DO saturation data;

(11) A listing of observed measurements values referenced by downstream river mileage;

(12) A listing of calculated DO, CBOD, NBOD, nitrogen forms, total and fecal-coliform bacteria, orthophosphate-phosphorus, and individual DO deficits for specified downstream river mileage intervals;

(13) Line printer plots of the CBOD, NBOD, orthophosphate-phosphorus, nitrogen forms, total and fecal-coliform bacteria, DO, and DO deficit concentrations;

(14) Line printer plots of depth versus downstream river mileage location and discharge versus downstream river mileage location;

(15) Conservative constituent concentration data tabular outputs; and

(16) Line printer plots of the conservative constituents versus downstream river mileage location.

DISCUSSION OF MODEL APPLICATION

After the model data have been set up and the initial model calibration run has been completed, the output should be checked for errors. This can be done by examining the input data table listings and checking the output plots for unexpected results.

When all of the input errors are corrected, further steps to calibrate the model can be taken. Plots of CBOD, NBOD, total- and fecal-coliform bacteria should be examined first. If they do not agree with the measured data, additional model runs should be made and respective model decay or reaction coefficients varied until adequate calibration is achieved.

When modeling the nitrogen cycle, the procedure for calibrating each nitrogen form is as follows:

(1) Attempt initially to calibrate using forward reaction coefficients equal to decay rates.

(2) Start by calibrating organic-nitrogen. Then proceed with ammonia-nitrogen, nitrite-nitrogen, and nitrate-nitrogen, respectively, using assumed reaction coefficients until each nitrogen form is calibrated in turn.

(3) After calibration is complete the effect of nitrogen transformations on DO concentrations must be checked.

(4) Computed DO concentrations may be values less than observed values. This indicates a possible sink in the nitrogen cycle. Forward reaction coefficients and decay rates may be adjusted to describe the suspected sink in the system.

A procedure for determining orthophosphate-phosphorus uptake rates is not well documented. However, it has been found that the model is much more sensitive to changes in K_{P1} than to K_{P2} (Bauer, Steele, and Anderson, 1978). If, for preliminary calibration, K_{P2} is assumed equal to zero, then equation 22 reduces to a form in which K_{P1} can be determined using the procedure described in attachment F. K_{P2} can then be adjusted until an adequate calibration is achieved.

After calibration is completed, one or more data sets are required to verify that the model can be used as a reliable predictive tool. The calibrated model is rerun using additional data sets. If an adequate verification is obtained (computed values match measured values with a reasonable degree of accuracy), the model can be used to simulate projected conditions with a reasonable degree of confidence. It is suggested that conditions under which the verification data sets are collected be as close as possible to the conditions that the model is expected to simulate. This will insure that the same reactions are occurring in both cases and that the calibrated-verified model is applicable to the simulation conditions.

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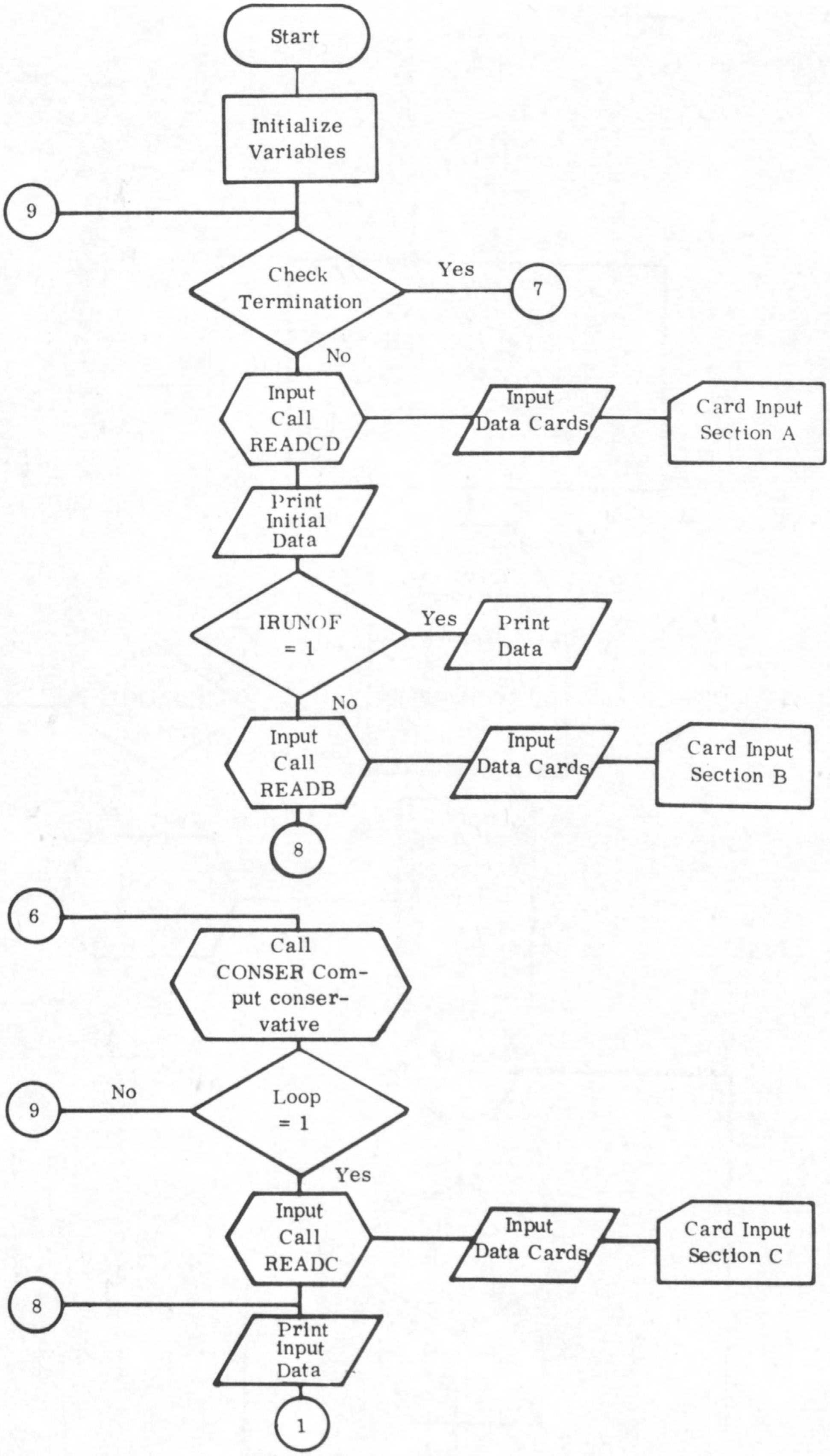
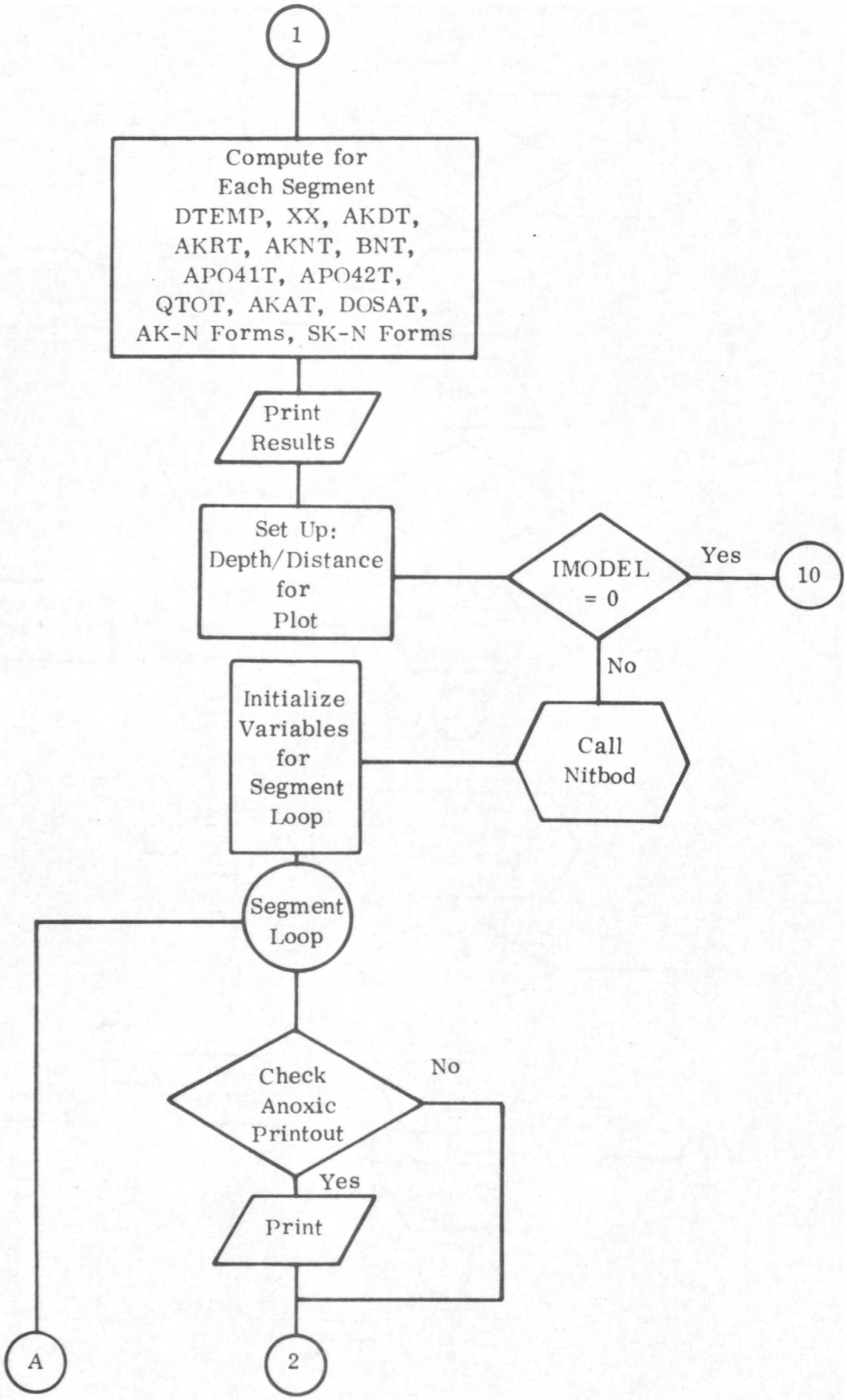
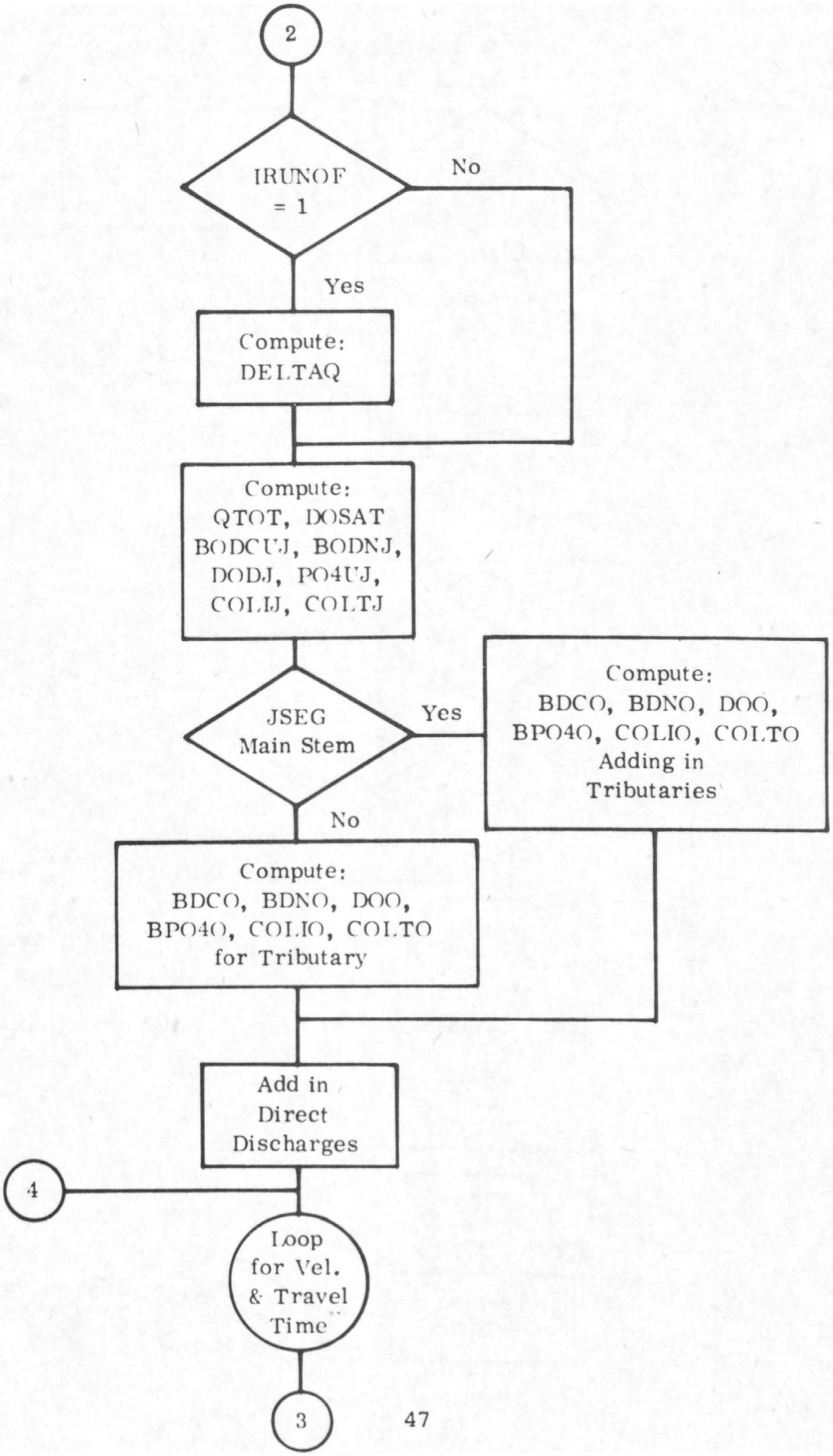
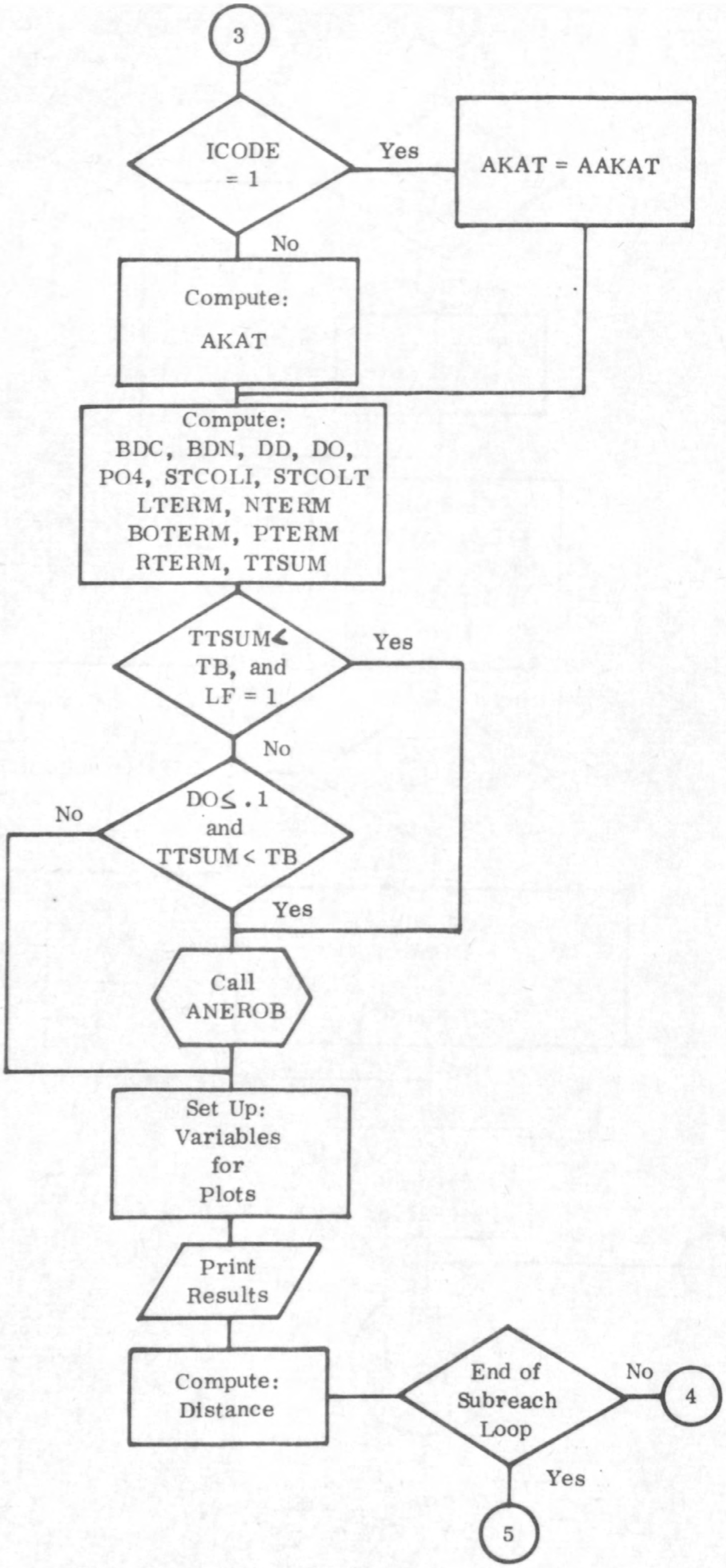
ATTACHMENTS

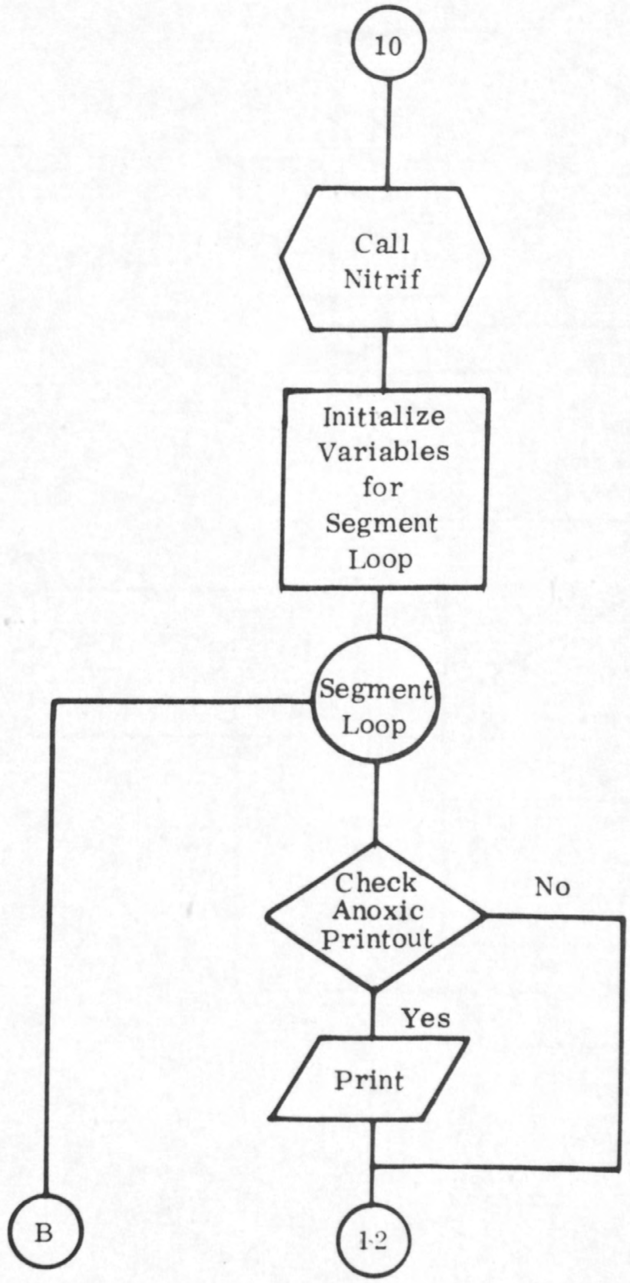
A. GENERALIZED PROGRAM FLOW CHART

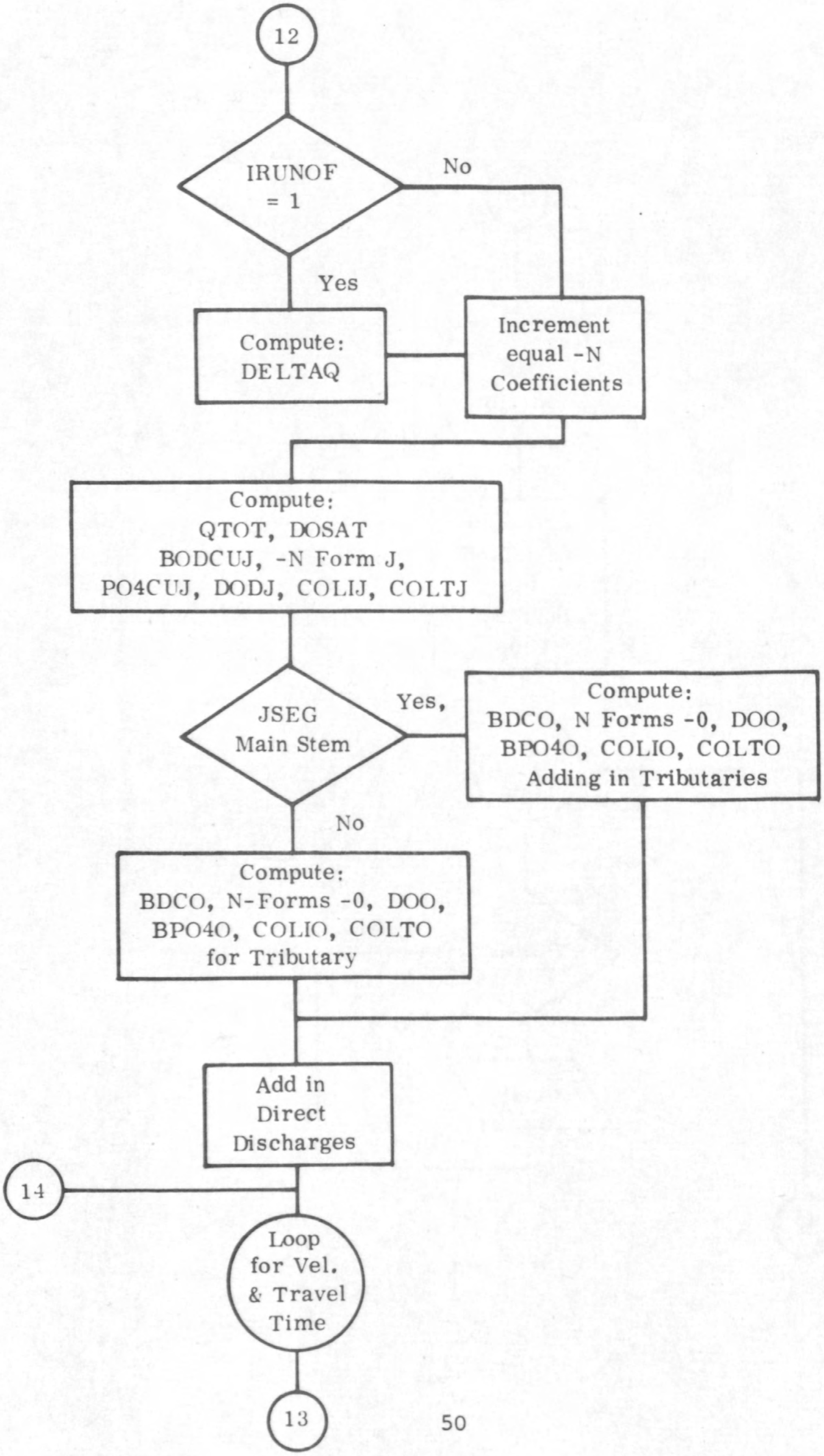

Start
Initialize Variables
9
Check Termination
Yes
7
No
Input Call READCD
Input Data Cards
Card Input Section A
Print Initial Data
IRUNOF = 1
Yes
Print Data
No
Input Call READB
Input Data Cards
Card Input Section B
8
6
Call CONSER Comput conservative
9
No
Loop = 1
Yes
Input Call READC
Input Data Cards
Card Input Section C
8
Print input Data
1

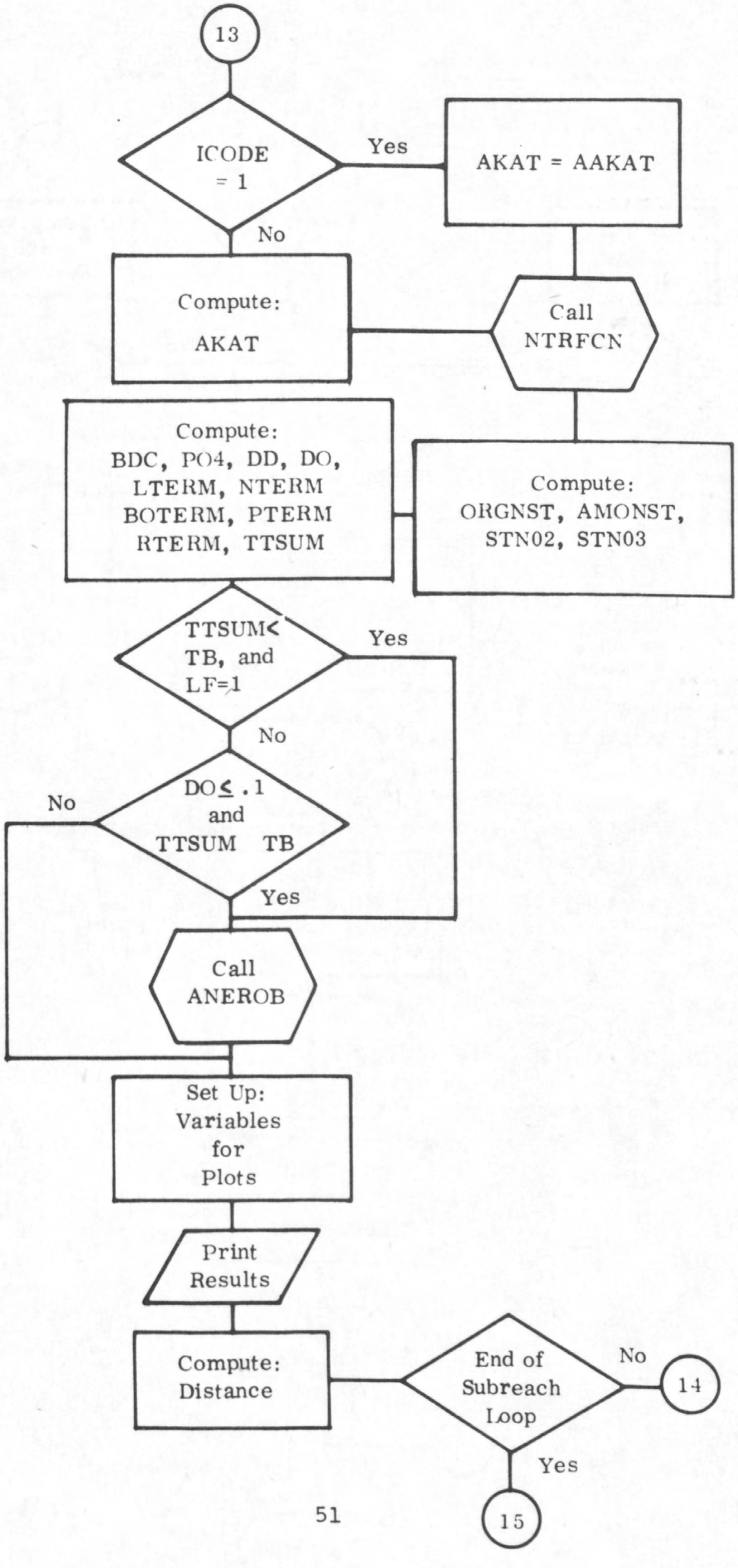

1
Compute for
Each Segment
DTEMP, XX, AKDT,
AKRT, AKNT, BNT,
APO41T, APO42T,
QTOT, AKAT, DOSAT,
AK-N Forms, SK-N Forms
Print
Results
Set Up:
Depth/Distance
for
Plot
IMODEL
= 0
Yes
10
No
Call
Nitbod
Initialize
Variables
for
Segment
Loop
Segment
Loop
Check
Anoxic
Printout
No
Yes
Print
A
2

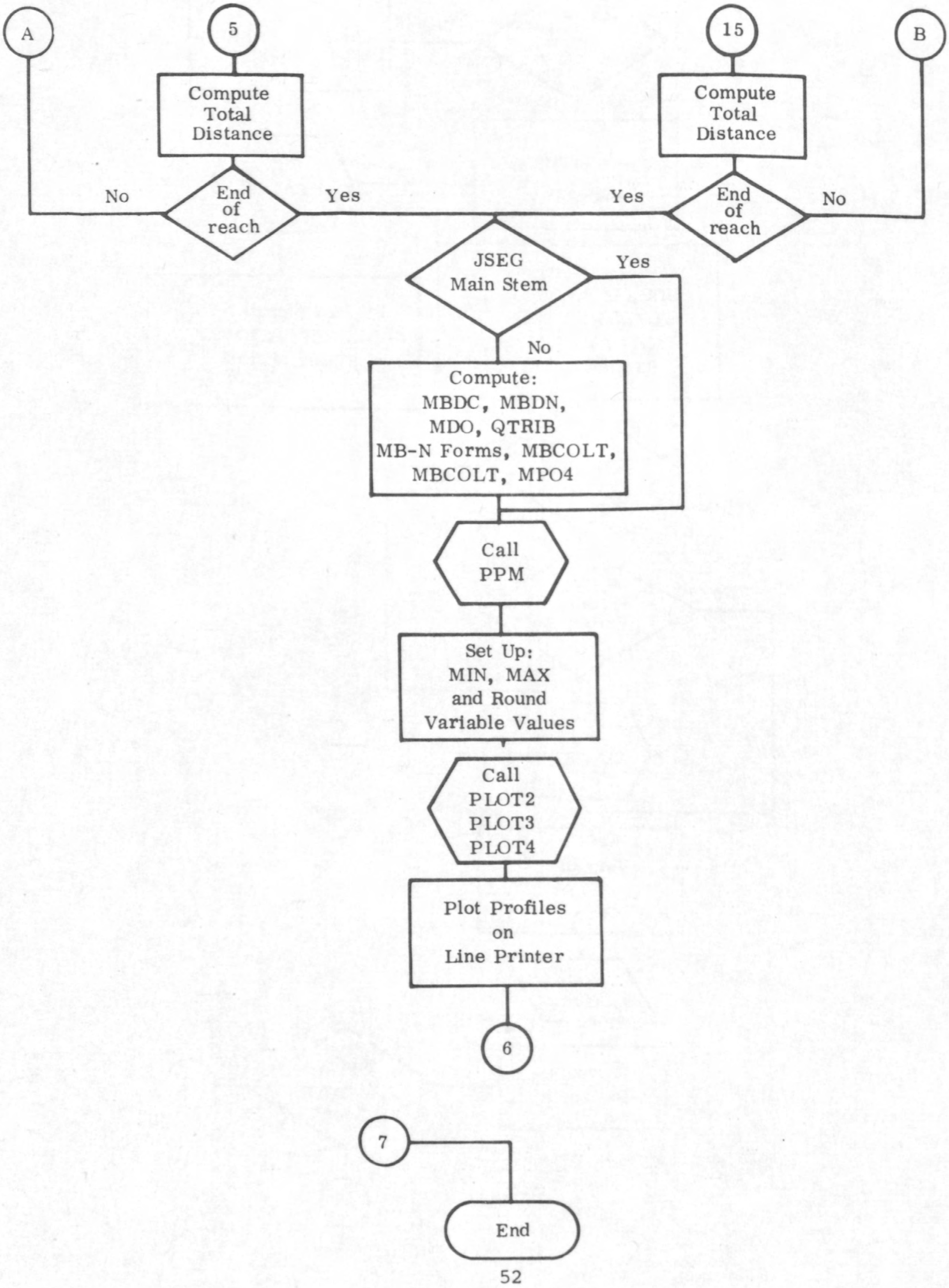

2
IRUNOF = 1
No
Yes
Compute: DELTAQ
Compute: QTOT, DOSAT BODCUJ, BODNJ, DODJ, PO4UJ, COLIJ, COLTJ
JSEG Main Stem
Yes
Compute: BDCO, BDNO, DOO, BPO4O, COLIO, COLTO Adding in Tributaries
No
Compute: BDCO, BDNO, DOO, BPO4O, COLIO, COLTO for Tributary
Add in Direct Discharges
4
Loop for Vel. & Travel Time
3


3
ICODE = 1
Yes
AKAT = AAKAT
No
Compute:
AKAT
Compute:
BDC, BDN, DD, DO,
PO4, STCOLI, STCOLT
LTERM, NTERM
BOTERM, PTERM
RTERM, TTSUM
TTSUM < TB, and LF = 1
Yes
No
No
DO ≤ .1 and TTSUM < TB
Yes
Call
ANEROB
Set Up:
Variables
for
Plots
Print
Results
Compute:
Distance
End of Subreach Loop
No
4
Yes
5


10
Call
Nitrif
Initialize
Variables
for
Segment
Loop
Segment
Loop
Check
Anoxic
Printout
No
Yes
Print
B
12


12
IRUNOF
= 1
No
Yes
Compute:
DELTAQ
Increment
equal -N
Coefficients
Compute:
QTOT, DOSAT
BODCUJ, -N Form J,
PO4CUJ, DODJ, COLIJ, COLTJ
JSEG
Main Stem
Yes,
Compute:
BDCO, N Forms -0, DOO,
BPO4O, COLIO, COLTO
Adding in Tributaries
No
Compute:
BDCO, N-Forms -0, DOO,
BPO4O, COLIO, COLTO
for Tributary
Add in
Direct
Discharges
14
Loop
for Vel.
& Travel
Time
13


13
ICODE = 1
Yes
AKAT = AAKAT
No
Compute: AKAT
Call NTRFCN
Compute: BDC, PO4, DD, DO, LTERM, NTERM BOTERM, PTERM RTERM, TTSUM
Compute: ORGNST, AMONST, STN02, STN03
TTSUM< TB, and LF=1
Yes
No
DO≤ .1 and TTSUM TB
No
Yes
Call ANEROB
Set Up: Variables for Plots
Print Results
Compute: Distance
End of Subreach Loop
No
14
Yes
15


A
5
15
B
Compute Total Distance
Compute Total Distance
No
End of reach
Yes
Yes
End of reach
No
JSEG Main Stem
Yes
No
Compute:
MBDC, MBDN,
MDO, QTRIB
MB-N Forms, MBCOLT,
MBCOLT, MPO4
Call PPM
Set Up:
MIN, MAX
and Round
Variable Values
Call
PLOT2
PLOT3
PLOT4
Plot Profiles on Line Printer
6
7
End

B. PROGRAM LISTING

```
C     ******************************************************************
C     *                                                                *
C     *             STEADY STATE WATER QUALITY MODEL                   *
C     *                                                                *
C     *              GULF COAST HYDROSCIENCE CENTER                    *
C     *                 U. S. GEOLOGICAL SURVEY                        *
C     *             LAST DATE OF REVISION, JUNE 1978                   *
C     *                                                                *
C     ******************************************************************
C
C
C     ..................................................................
C
C     D E S C R I P T I O N   O F   V A R I A B L E S
C
C     ..................................................................
C
C     VARIABLE UNITS DESCRIPTION
C
C     1 BODCU (MG/L) ULTIMATE CARBONACEOUS BOD CONCENTRATION OF THE
C     TRIBUTARY.
C     2 WBODCU (LB/DAY) ULTIMATE CARBONACEOUS BOD DIRECT DISCHARGE
C     3 BODN (MG/L) ULTIMATE NITROGENOUS BOD CONCENTRATION OF THE
C     TRIBUTARY.
C     4 WBODN (LB/DAY)
C     5 DOD (MG/L) DISSOLVED OXYGEN CONCENTRATION OF THE
C     TRIBUTARY CONVERTED TO DO DEFICIT WITHIN PROGRAM.
C     6 TEMPTR (MG/L) WATER TEMPERATURE OF MINOR TRIBUTARY
C     7 BN (MG/SQM/DAY) DISSOLVED OXYGEN UPTAKE OF BENTHIC DEPOSI
C     8 CHLA (UG/L) CHLOROPHYLL A CONCENTRATION
C     9 PNET (MG/L/DAY) NET AVERAGE DAILY PHOTOSYNTHETIC DISSOLVED OXYGE
C     10 C1 (MG/L) CONCENTRATION NO. 1
C     11 C2 (MG/L) CONCENTRATION NO. 2
C     12 C3 (MG/L) CONCENTRATION NO. 3
C     13 Q (CFS) TRIBUTARY FLOW
C     14 DEPTH (FT) STREAM DEPTH
C     15 AREA (SQ FT) CROSS SECTIONAL AREA
C     16 TEMP (DEG CENT) WATER TEMPERATURE OF THE SEGMENT
C     17 XSEG (MI) MILE AT WHICH SEGMENT ENDS
C     18 AKR (/DAY) CBOD DECAY RATE
C     19 AKD (/DAY) CBOD DEOXYGENATION RATE
C     20 AKN (/DAY) NBOD DEOXYGENATION RATE
C     PRODUCTION.
C     21 TTSUBR (HR) SUBREACH TRAVEL TIME
C
C     ..................................................................
C     NOTE: ALL CALCULATIONS DONE WITH BASE E PARAMETERS
C     PROGRAM PROVIDES A DO CALCULATION FOR ANOXIC CONDITIONS
C     ..................................................................
C
C     22 XL (FT) LENGTH ALONG THE STREAM
C     23 NSEG NO. OF STREAM SEGMENTS BEING CONSIDERED
C     24 DXPNT (MI) PRINT INTERVAL OF RESULTS
C     25 X (MI) LENGTH ALONG THE STREAM SEGMENT
C     26 DO (MG/L) DISSOLVED OXYGEN CONCENTRATION
C     27 DOSAT (MG/L) SATURATION CONCENTRATION OF DISSOLVED OXYGEN
```

```
C        28 CHLA (MG/L) CHLOROPHYLL A CONCENTRATION
C        29 JSEG SEGMENT WHERE TRIBUTARY ENTERS MAIN STREAM
C        30 XSTRT THE STARTING VALUE OF XL
C        31 JSEG SUBREACH OF MAIN STEM WHERE TRIBUTARY ENTERS
C        32 BP (LB/SQ IN) BAROMETRIC PRESSURE
C
C        LINEAR RUN-OFF
C
C        33 LNBODC (MG/L) ULTIMATE CARBONACEOUS BOD CONCENTRATION OF TRIBUT
C        34 LNBODN (MG/L) ULTIMATE NITROGENOUS
C        35 LNDO (MG/L) DO CONC.
C        36 LNC1 (MG/L) CONCENTRATION NO. 1
C        37 LNC2 (MG/L) CONCENTRATION NO. 2
C        38 LNC3 (MG/L) CONCENTRATION NO. 3
C        39 LNQ(CFS) FLOW INCREASES(OR DECREASE) IN REACH
C        ***OPTIONS AND ADDED VARIABLES***
C        40 ICODE OPTION TO COMPUTE REAERATION OR READ-IN RATES-ICODE=1
C        41 IRUNOF OPTION TO INPUT LINEAR RUNOFF DATA-IRUNOF=1
C        42 NCONSV OPTION-COMPUTE 1,2,3 CONSERVATIVE MINERALS-NCONSV=1,2,3
C        43 ITTIFO OPTION TO COMPUTE TRAVEL TIME OR READ-IN TIME-ITTIFO=1
C        44 IMODEL OPTION TO COMPUTE NITRIFICATION CYCLE-IMODEL=1
C        45 ICOLOP OPTION TO COMPUTE TOTAL AND FECAL COLIFORMS-ICOLOP=1
C        46 ORGNTB (MG/L) ORGANIC-N CONCENTRATION OF TRIBUTARY
C        47 ORGNLB (LB/D) ORGANIC-N DIRECT DISCHARGE
C        48 AMONTB (MG/L) AMMONIA CONCENTRATION OF TRIBUTARY
C        49 AMONLB (LB/D) AMMONIA-N DIRECT DISCHARGE
C        50 TBNO2 (MG/L) NITRITE-N CONCENTRATION OF TRIBUTARY
C        51 LBNO2 (LB/D) NITRITE-N DIRECT DISCHARGE
C        52 TBNO3 (MG/L) NITRATE-N CONCENTRATION OF TRIBUTARY
C        53 LBNO3 (LB/D) NITRATE-N DIRECT DISCHARGE
C        54 PO4CU (MG/L) ULTIMATE ORTHOPHOSPHATE CONCENTRATION OF TRIBUTARY
C        55 WPO4CU (LB/D) ULTIMATE ORTHOPNOSPHATE DIRECT DISCHARGE
C        56 COLITR (MPN/100ML) FECAL COLIFORM CONCENTRATION OF TRIBUTARY
C        57 COLTTR (MPN/100ML) TOTAL COLIFORM CONCENTRATION OF TRIBUTARY
C        58 AKORGN (1/DAY) ORGANIC-N FORWARD REACTION COEFFICIENT
C        59 SKORGN (1/DAY) ORGANIC-N DECAY RATE
C        60 AKAMON (1/DAY) AMMONIA-N FORWARD REACTION COEFFICIENT
C        61 SKAMON (1/DAY) AMMONIA-N DECAY RATE
C        62 AKNO2 (1/DAY) NITRITE-N FORWARD REACTION COEFFICIENT
C        63 SKNO2 (1/DAY) NITRITE-N DECAY RATE
C        64 AKNO3 (1/DAY) NITRATE-N DECAY RATE
C        65 KPO41 (1/DAY) ORTHOPHOSPHATE BENTHOS UPTAKE RATE
C        66 KPO42 (1/DAY) CHLOROPHYLL A ORTHOPHOSPHATE UPTAKE RATE
C        67 COLDIE (1/DAY) FECAL COLIFORM DIE OFF RATE
C        68 TOTDIE (1/DAY) TOTAL COLIFORM DIE OFF RATE
C        69 AAKAT (1/DAY) REAERATION RATE
C
C        LINEAR RUN-OFF
C        70 LNORGN (MG/L) ORGANIC-N CONCENTRATION
C        71 LNAMON (MG/L) AMMONIA-N CONCENTRATION
C        72 LNNO2 (MG/L) NITRITE-N CONCENTRATION
C        73 LNNO3 (MG/L) NITRATE-N CONCENTRATION
C        74 LNCOLI (MPN/100ML) FECAL COLIFORM CONCENTRATION
C        75 LNCOLT (MPN/100ML) TOTAL COLIFORM CONCENTRATION
C        76 LNPO4 (MG/L) ORTHOPHOSPHATE-PHOSPHORUS CONCENTRATION
C
```

```
                C     ****************************************************************
                C     ****************************************************************
                C     ****************************************************************
                C
                C
0001                   DIMENSION BODCU(50), WBODCU(50), BODN(50), WBODN(50), DOD(50), WDO
                      1D(50), Q(50), DEPTH(50), AREA(50), TEMP(50), XSEG(50), AKR(50), AK
                      2D(50), AKN(50), BN(50), PNET(50), XMOD(50,37), TITLE(19), DOSAT(50
                      3), C1(50), C2(50), C3(50), QTRIB(50), C1TRIB(50), C2TRIB(50), C3TR
                      4IB(50), TTSUBR(50)
0002                   DIMENSION GRAPH(2000), XDIST(999), CHLA(10), D1(999), D2(999), D8(
                      1999), D9(999), OBSMI(200), OBSDO(200), OBSC1(200), OBSC2(200), OBS
                      2C3(200), QPLOT(999), MIPLOT(200), DEPTPT(200), VELBTT(50)
0003                   DIMENSION TTLE(5)
0004                   DIMENSION CSTR1(999), CSTR2(999), CSTR3(999), XXSTR(999)
0005                   DIMENSION ORGNTB(50), AMONTB(50), TBNO2(50), TBNO3(50), ORGNLB(50)
                      1, AMONLB(50), LBNO2(50), LBNO3(50), AKORGN(50), AKAMON(50), AKNO2(
                      250), AKNO3(50), OBSORG(200), OBSAMN(200), OBSNO2(200), OBSNO3(200)
                      3, OBSCOL(200), OBSCOT(200), PLTCOL(999), PLTTOT(999), PLTORG(999),
                      4 PLTAMN(999), PLTNO2(999), PLTNO3(999), COLITR(50), COLTTR(50), CO
                      5LDIE(50), TOTDIE(50)
0006                   INTEGER IR
0007                   EQUIVALENCE (XMOD(1),BODCU), (XMOD(51),WBODCU), (XMOD(101),BODN),
                      1(XMOD(151),ORGNTB), (XMOD(201),AMONTB), (XMOD(251),TBNO2), (XMOD(3
                      201),TBNO3), (XMOD(351),WBODN), (XMOD(401),ORGNLB), (XMOD(451),AMON
                      3LB), (XMOD(501),LBNO2), (XMOD(551),LBNO3), (XMOD(601),DOD), (XMOD(
                      4651),TEMPTR), (XMOD(701),CHLA), (XMOD(751),BN), (XMOD(801),PNET),
                      5(XMOD(851),C1), (XMOD(901),C2), (XMOD(951),C3), (XMOD(1001),Q), (X
                      6MOD(1051),DEPTH), (XMOD(1101),AREA), (XMOD(1151),TEMP), (XMOD(1201
                      7),XSEG), (XMOD(1251),AKR), (XMOD(1301),AKD), (XMOD(1351),AKN), (XM
                      8OD(1401),AKORGN), (XMOD(1451),AKAMON), (XMOD(1501),AKNO2), (XMOD(1
                      9551),AKNO3), (XMOD(1601),COLITR), (XMOD(1651),COLTTR), (XMOD(1701)
                      $,COLDIE), (XMOD(1751),TOTDIE), (XMOD(1801),TTSUBR)
0008                   REAL*8 COBSMI(200),COBSDO(200),COBSC1(200),COBSC2(200),COBSC3(200)
0009                   REAL NTERM,MIPLOT
0010                   REAL LBNO2,LBNO3,LNPO4,MPO4,KPO41,KPO42
0011                   REAL LNBODC(50),LNORGN(50),LNAMON(50),LNNO2(50),LNNO3(50),LNDO(50)
                      1,LNC1(50),LNC2(50),LNC3(50),LNQ(50),LNCOLI(50),LNCOLT(50),LNBODN(5
                      20)
0012                   REAL MBDC(50),MBORGN(50),MBAMON(50),MBNO2(50),MBNO3(50),MDO(50),MB
                      1DN(50),MBCOLI(50),MBCOLT(50)
0013                   INTEGER CARD,PRINT
                C
0014                   COMMON /OBS/ OCBODU(200),ONBODU(200),OBSPO4(200)
0015                   COMMON /ADIT/ PO4CU,WPO4CU,MPO4,LNPO4,PLPO4,KPO41,KPO42,PO4,BP
0016                   DIMENSION KPO41(50), KPO42(50)
0017                   DIMENSION PO4CU(50), WPO4CU(50), MPO4(50), LNPO4(50), PLPO4(999)
0018                   COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
                      1AKNT,BDN,BNT,AKRT,BDC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
                      2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
                      3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
                      4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAU,ISW,TITLE,INITSW,ICDBUF,IRUNOF
                      5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
                      6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
                      7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
                      8ICOLOP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
```

```
              C
0019                COMMON /LCPLOT/ D1,D2,D8,D9,PLTORG,PLTAMN,PLTNO2,PLTNO3,PLTCOL,P_T
                   1TOT,XDIST,QPLOT
0020                COMMON /LCWORK/ X,XL,XX,QUP,TSUM,DTEMP,VELBTT,MDO,IFLAG,ISW1,IFIN,
                   1JJ
0021                COMMON /LC1/ ORGNO,AMONO,FNO20,FNO30,DELTT,AKORGT,AKAMNT,AKNO2T,AK
                   1NO3T,ORGNST,AMONST,STNO2,STNO3
0022                COMMON /LCMB/ MBDC,MBDN,MBORGN,MBAMON,MBNO2,MBNO3,MBCOLI,MBCOLT
0023                COMMON /LCNEW/ IMODEL
0024                COMMON /FILES/ CARD,PRINT
0025                DIMENSION SKORGN(50), SKAMON(50), SKNO2(50), AAKAT(50)
0026                COMMON /SINK/ SKORGN,SKAMON,SKNO2,AAKAT,SKORGT,SKAMNT,SKNO2T
              C
              C     INITIAL QTRIB
              C
0027                DO 10 I=1,50
0028                QTRIB(I)=0.0
0029                C1TRIB(I)=0.0
0030                C2TRIB(I)=0.0
0031                C3TRIB(I)=0.0
0032                LNQ(I)=0.0
0033                LNBODC(I)=0.0
0034                LNBODN(I)=0.0
0035                LNORGN(I)=0.
0036                LNAMON(I)=0.
0037                LNNO2(I)=0.
0038                LNNO3(I)=0.
0039                LNDO(I)=0.0
0040                LNC1(I)=0.0
0041                LNC2(I)=0.0
0042                LNC3(I)=0.0
0043                MBDC(I)=0.0
0044                MBDN(I)=0.0
0045                MBORGN(I)=0.
0046                MBAMON(I)=0.
0047                MBNO2(I)=0.
0048                MBNO3(I)=0.
0049                MDO(I)=0.
0050                LNCOLI(I)=0.
0051                LNCOLT(I)=0.
0052                MBCOLI(I)=0.
0053                MBCOLT(I)=0.
0054                LNPO4(I)=0.0
0055                MPO4(I)=0.0
0056                KPO41(I)=0.0
0057                KPO42(I)=0.0
0058             10 CONTINUE
0059                ISW=0
0060                ISW1=0
0061                IEND=0
0062                INITSW=0
0063                ICDRUF=0
0064                IPT=0
              C
              C
0065             20 IF (IEND.NE.0) GO TO 500
```

```
              C
              C     READ SEC. A DATA,CARDS=1,2,I,P,3,4,5,A
              C
    0065            CALL READCD
              C
    0067            IF (ISWBAD.EQ.1) GO TO 490
              C
    0068            MPT=ICTY
    0069            IF (IMODEL.NE.0) GO TO 30
    0070            WRITE (PRINT,510) TITLE,NSEG,DXPNT,XSTRT,BDC,BDN,DO,PO4,STCOLT,STC
                   1OLI,QUPS
    0071            GO TO 40
    0072         30 CONTINUE
    0073            WRITE (PRINT,860) TITLE,NSEG,DXPNT,XSTRT,BDC,ORGNST,AMONST,STNO2,S
                   1TNO3,DO,PO4,STCOLT,STCOLI,QUPS
    0074         40 CONTINUE
              C
              C     CHECK FOR CONSERVATIVES
    0075            IF (NCONSV.EQ.0) GO TO 80
              C
    0076            GO TO (50,60,70), NCONSV
              C
    0077         50 CONTINUE
    0078            WRITE (PRINT,950) PTINC1,C1UPST
    0079            GO TO 80
              C
    0080         60 CONTINUE
    0081            WRITE (PRINT,960) PTINC1,C1UPST,PTINC2,C2UPST
              C
    0082            GO TO 80
              C
    0083         70 CONTINUE
              C
    0084            WRITE (PRINT,570) PTINC1,C1UPST,PTINC2,C2UPST,PTINC3,C3UPST
              C
    0085         80 CONTINUE
    0086            IF (IRUNOF.NE.1) GO TO 120
    0087            WRITE (PRINT,760) TITLE
    0088            IF (NCONSV.NE.0) GO TO 100
    0089            IF (IMODEL.NE.0) GO TO 90
    0090            WRITE (PRINT,820)
    0091            WRITE (PRINT,830) (J,LNQ(J),LNBODC(J),LNBODN(J),LNDO(J),LNPO4(J),J
                   1=1,NSEG)
    0092            GO TO 120
    0093         90 CONTINUE
    0094            WRITE (PRINT,990)
    0095            WRITE (PRINT,1000) (J,LNQ(J),LNBODC(J),LNORGN(J),LNAMON(J),LNNO2(J
                   1),LNNO3(J),LNDO(J),LNPO4(J),J=1,NSEG)
    0096            GO TO 120
    0097        100 CONTINUE
    0098            IF (IMODEL.NE.0) GO TO 110
    0099            WRITE (PRINT,770) PTC1,PTC2,PTC3
    0100            WRITE (PRINT,780) (J,LNQ(J),LNBODC(J),LNBODN(J),LNDO(J),LNC1(J),LN
                   1C2(J),LNC3(J),LNPO4(J),J=1,NSEG)
    0101            GO TO 120
    0102        110 CONTINUE
```

```
0103           WRITE (PRINT,970) PTC1,PTC2,PTC3
0104           WRITE (PRINT,980) (J,LNQ(J),LNBODC(J),LNORGN(J),LNAMON(J),LNNO2(J)
              1,LNNO3(J),LNDO(J),LNC1(J),LNC2(J),LNC3(J),LNPO4(J),J=1,NSEG)
         C
0105       120 CONTINUE
         C
         C     READ SEC. B DATA,CARDS=6,7,&8
         C
0106           IF (ISW.EQ.0) CALL READB
         C
0107           IF (ISWBAD.EQ.1) GO TO 490
         C
0108           IFIN=0
0109           MLX=0
0110           XA=0.0
0111           XB=0.0
0112           XC=0.0
0113           GO TO 150
         C
0114       130 CONTINUE
         C
         C     CHECK FOR CONSERVATIVE COMPUTATION
0115           IF (NCONSV.EQ.0) GO TO 140
         C      GO COMPUTE CONSERVATIVES **
0116           XSTRT=XSAVE
         C
0117           CALL CONSER
         C
0118       140 CONTINUE
         C     READ MODIFICATIONS
         C
0119           IF (LOOP.EQ.0) GO TO 20
0120           WRITE (PRINT,560)
         C
         C     READ SEC. C DATA,CARD=9
         C
         C
0121           IF (IEND.NE.0) GO TO 500
         C
0122           CALL READC
         C
0123           IF (ISWBAD.EQ.1) GO TO 490
0124           IFIN=0
         C
0125       150 CONTINUE
0126           IF (IMODEL.NE.0) GO TO 180
0127           WRITE (PRINT,520) TITLE
0128           JJ=0
0129           WRITE (PRINT,530) (I,BODCU(I),BODN(I),DOD(I),PO4CU(I),COLTTR(I),CO
              1LITR(I),I=1,NSEG)
0130           WRITE (PRINT,550)
0131           WRITE (PRINT,540) (I,WBODCU(I),WBODN(I),DOD(I),WPO4CU(I),I=1,NSEG)
0132           WRITE (PRINT,580) TITLE,(J,PNET(J),BN(J),J=1,NSEG)
0133           IF (ITTIFO.EQ.0) GO TO 160
0134           WRITE (PRINT,850) (J,Q(J),AREA(J),DEPTH(J),TTSUBR(J),TEMP(J),XSEG(
              1J),J=1,NSEG)
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```
0135          GO TO 170
0136      160 WRITE (PRINT,590) (J,Q(J),AREA(J),DEPTH(J),TEMP(J),XSEG(J),J=1,NSE
             1G)
0137      170 CONTINUE
0138          WRITE (PRINT,600) TITLE
0139          WRITE (PRINT,610) (J,AKR(J),AKD(J),AKN(J),COLDIE(J),TOTDIE(J),KPO4
             11(J),KPO42(J),J=1,NSEG)
0140          WRITE (PRINT,620)
0141          GO TO 220
0142      180 CONTINUE
0143          WRITE (PRINT,870) TITLE
0144          JJ=0
0145          WRITE (PRINT,940) (I,BODCU(I),ORGNTB(I),AMONTB(I),TBNO2(I),TBNO3(I
             1),DOD(I),PO4CU(I),COLTTR(I),COLITR(I),I=1,NSEG)
0146          WRITE (PRINT,890)
0147          WRITE (PRINT,880) (I,WBODCU(I),ORGNLB(I),AMONLB(I),LBNO2(I),LBNO3(
             1I),DOD(I),WPO4CU(I),I=1,NSEG)
0148          WRITE (PRINT,580) TITLE,(J,PNET(J),BN(J),J=1,NSEG)
0149          IF (ITTIFO.EQ.0) GO TO 190
0150          WRITE (PRINT,850) (J,Q(J),AREA(J),DEPTH(J),TTSUBR(J),TEMP(J),XSEG(
             1J),J=1,NSEG)
0151          GO TO 200
0152      190 WRITE (PRINT,590) (J,Q(J),AREA(J),DEPTH(J),TEMP(J),XSEG(J),J=1,NSE
             1G)
0153      200 CONTINUE
0154          WRITE (PRINT,900) TITLE
0155          DO 210 J=1,NSEG
0156      210 WRITE (PRINT,910) J,AKR(J),AKD(J),AKORGN(J),SKORGN(J),AKAMON(J),SK
             1AMON(J),AKNO2(J),SKNO2(J),AKNO3(J),COLDIE(J),TOTDIE(J),KPO41(J),KP
             2042(J)
0157          WRITE (PRINT,920)
0158      220 CONTINUE
0159          QTOT=QUPS
0160          QUP=0.
0161          FMIOLD=XSTRT
0162          DO 310 J=1,NSEG
0163          DTEMP=TEMP(J)-20.
0164          XX=1.047**DTEMP
0165          AKDT=AKD(J)*XX
0166          AKRT=AKR(J)*XX
0167          XX=1.09**DTEMP
0168          AKNT=AKN(J)*XX
0169          APO41T=KPO41(J)*XX
0170          APO42T=KPO42(J)*XX
0171          AKORGT=AKORGN(J)*XX
0172          AKAMNT=AKAMON(J)*XX
0173          AKNO2T=AKNO2(J)*XX
0174          AKNO3T=AKNO3(J)*XX
0175          SKORGT=SKORGN(J)*XX
0176          SKAMNT=SKAMON(J)*XX
0177          SKNO2T=SKNO2(J)*XX
0178          XX=1.065**DTEMP
0179          BNT=BN(J)*XX
0180          IF (JSEG.EQ.0) GO TO 230
0181          QTOT=QTOT+Q(J)+LNQ(J)/2.
0182          GO TO 240
```

```
0183       230 QTOT=QTOT+Q(J)+QTRIB(J)+LNQ(J)/2.
0184       240 CONTINUE
         C     TEST FOR TT OPTION
0185           IF (ITTIFO.EQ.0) GO TO 250
         C     COMPUTE AVERAGE VELOCITY (FT/SEC) FROM LENGTH AND TRAVEL TIME
0186           VELBTT(J)=(FMIOLD-XSEG(J))*5280./(TTSUBR(J)*3600.)
0187           AKAT=(8.76*(VELBTT(J))**0.607/DEPTH(J)**1.689)*1.021**DTEMP
0188           AKAT=AKAT*2.303
0189           FMIOLD=XSEG(J)
         C     TEST FOR K2 TO BE READ
0190       250 IF (ICODE.GT.0) GO TO 260
         C     TEST FOR K2 TO BE COMPUTED BY Q/A
0191           IF (ITTIFO.GT.0) GO TO 270
         C
         C     BENNETT-RATHBUN REAERATION EQUATION
         C
0192           AKAT=(8.76*(QTOT/AREA(J))**0.607/DEPTH(J)**1.689)*1.021**DTEMP
0193           AKAT=AKAT*2.303
0194           GO TO 280
0195       260 AKAT=AAKAT(J)
0196       270 CONTINUE
0197       280 CONTINUE
         C
0198           DOSAT(J)=14.652-.41022*TEMP(J)+.007910*TEMP(J)**2-.00007777*TEMP(
              1J)**3
         C
0199           DOSAT(J)=BP/29.92*DOSAT(J)
0200           IF (IMODEL.NE.0) GO TO 290
0201           WRITE (PRINT,630) J,AKRT,AKDT,AKNT,AKAT,AP041T,AP042T
0202           GO TO 300
0203       290 CONTINUE
0204           WRITE (PRINT,930) J,AKRT,AKDT,AKORGT,SKORGT,AKAMNT,SKAMNT,AKNO2T,S
              1KNO2T,AKNO3T,AKAT,AP041T,AP042T
0205       300 CONTINUE
0206           QTOT=QTOT+LNQ(J)/2.
0207       310 CONTINUE
0208           WRITE (PRINT,650) TITLE,(J,DOSAT(J),J=1,NSEG)
         C     CHECK FOR OBSERVED
0209           IF (MPT.EQ.0) GO TO 370
         C     CHECK FOR CONSERVATIVES
0210           IF (NCONSV.EQ.0) GO TO 340
0211           WRITE (PRINT,690) TITLE,PTC1,PTC2,PTC3
         C
0212           DO 330 I=1,MPT
0213           IF (IPT.LT.45) GO TO 320
0214           WRITE (PRINT,690) TITLE,PTC1,PTC2,PTC3
0215           IPT=0
0216       320 CONTINUE
0217           WRITE (PRINT,710) OBSMI(I),OBSDO(I),OBSC1(I),OBSC2(I),OBSC3(I),OCB
              1ODU(I),ONBODU(I),OBSORG(I),OBSAMN(I),OBSNO2(I),OBSNO3(I),OBSCOT(I)
              7,OBSCOL(I),OBSP04(I)
         C
0218           IPT=IPT+1
0219       330 CONTINUE
0220           GO TO 370
0221       340 CONTINUE
```

```
0222            IPT=0
0223            WRITE (PRINT,660) TITLE
0224            DO 360 I=1,MPT
0225            IF (IPT.LT.45) GO TO 350
0226            WRITE (PRINT,660) TITLE
0227            IPT=0
0228        350 CONTINUE
          C
0229            WRITE (PRINT,670) OBSMI(I),OBSDO(I),OCBODU(I),ONBODU(I),OBSORG(I),
               1OBSAMN(I),OBSNO2(I),OBSNO3(I),OBSCOT(I),OBSCOL(I),OBSPO4(I)
0230            IPT=IPT+1
0231        360 CONTINUE
          C
0232        370 CONTINUE
          C
          C     SET UP DEPTH FOR PLOT
          C
0233            KK=2
0234            MIPLOT(1)=XSTRT
0235            MIPLOT(2)=XSEG(1)
0236            DEPTPT(1)=DEPTH(1)
0237            DEPTPT(2)=DEPTH(1)
0238            IF (NSEG.LT.2) GO TO 390
0239            DO 380 I=2,NSEG
0240            KK=KK+1
0241            MIPLOT(KK)=XSEG(I-1)
0242            DEPTPT(KK)=DEPTH(I)
0243            KK=KK+1
0244            MIPLOT(KK)=XSEG(I)
0245            DEPTPT(KK)=DEPTH(I)
0246        380 CONTINUE
          C
0247        390 CONTINUE
          C
          C     INITIALIZE
          C
0248            XSAVE=XSTRT
0249            X=XSTRT
0250            QTOT=QUPS
0251            QUP=0.
0252            XL=XSTRT
0253            IFLAG=0
0254            TSUM=0.0
0255            DELTAQ=0.0
0256            TT=0.0
          C
          C     PARAMETERS TB AND LF DEFINED FOR ZERO DO CALCULATIONS
          C
0257            TB=0999.99
0258            LF=0
0259            KFLAG=1
          C
          C     SEGMENT LOOP
          C
          C
0260            IF (IMODEL.EQ.0) GO TO 400
```

```
0261          CALL NITRIF
0262          GO TO 410
0263      400 CALL NITBOD
0264      410 CONTINUE
        C
0265          IF (MLX.EQ.1) GO TO 420
0266          GO TO 440
0267      420 IF (IFIN.LT.60) GO TO 430
0268          WRITE (PRINT,640) TITLE
0269          IFIN=13
0270      430 CONTINUE
0271          IFIN=IFIN+1
        C
        C     ONLY FOR TRIBUTARY CALCULATIONS
        C
0272      440 IF (JSEG.LE.0) GO TO 450
0273          MBDC(JSEG)=BDC
0274          MBDN(JSEG)=BDN
0275          MDO(JSEG)=DO
0276          MPO4(JSEG)=PO4
0277          MBORGN(JSEG)=ORGNST
0278          MBAMON(JSEG)=AMONST
0279          MBNO2(JSEG)=STNO2
0280          MBNO3(JSEG)=STNO3
0281          MBCOLI(JSEG)=STCOLI
0282          MBCOLT(JSEG)=STCOLT
0283          QTRIB(JSEG)=QTOT
0284      450 CONTINUE
0285          IF (IMODEL.NE.0) GO TO 460
        C
0286          CALL PMM (D1MIN,D1MAX,D1,JJ)
0287          CALL PMM (OBMIN,OBMAX,OCBODU,MPT)
0288          AMAX=AMAX1(D1MAX,OBMAX)
0289          AMIN=0.0
0290          TRUNAX=FLOAT(IFIX(AMAX))
0291          AMAX=TRUNAX+1.0
0292          WRITE (PRINT,680) TITLE
0293          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0294          CALL PLOT3 (1HC,XDIST,D1,JJ)
0295          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OCBODU,MPT)
0296          CALL PLOT4 (36,36H                CONCENTRATION IN MG/L)
0297          WRITE (PRINT,700)
0298          CALL PMM (D2MIN,D2MAX,D2,JJ)
0299          CALL PMM (OBMIN,OBMAX,ONBODU,MPT)
0300          AMAX=AMAX1(D2MAX,OBMAX)
0301          AMIN=0.0
0302          TRUNAX=FLOAT(IFIX(AMAX))
0303          AMAX=TRUNAX+1.0
0304          WRITE (PRINT,720) TITLE
0305          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0306          CALL PLOT3 (1HC,XDIST,D2,JJ)
0307          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,ONBODU,MPT)
0308          CALL PLOT4 (36,36H                CONCENTRATION IN MG/L)
0309          WRITE (PRINT,730)
0310          CALL PMM (PO4MIN,PO4MAX,PLPO4,JJ)
0311          CALL PMM (OBMIN,OBMAX,OBSPO4,MPT)
```

```
0312            AMIN=AMIN1(PO4MIN,OBMIN)
0313            AMAX=AMAX1(PO4MAX,OBMAX)
0314            TRUNAN=FLOAT(IFIX(AMIN))
0315            DIFF=AMIN-TRUNAN
0316            IF (DIFF.EQ.0.0) TRUNAN=TRUNAN-1.0
0317            AMIN=TRUNAN
0318            TRUNAX=FLOAT(IFIX(AMAX))
0319            AMAX=TRUNAX+1.0
0320            WRITE (PRINT,1130) TITLE
0321            CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0322            CALL PLOT3 (1HC,XDIST,PLPO4,JJ)
0323            IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSPO4,MPT)
0324            CALL PLOT4 (36,36H            CONCENTRATION IN MG/L)
0325            WRITE (PRINT,1140)
      C
0326            IF (ICOLOR.EQ.0) GO TO 480
0327            CALL PMM (TOTMIN,TOTMAX,PLTTOT,JJ)
0328            CALL PMM (COTMIN,COTMAX,OBSCOT,MPT)
0329            AMAX=AMAX1(TOTMAX,COTMAX)
0330            AMIN=0.0
0331            TRUNAX=FLOAT(IFIX(AMAX))
0332            AMAX=TRUNAX+1.
0333            WRITE (PRINT,1090) TITLE
0334            CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0335            CALL PLOT3 (1HC,XDIST,PLTTOT,JJ)
0336            IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSCOT,MPT)
0337            CALL PLOT4 (40,40H      CONCENTRATIONS IN MPN/100 ML)
0338            WRITE (PRINT,1110)
0339            CALL PMM (COFMIN,COFMAX,PLTCOL,JJ)
0340            CALL PMM (COLMIN,COLMAX,OBSCOL,MPT)
0341            AMAX=AMAX1(COFMAX,COLMAX)
0342            AMIN=0.0
0343            TRUNAX=FLOAT(IFIX(AMAX))
0344            AMAX=TRUNAX+1.
0345            WRITE (PRINT,1100) TITLE
0346            CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0347            CALL PLOT3 (1HC,XDIST,PLTCOL,JJ)
0348            IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSCOL,MPT)
0349            CALL PLOT4 (40,40H      CONCENTRATIONS IN MPN/100 ML)
0350            WRITE (PRINT,1120)
      C
0351            GO TO 480
      C         C
0352        460 CONTINUE
0353            CALL PMM (DIMIN,DIMAX,DI,JJ)
0354            CALL PMM (OBMIN,OBMAX,OCBODU,MPT)
0355            AMAX=AMAX1(DIMAX,OBMAX)
0356            AMIN=0.0
0357            TRUNAX=FLOAT(IFIX(AMAX))
0358            AMAX=TRUNAX+1.0
0359            WRITE (PRINT,680) TITLE
0360            CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0361            CALL PLOT3 (1HC,XDIST,DI,JJ)
0362            IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OCBODU,MPT)
0363            CALL PLOT4 (36,36H            CONCENTRATION IN MG/L)
0364            WRITE (PRINT,700)
```

```
      C
0365        CALL PMM (PO4MIN,PO4MAX,PLPO4,JJ)
0366        CALL PMM (OBMIN,OBMAX,OBSPO4,MPT)
0367        AMAX=AMAX1(PO4MAX,OBMAX)
0368        AMIN=0.0
0369        TRUNAX=FLOAT(IFIX(AMAX))
0370        AMAX=TRUNAX+1.0
0371        WRITE (PRINT,1130) TITLE
0372        CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0373        CALL PLOT3 (1HC,XDIST,PLPO4,JJ)
0374        IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSPO4,MPT)
0375        CALL PLOT4 (36,36H          CONCENTRATION IN MG/L)
0376        WRITE (PRINT,1140)
      C
      C
0378        CALL PMM (ORGMIN,ORGMAX,PLTORG,JJ)
0379        CALL PMM (OBOMIN,OBOMAX,OBSORG,MPT)
0380        AMAX=AMAX1(ORGMAX,OBOMAX)
0381        AMIN=0.0
0382        TRUNAX=FLOAT(IFIX(AMAX))
0383        AMAX=TRUNAX+1.0
0384        WRITE (PRINT,1010) TITLE
0385        CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0386        CALL PLOT3 (1HC,XDIST,PLTORG,JJ)
0387        IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSORG,MPT)
0388        CALL PLOT4 (36,36H          CONCENTRATION IN MG/L)
0389        WRITE (PRINT,1020)
0390        CALL PMM (AMNMIN,AMNMAX,PLTAMN,JJ)
0391        CALL PMM (OBAMIN,OBAMAX,OBSAMN,MPT)
0392        AMAX=AMAX1(AMNMAX,OBAMAX)
0393        AMIN=0.0
0394        TRUNAX=FLOAT(IFIX(AMAX))
0395        AMAX=TRUNAX+1.
0396        WRITE (PRINT,1030) TITLE
0397        CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0398        CALL PLOT3 (1HC,XDIST,PLTAMN,JJ)
0399        IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSAMN,MPT)
0400        CALL PLOT4 (36,36H          CONCENTRATION IN MG/L)
0401        WRITE (PRINT,1040)
      C
0402        CALL PMM (O2MIN,O2MAX,PLTNO2,JJ)
0403        CALL PMM (OB2MIN,OB2MAX,OBSNO2,MPT)
0404        AMAX=AMAX1(O2MAX,OB2MAX)
0405        AMIN=0.0
0406        TRUNAX=FLOAT(IFIX(AMAX))
0407        AMAX=TRUNAX+1.
0408        WRITE (PRINT,1050) TITLE
0409        CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0410        CALL PLOT3 (1HC,XDIST,PLTNO2,JJ)
0411        IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSNO2,MPT)
0412        CALL PLOT4 (36,36H          CONCENTRATION IN MG/L)
0413        WRITE (PRINT,1060)
      C
0414        CALL PMM (O3MIN,O3MAX,PLTNO3,JJ)
0415        CALL PMM (OB3MIN,OB3MAX,OBSNO3,MPT)
0416        AMAX=AMAX1(O3MAX,OB3MAX)
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0417          AMIN=0.0
0418          TRUNAX=FLOAT(IFIX(AMAX))
0419          AMAX=TRUNAX+1.
0420          WRITE (PRINT,1070) TITLE
0421          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0422          CALL PLOT3 (1HC,XDIST,PLTNO3,JJ)
0423          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSNO3,MPT)
0424          CALL PLOT4 (36,36H                       CONCENTRATION IN MG/L)
0425          WRITE (PRINT,1080)
        C
0426      470 CONTINUE
        C
0427          IF (ICOLOP.EQ.0) GO TO 480
0428          CALL PMM (TOTMIN,TOTMAX,PLTTOT,JJ)
0429          CALL PMM (COTMIN,COTMAX,OBSCOT,MPT)
0430          AMAX=AMAX1(TOTMAX,COTMAX)
0431          AMIN=0.0
0432          TRUNAX=FLOAT(IFIX(AMAX))
0433          AMAX=TRUNAX+1.
0434          WRITE (PRINT,1090) TITLE
0435          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0436          CALL PLOT3 (1HC,XDIST,PLTTOT,JJ)
0437          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSCOT,MPT)
0438          CALL PLOT4 (40,40H              CONCENTRATIONS IN MPN/100 ML)
0439          WRITE (PRINT,1110)
0440          CALL PMM (COFMIN,COFMAX,PLTCOL,JJ)
0441          CALL PMM (COLMIN,COLMAX,OBSCOL,MPT)
0442          AMAX=AMAX1(COFMAX,COLMAX)
0443          AMIN=0.0
0444          TRUNAX=FLOAT(IFIX(AMAX))
0445          AMAX=TRUNAX+1.
0446          WRITE (PRINT,1100) TITLE
0447          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0448          CALL PLOT3 (1HC,XDIST,PLTCOL,JJ)
0449          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSCOL,MPT)
0450          CALL PLOT4 (40,40H              CONCENTRATIONS IN MPN/100 ML)
0451          WRITE (PRINT,1120)
        C
        C
0452      480 CONTINUE
0453          CALL PMM (D9MIN,D9MAX,D9,JJ)
0454          CALL PMM (OBSMIN,OBSMAX,OBSDO,MPT)
0455          CALL PMM (D8MIN,D8MAX,D8,JJ)
0456          BMAX=D9MAX
0457          IF (OBSMAX.GT.D9MAX) BMAX=OBSMAX
0458          IF (D8MAX.GT.OBSMAX.AND.D8MAX.GT.D9MAX) BMAX=D8MAX
0459          BMIN=0.0
0460          TRUNBX=FLOAT(IFIX(BMAX))
0461          BMAX=TRUNBX+1.0
0462          WRITE (PRINT,740) TITLE
0463          CALL PLOT2 (GRAPH,XL,XSAVE,BMAX,BMIN,PRINT)
0464          CALL PLOT3 (1HC,XDIST,D9,JJ)
0465          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSDO,MPT)
0466          CALL PLOT3 (1HD,XDIST,D8,JJ)
0467          CALL PLOT4 (36,36H                       CONCENTRATION IN MG/L)
0468          WRITE (PRINT,750)
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0469          CALL PMM (QMIN,QMAX,QPLOT,JJ)
0470          AMIN=QMIN
0471          AMAX=QMAX
0472          AMIN=AMIN-AMIN*.25
0473          AMAX=(AMAX+AMAX*.25)+1.
0474          AMIN=FLOAT(IFIX(AMIN))
0475          AMAX=FLOAT(IFIX(AMAX))
0476          WRITE (PRINT,790) TITLE
0477          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0478          CALL PLOT3 (1HX,XDIST,QPLOT,JJ)
0479          CALL PLOT4 (34,34H                    DISCHARGE  CFS)
0480          WRITE (PRINT,800)
0481          CALL PMM (DEPMIN,DEPMAX,DEPTPT,KK)
0482          AMIN=DEPMIN
0483          AMAX=DEPMAX
0484          AMIN=AMIN-AMIN*.25
0485          AMAX=(AMAX+AMAX*.25)+1.
0486          AMIN=FLOAT(IFIX(AMIN))
0487          AMAX=FLOAT(IFIX(AMAX))
0488          WRITE (PRINT,810) TITLE
0489          CALL PLOT2 (GRAPH,XL,XSAVE,AMAX,AMIN,PRINT)
0490          CALL PLOT3 (1HX,MIPLOT,DEPTPT,KK)
0491          CALL PLOT4 (34,34H                         DEPTH  FEET)
0492          WRITE (PRINT,800)
0493          GO TO 130
0494      490 WRITE (PRINT,840)
0495      500 STOP
        C
        C
        C
0496      510 FORMAT (1H1,///////47X,45H       STEADY STATE WATER QUALITY MODEL
             1      //54X,30HGULF COAST HYDROSCIENCE CENTER//57X,23HU. S. GEOLOGI
             2CAL SURVEY//51X,37HDATE OF LAST REVISION, FEBRUARY  1978/////40X,1
             39A4//48X,40HNUMBER OF SUBREACHES FOR THIS PROBLEM = ,I4/////52X,28
             4HPRINTING INTERVAL (MILES) = ,F7.3//51X,28HSTARTING DISTANCE (MILE
             5S) = ,F8.3//42X,48HINITIAL CBOD CONC (MG/L) AT STARTING DISTANCE =
             6 ,F7.3//42X,48HINITIAL NBOD CONC (MG/L) AT STARTING DISTANCE = ,F7
             7.3//43X,45HINITIAL DO CONC (MG/L) AT STARTING DISTANCE = ,F7.3//42
             8X,53HINITIAL PHOSPHATE CONC (MG/L) AT STARTING DISTANCE = ,F7.3//4
             92X,60HINITIAL TOT. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE =
             $,F8.0//42X,60HINITIAL FEC. COLIF. CONC (MPN/100ML) AT STARTING DIS
             $TANCE = ,F8.0//46X,40HSTREAMFLOW (CFS) AT STARTING DISTANCE = ,F9.
             $3//)
0497      520 FORMAT (1H1,////40X,19A4///54X,30HI N P U T   P A R A M E T E R S,/
             1//60X,26HCONCENTRATIONS(MG/L) OF --,//04X,10H SUBREACH ,01X,21HCAR
             2BONACEOUS ULT. BOD,13X,15HNITROGENOUS BOD,08X,10HDO DEFICIT,8X,9HP
             3HOSPHATE,2X,10HTOT.COLIF.,2X,10HFEC.COLIF./)
0498      530 FORMAT (05X,I4,07X,F10.3,22X,F10.3,12X,F10.3,6X,F10.3,5X,F8.0,4X,F
             18.0)
0499      540 FORMAT (15X,I4,27X,F10.3,22X,F10.3,12X,F10.3,6X,F10.3)
0500      550 FORMAT (///,58X,31HDIRECT DISCHARGES(LB/DAY) OF --,//15X,8HSUBREAC
             1H,20X,21HCARBONACEOUS ULT. BOD,13X,15HNITROGENOUS BOD,10X,10HDO DE
             2FICIT,8X,9HPHOSPHATE/)
0501      560 FORMAT (1H1)
0502      570 FORMAT (45X,10A4,2H =,F7.2//46X,10A4,2H =,F7.3//46X,10A4,2H =,F7.3
             1)
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0503         580 FORMAT (1H1////40X,19A4///21X,10H SUBREACH ,21X,32HNET PHOTOSYNTHE
                1TIC DO PRODUCTION,17X,17HBENTHIC DO DEMAND/53X,10H(MG/L/DAY),31X,1
                22H(G/SQ M/DAY)//(24X,I3,38X,F6.3,36X,F6.3))
0504         590 FORMAT (//61X,15HG E O M E T R Y,//2X,8HSUBREACH,16X,11HFLOW CHANG
                1E,18X,4HAREA,18X,5HDEPTH,20X,4HTEMP,20X,6HEND MI,/29X,5H(CFS),20X,
                26H(SQFT),18X,4H(FT),17X,10H(DEG.CENT),18X,4H(MI)//(4X,I3,18X,F9.1,
                318X,F7.0,16X,F7.2,18X,F7.2,18X,F7.2))
0505         600 FORMAT (1H1////40X,19A4///45X,48HR E A C T I O N   C O E F F I C I
                1 E N T S (/DAY)//19X,8HSUBREACH,10X,2HKR,14X,2HKD,13X,2HKN,9X,5HKC
                2OLF,8X,5HKCOLT,8X,5HKPO41,8X,5HKPO42//)
0506         610 FORMAT (21X,I3,9X,F7.3,9X,F7.3,8X,F7.3,6X,F7.3,6X,F7.3,6X,F7.3,6X,
                1F7.3)
0507         620 FORMAT (//48X,50HTEMPERATURE CORRECTED REACTION COEFFICIENTS (/DAY
                1),//,19X,8HSUBREACH,10X,2HKR,14X,2HKD,13X,2HKN,09X,2HKA,08X,5HKPO4
                21,09X,5HKPO42//)
0508         630 FORMAT (21X,I3,9X,F7.3,9X,F7.3,8X,F7.3,6X,F7.3,6X,F7.3,6X,F7.3)
0509         640 FORMAT (1H1/40X,19A4//57X,23HRESULTS OF COMPUTATIONS///52X,55H
                1S U B R E A C H     D E F I C I T S/54X,54(1H_))
0510         650 FORMAT (1H1////40X,19A4///50X,8HSUBREACH,19X,13HDO SATURATION/80X,
                16H(MG/L)//(52X,I3,22X,F9.3))
0511         660 FORMAT (1H1////40X,19A4///44X,40HO B S E R V E D   M E A S U R E M
                1E N T S,/42X,44(1H-)//5X,8HDISTANCE,4X,7HDO CONC,5X,5HCBODU,5X,5HN
                2BODU,5X,5HORG-N,5X,5HNH3-N,5X,5HNO2-N,5X,5HNO3-N,6X,5HTOTAL,6X,5HF
                3ECAL,5X,3HPO4/7X,4H(MI),7X,6H(MG/L),4X,6H(MG/L),4X,6H(MG/L),5X,6H(
                4MG/L),4X,6H(MG/L),4X,6H(MG/L),3X,6H(MG/L),4X,8HCOLIFORM,3X,8HCOLIF
                5ORM,3X,6H(MG/L)/)
0512         670 FORMAT (2X,F8.2,5X,F8.2,4X,F6.2,4X,F6.2,5X,F6.2,4X,F6.2,4X,F6.2,4X
                1,F6.2,4X,F8.2,3X,F8.2,F8.2)
0513         680 FORMAT (1H1,40X,19A4/30X,59HCALCULATED AND OBSERVED CBOD CONCENTRA
                1TIONS VERSUS DISTANCE/)
0514         690 FORMAT (1H1////40X,19A4///44X,40HO B S E R V E D   M E A S U R E M
                1E N T S,/42X,44(1H-)//2X,8HDISTANCE,3X,7HDO CONC,2X,2A4,2X,2A4,2X,
                22A4,2X,5HCBODU,2X,5HNBODU,3X,5HORG-N,3X,5HNH3-N,3X,5HNO2-N,3X,5HNO
                33-N,4X,5HTOTAL,6X,5HFECAL,4X,3HPO4/4X,4H(MI),6X,6H(MG/L),3X,6H(MG/
                4L),4X,6H(MG/L),4X,6H(MG/L),2X,6H(MG/L),2X,6H(MG/L),2X,6H(MG/L),2X,
                56H(MG/L),2X,6H(MG/L),2X,6H(MG/L),1X,8HCOLIFORM,3X,8HCOLIFORM,2X,6H
                6(MG/L)/)
0515         700 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,25HCALCULATED CBODU CONC
                1= C/11X,23HOBSERVED CBODU CONC = O)
0516         710 FORMAT (1X,F8.2,3X,F8.2,1X,F8.2,2X,F8.2,2X,F8.2,1X,F8.2,F8.2,F8.2,
                1F8.2,F8.2,F8.2,1X,F8.0,2X,F8.0,F8.2)
0517         720 FORMAT (1H1,40X,19A4/30X,59HCALCULATED AND OBSERVED NBOD CONCENTRA
                1TIONS VERSUS DISTANCE/)
0518         730 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,25HCALCULATED NBODU CONC
                1= C/11X,23HOBSERVED NBODU CONC = O)
0519         740 FORMAT (1H1,40X,19A4/32X,72HCALCULATED AND OBSERVED DO CONCENTRATI
                1ONS AND DO DEFICIT VERSUS DISTANCE/)
0520         750 FORMAT (1H ,/61X,17HDISTANCE IN MILES/11X,22HCALCULATED DO CONC =
                1C/11X,20HOBSERVED DO CONC = O/11X,14HDO DEFICIT = D)
0521         760 FORMAT (1H1////40X,19A4)
0522         770 FORMAT (///37X,50HS U B R E A C H   L I N E A R   R U N O F F   D A T
                1 A/35X,54(1H_)//05X,8HSUBREACH,10X,1HQ,10X,4HCBOD,10X,4HNBOD,8X,2H
                2DO,16X,2A4,8X,2A4,8X,2A4,8X,3HPO4/21X,5H(CFS),7X,6H(MG/L),7X,6H(MG
                3/L),6X,6H(MG/L),14X,6H(MG/L),10X,6H(MG/L),12X,6H(MG/L),7X,6H(MG/L)
                4/)
0523         780 FORMAT (07X,I3,6X,F9.2,3X,F9.1,6X,F9.1,4X,F7.1,11X,F9.1,9X,F7.1,10
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                1X,F7.1,6X,F7.1)
0524       790 FORMAT (1H1,40X,19A4/46X,39HDISCHARGE (CFS) VERSUS DISTANCE (MILES
                1))
0525       800 FORMAT (1H /61X,16HDISTANCE (MILES))
0526       810 FORMAT (1H1,40X,19A4/46X,36HDEPTH (FEET) VERSUS DISTANCE (MILES))
0527       820 FORMAT (///37X,50HS U B R E A C H  L I N E A R  R U N O F F  D A T
               1 A/35X,54(1H_)//10X,8HSUBREACH,10X,1HQ,10X,4HCBOD,10X,4HNBOD,8X,2H
               2DO,6X,3HPO4/26X,5H(CFS),7X,6H(MG/L),8X,6H(MG/L),6X,6H(MG/L),4X,6H(
               3MG/L))
0528       830 FORMAT (12X,I3,5X,F9.2,3X,F9.1,6X,F9.1,4X,F7.1,2X,F7.1)
0529       840 FORMAT (1H1,10X,32HERROR HAS OCCURRED IN INPUT DATA)
0530       850 FORMAT (//61X,15HG E O M E T R Y,//2X,8HSUBREACH,12X,11HFLOW CHANG
               1E,14X,4HAREA,14X,5HDEPTH,10X,9HTRAV.TIME,16X,4HTEMP,17X,6HEND MI,/
               225X,5H(CFS),16X,6H(SQFT),14X,4H(FT),12X,5H(HRS),15X,10H(DEG.CENT),
               315X,4H(MI)//(4X,I3,15X,F9.1,14X,F7.0,12X,F7.2,9X,F7.4,15X,F7.1,15X
               4,F7.2))
0531       860 FORMAT (1H1,///////47X,45HSTEADY STATE SEGMENTED DISSOLVED OXYGEN
               1MODEL//54X,30HGULF COAST HYDROSCIENCE CENTER//57X,23HU. S. GEOLOGI
               2CAL SURVEY//51X,37HDATE OF LAST REVISION, FEBRUARY  1978/////40X,1
               39A4//48X,'NITRIFICATION CYCLE INCLUDED IN MODEL'////48X,40HNUMBER
               4OF SUBREACHES FOR THIS PROBLEM = ,I4/////52X,28HPRINTING INTERVAL
               5(MILES) = ,F7.3//51X,28HSTARTING DISTANCE (MILES) = ,F8.3//42X,48H
               6INITIAL CBOD CONC (MG/L) AT STARTING DISTANCE = ,F7.2//42X,'INITIA
               7L ORGANIC NITROGEN CONC (MG/L) AT STARTING DISTANCE = ',F7.3//42X,
               8'INITIAL AMMONIUM NITROGEN CONC (MG/L) AT STARTING DISTANCE = ',F7
               9.3//42X,'INITIAL NITRITE NITROGEN CONC (MG/L) AT STARTING DISTANCE
               $ = ',F7.3//42X,'INITIAL NITRATE NITROGEN CONC (MG/L) AT STARTING D
               $ISTANCE = ',F7.3//42X,46HINITIAL DO CONC (MG/L) AT STARTING DISTAN
               $CE = ,F7.3//42X,53HINITIAL PHOSPHATE CONC (MG/L) AT STARTING DISTA
               $NCE = ,F7.3//42X,60HINITIAL TOT. COLIF. CONC (MPN/100ML) AT STARTI
               $NG DISTANCE = ,F8.0//42X,60HINITIAL FEC. COLIF. CONC (MPN/100ML) A
               $T STARTING DISTANCE = ,F8.0//46X,40HSTREAMFLOW (CFS) AT STARTING D
               $ISTANCE = ,F9.3//)
0532       870 FORMAT (1H1,////40X,19A4///54X,30HI N P U T  P A R A M E T E R S,/
               1//60X,26HCONCENTRATIONS(MG/L) OF --,//5X,8HSUBREACH,3X,8HCARB BOD,
               24X,5HORG-N,6X,5HNH3-N,6X,5HNO2-N,6X,5HNO3-N,5X,10HDO DEFICIT,4X,3H
               3PO4,5X,10HTOT.COLIF.,5X,10HFEC.COLIF./)
0533       880 FORMAT (4X,I5,6X,F10.2,10X,F10.2,8X,F10.2,8X,F10.2,8X,F10.2,8X,F10
               1.0,1X,F10.0)
0534       890 FORMAT (///,58X,31HDIRECT DISCHARGES(LB/DAY) OF --,//4X,8HSUBREACH
               1,2X,21HCARBONACEOUS ULT. BOD,2X,16HORGANIC NITROGEN,2X,16HAMMONIA
               2NITROGEN,2X,16HNITRITE NITROGEN,2X,16HNITRATE NITROGEN,2X,10HDO DE
               3FICIT,2X,9HPHOSPHATE/)
0535       900 FORMAT (1H1////40X,19A4///45X,48HR E A C T I O N   C O E F F I C I
               1 E N T S (/DAY)//5X,8HSUBREACH,9X,2HKR,9X,2HKD,10X,4HKORG,1X,5HSKO
               2RG,2X,4HKNH3,1X,5HSKNH3,2X,4HKNO2,1X,5HSKNO2,2X,4HKNO3,10X,5HKCOLF
               3,9X,5HKCOLT,3X,5HKPO41,3X,5HKPO42/)
0536       910 FORMAT (5X,I5,7X,F8.2,3X,F8.2,8X,3(F5.2,1X,F5.2,1X),F5.2,7X,F8.2,6
               1X,F8.2,2F8.2)
0537       920 FORMAT (//48X,50HTEMPERATURE CORRECTED REACTION COEFFICIENTS (/DAY
               1)//5X,8HSUBREACH,5X,2HKR,9X,2HKD,7X,4HKORG,1X,5HSKORG,2X,4HKNH3,1X
               2,5HSKNH3,2X,4HKNO2,1X,5HSKNO2,2X,4HKNO3,8X,2HKA,10X,5HKPO41,9X,5HK
               3PO42/)
0538       930 FORMAT (5X,I5,3X,F8.2,3X,F8.2,5X,3(F5.2,1X,F5.2,1X),F5.2,3X,F8.2,6
               1X,F8.2,6X,F8.2)
0539       940 FORMAT (6X,I4,5X,F7.2,3X,F7.2,4X,F7.2,4X,F7.2,4X,F7.2,7X,F7.2,2X,F
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              17.2,F12.2,3X,F12.2)
0540      950 FORMAT (46X,10A4,2H =,F7.2)
0541      960 FORMAT (46X,10A4,2H =,F7.2//46X,10A4,2H =,F7.3)
0542      970 FORMAT (///37X,50HS U B R E A C H   L I N E A R   R U N O F F   D A T
              1 A/35X,54(1H_)//11X,8HSUBREACH,5X,1HQ,8X,4HCBOD,5X,7HORGANIC,3X,7H
              2AMMONIA,3X,7HNITRITE,3X,7HNITRATE,5X,2HDO,6X,2A4,5X,2A4,2X,2A4,3X,
              33HPO4/22X,5H(CFS),5X,6H(MG/L),5(4X,6H(MG/L)),6X,6H(MG/L),6X,6H(MG/
              4L),4X,6H(MG/L),3X,6H(MG/L))
0543      980 FORMAT (10X,I5,F12.2,6F10.2,2F12.2,F10.2,F9.2)
0544      990 FORMAT (///37X,50HS U B R E A C H   L I N E A R   R U N O F F   D A T
              1 A/35X,54(1H_)//11X,8HSUBREACH,5X,1HQ,8X,4HCBOD,5X,7HORGANIC,3X,7H
              2AMMONIA,3X,7HNITRITE,3X,7HNITRATE,5X,2HDO,7X,3HPO4//22X,5H(CFS),5X
              3,6H(MG/L),6(4X,6H(MG/L)))
0545     1000 FORMAT (10X,I5,F12.2,7F10.1)
0546     1010 FORMAT (1H1,30X,19A4/20X,83HCALCULATED AND OBSERVED ORGANIC NITROG
              1EN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE)
0547     1020 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,36HCALCULATED ORGANIC NIT
              1ROGEN CONC = C/11X,34HOBSERVED ORGANIC NITROGEN CONC = O)
0548     1030 FORMAT (1H1,30X,19A4/20X,83HCALCULATED AND OBSERVED AMMONIA NITROG
              1EN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE)
0549     1040 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,36HCALCULATED AMMONIA NIT
              1ROGEN CONC = C/11X,34HOBSERVED AMMONIA NITROGEN CONC = O)
0550     1050 FORMAT (1H1,30X,19A4/20X,83HCALCULATED AND OBSERVED NITRITE NITROG
              1EN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE)
0551     1060 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,36HCALCULATED NITRITE NIT
              1ROGEN CONC = C/11X,34HOBSERVED NITRITE NITROGEN CONC = O)
0552     1070 FORMAT (1H1,30X,19A4/20X,83HCALCULATED AND OBSERVED NITRATE NITROG
              1EN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE)
0553     1080 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,36HCALCULATED NITRATE NIT
              1ROGEN CONC = C/11X,34HOBSERVED NITRATE NITROGEN CONC = O)
0554     1090 FORMAT (1H1,20X,19A4/15X,69HCALCULATED AND OBSERVED TOTAL COLIFORM
              1 CONCENTRATIONS VERSUS DISTANCE)
0555     1100 FORMAT (1H1,20X,19A4/15X,69HCALCULATED AND OBSERVED FECAL COLIFORM
              1 CONCENTRATIONS VERSUS DISTANCE)
0556     1110 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,34HCALCULATED TOTAL COLIF
              1ORM CONC = C/11X,32HOBSERVED TOTAL COLIFORM CONC = O)
0557     1120 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,34HCALCULATED FECAL COLIF
              1ORM CONC = C/11X,32HOBSERVED FECAL COLIFORM CONC = O)
0558     1130 FORMAT (1H1,40X,19A4/30X,58HCALCULATED AND OBSERVED PO4 CONCENTRAT
              1IONS VERSUS DISTANCE/)
0559     1140 FORMAT (1H /61X,17HDISTANCE IN MILES/11X,23HCALCULATED PO4 CONC =
              1C/11X,21HOBSERVED PO4 CONC = O)
0560          END
```

```
0001          SUBROUTINE CONSER
         C
         C    * SUBROUTINE TO COMPUTE CONSERVATIVE ****
         C
         C    LAST DATE OF REVISION, FEBRUARY 1978
         C
0002          DIMENSION BODCU(50), WBODCU(50), BODN(50), WBODN(50), DOD(50), WDO
             1D(50), Q(50), DEPTH(50), AREA(50), TEMP(50), XSEG(50), AKR(50), AK
             2D(50), AKN(50), BN(50), PNET(50), XMOD(50,37), TITLE(19), DOSAT(50
             3), C1(50), C2(50), C3(50), QTRIB(50), C1TRIB(50), C2TRIB(50), C3TR
             4IB(50), TTSUBR(50)
0003          DIMENSION GRAPH(2000), XDIST(999), CHLA(10), D1(999), D2(999), D8(
             1999), D9(999), OBSMI(200), OBSDO(200), OBSC1(200), OBSC2(200), OBS
             2C3(200), QPLOT(999), MIPLOT(200), DEPTPT(200)
0004          DIMENSION ORGNTB(50), AMONTB(50), TBNO2(50), TBNO3(50), ORGNLB(50)
             1, AMONLB(50), LBNO2(50), LBNO3(50), AKORGN(50), AKAMON(50), AKNO2(
             250), AKNO3(50), OBSORG(200), OBSAMN(200), OBSNO2(200), OBSNO3(200)
             3, OBSCOL(200), OBSCOT(200), PLTCOL(999), PLTTOT(999), PLTORG(999),
             4 PLTAMN(999), PLTNO2(999), PLTNO3(999), COLITR(50), COLTTR(50), CO
             5LDIE(50), TOTDIE(50)
0005          DIMENSION CSTR1(999), CSTR2(999), CSTR3(999), XXSTR(999)
0006          EQUIVALENCE (XMOD(1),BODCU), (XMOD(51),WBODCU), (XMOD(101),BODN),
             1(XMOD(151),ORGNTB), (XMOD(201),AMONTB), (XMOD(251),TBNO2), (XMOD(3
             201),TBNO3), (XMOD(351),WBODN), (XMOD(401),ORGNLB), (XMOD(451),AMON
             3LB), (XMOD(501),LBNO2), (XMOD(551),LBNO3), (XMOD(601),DOD), (XMOD(
             4651),TEMPTR), (XMOD(701),CHLA), (XMOD(751),BN), (XMOD(801),PNET),
             5(XMOD(851),C1), (XMOD(901),C2), (XMOD(951),C3), (XMOD(1001),Q), (X
             6MOD(1051),DEPTH), (XMOD(1101),AREA), (XMOD(1151),TEMP), (XMOD(1201
             7),XSEG), (XMOD(1251),AKR), (XMOD(1301),AKD), (XMOD(1351),AKN), (XM
             8OD(1401),AKORGN), (XMOD(1451),AKAMON), (XMOD(1501),AKNO2), (XMOD(1
             9551),AKNO3), (XMOD(1601),COLITR), (XMOD(1651),COLTTR), (XMOD(1701)
             $,COLDIE), (XMOD(1751),TOTDIE), (XMOD(1801),TTSUBR)
0007          REAL*8 COBSMI(200),COBSDO(200),COBSC1(200),COBSC2(200),COBSC3(200)
0008          INTEGER CARD,PRINT
0009          REAL LNBODC(50),LNORGN(50),LNAMON(50),LNNO2(50),LNNO3(50),LNDO(50)
             1,LNC1(50),LNC2(50),LNC3(50),LNQ(50),LNCOLI(50),LNCOLT(50),LNBODN(5
             20)
0010          REAL LBNO2,LBNO3
0011          COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
             1AKNT,BDN,BNT,AKRT,BDC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
             2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
             3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
             4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAD,ISW,TITLE,INITSW,ICDBUF,IRUNOF
             5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
             6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
             7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
             8ICOLOP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
0012          COMMON /FILES/ CARD,PRINT
         C
0013          COMMON /LCPLOT/ D1,D2,D8,D9,PLTORG,PLTAMN,PLTNO2,PLTNO3,PLTCOL,PLT
             1TOT,XDIST,QPLOT
0014          COMMON /LC1/ ORGNO,AMONO,FNO2O,FNO3O,DELTT,AKORGT,AKAMNT,AKNO2T,AK
             1NO3T,ORGNST,AMONST,STNO2,STNO3
         C
         C
0015          MPT=ICTY
```

```
      QTOT=QUPS
      XXMI=XSTRT+DXPNT
      WRITE (PRINT,240) TITLE
      ICNTR=3
      ICNT=0
      DO 120 I=1,NSEG
      MBFLAG=1
      DELTAQ=LNQ(I)*DXPNT/(XXMI-XSEG(I))
C
C
C     ADD TRIBUTARIES AND LINEAR RUNOFF--ALLOW FOR NEGATIVE FLOWS
C
      IF (JSEG.NE.0) GO TO 10
      R=1./(QTOT+Q(I)+QTRIB(I))
      TEMP1=(QTOT*C1UPST+Q(I)*C1(I)+QTRIB(I)*C1TRIB(I))*R
      TEMP2=(QTOT*C2UPST+Q(I)*C2(I)+QTRIB(I)*C2TRIB(I))*R
      TEMP3=(QTOT*C3UPST+Q(I)*C3(I)+QTRIB(I)*C3TRIB(I))*R
      GO TO 20
   10 CONTINUE
      R=1./(QTOT+Q(I))
      TEMP1=(QTOT*C1UPST+Q(I)*C1(I))*R
      TEMP2=(QTOT*C2UPST+Q(I)*C2(I))*R
      TEMP3=(QTOT*C3UPST+Q(I)*C3(I))*R
   20 CONTINUE
      IF(Q(I).GT.0.) GO TO 25
      TEMP1=C1UPST
      TEMP2=C2UPST
      TEMP3=C3UPST
   25 CONTINUE
      TP1SAV=TEMP1
      TP2SAV=TEMP2
      TP3SAV=TEMP3
      IF (ICNTR+13.LT.50) GO TO 30
      WRITE (PRINT,240) TITLE
      ICNTR=3
   30 WRITE (PRINT,250) I
      WRITE (PRINT,260) PTC1,PTC2,PTC3
      ICNTR=ICNTR+9
C
   40 XXMI=XXMI-DXPNT
      ICNT=ICNT+1
      IF (XXMI.GE.XSEG(I)) GO TO 50
      TXXMI=DXPNT-(XSEG(I)-XXMI)
      XXMI=XSEG(I)-.00001
      DELTAQ=DELTAQ*TXXMI/DXPNT
   50 XXSTR(ICNT)=XXMI
      IF (IRUNOF.NE.1.OR.MBFLAG.GE.1) GO TO 80
      IF (JSEG.NE.0) GO TO 60
      QONTOP=QTOT+Q(I)+QTRIB(I)
      QBELOW=QTOT+Q(I)+QTRIB(I)+DELTAQ
      GO TO 70
   60 CONTINUE
      QONTOP=QTOT+Q(I)
      QBELOW=QTOT+Q(I)+DELTAQ
   70 CONTINUE
      TEMP1=(TEMP1*QONTOP+LNC1(I)*DELTAQ)/QBELOW
```

```
0067         TEMP2=(TEMP2*QONTOP+LNC2(I)*DELTAQ)/QBELOW
0068         TEMP3=(TEMP3*QONTOP+LNC3(I)*DELTAQ)/QBELOW
0069         QTOT=QTOT+DELTAQ
0070         IF(DELTAQ.GT.0.) GO TO 75
0071         TEMP1=TP1SAV
0072         TEMP2=TP2SAV
0073         TEMP3=TP3SAV
0074      75 CONTINUE
        C
0075      80 CSTR1(ICNT)=TEMP1
0076         CSTR2(ICNT)=TEMP2
0077         CSTR3(ICNT)=TEMP3
0078         IF (ICNTR.LT.50) GO TO 90
        C
0079         WRITE (PRINT,240) TITLE
0080         WRITE (PRINT,250) I
0081         WRITE (PRINT,260) PTC1,PTC2,PTC3
        C
0082         ICNTR=12
0083      90 CONTINUE
0084         WRITE (PRINT,270) XXSTR(ICNT),CSTR1(ICNT),CSTR2(ICNT),CSTR3(ICNT)
0085         ICNTR=ICNTR+1
        C
0086         MBFLAG=0
0087         IF (XXMI.GT.XSEG(I)) GO TO 40
0088         C1UPST=TEMP1
0089         C2UPST=TEMP2
0090         C3UPST=TEMP3
0091         XXMI=XSEG(I)+DXPNT
0092         IF (JSEG.NE.0) GO TO 100
0093         QTOT=QTOT+Q(I)+QTRIB(I)
0094         GO TO 110
0095     100 QTOT=QTOT+Q(I)
0096     110 CONTINUE
0097     120 CONTINUE
0098         XXMI=XXMI-DXPNT
0099         IF (JSEG.EQ.0) GO TO 130
0100         C1TRIB(JSEG)=CSTR1(ICNT)
0101         C2TRIB(JSEG)=CSTR2(ICNT)
0102         C3TRIB(JSEG)=CSTR3(ICNT)
0103     130 CONTINUE
0104         WRITE (PRINT,280) TITLE,PTC1
0105         CALL PMM (C1MIN,C1MAX,CSTR1,ICNT)
0106         IF (MPT.EQ.0) GO TO 140
0107         CALL PMM (OC1MIN,OC1MAX,OBSC1,MPT)
0108     140 CONTINUE
0109         AMIN=C1MIN
0110         IF (MPT.EQ.0) GO TO 150
0111         IF (OC1MIN.LT.C1MIN) AMIN=OC1MIN
0112     150 CONTINUE
0113         AMAX=C1MAX
0114         IF (MPT.EQ.0) GO TO 160
0115         IF (OC1MAX.GT.C1MAX) AMAX=OC1MAX
0116     160 CONTINUE
0117         AMIN=AMIN-AMIN*.25
0118         AMAX=(AMAX+AMAX*.25)+1.
```

```
0119          AMIN=FLOAT(IFIX(AMIN))
0120          AMAX=FLOAT(IFIX(AMAX))
0121          CALL PLOT2 (GRAPH,XXMI,XSTRT,AMAX,AMIN,PRINT)
0122          CALL PLOT3 (1HX,XXSTR,CSTR1,ICNT)
0123          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSC1,MPT)
0124          CALL PLOT4 (36,36H           CONCENTRATION IN MG/L)
0125          WRITE (PRINT,290)
        C
0126          IF (NCONSV.NE.2.AND.NCONSV.NE.3) GO TO 230
        C
0127          WRITE (PRINT,280) TITLE,PTC2
0128          CALL PMM (C2MIN,C2MAX,CSTR2,ICNT)
0129          IF (MPT.EQ.0) GO TO 170
0130          CALL PMM (OC2MIN,OC2MAX,OBSC2,MPT)
0131      170 CONTINUE
0132          AMIN=C2MIN
0133          IF (MPT.EQ.0) GO TO 180
0134          IF (OC2MIN.LT.C2MIN) AMIN=OC2MIN
0135      180 CONTINUE
0136          AMAX=C2MAX
0137          IF (MPT.EQ.0) GO TO 190
0138          IF (OC2MAX.GT.C2MAX) AMAX=OC2MAX
0139      190 CONTINUE
0140          AMIN=AMIN-AMIN*.25
0141          AMAX=(AMAX+AMAX*.25)+1.
0142          AMIN=FLOAT(IFIX(AMIN))
0143          AMAX=FLOAT(IFIX(AMAX))
0144          CALL PLOT2 (GRAPH,XXMI,XSTRT,AMAX,AMIN,PRINT)
0145          CALL PLOT3 (1HX,XXSTR,CSTR2,ICNT)
0146          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSC2,MPT)
0147          CALL PLOT4 (36,36H           CONCENTRATION IN MG/L)
0148          WRITE (PRINT,290)
        C
0149          IF (NCONSV.NE.3) GO TO 230
        C
0150          WRITE (PRINT,280) TITLE,PTC3
0151          CALL PMM (C3MIN,C3MAX,CSTR3,ICNT)
0152          IF (MPT.EQ.0) GO TO 200
0153          CALL PMM (OC3MIN,OC3MAX,OBSC3,MPT)
0154      200 CONTINUE
0155          AMIN=C3MIN
0156          IF (MPT.EQ.0) GO TO 210
0157          IF (OC3MIN.LT.C3MIN) AMIN=OC3MIN
0158      210 CONTINUE
0159          AMAX=C3MAX
0160          IF (MPT.EQ.0) GO TO 220
0161          IF (OC3MAX.GT.C3MAX) AMAX=OC3MAX
0162      220 CONTINUE
0163          AMIN=AMIN-AMIN*.25
0164          AMAX=(AMAX+AMAX*.25)+1.
0165          AMIN=FLOAT(IFIX(AMIN))
0166          AMAX=FLOAT(IFIX(AMAX))
0167          CALL PLOT2 (GRAPH,XXMI,XSTRT,AMAX,AMIN,PRINT)
0168          CALL PLOT3 (1HX,XXSTR,CSTR3,ICNT)
0169          IF (MPT.GT.0) CALL PLOT3 (1HO,OBSMI,OBSC3,MPT)
0170          CALL PLOT4 (36,36H           CONCENTRATION IN MG/L)
```

```
0171            WRITE (PRINT,290)                                                      B 212
          C                                                                            B 213
0172        230 CONTINUE                                                               B 214
0173            RETURN                                                                 B 215
          C                                                                            B 216
          C                                                                            B 217
          C                                                                            B 218
0174        240 FORMAT (1H1//40X,19A4)                                                 B 219
0175        250 FORMAT (////7X,19HC A L C U L A T E D,4X,23HC O N S E R V A T I V E    B 220
               1,4X,25HC O N C E N T R A T I O N,4X,24HD A T A   S U B R E A C H,I3    B 221
               2//)                                                                    B 222
0176        260 FORMAT (22X,4HMILE,19X,2A4,15X,2A4,14X,2A4/21X,8HLOCATION,16X,6H(M    B 223
               1G/L),18X,6H(MG/L),15X,6H(MG/L)/)                                       B 224
0177        270 FORMAT (20X,F6.2,16X,F9.1,18X,F6.1,15X,F6.1)                           B 225
0178        280 FORMAT (1H1,40X,19A4/53X,2A4,16H VERSUS DISTANCE/)                     B 226
0179        290 FORMAT (1H /57X,17HDISTANCE IN MILES/11X,12HOBSERVED = O/11X,12HCO     B 227
               1MPUTED = X)                                                            B 228
0180            END                                                                    B 229-
```

```
0001          SUBROUTINE ANEROB (J)
        C
        C       SUBROUTINE  FOR ANOXIC COMPUTATIONS
        C
        C     LAST DATE OF REVISION, FEBRUARY 1978
        C
0002          DIMENSION BODCU(50), WBODCU(50), BODN(50), WBODN(50), DOD(50), WDO
             10(50), Q(50), DEPTH(50), AREA(50), TEMP(50), XSEG(50), AKR(50), AK
             2D(50), AKN(50), BN(50), PNET(50), XMOD(50,37), TITLE(19), DOSAT(50
             3), C1(50), C2(50), C3(50), QTRIB(50), C1TRIB(50), C2TRIB(50), C3TR
             4IB(50), TTSUBR(50)
0003          DIMENSION GRAPH(2000), XDIST(999), CHLA(10), D1(999), D2(999), D8(
             1999), D9(999), OBSMI(200), OBSDO(200), OBSC1(200), OBSC2(200), OBS
             2C3(200), QPLOT(999), MIPLOT(200), DEPTPT(200)
0004          DIMENSION CSTR1(999), CSTR2(999), CSTR3(999), XXSTR(999)
0005          DIMENSION ORGNTB(50), AMONTB(50), TBNO2(50), TBNO3(50), ORGNLB(50)
             1, AMONLB(50), LBNO2(50), LBNO3(50), AKORGN(50), AKAMON(50), AKNO2(
             250), AKNO3(50), OBSORG(200), OBSAMN(200), OBSNO2(200), OBSNO3(200)
             3, OBSCOL(200), OBSCOT(200), PLTCOL(999), PLTTOT(999), PLTORG(999),
             4 PLTAMN(999), PLTNO2(999), PLTNO3(999), COLITR(50), COLTTR(50), CO
             5LDIE(50), TOTDIE(50)
0006          EQUIVALENCE (XMOD(1),BODCU), (XMOD(51),WBODCU), (XMOD(101),BODN),
             1(XMOD(151),ORGNTB), (XMOD(201),AMONTB), (XMOD(251),TBNO2), (XMOD(3
             201),TBNO3), (XMOD(351),WBODN), (XMOD(401),ORGNLB), (XMOD(451),AMON
             3LB), (XMOD(501),LBNO2), (XMOD(551),LBNO3), (XMOD(601),DOD), (XMOD(
             4651),TEMPTR), (XMOD(701),CHLA), (XMOD(751),BN), (XMOD(801),PNET),
             5(XMOD(851),C1), (XMOD(901),C2), (XMOD(951),C3), (XMOD(1001),Q), (X
             6MOD(1051),DEPTH), (XMOD(1101),AREA), (XMOD(1151),TEMP), (XMOD(1201
             7),XSEG), (XMOD(1251),AKR), (XMOD(1301),AKD), (XMOD(1351),AKN), (XM
             8OD(1401),AKORGN), (XMOD(1451),AKAMON), (XMOD(1501),AKNO2), (XMOD(1
             9551),AKNO3), (XMOD(1601),COLITR), (XMOD(1651),COLTTR), (XMOD(1701)
             $,COLDIE), (XMOD(1751),TOTDIE), (XMOD(1801),TTSUBR)
0007          REAL LBNO2,LBNO3
0008          REAL LNBODC(50),LNORGN(50),LNAMON(50),LNNO2(50),LNNO3(50),LNDO(50)
             1,LNC1(50),LNC2(50),LNC3(50),LNQ(50),LNCOLI(50),LNCOLT(50),LNBODN(5
             20)
0009          REAL*8 COBSMI(200),COBSDO(200),COBSC1(200),COBSC2(200),COBSC3(200)
        C
0010          COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
             1AKNT,BDN,BNT,AKRT,BDC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
             2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
             3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
             4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAD,ISW,TITLE,INITSW,ICDBUF,IRUNOF
             5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
             6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
             7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
             8ICOLDP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
0011          COMMON /LC1/ ORGNO,AMONO,FNO2O,FNO3O,DELTT,AKORGT,AKAMNT,AKNO2T,AK
             1NO3T,ORGNST,AMONST,STNO2,STNO3
        C
0012          COMMON /LCPLOT/ D1,D2,D8,D9,PLTORG,PLTAMN,PLTNO2,PLTNO3,PLTCOL,PLT
             1TOT,XDIST,QPLOT
        C
        C
0013       10 IF (KFLAG.EQ.0) GO TO 20
0014          ALB1=AKAT*DOSAT(J)-AKNT*BDN-CHLA(J)*.025*PNET(J)-BNT/DEPTH(J)*.304
```

```
   18
      ALB=ALBI/AKRT
      ALA=BDC
      TB=(ALA-ALB)/(ALBI)+TTSUM
      XB=TB-TTSUM
      XC=TTSUM
   20 DD=0.0
      XA=TB
      MLX=1
      LF=1
      KFLAG=0
      RETURN
      END
```

```
0001            SUBROUTINE TEST (CHARST,IRET,CHERR)
          C
          C     ROUTINE TO CHECK FOR BAD CHAR.  **
          C
          C     LAST DATE OF REVISION, FEBRUARY 1974
          C
0002            INTEGER*2 TESTY1,TESTY2,TESTY3,TESTY4,TESTY5,CHARST(80)
0003            DATA TESTY1,TESTY2,TESTY3,TESTY4,TESTY5/1H0,1H9,1H.,1H ,1H-/
0004            INTEGER*2 CHERR
          C
0005            IRET=0
0006            DO 10 I=2,80
0007            IF (CHARST(I).EQ.TESTY3) GO TO 10
0008            IF (CHARST(I).EQ.TESTY4) GO TO 10
0009            IF (CHARST(I).EQ.TESTY5) GO TO 10
0010            IF (CHARST(I).GE.TESTY1.AND.CHARST(I).LE.TESTY2) GO TO 10
          C     BAD CHAR
0011            CHERR=CHARST(I)
0012            IRET=1
0013         10 CONTINUE
0014            RETURN
0015            END
```

```
FORTRAN IV G LEVEL  21                 BLK DATA            DATE = 78181            08/51/31                PAGE 0001

 0001            BLOCK DATA                                                                 E   1
 0002            INTEGER CARD,PRINT                                                         E   2
 0003            COMMON /FILES/ CARD,PRINT                                                  E   3
 0004            DATA CARD/5/,PRINT/6/                                                      E   4
 0005            END                                                                        E   5-
```

```
FORTRAN IV G LEVEL  21                 ERROR              DATE = 78181          08/51/31                 PAGE 0001

0001             SUBROUTINE ERROR
           C     SUBROUTINE TO SCAN DATA CARDS
           C
           C     LAST DATE OF REVISION, FEBRUARY 1974
           C
0002             INTEGER*2 CHARST(80),CARD1,CARD2,CARD3,CARD4,CARD5,CARD6
0003             INTEGER*2 CARD7,CARD8,CARD9,CARDA,CARDI,CARDP,CARDK
0004             DATA CARD1,CARD2,CARD3,CARD4,CARD5,CARD6,CARD7,CARD8,CARD9,CARDA,C
                1ARDI,CARDP,CARDK/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1HA,1HI,1HP,1
                2HK/
0005             INTEGER*2 CHERR
0006             INTEGER CARD,PRINT
0007             COMMON /FILES/ CARD,PRINT
           C
           C
0008          10 READ (CARD,40,END=30) CHARST
0009             IF (CHARST(1).EQ.CARD1) GO TO 10
0010             IF (CHARST(1).EQ.CARDI) GO TO 10
0011             IF (CHARST(1).EQ.CARDP) GO TO 10
0012             IF (CHARST(1).EQ.CARD6) GO TO 10
0013             IF (CHARST(1).EQ.CARD7) GO TO 10
0014             IF (CHARST(1).EQ.CARDK) GO TO 10
0015             IF (CHARST(1).EQ.CARD8) GO TO 10
0016             CALL TEST (CHARST,IRET,CHERR)
0017             IF (IRET.EQ.1) GO TO 20
0018             IF (CHARST(1).EQ.CARD2) GO TO 10
0019             IF (CHARST(1).EQ.CARD3) GO TO 10
0020             IF (CHARST(1).EQ.CARD4) GO TO 10
0021             IF (CHARST(1).EQ.CARD5) GO TO 10
0022             IF (CHARST(1).EQ.CARDA) GO TO 10
0023             IF (CHARST(1).EQ.CARD9) GO TO 10
0024             WRITE (PRINT,60) CHARST
0025             GO TO 10
0026          20 WRITE (PRINT,50) CHARST,CHERR
0027             GO TO 10
0028          30 RETURN
           C
           C
           C
0029          40 FORMAT (80A1)
0030          50 FORMAT (//10X,29HADDITION ERRORS IN INPUT DATA//10X,13HCARD IMAGE
                1= ,80A1/10X,12HBAD CHAR. = ,A1)
0031          60 FORMAT (//10X,28HBAD CARD TYPE, CARD IMAGE = ,80A1)
0032             END
```

```
      SUBROUTINE PMM (XMN,XMX,A,N)
      DIMENSION A(1)
      IF (N.LT.2) GO TO 20
      XMN=A(1)
      XMX=XMN
      DO 10 I=2,N
      IF (A(I).LT.XMN) XMN=A(I)
      IF (A(I).GT.XMX) XMX=A(I)
   10 CONTINUE
      RETURN
   20 IF (N.LT.1) GO TO 30
      XMN=A(1)
      XMX=XMN
      RETURN
   30 XMN=0.0
      XMX=0.0
      RETURN
      END
```

```
0001          SUBROUTINE NITRIF
        C
        C     THIS IS SEGMENT OR SUBREACH LOOP FROM ORIGINAL VERSION OF G-475
        C
        C     THIS SUBROUTINE CONTROLS THE STEPPING OF TIME AND CALLS THE NITRIF
        C     ROUTINE *****
        C
0002          DIMENSION BODCU(50), WBODCU(50), BODN(50), WBODN(50), DOD(50), WDO
             1D(50), Q(50), DEPTH(50), AREA(50), TEMP(50), XSEG(50), AKR(50), AK
             2D(50), AKN(50), BN(50), PNET(50), XMOD(50,37), TITLE(19), DOSAT(50
             3), C1(50), C2(50), C3(50), QTRIB(50), C1TRIB(50), C2TRIB(50), C3TR
             4IB(50), TTSUBR(50)
0003          DIMENSION GRAPH(2000), XDIST(999), CHLA(10), D1(999), D2(999), D8(
             1999), D9(999), OBSMI(200), OBSDO(200), OBSC1(200), OBSC2(200), OBS
             2C3(200), QPLOT(999), MIPLOT(200), DEPTPT(200), VELBTT(50)
0004          DIMENSION TTLE(5)
0005          DIMENSION CSTR1(999), CSTR2(999), CSTR3(999), XXSTR(999)
0006          DATA END/1HE/
0007          DIMENSION OUT(133)
0008          DIMENSION ORGNTB(50), AMONTB(50), TBNO2(50), TBNO3(50), ORGNLB(50)
             1, AMONLB(50), LBNO2(50), LBNO3(50), AKORGN(50), AKAMON(50), AKNO2(
             250), AKNO3(50), OBSORG(200), OBSAMN(200), OBSNO2(200), OBSNO3(200)
             3, OBSCOL(200), OBSCOT(200), PLTCOL(999), PLTTOT(999), PLTORG(999),
             4 PLTAMN(999), PLTNO2(999), PLTNO3(999), COLITR(50), COLTTR(50), CO
             5LDIE(50), TOTDIE(50)
0009          INTEGER IR
0010          EQUIVALENCE (XMOD(1),BODCU), (XMOD(51),WBODCU), (XMOD(101),BODN),
             1(XMOD(151),ORGNTB), (XMOD(201),AMONTB), (XMOD(251),TBNO2), (XMOD(3
             201),TBNO3), (XMOD(351),WBODN), (XMOD(401),ORGNLB), (XMOD(451),AMON
             3LB), (XMOD(501),LBNO2), (XMOD(551),LBNO3), (XMOD(601),DOD), (XMOD(
             4651),TEMPTR), (XMOD(701),CHLA), (XMOD(751),BN), (XMOD(801),PNET),
             5(XMOD(851),C1), (XMOD(901),C2), (XMOD(951),C3), (XMOD(1001),Q), (X
             6MOD(1051),DEPTH), (XMOD(1101),AREA), (XMOD(1151),TEMP), (XMOD(1201
             7),XSEG), (XMOD(1251),AKR), (XMOD(1301),AKD), (XMOD(1351),AKN), (XM
             8OD(1401),AKORGN), (XMOD(1451),AKAMON), (XMOD(1501),AKNO2), (XMOD(1
             9551),AKNO3), (XMOD(1601),COLITR), (XMOD(1651),COLTTR), (XMOD(1701)
             $,COLDIE), (XMOD(1751),TOTDIE), (XMOD(1801),TTSUBR)
0011          REAL*8 COBSMI(200),COBSDO(200),COBSC1(200),COBSC2(200),COBSC3(200)
0012          REAL NTERM,MIPLOT
0013          REAL LBNO2,LBNO3,LNPO4,MPO4,KPO41,KPO42
0014          REAL LNBODC(50),LNORGN(50),LNAMON(50),LNNO2(50),LNNO3(50),LNDO(50)
             1,LNC1(50),LNC2(50),LNC3(50),LNQ(50),LNCOLI(50),LNCOLT(50),LNBODN(5
             20)
0015          REAL MBDC(50),MBORGN(50),MBAMON(50),MBNO2(50),MBNO3(50),MDO(50),MB
             1DN(50),MBCOLI(50),MBCOLT(50)
0016          INTEGER CARD,PRINT
0017          COMMON /OBS/ OCBODU(200),ONBODU(200),OBSPO4(200)
0018          COMMON /ADIT/ PO4CU,WPO4CU,MPO4,LNPO4,PLPO4,KPO41,KPO42,PO4,BP
0019          DIMENSION PO4CU(50), WPO4CU(50), MPO4(50), LNPO4(50), PLPO4(999)
0020          DIMENSION KPO41(50), KPO42(50)
        C
0021          COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
             1AKNT,BDN,BNT,AKRT,BDC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
             2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
             3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
             4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAD,ISW,TITLE,INITSW,ICDBUF,IRUNDF
```

```
          5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
          6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
          7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
          8ICOLOP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
      C
0022       COMMON /LCPLOT/ D1,D2,D8,D9,PLTORG,PLTAMN,PLTNO2,PLTNO3,PLTCOL,PLT
          1TOT,XDIST,QPLOT
0023       COMMON /LCWORK/ X,XL,XX,QUP,TSUM,DTEMP,VELBTT,MDO,IFLAG,ISW1,IFIN,
          1JJ
0024       COMMON /LC1/ ORGNO,AMONO,FNO2O,FNO3O,DELTT,AKORGT,AKAMNT,AKNO2T,AK
          1NO3T,ORGNST,AMONST,STNO2,STNO3
0025       COMMON /LC2/ DELAMN,DELNO2
0026       COMMON /LCMB/ MBDC,MBDN,MBORGN,MBAMON,MBNO2,MBNO3,MBCOLI,MBCOLT
0027       COMMON /FILES/ CARD,PRINT
0028       DIMENSION SKORGN(50), SKAMON(50), SKNO2(50), AAKAT(50)
0029       COMMON /SINK/ SKORGN,SKAMON,SKNO2,AAKAT,SKORGT,SKAMNT,SKNO2T
      C
0030       DO 330 J=1,NSEG
0031       ISW1=0
      C     CHECK FOR ANOXIC  PRINTOUT ***
0032       IF (LF.EQ.0) GO TO 30
0033       IF (TB.GT.TTSUM) GO TO 10
0034       ATOUT=TB
0035       GO TO 20
0036    10 ATOUT=TTSUM
0037       XB=TTSUM-XC
0038    20 CONTINUE
0039       WRITE (PRINT,340) XB,XC,ATOUT
0040       IFIN=IFIN+5
0041       KFLAG=1
0042       LF=0
0043       TB=999.99
0044    30 CONTINUE
0045       IF (IFIN.EQ.0.OR.IFIN.GT.45) GO TO 40
      C     TABLE HEADING ***
0046       WRITE (PRINT,360)
0047       IFIN=IFIN+6
0048       GO TO 50
0049    40 WRITE (PRINT,350) TITLE
0050       WRITE (PRINT,360)
0051       IFIN=16
0052    50 IF (J.EQ.1) GO TO 60
0053       X=XSEG(J-1)
0054       XSTRT=XSEG(J-1)
0055    60 CONTINUE
      C
0056       IF (IRUNOF.NE.1) GO TO 70
0057       DELTAQ=LNQ(J)*DXPNT/(XSTRT-XSEG(J))
      C
      C    TEMPERATURE CORRECT THE REACTIONS
0058    70 CONTINUE
0059       DTEMP=TEMP(J)-20.
0060       XX=1.047**DTEMP
0061       AKDT=AKD(J)*XX
0062       AKRT=AKR(J)*XX
0063       XX=1.09**DTEMP
```

```
0064          APO41T=KPO41(J)*XX
0065          APO42T=KPO42(J)*XX
0066          AKORGT=AKORGN(J)*XX
0067          AKAMNT=AKAMON(J)*XX
0068          AKNO2T=AKNO2(J)*XX
0069          AKNO3T=AKNO3(J)*XX
0070          SKORGT=SKORGN(J)*XX
0071          SKAMNT=SKAMON(J)*XX
0072          SKNO2T=SKNO2(J)*XX
0073          XX=1.065**DTEMP
0074          BNT=BN(J)*XX
        C
        C     CHECK FOR EQUAL NITROGEN COEFICIENTS
        C     FOR THOSE EQUAL INCREMENT ONE BY SMALL AMOUNT
        C
0075          IF (AKNO3T.EQ.AKORGT) AKORGT=AKORGT-.001
0076          IF (AKNO3T.EQ.AKNO2T) AKNO2T=AKNO2T-.001
0077          IF (AKNO3T.EQ.AKAMNT) AKAMNT=AKAMNT-.001
0078          IF (AKAMNT.EQ.AKORGT) AKORGT=AKORGT-.002
0079          IF (AKNO2T.EQ.AKAMNT) AKAMNT=AKAMNT-.001
0080          IF (AKNO2T.EQ.AKORGT) AKORGT=AKORGT-.001
        C
        C      ***ADDED NITROGEN SINK COEFFICIENTS***
        C
0081          IF (SKNO3T.EQ.SKORGT) SKORGT=SKORGT-.001
0082          IF (SKNO3T.EQ.SKNO2T) SKNO2T=SKNO2T-.001
0083          IF (SKNO3T.EQ.SKAMNT) SKAMNT=SKAMNT-.001
0084          IF (SKAMNT.EQ.SKORGT) SKORGT=SKORGT-.002
0085          IF (SKNO2T.EQ.SKAMNT) SKAMNT=SKAMNT-.001
0086          IF (SKNO2T.EQ.SKORGT) SKORGT=SKORGT-.001
        C
        C     RECORD UPSTREAM FLOW
        C
0087          QUP=QTOT
        C
        C     CALCULATE DOWNSTREAM FLOW
        C
0088          IF (JSEG.EQ.0) GO TO 80
0089          QTOT=QTOT+Q(J)
0090          GO TO 90
0091       80 QTOT=QTOT+Q(J)+QTRIB(J)
0092       90 CONTINUE
        C
        C
        C     CALCULATE DOSAT
0093          DOSAT(J)=14.652-.41022*TEMP(J)+.007910*TEMP(J)**2-.000077774*TEMP(
             1J)**3
        C
0094          DOSAT(J)=BP/29.92*DOSAT(J)
        C
        C     CALCULATE INITIAL CONCENTRATION FROM UPSTREAM CONCENTRATIONS.
        C     BDCU, BDN, DO, AND TRIBURARY CONCENTRATIONS, BODCU, BODN, DOD
        C
        C     ALLOW FOR NEGATIVE FLOWS
        C
0095          IF (Q(J).GT.0.0) GO TO 100
```

```
0096          BODCUJ=BDC
0097          PO4CUJ=PO4
0098          ORGNJ=ORGNST
0099          AMONJ=AMONST
0100          FNO2J=STNO2
0101          FNO3J=STNO3
0102          COLIJ=STCOLI
0103          COLTJ=STCOLT
0104          DODJ=DOSAT(J)-DO
0105          GO TO 110
0106      100 BODCUJ=BODCU(J)
0107          PO4CUJ=PO4CU(J)
0108          ORGNJ=ORGNTB(J)
0109          AMONJ=AMONTB(J)
0110          FNO2J=TBNO2(J)
0111          FNO3J=TBNO3(J)
0112          COLIJ=COLITR(J)
0113          COLTJ=COLTTR(J)
0114          DODJ=DOD(J)
0115      110 CONTINUE
0116          IF (JSEG.GT.0) GO TO 120
        C     MAIN STEM ***
0117          BDCO=(BDC*QUP+BODCUJ*Q(J)+MBDC(J)*QTRIB(J))/QTOT
0118          BPO4O=(PO4*QUP+PO4CUJ*Q(J)+MPO4(J)*QTRIB(J))/QTOT
0119          ORGNO=(ORGNST*QUP+ORGNJ*Q(J)+MBORGN(J)*QTRIB(J))/QTOT
0120          AMONO=(AMONST*QUP+AMONJ*Q(J)+MBAMON(J)*QTRIB(J))/QTOT
0121          FNO2O=(STNO2*QUP+FNO2J*Q(J)+MBNO2(J)*QTRIB(J))/QTOT
0122          FNO3O=(STNO3*QUP+FNO3J*Q(J)+MBNO3(J)*QTRIB(J))/QTOT
0123          COLIO=(STCOLI*QUP+COLIJ*Q(J)+MBCOLI(J)*QTRIB(J))/QTOT
0124          COLTO=(STCOLT*QUP+COLTJ*Q(J)+MBCOLT(J)*QTRIB(J))/QTOT
0125          DOO=(DO*QUP+(DOSAT(J)-DODJ)*Q(J)+MDO(J)*QTRIB(J))/QTOT
0126          GO TO 130
        C      TRIBUTARY ***
0127      120 BDCO=(BDC*QUP+BODCUJ*Q(J))/QTOT
0128          BPO4O=(PO4*QUP+PO4CUJ*Q(J))/QTOT
0129          ORGNO=(ORGNST*QUP+ORGNJ*Q(J))/QTOT
0130          AMONO=(AMONST*QUP+AMONJ*Q(J))/QTOT
0131          FNO2O=(STNO2*QUP+FNO2J*Q(J))/QTOT
0132          FNO3O=(STNO3*QUP+FNO3J*Q(J))/QTOT
0133          COLIO=(STCOLI*QUP+COLIJ*Q(J))/QTOT
0134          COLTO=(STCOLT*QUP+COLTJ*Q(J))/QTOT
        C
        C     DO MASS BALANCE FOR DO, NOT DO DEFICIT
        C
0135          DOO=(DO*QUP+(DOSAT(J)-DODJ)*Q(J))/QTOT
0136      130 CONTINUE
0137          DDO=DOSAT(J)-DOO
        C
        C     ADD IN DIRECT DISCHARGES
        C
0138          BDCO=WBODCU(J)/QTOT/5.4+BDCO
0139          BPO4O=WPO4CU(J)/QTOT/5.4+BPO4O
0140          ORGNO=ORGNLB(J)/QTOT/5.4+ORGNO
0141          AMONO=AMONLB(J)/QTOT/5.4+AMONO
0142          FNO2O=LBNO2(J)/QTOT/5.4+FNO2O
0143          FNO3O=LBNO3(J)/QTOT/5.4+FNO3O
```

```
              C      DO HAS BEEN ADDED DURING TRIB OR MAIN STEM CALCULATIONS
              C      SAVE LAST VALUE COMPUTED
              C
0144                 DOOLD=DOSAT(J)-DDO
0145                 BDCOLD=BDCO
0146                 PO4OLD=BPO40
0147                 OLDORG=ORGNO
0148                 OLDAMN=AMONO
0149                 OLDNO2=FNO20
0150                 OLDNO3=FNO30
0151                 OLDCOI=COLIO
0152                 OLDCOT=COLTO
              C
              C      CALCULATION LOOP
              C
0153             140 CONTINUE
              C
              C
              C       TEST FOR FIRST NODE
              C
0154                 IF (X.EQ.XSTRT) GO TO 180
0155                 IF (DELTAQ.LE.0.0) GO TO 160
              C
0156                 IF (IFLAG.LT.1) GO TO 150
0157                 DELTAQ=DELTAQ*(ENDRCH/DXPNT)
0158             150 CONTINUE
              C
0159                 BDCO=(BDCOLD*QTOT+LNBODC(J)*DELTAQ)/(QTOT+DELTAQ)
0160                 BPO40=(PO4OLD*QTOT+LNPO4(J)*DELTAQ)/(QTOT+DELTAQ)
0161                 ORGNO=(OLDORG*QTOT+LNORGN(J)*DELTAQ)/(QTOT+DELTAQ)
0162                 AMONO=(OLDAMN*QTOT+LNAMON(J)*DELTAQ)/(QTOT+DELTAQ)
0163                 FNO20=(OLDNO2*QTOT+LNNO2(J)*DELTAQ)/(QTOT+DELTAQ)
0164                 FNO30=(OLDNO3*QTOT+LNNO3(J)*DELTAQ)/(QTOT+DELTAQ)
0165                 COLIO=(OLDCOI*QTOT+LNCOLI(J)*DELTAQ)/(QTOT+DELTAQ)
0166                 COLTO=(OLDCOT*QTOT+LNCOLT(J)*DELTAQ)/(QTOT+DELTAQ)
0167                 DDO=(DOOLD*QTOT+LNDO(J)*DELTAQ)/(QTOT+DELTAQ)
0168                 DDO=DOSAT(J)-DDO
0169                 QTOT=QTOT+DELTAQ
0170                 GO TO 180
              C      NEGATIVE FLOW OR NO LINEAR RUNOFF
0171             160 BDCO=BDCOLD
0172                 BPO40=PO4OLD
0173                 ORGNO=OLDORG
0174                 AMONO=OLDAMN
0175                 FNO20=OLDNO2
0176                 FNO30=OLDNO3
0177                 COLIO=OLDCOI
0178                 COLTO=OLDCOT
0179                 DDO=DOOLD
0180                 DDO=DOSAT(J)-DDO
0181                 IF (IFLAG.LT.1) GO TO 170
0182                 DELTAQ=DELTAQ*(ENDRCH/DXPNT)
0183             170 QTOT=QTOT+DELTAQ
0184             180 CONTINUE
              C
              C      A) VELOCITY AND TRAVEL TIME
```

```
              C
0185               IF (ITTIFD.EQ.0) GO TO 190
0186               U=VELBTT(J)*16.3636
0187               GO TO 200
0188           190 U=QTOT/AREA(J)*16.3636
0189           200 CONTINUE
              C
0190               DELTT=DXPNT/U
              C
              C    ADJUST TRAVEL TIME FOR SHORT DISTANCE AT END OF SUBREACH***
              C
0191               IF (IFLAG.LT.1) GO TO 210
0192               DELTT=DELTT*(ENDRCH/DXPNT)
0193           210 CONTINUE
              C    CALCULATE AKAT
              C
              C    TEST FOR FIRST PASS  **
              C
0194               IF (ISW1.EQ.1) GO TO 220
0195               DELTT=0.0
0196               ISW1=1
0197           220 CONTINUE
              C    INCREMENT TRAVEL TIME FOR SUBREACH
0198               TT=TT+DELTT
0199               IF (ICODE.GT.0) GO TO 230
              C    BENNETT-RATHBUN REAERATION EQUATION
0200               UZIE=(QTOT/AREA(J))
0201               IF (ITTIFD.EQ.1) UZIE=VELBTT(J)
0202               AKAT=(8.76*(UZIE)**0.607/DEPTH(J)**1.689)*1.021**DTEMP
              C    AKAT = 13. * SQRT (QTOT/AREA(J)/DEPTH(J)**3)*1.024**DTEMP
0203               AKAT=AKAT*2.303
0204               GO TO 240
0205           230 AKAT=AAKAT(J)
0206           240 CONTINUE
              C    B) EXPONENTIALS
              C
0207               ER=EXP(-AKRT*DELTT)
0208               EA=EXP(-AKAT*DELTT)
0209               EP1=EXP(-APO41T*DELTT)
0210               EP2=EXP(-APO42T*DELTT)
              C
              C    C) SOLUTIONS
              C
0211               BDC=BDCO*ER
0212               PO4=BPO40*EP1-APO42T*(CHLA(J)*(1-EP2))
              C
              C    THIS SUBROUTINE COMPUTES NEW CONCENTRATIONS OF NITROGEN SPECIES
              C    ( NITRIFICATION PROCESS )
              C
0213               CALL NTRFCN
              C
0214               DD=DDO*EA
0215               DIO=DD
0216               CTERM=BDCO*AKDT/(AKAT-AKRT)*(ER-EA)
0217               DD=DD+CTERM
0218               TRMNO2=3.43*DELAMN
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```
0219          TRMNO3=1.14*DELNO2
0220          DD=DD+TRMNO2+TRMNO3
0221          BOTERM=BNT/(DEPTH(J)*0.3048)*(1.-EA)/AKAT
0222          DD=DD+BOTERM
0223          PTERM=-PNET(J)*(1.-EA)/AKAT
0224          DD=DD+PTERM
0225          RTERM=CHLA(J)*.025*(1.-EA)/AKAT
0226          DD=DD+RTERM
0227          DB(JJ+1)=DD
0228          TTSUM=TSUM+TT
0229          DO=DOSAT(J)-DD
0230          STCOLI=COLIO*EXP(-COLDIE(J)*DELTT)
0231          STCOLT=COLTO*EXP(-TOTDIE(J)*DELTT)
        C
        C     ZERO DO CALCULATION CHECKS
        C
0232          IF (DO.LE.0.1.AND.TB.LT.TTSUM) TB=TTSUM+.0001
0233          IF (TTSUM.LT.TB.AND.LF.EQ.1) GO TO 250
0234          IF (DO.LE.0.1.AND.TTSUM.LT.TB) GO TO 250
0235          GO TO 260
        C     ****APPROX VALUES FOR ANOXIC COMPUTATIONS*****************
0236      250 BDN=4.57*(ORGNST+AMONST)
0237          AKNT=(AKORGT+AKMNT)/2.
0238          CALL ANEROB (J)
0239      260 CONTINUE
0240          IF (TTSUM.GE.TB.AND.KFLAG.EQ.0) KFLAG=1
0241          JJ=JJ+1
0242          D9(JJ)=DO
0243          D1(JJ)=BDC
0244          PLTORG(JJ)=ORGNST
0245          PLTAMN(JJ)=AMONST
0246          PLTNO2(JJ)=STNO2
0247          PLTNO3(JJ)=STNO3
0248          PLTCOL(JJ)=STCOLI
0249          PLTTOT(JJ)=STCOLT
0250          XDIST(JJ)=XL
0251          QPLOT(JJ)=QTOT
0252          PLPO4(JJ)=PO4
0253          IF (IFIN.LT.50) GO TO 270
0254          WRITE (PRINT,350) TITLE
0255          WRITE (PRINT,360)
0256          IFIN=16
0257      270 WRITE (PRINT,370) J,XL,TTSUM,BDC,D10,CTERM,BOTERM,PTERM,RTERM,PO4
0258          WRITE (8,400) J,XL,TTSUM,ORGNST,AMONST,STNO2,STNO3,TRMNO2,TRMNO3,S
             1TCOLT,STCOLI,DD,DO
0259          IFIN=IFIN+1
        C
        C
        C     SAVE OLD BOD,AND DO TERMS FOR NEXT COMP.
        C
0260          DOOLD=DO
0261          BDCOLD=BDC
0262          PO4OLD=PO4
0263          OLDORG=ORGNST
0264          OLDAMN=AMONST
0265          OLDNO2=STNO2
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0266          OLDNO3=STNO3
0267          OLDCOI=STCOLI
0268          OLDCOT=STCOLT
        C
        C     INCREMENT X AND XL AND LOOP
        C
0269          X=X-ABS(DXPNT)
0270          XL=XL-DXPNT
0271          IF (IFLAG.GT.0) GO TO 280
0272          XTEMP=XSEG(J)-XL
        C     TEST FOR SMALL DIST. CLOSE TO END OF SUBREACH
0273          ENDRCH=DXPNT-XTEMP
0274          IF (XTEMP.GE.-0.01) XTEMP=0.0
        C
        C     THIS IS A SIGNF FUNCTION
        C
0275          XTEMP=XTEMP*DXPNT/ABS(DXPNT)
0276          IF (XTEMP.LT.0.0) GO TO 140
0277          IFLAG=1
0278          X=XSEG(J)
0279          XL=XSEG(J)
0280          GO TO 140
0281      280 IFLAG=0
0282          XL=XSEG(J)
0283          TSUM=TSUM+TT
        C     RESET SUBREACH TRAVEL TIME
0284          TT=0.0
        C
0285          WRITE (8,410) END
        C     WRITE EOF FILE 8
        C
0286          END FILE 8
        C     REWIND FILE 8
        C
0287          REWIND 8
        C
0288          IF (IFIN.LT.40) GO TO 290
0289          WRITE (PRINT,350) TITLE
0290          IFIN=10
0291      290 CONTINUE
        C
0292          WRITE (PRINT,380)
0293          WRITE (PRINT,390)
0294          IFIN=IFIN+12
0295          IFG=0
        C
0296      300 READ (8,410) OUT
0297          IF (OUT(1).EQ.END) GO TO 320
        C
0298          IF (IFG.EQ.0) GO TO 310
        C
0299          IF (IFIN.LT.50) GO TO 310
0300          WRITE (PRINT,350) TITLE
0301          WRITE (PRINT,380)
0302          WRITE (PRINT,390)
0303          IFIN=21
```

```
0304       310 CONTINUE
         C
0305           IFG=1
0306           WRITE (PRINT,410) OUT
0307           IFIN=IFIN+1
0308           GO TO 300
0309       320 CONTINUE
0310           REWIND 8
         C
0311       330 CONTINUE
0312           RETURN
         C
         C
0313       340 FORMAT (//24X,35H  LENGTH OF TIME FOR ANOXIC ZONE = ,F6.3,17H DAYS
              1 (FROM TT = ,F6.3,14H DAYS TO TT = ,F6.3,7H DAYS )//)
0314       350 FORMAT (1H1//40X,19A4//57X,23HRESULTS OF COMPUTATIONS///52X,55H
              1S  U  B  R  E  A  C  H        D  E  F  I  C  I  T  S/54X,54(1H_))
0315       360 FORMAT (//6X,8HSUBREACH,2X,9HDISTANCE,3X,6HTRAVEL,3X,5HCBODU,5X,7H
              1INITIAL,4X,4HCBOD,5X,7HBENTHAL,3X,6HPHOTO.,4X,7HRESPIRE,9X,3HPO4/2
              28X,4HTIME,5X,4HCONC,5X,7HDEFICIT,3X,7HDEFICIT,3X,7HDEFICIT,3X,7HDE
              3FICIT,3X,7HDEFICIT,9X,4HCONC//)
0316       370 FORMAT (6XI5,5XF8.2,2(2XF7.2),2(3XF7.2),2(3XF7.3),2(5XF7.3))
0317       380 FORMAT (//40X,'NITRIFICATION AND COLIFORM CONCENTRATIONS'//)
0318       390 FORMAT (//85X'TOTAL       FECAL                     './1X'SUBREACH  D
              1ISTANCE  TRAVEL  ORGANIC  AMMONIA   NO2'.6X'NO3    AMMONIA  NITRIT
              2E    COLIFORM  COLIFORM       DO    '.2X'   DO    '/22X'TIME     CONC
              3    CONC    CONC       CONC'.4X'DEFICIT  DEFICIT      CONC       CONC
              4  DEFICIT     CONC  '//)
0319       400 FORMAT (1XI4,4XF9.2,1XF8.2,1XF7.2,2XF7.2,1XF7.2,1XF8.2,2F9.3,F11.0
              1,F10.0,F10.2,F9.2)
0320       410 FORMAT (133A1)
0321           END
```

```
0001            SUBROUTINE READCD
          C
          C       SUBROUTINE TO READ INPUT DATA
          C
          C     LAST DATE OF REVISION, FEBRUARY 1978
          C
0002            DIMENSION BODCU(50), WBODCU(50), BODN(50), WBODN(50), DOD(50), WDO
               1D(50), Q(50), DEPTH(50), AREA(50), TEMP(50), XSEG(50), AKR(50), AK
               2D(50), AKN(50), BN(50), PNET(50), XMOD(50,37), TITLE(19), DOSAT(50
               3), C1(50), C2(50), C3(50), QTRIB(50), C1TRIB(50), C2TRIB(50), C3TR
               4IB(50), TTSUBR(50)
0003            DIMENSION GRAPH(2000), XDIST(999), CHLA(10), D1(999), D2(999), D8(
               1999), D9(999), OBSMI(200), OBSDO(200), OBSC1(200), OBSC2(200), OBS
               2C3(200), QPLOT(999), MIPLOT(200), DEPTPT(200)
0004            DIMENSION CSTR1(999), CSTR2(999), CSTR3(999), XXSTR(999)
0005            DIMENSION TTLE(5)
0006            DIMENSION ORGNTB(50), AMONTB(50), TBNO2(50), TBNO3(50), ORGNLB(50)
               1, AMONLB(50), LBNO2(50), LBNO3(50), AKORGN(50), AKAMON(50), AKNO2(
               250), AKNO3(50), OBSORG(200), OBSAMN(200), OBSNO2(200), OBSNO3(200)
               3, OBSCOL(200), OBSCOT(200), PLTCOL(999), PLTTOT(999), PLTORG(999),
               4 PLTAMN(999), PLTNO2(999), PLTNO3(999), COLITR(50), COLTTR(50), CO
               5LDIE(50), TOTDIE(50), MBCOLI(50), MBCOLT(50)
0007            INTEGER IR
0008            REAL*8 COBSMI(200),COBSDO(200),COBSC1(200),COBSC2(200),COBSC3(200)
0009            INTEGER CARD,PRINT
0010            EQUIVALENCE (XMOD(1),BODCU), (XMOD(51),WBODCU), (XMOD(101),BODN),
               1(XMOD(151),ORGNTB), (XMOD(201),AMONTB), (XMOD(251),TBNO2), (XMOD(3
               201),TBNO3), (XMOD(351),WBODN), (XMOD(401),ORGNLB), (XMOD(451),AMON
               3LB), (XMOD(501),LBNO2), (XMOD(551),LBNO3), (XMOD(601),DOD), (XMOD(
               4651),TEMPTR), (XMOD(701),CHLA), (XMOD(751),BN), (XMOD(801),PNET),
               5(XMOD(851),C1), (XMOD(901),C2), (XMOD(951),C3), (XMOD(1001),Q), (X
               6MOD(1051),DEPTH), (XMOD(1101),AREA), (XMOD(1151),TEMP), (XMOD(1201
               7),XSEG), (XMOD(1251),AKR), (XMOD(1301),AKD), (XMOD(1351),AKN), (XM
               8OD(1401),AKORGN), (XMOD(1451),AKAMON), (XMOD(1501),AKNO2), (XMOD(1
               9551),AKNO3), (XMOD(1601),COLITR), (XMOD(1651),COLTTR), (XMOD(1701)
               $,COLDIE), (XMOD(1751),TOTDIE), (XMOD(1801),TTSUBR)
0011            DIMENSION PTINIT(30)
0012            DIMENSION TTLKEY(19)
0013            REAL LBNO2,LBNO3,LNPO4,MPO4,KPO41,KPO42
0014            REAL LNBODC(50),LNORGN(50),LNAMON(50),LNNO2(50),LNNO3(50),LNDO(50)
               1,LNC1(50),LNC2(50),LNC3(50),LNQ(50),LNCOLI(50),LNCOLT(50),LNBODN(5
               20)
          C
0015            COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
               1AKNT,BDN,BNT,AKRT,BDC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
               2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
               3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
               4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAD,ISW,TITLE,INITSW,ICDBUF,IRUNOF
               5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
               6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
               7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
               8ICOLOP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
          C
0016            COMMON /LCPLOT/ D1,D2,D8,D9,PLTORG,PLTAMN,PLTNO2,PLTNO3,PLTCOL,PLT
               1TOT,XDIST,QPLOT
0017            COMMON /LC1/ ORGNO,AMONO,FNO2O,FNO3O,DELTT,AKORGT,AKAMNT,AKNO2T,AK
```

```
              IND3T,ORGNST,AMONST,STNO2,STNO3
0018          COMMON /OBS/ OCBODU(200),ONBODU(200),OBSPO4(200)
0019          COMMON /ADIT/ PO4CU,WPO4CU,WPO4,LNPO4,PLPO4,KPO41,KPO42,PO4,BP
0020          DIMENSION KPO41(50), KPO42(50)
0021          DIMENSION PO4CU(50), WPO4CU(50), WPO4(50), LNPO4(50), PLPO4(999)
0022          DIMENSION SKORGN(50), SKAMON(50), SKNO2(50), AAKAT(50)
0023          COMMON /SINK/ SKORGN,SKAMON,SKNO2,AAKAT,SKORGT,SKAMNT,SKNO2T
0024          COMMON /LCNEW/ IMODEL
0025          COMMON /FILES/ CARD,PRINT
       C
0026          INTEGER*2 CHARST(80),CARD1,CARD2,CARD3,CARD4,CARD5,CARD6
0027          INTEGER*2 CARD7,CARD8,CARD9,CARDA,CARDI,CARDP,CARDK
0028          DATA CARD1,CARD2,CARD3,CARD4,CARD5,CARD6,CARD7,CARD8,CARD9,CARDA,C
             1ARDI,CARDP,CARDK/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1HA,1HI,1HP,1
             2HK/
0029          INTEGER*2 CHERR
       C
       C      INITIALIZE VAR.
0030          ISECT=1
0031          ICTY=0
0032          ICTY1=0
0033          J=0
0034          JJ=0
0035          JJ1=0
0036          K=0
0037          K1=0
0038          KK=0
0039          L=0
0040          ICTY2=0
0041          IEND=0
0042          ISWBAD=0
       C
0043          IGOT1=0
       C      INITILIZE REREAD CARD INPUT FUNCTION
       C
0044          IF (INITSW.NE.0) GO TO 10
0045          CALL REREAD
       C      CK FOR CARD IN BUFFER
0046       10 IF (ICDBUF.NE.0) GO TO 30
0047       20 READ (CARD,510,END=490) CHARST
0048       30 IF (CHARST(1).EQ.CARD1) GO TO 40
0049          IF (CHARST(1).EQ.CARDI) GO TO 80
0050          IF (CHARST(1).EQ.CARDP) GO TO 90
0051          IF (CHARST(1).EQ.CARD6) GO TO 220
0052          CALL TEST (CHARST,IRET,CHERR)
0053          IF (IRET.EQ.1) GO TO 450
       C      CARD CK OKAY
       C
0054          IF (CHARST(1).EQ.CARD2) GO TO 50
0055          IF (CHARST(1).EQ.CARD3) GO TO 100
0056          IF (CHARST(1).EQ.CARD4) GO TO 130
0057          IF (CHARST(1).EQ.CARD5) GO TO 160
0058          IF (CHARST(1).EQ.CARDA) GO TO 190
       C
0059          GO TO 440
       C      STREAM TITLE CARD
```

```
0060        40 IF (IGOT1.EQ.1) GO TO 220
0061           IGOT1=1
0062           READ (99,520) TITLE
0063           GO TO 20
         C
         C     INPUT PARM.
0064        50 CONTINUE
0065           IF (CHARST(2).EQ.CARD2) GO TO 60
0066           READ (99,530) NSEG,JSEG,ICODE,LOOP,IRUNOF,NCONSV,ITTIFO,IMODEL,ICO
              1LOP,XSTRT,DXPNT,BDC,BDN,ORGNST,AMONST,STNO2,STNO3,DO,QUPS,STCOLI,S
              2TCOLT,C1UPST,C2UPST,C3UPST
0067           STCOLI=STCOLI*1000.
0068           STCOLT=STCOLT*1000.
0069           GO TO 70
         C     READ IN PO4
0070        60 CONTINUE
0071           READ (99,560) PO4,BP
0072        70 CONTINUE
         C
0073           IF (NSEG.GT.50) GO TO 480
         C
0074           GO TO 20
         C
         C     DATA CARD FOR INITIAL C1,C2,C3
0075        80 KK=KK+1
0076           LL=KK+9
0077           READ (99,800) (PTINIT(KJ),KJ=KK,LL)
0078           KK=KK+9
0079           IF (LL.GT.30) GO TO 470
0080           GO TO 20
         C
         C     DATA CARD FOR C1,C2,C3  TITLE
         C
0081        90 READ (99,770) PTC1,PTC2,PTC3
0082           GO TO 20
         C
         C     OBSERVED DATA
0083       100 CONTINUE
0084           IF (CHARST(2).EQ.CARD2) GO TO 110
0085           ICTY=ICTY+1
0086           READ (99,550) OBSMI(ICTY),OBSDO(ICTY),OBSORG(ICTY),OBSAMN(ICTY),OB
              1SNO2(ICTY),OBSNO3(ICTY),OBSCOL(ICTY),OBSCOT(ICTY),OBSC1(ICTY),OBSC
              22(ICTY),OBSC3(ICTY)
0087           READ (99,810) COBSMI(ICTY),COBSDO(ICTY),COBSC1(ICTY),COBSC2(ICTY),
              1COBSC3(ICTY)
0088           GO TO 120
0089       110 CONTINUE
0090           ICTY1=ICTY1+1
0091           READ (99,550) OCBODU(ICTY1),ONBODU(ICTY1),OBSPO4(ICTY1)
0092       120 CONTINUE
0093           IF (ICTY1.GT.200) GO TO 470
0094           IF (ICTY.GT.200) GO TO 470
0095           GO TO 20
         C
         C     SEGMENT PARM.
         C
```

```
0096        130 CONTINUE
0097            IF (CHARST(2).EQ.CARD2) GO TO 140
0098            J=J+1
0099            READ (99,560) BODCU(J),WBODCU(J),BODN(J),ORGNTB(J),AMONTB(J),TBNO2
               1(J),TBNO3(J),WBODN(J),ORGNLB(J),AMONLB(J),LBNO2(J),LBNO3(J)
0100            GO TO 150
0101        140 CONTINUE
0102            L=L+1
0103            READ (99,560) DOD(L),WDOD(L),BN(L),CHLA(L),PNET(L),C1(L),C2(L),C3(
               1L),PO4CU(L),WPO4CU(L)
          C     CONVERT TRIBUTARY DO CONCENTRATIONS TO DO DEFICITS
0104            TEMPTR=WDOD(L)
0105            SATDO=(14.652-.41022*TEMPTR+.007910*TEMPTR**2-.000077774*TEMPTR**3
               1)*BP/29.92
0106            DOD(L)=SATDO-DOD(L)
0107            IF(TEMPTR.LE.0.0.AND.DOD(L).GE.SATDO) DOD(L)=0.
0108            IF (L.GT.50) GO TO 470
0109        150 CONTINUE
0110            IF (J.GT.50) GO TO 470
0111            GO TO 20
          C
          C     SEGMENT DATA
          C
0112        160 CONTINUE
0113            IF (CHARST(2).EQ.CARD2) GO TO 170
0114            K=K+1
0115            READ (99,570) Q(K),DEPTH(K),AREA(K),TEMP(K),XSEG(K),AKR(K),AKD(K),
               1AKN(K),AKORGN(K),AKAMON(K),AKNO2(K),AKNO3(K),COLITR(K),COLTTR(K),C
               2OLDIE(K),TOTDIE(K),TTSUBR(K)
0116            COLITR(K)=COLITR(K)*1000.
0117            COLTTR(K)=COLTTR(K)*1000.
0118            GO TO 180
          C     READ KPO41,KPO42
0119        170 CONTINUE
0120            K1=K1+1
0121            READ (99,580) KPO41(K1),KPO42(K1),SKORGN(K1),SKAMON(K1),SKNO2(K1),
               1AAKAT(K1)
0122            IF (K1.GT.50) GO TO 470
0123        180 CONTINUE
0124            IF (K.GT.50) GO TO 470
0125            GO TO 20
          C
          C     LINEAR DATA
          C
0126        190 CONTINUE
0127            IF (CHARST(2).EQ.CARD2) GO TO 200
0128            JJ=JJ+1
0129            READ (99,660) LNBODC(JJ),LNBODN(JJ),LNORGN(JJ),LNAMON(JJ),LNNO2(JJ
               1),LNNO3(JJ),LNDO(JJ),LNCOLI(JJ),LNCOLT(JJ),LNC1(JJ),LNC2(JJ),LNC3(
               2JJ),LNQ(JJ)
0130            LNCOLI(JJ)=LNCOLI(JJ)*1000.
0131            LNCOLT(JJ)=LNCOLT(JJ)*1000.
0132            GO TO 210
0133        200 CONTINUE
0134            JJ1=JJ1+1
0135            READ (99,660) LNPO4(JJ1)
```

```
0136            IF (JJ1.GT.50) GO TO 470                              I 224
0137        210 CONTINUE                                              I 225
0138            IF (JJ.GT.50) GO TO 470                               I 226
0139            GO TO 20                                              I 227
          C     END OF SEC A CARD INPUT **                            I 228
          C                                                           I 229
0140        220 ICDBUF=1                                              I 230
0141            INITSW=1                                              I 231
0142            DO 230 I=1,10                                         I 232
0143            PTINC1(I)=PTINIT(I)                                   I 233
0144            PTINC2(I)=PTINIT(I+10)                                I 234
0145            PTINC3(I)=PTINIT(I+20)                                I 235
0146        230 CONTINUE                                              I 236
0147            RETURN                                                I 237
          C                                                           I 238
          C                                                           I 239
          C     CARD SET B ENTRY                                      I 240
          C                                                           I 241
0148            ENTRY READB                                           I 242
          C                                                           I 243
          C     INITIAL VAR.                                          I 244
0149            ISECT=2                                               I 245
0150            IPNT=0                                                I 246
0151            IPNT1=0                                               I 247
0152            IPNT2=0                                               I 248
0153            IPNT3=0                                               I 249
0154            IF (ICDBUF.NE.0) GO TO 250                            I 250
0155        240 READ (CARD,510,END=490) CHARST                        I 251
0156        250 IF (CHARST(1).EQ.CARD6) GO TO 260                     I 252
0157            IF (CHARST(1).EQ.CARD7) GO TO 280                     I 253
0158            IF (CHARST(1).EQ.CARDK) GO TO 350                     I 254
0159            IF (CHARST(1).EQ.CARD8) GO TO 370                     I 255
0160            IF (CHARST(1).EQ.CARD9) GO TO 390                     I 256
0161            IF (CHARST(1).EQ.CARD1) GO TO 390                     I 257
          C                                                           I 258
          C     BAD CARD TYPE PRINT MESSAGE AND RETURN                I 259
0162            GO TO 440                                             I 260
          C                                                           I 261
0163        260 CONTINUE                                              I 262
0164            IF (IPNT.NE.0) GO TO 270                              I 263
0165            WRITE (PRINT,650)                                     I 264
0166            IPNT=1                                                I 265
0167        270 READ (99,600) IR,C,TTLE,A,B                           I 266
0168            WRITE (PRINT,720) IR,C,TTLE,A,B                       I 267
0169            GO TO 240                                             I 268
          C                                                           I 269
          C                                                           I 270
0170        280 CONTINUE                                              I 271
0171            IF (IPNT1.NE.0) GO TO 310                             I 272
0172            WRITE (PRINT,670)                                     I 273
0173            WRITE (PRINT,680)                                     I 274
0174            IF (NCONSV.NE.0) GO TO 290                            I 275
0175            WRITE (PRINT,690)                                     I 276
0176            GO TO 300                                             I 277
0177        290 WRITE (PRINT,700) PTC1,PTC2,PTC3                      I 278
0178        300 IPNT1=1                                               I 279
```

```
0179          310 IF (CHARST(2).EQ.CARD2) GO TO 320
0180              READ (99,610) IR,MO,DA,CDE,TTLE,A,B,C,D,E,F,G,H,S
0181              GO TO 330
0182          320 READ (99,840) DORG,DAMON,DNO2,DNO3,DCF,DCT
0183              GO TO 240
0184          330 IF (NCONSV.NE.0) GO TO 340
0185              WRITE (PRINT,740) IR,MO,DA,CDE,TTLE,A,B,C,D,E,F
0186              GO TO 240
0187          340 WRITE (PRINT,730) IR,MO,DA,CDE,TTLE,A,B,C,D,E,F,G,H,S
0188              GO TO 240
            C
            C     DATA CARD FOR KEY DESCRIPTION
0189          350 CONTINUE
0190              IF (IPNT3.NE.0) GO TO 360
0191              WRITE (PRINT,750)
0192              IPNT3=1
0193          360 READ (99,780) SCODE,TTLKEY
0194              WRITE (PRINT,790) SCODE,TTLKEY
0195              GO TO 240
            C
0196          370 CONTINUE
0197              IF (IPNT2.NE.0) GO TO 380
0198              WRITE (PRINT,680)
0199              WRITE (PRINT,710)
0200              IPNT2=1
0201          380 READ (99,620) IR,A,B,C,D
0202              WRITE (PRINT,760) IR,A,B,C,D
0203              GO TO 240
            C
            C      END OF SEC B CARD INPUT
            C
0204          390 ICDBUF=1
0205              ISW=1
0206              RETURN
            C
0207              ENTRY READC
            C
            C
            C     INITIALIZE VAR.
0208              ISECT=3
0209              ICTY2=1
0210              INUM=0
0211              ICNTCD=0
            C
0212              IF (ICDBUF.NE.0) GO TO 410
0213          400 READ (CARD,510,END=490) CHARST
0214          410 IF (CHARST(1).EQ.CARD9) GO TO 420
0215              IF (CHARST(1).EQ.CARD1) GO TO 430
            C
            C     BAD CARD TYPE PRINT MESSAGE AND RETURN
0216              GO TO 440
            C
0217          420 CALL TEST (CHARST,IRET,CHERR)
0218              IF (IRET.EQ.1) GO TO 450
            C
            C     DATA CK OKAY
```

```
             C
0219                ICTY3=ICTY2+9
0220                ICNTCD=ICNTCD+1
0221                READ (99,530) NMOD,(XMOD(J,NMOD),J=ICTY2,ICTY3)
0222                INUM=INUM+1
0223                WRITE (PRINT,500) NMOD,(XMOD(J,NMOD),J=ICTY2,ICTY3)
0224                ICTY2=ICTY2+10
0225                IF (NMOD.GT.21) GO TO 470
0226                IF (ICTY3.GT.30) GO TO 470
0227                IF (ICNTCD.LT.2) GO TO 400
0228                ICNTCD=0
0229                ICTY2=1
0230                GO TO 400
             C
             C      END OF SEC C CARD INPUT
             C
0231           430 ICDBUF=1
0232                INODE=INUM/2
0233                IF (INODE.NE.LOOP) GO TO 460
0234                LOOP=0
0235                RETURN
             C
             C
             C      INVALID CARD TYPE
0236           440 WRITE (PRINT,590) CHARST(1),ISECT,CHARST
0237                ISWBAD=1
0238                CALL ERROR
0239                RETURN
0240           450 WRITE (PRINT,540) ISECT,CHARST,CHERR
0241                ISWBAD=1
0242                CALL ERROR
0243                RETURN
             C
             C      INCORRECT NUMBER CARDS FOR MODIFICATION RUN  **
0244           460 WRITE (PRINT,640) INUM,LOOP,INODE
0245                ISWBAD=1
0246                CALL ERROR
0247                RETURN
             C      INPUT DATA HAS EXCEEDED SPACE PROVIDED
             C
0248           470 WRITE (PRINT,820) LL,ICTY,J,K,JJ,ICTY3,NMOD
0249                ISWBAD=1
0250                CALL ERROR
0251                RETURN
             C
0252           480 WRITE (PRINT,830)
0253                ISWBAD=1
0254                CALL ERROR
0255                RETURN
             C
             C      END OF CARD INPUT, SET FLAG
0256           490 IEND=1
0257                RETURN
             C
             C
             C
```

```
0258      500 FORMAT (//,10X,12HVARIABLE NO.,I3,32HMODIFIED --- NEW VALUES ARE -
             1--//(10(5X,F8.2)))
0259      510 FORMAT (80A1)
0260      520 FORMAT (1X,19A4)
0261      530 FORMAT (2X,2I2,7I1,F6.2,8F4.0,F5.0,2F4.0,2F5.0,F4.0)
0262      540 FORMAT (1H1,////10X,35HERROR ON INPUT DATA CARD FOR SECT. ,I1//10X
             1,13HCARD IMAGE = ,80A1//10X,12HBAD CHAR. = ,A1)
0263      550 FORMAT (2X,F6.0,10F7.0)
0264      560 FORMAT (2X,12F6.0)
0265      570 FORMAT (2X,F5.0,F5.0,F5.0,F3.0,F6.0,7F4.0,2F6.0,2F4.0,F6.0)
0266      580 FORMAT (2X,2F5.0,3F4.0,F5.0)
0267      590 FORMAT (1H1,10X,20HINVALID CARD TYPE = ,A1/10X,21HCARD INPUT SECTI
             1ON = ,I1//10X,13HCARD IMAGE = ,80A1)
0268      600 FORMAT (1X,I3,A2,5A4,F8.0,F8.0)
0269      610 FORMAT (2X,I3,3A2,5A4,F6.0,3F6.0,F5.0,F4.0,2F6.0,F4.0)
0270      620 FORMAT (1X,I3,4F10.0)
0271      630 FORMAT (1X,I3,10F6.0)
0272      640 FORMAT (1H121HINCORRECT NUMBER CDS-,I4,3X,22HNUMBER NODES SPECIFIE
             1D,I4,3X,20HNUMBER NODES CHANGED,I4)
0273      650 FORMAT (1H1///////23X,78HR E A C H   D E S C R I P T I O N   D A T A
             1  ( MAJOR TRIBUTARIES AND MAIN STEM )/21X,81(1H_)//10X,8HSUBREACH,
             25X,4HCODE,20X,4HNAME,20X,5HBEGIN,22X,3HEND/71X,6H(MILE),20X,6H(MIL
             3E)/)
0274      660 FORMAT (2X,F5.0,12F6.0)
0275      670 FORMAT (///////////10X,4HKEY:,3X,4HCODE//18X,44HA  ROCKY BOTTOM-POO
             1L RIFFLE-LIGHT VEGETATION/18X,45HB  ROCKY BOTTOM-POOL RIFFLE-MEDIU
             2M VEGETATION/18X,44HC  ROCKY BOTTOM-POOL RIFFLE-HEAVY VEGETATION/1
             38X,48HD  ROCKY BOTTOM-CHANNEL CONTROL-LIGHT VEGETATION/18X,49HE  R
             4OCKY BOTTOM-CHANNEL CONTROL-MEDIUM VEGETATION/18X,48HF  ROCKY BOTT
             5OM-CHANNEL CONTROL-HEAVY VEGETATION/18X,42HG  MUD BOTTOM-POOL RIFF
             6LE-LIGHT VEGETATION/18X,43HH  MUD BOTTOM-POOL RIFFLE-MEDIUM VEGETA
             7TION/18X,42HI  MUD BOTTOM-POOL RIFFLE-HEAVY VEGETATION/18X,46HJ  M
             8UD BOTTOM-CHANNEL CONTROL-LIGHT VEGETATION/18X,47HK  MUD BOTTOM-CH
             9ANNEL CONTROL-MEDIUM VEGETATION/18X,46HL  MUD BOTTOM-CHANNEL CONTR
             $OL-HEAVY VEGETATION)
0276      680 FORMAT (1H1)
0277      690 FORMAT (///////26X,68HW A S T E   S O U R C E   A N D   M I N O R   T
             1R I B U T A R Y   D A T A/24X,72(1H_)//1X,8HSUBREACH,2X,4HDATE,5H C
             2ODE,9X,4HNAME,11X,4HMILE,6X,1HQ,7X,4HCBOD,5X,4HNBOD,7X,2HDO,5X,4HT
             3EMP/,42X,8HLOCATION,2X,5H(CFS),4X,6H(MG/L),3X,6H(MG/L),4X,6H(MG/L)
             42X,8H(DEG. C))
0278      700 FORMAT (///////26X,68HW A S T E   S O U R C E   A N D   M I N O R   T
             1R I B U T A R Y   D A T A/24X,72(1H_)//1X,8HSUBREACH,2X,4HDATE,5H C
             2ODE,9X,4HNAME,11X,4HMILE,6X,1HQ,7X,4HCBOD,5X,4HNBOD,7X,2HDO,5X,4HT
             3EMP,8X,2A4,3X,2A4,4X,2A4,/42X,8HLOCATION,2X,5H(CFS),4X,6H(MG/L),3X
             4,6H(MG/L),4X,6H(MG/L),2X,8H(DEG. C),5X,6H(MG/L),5X,6H(MG/L),5X,6H(
             5MG/L))
0279      710 FORMAT (///16X,91HA V E R A G E   R E A C H   S T R E A M F L O W   D
             1 A T A  ( MAJOR TRIBUTARIES AND MAIN STEM )/14X,95(1H_)//17X,8HSUB
             2REACH,12X,7HAVERAGE,2H Q,9X,13HAVERAGE DEPTH,5X,16HAVERAGE VELOCIT
             3Y,5X,13HAVERAGE WIDTH/39X,5H(CFS),14X,6H(FEET),12X,10H(FEET/SEC),1
             42X,6H(FEET)/)
0280      720 FORMAT (13X,I3,7X,A2,15X,5A4,12X,F6.2,23X,F6.2)
0281      730 FORMAT (4X,I3,3X,A2,1H/,A2,2X,A2,3X,5A4,1X,F6.2,2F9.1,1X,F9.1,F9.1
             1,2X,F7.1,4X,F9.1,3X,F7.1,4X,F7.1)
0282      740 FORMAT (4X,I3,3X,A2,1H/,A2,2X,A2,3X,5A4,1X,F6.2,2F9.1,1X,F9.1,F9.1
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                1,2X,F7.1)
0283      750 FORMAT (//////////4X,18HKEY:  SOURCE  CODE/)
0284      760 FORMAT (20X,I3,12X,F9.1,13X,F5.1,15X,F5.2,14X,F7.1)
0285      770 FORMAT (1X,2A4,2X,2A4,2X,2A4)
0286      780 FORMAT (1X,A1,19A4)
0287      790 FORMAT (19X,A1,19A4)
0288      800 FORMAT (1X,10A4)
0289      810 FORMAT (1X,2A7,42X,3A7)
0290      820 FORMAT (1H1,2X,60HINPUT DATA HAS EXCEEDED SPACE PROVIDED,CHECK REA
             1DCD ROUTINE.//10X,4HLL= ,I3,2X,6HICTY= ,I3,2X,3HJ= ,I3,2X,3HK= ,I3
             2,2X,4HJJ= ,I3,2X,7HICTY3= ,I3,2X,6HNMOD= ,I3)
0291      830 FORMAT (1H1////45HNSEG EXCEEDS FIRST DIMENSION STATEMENT VALUES)
0292      840 FORMAT (2X,4F6.0,2F8.0)
0293          END
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0001         SUBROUTINE NITBOD
        C
        C    THIS IS SEGMENT OR SUBREACH LOOP FROM ORIGINAL VERSION OF G-475
        C    THIS SUBROUTINE WAS REMOVED FROM THE ORIGINAL VERSION OF  G-475
        C
0002         DIMENSION BODCU(50), WBODCU(50), BODN(50), WBODN(50), DOD(50), WDO
            1D(50), Q(50), DEPTH(50), AREA(50), TEMP(50), XSEG(50), AKR(50), AK
            2D(50), AKN(50), BN(50), PNET(50), XMOD(50,37), TITLE(19), DOSAT(50
            3), C1(50), C2(50), C3(50), QTRIB(50), C1TRIB(50), C2TRIB(50), C3TR
            4IB(50), TTSUBR(50)
0003         DIMENSION GRAPH(2000), XDIST(999), CHLA(10), D1(999), D2(999), D8(
            1999), D9(999), OBSMI(200), OBSDO(200), OBSC1(200), OBSC2(200), OBS
            2C3(200), QPLOT(999), MIPLOT(200), DEPTPT(200), VELBTT(50)
0004         DIMENSION TTLE(5)
0005         DIMENSION CSTR1(999), CSTR2(999), CSTR3(999), XXSTR(999)
0006         DIMENSION ORGNTB(50), AMONTB(50), TBNO2(50), TBNO3(50), ORGNLB(50)
            1, AMONLB(50), LBNO2(50), LBNO3(50), AKORGN(50), AKAMON(50), AKNO2(
            250), AKNO3(50), OBSORG(200), OBSAMN(200), OBSNO2(200), OBSNO3(200)
            3, OBSCOL(200), OBSCOT(200), PLTCOL(999), PLTTOT(999), PLTORG(999),
            4 PLTAMN(999), PLTNO2(999), PLTNO3(999), COLITR(50), COLTTR(50), CO
            5LDIE(50), TOTDIE(50)
0007         INTEGER IR
0008         EQUIVALENCE (XMOD(1),BODCU), (XMOD(51),WBODCU), (XMOD(101),BODN),
            1(XMOD(151),ORGNTB), (XMOD(201),AMONTB), (XMOD(251),TBNO2), (XMOD(3
            201),TBNO3), (XMOD(351),WBODN), (XMOD(401),ORGNLB), (XMOD(451),AMON
            3LB), (XMOD(501),LBNO2), (XMOD(551),LBNO3), (XMOD(601),DOD), (XMOD(
            4651),TEMPTR), (XMOD(701),CHLA), (XMOD(751),BN), (XMOD(801),PNET),
            5(XMOD(851),C1), (XMOD(901),C2), (XMOD(951),C3), (XMOD(1001),Q), (X
            6MOD(1051),DEPTH), (XMOD(1101),AREA), (XMOD(1151),TEMP), (XMOD(1201
            7),XSEG), (XMOD(1251),AKR), (XMOD(1301),AKD), (XMOD(1351),AKN), (XM
            8OD(1401),AKORGN), (XMOD(1451),AKAMON), (XMOD(1501),AKNO2), (XMOD(1
            9551),AKNO3), (XMOD(1601),COLITR), (XMOD(1651),COLTTR), (XMOD(1701)
            $,COLDIE), (XMOD(1751),TOTDIE), (XMOD(1801),TTSUBR)
0009         REAL*8 COBSMI(200),COBSDO(200),COBSC1(200),COBSC2(200),COBSC3(200)
0010         REAL NTERM,MIPLOT
0011         REAL LBNO2,LBNO3,LNPO4,MPO4,KPO41,KPO42
0012         REAL LNBODC(50),LNORGN(50),LNAMON(50),LNNO2(50),LNNO3(50),LNDO(50)
            1,LNC1(50),LNC2(50),LNC3(50),LNQ(50),LNCOLI(50),LNCOLT(50),LNBODN(5
            20)
0013         REAL MBDC(50),MBORGN(50),MBAMON(50),MBNO2(50),MBNO3(50),MDO(50),MB
            1DN(50),MBCOLI(50),MBCOLT(50)
0014         INTEGER CARD,PRINT
0015         DIMENSION PO4CU(50), WPO4CU(50), MPO4(50), LNPO4(50), PLPO4(999)
0016         DIMENSION KPO41(50), KPO42(50)
0017         COMMON /ADIT/ PO4CU,WPO4CU,MPO4,LNPO4,PLPO4,KPO41,KPO42,PO4,BP
0018         COMMON /OBS/ OCBODU(200),ONBODU(200),OBSPO4(200)
        C
0019         COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
            1AKNT,BDN,BNT,AKRT,BDC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
            2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
            3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
            4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAD,ISW,TITLE,INITSW,ICDBUF,IRUNOF
            5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
            6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
            7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
            8ICOLOP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
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               C
      0020          COMMON /LCPLOT/ D1,D2,D8,D9,PLTORG,PLTAMN,PLTNO2,PLTNO3,PLTCOL,PLT
                   1TOT,XDIST,QPLOT
      0021          COMMON /LCWORK/ X,XL,XX,QUP,TSUM,DTEMP,VELBTT,MDO,IFLAG,ISW1,IFIN,
                   1JJ
      0022          COMMON /LC1/ ORGNO,AMONO,FNO20,FNO30,DELTT,AKORGT,AKAMNT,AKNO2T,AK
                   1NO3T,ORGNST,AMONST,STNO2,STNO3
      0023          COMMON /LCMB/ MBDC,MBDN,MBORGN,MBAMON,MBNO2,MBNO3,MBCOLI,MBCOLT
      0024          COMMON /FILES/ CARD,PRINT
      0025          DIMENSION SKORGN(50), SKAMON(50), SKNO2(50), AAKAT(50)
      0026          COMMON /SINK/ SKORGN,SKAMON,SKNO2,AAKAT,SKORGT,SKAMNT,SKNO2T
               C
      0027          DO 290 J=1,NSEG
      0028          ISW1=0
               C     CHECK FOR ANOXIC  PRINTOUT ***
      0029          IF (LF.EQ.0) GO TO 30
      0030          IF (TB.GT.TTSUM) GO TO 10
      0031          ATOUT=TB
      0032          GO TO 20
      0033       10 ATOUT=TTSUM
      0034          XB=TTSUM-XC
      0035       20 CONTINUE
      0036          WRITE (PRINT,310) XB,XC,ATOUT
      0037          IFIN=IFIN+5
      0038          KFLAG=1
      0039          LF=0
      0040          TB=999.99
      0041       30 CONTINUE
      0042          IF (IFIN.EQ.0.OR.IFIN.GT.52) GO TO 40
               C     TABLE HEADING ***
      0043          WRITE (PRINT,340)
      0044          IFIN=IFIN+6
      0045          GO TO 50
      0046       40 WRITE (PRINT,320) TITLE
      0047          WRITE (PRINT,340)
      0048          IFIN=13
      0049       50 IF (J.EQ.1) GO TO 60
      0050          X=XSEG(J-1)
      0051          XSTRT=XSEG(J-1)
      0052       60 CONTINUE
               C
      0053          IF (IRUNOF.NE.1) GO TO 70
      0054          DELTAQ=LNQ(J)*DXPNT/(XSTRT-XSEG(J))
               C
               C    TEMPERATURE CORRECT THE REACTIONS
      0055       70 CONTINUE
      0056          DTEMP=TEMP(J)-20.
      0057          XX=1.047**DTEMP
      0058          AKDT=AKD(J)*XX
      0059          AKRT=AKR(J)*XX
      0060          XX=1.09**DTEMP
      0061          AKNT=AKN(J)*XX
      0062          APO41T=KPO41(J)*XX
      0063          APO42T=KPO42(J)*XX
      0064          XX=1.065**DTEMP
      0065          BNT=BN(J)*XX
```

```
                C
                C     RECORD UPSTREAM FLOW
                C
0066                  QUP=QTOT
                C
                C     CALCULATE DOWNSTREAM FLOW
                C
0067                  IF (JSEG.EQ.0) GO TO 80
0068                  QTOT=QTOT+Q(J)
0069                  GO TO 90
0070               80 QTOT=QTOT+Q(J)+QTRIB(J)
0071               90 CONTINUE
                C
                C
                C     CALCULATE DOSAT
                C
0072                  DOSAT(J)=14.652-.41022*TEMP(J)+.007910*TEMP(J)**2-.000077774*TEMP(
                     1J)**3
                C
0073                  DOSAT(J)=BP/29.92*DOSAT(J)
                C
                C     CALCULATE INITIAL CONCENTRATION FROM UPSTREAM CONCENTRATIONS.
                C     BDCU, BDN, DO, AND TRIBURARY CONCENTRATIONS, BODCU, BODN, DOD
                C
                C     ALLOW FOR NEGATIVE FLOWS
                C
0074                  IF (Q(J).GT.0.0) GO TO 100
0075                  BODCUJ=BDC
0076                  BODNJ=BDN
0077                  COLIJ=STCOLI
0078                  COLTJ=STCOLT
0079                  DODJ=DOSAT(J)-DO
0080                  PO4CUJ=PO4
0081                  GO TO 110
0082              100 BODCUJ=BODCU(J)
0083                  PO4CUJ=PO4CU(J)
0084                  BODNJ=BODN(J)
0085                  COLIJ=COLITR(J)
0086                  COLTJ=COLTTR(J)
0087                  DODJ=DOD(J)
0088              110 CONTINUE
0089                  IF (JSEG.GT.0) GO TO 120
                C     MAIN STEM ***
0090                  BDCO=(BDC*QUP+BODCUJ*Q(J)+MBDC(J)*QTRIB(J))/QTOT
0091                  BPO40=(PO4*QUP+PO4CUJ*Q(J)+MPO4(J)*QTRIB(J))/QTOT
0092                  BDNO=(BDN*QUP+BODNJ*Q(J)+MBDN(J)*QTRIB(J))/QTOT
0093                  COLIO=(STCOLI*QUP+COLIJ*Q(J)+MBCOLI(J)*QTRIB(J))/QTOT
0094                  COLTO=(STCOLT*QUP+COLTJ*Q(J)+MBCOLT(J)*QTRIB(J))/QTOT
0095                  DOO=(DO*QUP+(DOSAT(J)-DODJ)*Q(J)+MDO(J)*QTRIB(J))/QTOT
                C
0096                  GO TO 130
                C      TRIBUTARY ***
0097              120 BDCO=(BDC*QUP+BODCUJ*Q(J))/QTOT
0098                  BPO40=(PO4*QUP+PO4CUJ*Q(J))/QTOT
0099                  BDNO=(BDN*QUP+BODNJ*Q(J))/QTOT
0100                  COLIO=(STCOLI*QUP+COLIJ*Q(J))/QTOT
```

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0101          COLTO=(STCOLT*QUP+COLTJ*Q(J))/QTOT
        C
        C     DO MASS BALANCE FOR DO, NOT DO DEFICIT
        C
0102          DOO=(DO*QUP+(DOSAT(J)-DOOJ)*Q(J))/QTOT
0103      130 CONTINUE
0104          DDO=DOSAT(J)-DOO
        C
        C     ADD IN DIRECT DISCHARGES
        C
0105          BDCO=WBODCU(J)/QTOT/5.4+BDCO
0106          BPO40=WPO4CU(J)/QTOT/5.4+BPO40
0107          BDNO=WBODN(J)/QTOT/5.4+BDNO
        C     DO HAS BEEN ADDED DURING TRIB OR MAIN STEM CALCULATIONS
        C     SAVE LAST VALUE COMPUTED
        C
0108          DOOLD=DOSAT(J)-DDO
0109          BDCOLD=BDCO
0110          PO4OLD=BPO40
0111          BDNOLD=BDNO
0112          OLDCOI=COLIO
0113          OLDCOT=COLTO
        C
        C     CALCULATION LOOP
        C
0114      140 CONTINUE
        C
        C
        C      TEST FOR FIRST NODE
        C
0115          IF (X.EQ.XSTRT) GO TO 180
0116          IF (DELTAQ.LE.0.0) GO TO 160
        C
0117          IF (IFLAG.LT.1) GO TO 150
0118          DELTAQ=DELTAQ*(ENDRCH/DXPNT)
0119      150 CONTINUE
        C
0120          BDCO=(BDCOLD*QTOT+LNBODC(J)*DELTAQ)/(QTOT+DELTAQ)
0121          BPO40=(PO4OLD*QTOT+LNPO4(J)*DELTAQ)/(QTOT+DELTAQ)
0122          BDNO=(BDNOLD*QTOT+LNBODN(J)*DELTAQ)/(QTOT+DELTAQ)
0123          COLIO=(OLDCOI*QTOT+LNCOLI(J)*DELTAQ)/(QTOT+DELTAQ)
0124          COLTO=(OLDCOT*QTOT+LNCOLT(J)*DELTAQ)/(QTOT+DELTAQ)
0125          DOO=(DOOLD*QTOT+LNDO(J)*DELTAQ)/(QTOT+DELTAQ)
0126          DDO=DOSAT(J)-DOO
0127          QTOT=QTOT+DELTAQ
        C
0128          GO TO 180
        C     NEGATIVE FLOW OR NO LINEAR RUNOFF
0129      160 BDCO=BDCOLD
0130          BPO40=PO4OLD
0131          BDNO=BDNOLD
0132          COLIO=OLDCOI
0133          COLTO=OLDCOT
0134          DOO=DOOLD
0135          DDO=DOSAT(J)-DOO
0136          IF (IFLAG.LT.1) GO TO 170
```

```
0137            DELTAQ=DELTAQ*(ENDRCH/DXPNT)
0138        170 QTOT=QTOT+DELTAQ
0139        180 CONTINUE
          C     A) VELOCITY AND TRAVEL TIME
          C
0140            IF (ITTIFD.EQ.0) GO TO 190
0141            U=VELBTT(J)*16.3636
0142            GO TO 200
0143        190 U=QTOT/AREA(J)*16.3636
0144        200 CONTINUE
          C
0145            DELTT=DXPNT/U
          C
          C     ADJUST TRAVEL TIME FOR SHORT DISTANCE AT END OF SUBREACH***
          C
0146            IF (IFLAG.LT.1) GO TO 210
0147            DELTT=DELTT*(ENDRCH/DXPNT)
0148        210 CONTINUE
          C     CALCULATE AKAT
          C
          C     TEST FOR FIRST PASS  **
          C
0149            IF (ISW1.EQ.1) GO TO 220
0150            DELTT=0.0
0151            ISW1=1
0152        220 CONTINUE
          C     INCREMENT TRAVEL TIME FOR SUBREACH
0153            TT=TT+DELTT
0154            IF (ICODE.GT.0) GO TO 230
          C     BENNETT-RATHBUN REAERATION EQUATION
0155            UZIE=(QTOT/AREA(J))
0156            IF (ITTIFD.EQ.1) UZIE=VELBTT(J)
0157            AKAT=(8.76*(UZIE)**0.607/DEPTH(J)**1.689)*1.021**DTEMP
          C     AKAT = 13. * SQRT (QTOT/AREA(J)/DEPTH(J)**3)*1.024**DTEMP
0158            AKAT=AKAT*2.303
0159            GO TO 240
0160        230 AKAT=AAKAT(J)
0161        240 CONTINUE
          C     B) EXPONENTIALS
          C
0162            ER=EXP(-AKRT*DELTT)
0163            EN=EXP(-AKNT*DELTT)
0164            EA=EXP(-AKAT*DELTT)
0165            EP1=EXP(-APO41T*DELTT)
0166            EP2=EXP(-APO42T*DELTT)
          C
          C     C) SOLUTIONS
          C
0167            BDC=BDCO*ER
0168            PO4=BPO40*EP1-APO42T*(CHLA(J)*(1-EP2))
0169            BDN=BDNO*EN
0170            DD=DDO*EA
0171            D1O=DD
0172            CTERM=BDCO*AKDT/(AKAT-AKRT)*(ER-EA)
0173            DD=DD+CTERM
0174            NTERM=BDNO*AKNT/(AKAT-AKNT)*(EN-EA)
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```
0175            DO=DO+NTERM
0176            BOTERM=BNT/(DEPTH(J)*0.3048)*(1.-EA)/AKAT
0177            DO=DO+BOTERM
0178            PTERM=-PNET(J)*(1.-EA)/AKAT
0179            DO=DO+PTERM
0180            RTERM=CHLA(J)*.025*(1.-EA)/AKAT
0181            DO=DO+RTERM
0182            D9(JJ+1)=DO
0183            TTSUM=TSUM+TT
0184            DD=DOSAT(J)-DO
0185            STCOLI=COLIO*EXP(-COLDIE(J)*DELTT)
0186            STCOLT=COLTO*EXP(-TOTDIE(J)*DELTT)
          C
          C     ZERO DO CALCULATION CHECKS
          C
0187            IF (DO.LE.0.1.AND.TB.LT.TTSUM) TB=TTSUM+.0001
0188            IF (TTSUM.LT.TB.AND.LF.EQ.1) GO TO 250
0189            IF (DO.LE.0.1.AND.TTSUM.LT.TB) GO TO 250
0190            GO TO 260
0191        250 CALL ANEROB (J)
0192        260 CONTINUE
0193            IF (TTSUM.GE.TB.AND.KFLAG.EQ.0) KFLAG=1
0194            JJ=JJ+1
0195            D9(JJ)=DO
0196            D1(JJ)=BDC
0197            D2(JJ)=BDN
0198            PLTCOL(JJ)=STCOLI
0199            PLTTOT(JJ)=STCOLT
0200            XDIST(JJ)=XL
0201            QPLOT(JJ)=QTOT
0202            PLPO4(JJ)=PO4
0203            IF (IFIN.LT.60) GO TO 270
0204            WRITE (PRINT,320) TITLE
0205            WRITE (PRINT,340)
0206            IFIN=13
0207        270 WRITE (PRINT,330) J,XL,TTSUM,BDC,BDN,DIO,CTERM,NTERM,BOTERM,PTERM,
               1RTERM,STCOLT,STCOLI,DD,DO,PO4
0208            IFIN=IFIN+1
          C
          C
          C     SAVE OLD BOD,AND DO TERMS FOR NEXT COMP.
          C
0209            DOOLD=DO
0210            BDCOLD=BDC
0211            PO4OLD=PO4
0212            BDNOLD=BDN
0213            OLDCOI=STCOLI
0214            OLDCOT=STCOLT
          C
          C     INCREMENT X AND XL AND LOOP
          C
0215            X=X-ABS(DXPNT)
0216            XL=XL-DXPNT
0217            IF (IFLAG.GT.0) GO TO 280
0218            XTEMP=XSE3(J)-XL
          C     TEST FOR SMALL DIST. CLOSE TO END OF SUBREACH
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0219                ENDRCH=DXPNT-XTEMP
0220                IF (XTEMP.GE.-0.01) XTEMP=0.0
              C
              C     THIS IS A SIGNF FUNCTION
              C
0221                XTEMP=XTEMP*DXPNT/ABS(DXPNT)
0222                IF (XTEMP.LT.0.0) GO TO 140
0223                IFLAG=1
0224                X=XSEG(J)
0225                XL=XSEG(J)
0226                GO TO 140
0227            280 IFLAG=0
0228                XL=XSEG(J)
0229                TSUM=TSUM+TT
              C     RESET SUBREACH TRAVEL TIME
0230                TT=0.0
0231            290 CONTINUE
0232                RETURN
              C
              C
              C
0233            310 FORMAT (//24X,35H  LENGTH OF TIME FOR ANOXIC ZONE = ,F6.3,17H DAYS
                   1 (FROM TT = ,F6.3,14H DAYS TO TT = ,F6.3,7H DAYS )//)
0234            320 FORMAT (1H1,40X,19A4//57X,23HRESULTS OF COMPUTATIONS///52X,55H   S
                   1  U  B  R  E  A  C  H          D  E  F  I  C  I  T  S/54X,54(1H_))
0235            330 FORMAT (1X,I3,3X,F7.2,2X,F7.2,1X,F6.2,1X,F6.2,1X,F7.3,1X,F7.3,2X,F
                   17.3,2X,F7.3,2X,F7.3,2X,F7.3,2X,2(F10.0,1X),2(F6.2,1X),F6.2)
0236            340 FORMAT (//1X,4HSUB-,2X,8HDISTANCE,2X,6HTRAVEL,2X,5HCBODU,2X,4HNBOD
                   1,2X,7HINITIAL,3X,4HCBOD,4X,4HNBOD,4X,7HBENTHAL,2X,6HPHOTO.,3X,7HRE
                   2SPIRE,5X,5HTOTAL,6X,5HFECAL,5X,2HDO,5X,2HDO,5X,3HPO4/1X,5HREACH,12
                   3X,4HTIME,4X,4HCONC,2X,4HCONC,2X,7HDEFICIT,1X,7HDEFICIT,2X,7HDEFICI
                   4T,2X,7HDEFICIT,2X,7HDEFICIT,2X,7HDEFICIT,3X,8HCOLIFORM,3X,8HCOLIFO
                   5RM,2X,7HDEFICIT,2X,4HCONC,3X,4HCONC/94X,4HCONC,7X,4HCONC/)
0237                END
```

```
0001       SUBROUTINE NTRFCN
0002       COMMON /LC1/ ORGNO,AMONO,FNO20,FNO30,DELTT,AKORGT,AKAMNT,AKNO2T,AK
          1NO3T,ORGNST,AMONST,STNO2,STNO3
0003       COMMON /ARSUB/ COBSMI,COBSC1,COBSC2,COBSC3,COBSDO,XMOD,AKAT,DOSAT,
          1AKNT,BON,BNT,AKRT,BOC,TT,XB,TB,DO,XC,XA,MLX,LF,KFLAG,QTOT,QUPS,C1U
          2PST,C2UPST,C3UPST,NSEG,NCONSV,DXPNT,OBSMI,OBSC1,OBSC2,OBSC3,QTRIB,
          3ICTY,C1TRIB,C2TRIB,C3TRIB,JSEG,TTSUM,CSTR1,CSTR2,CSTR3,OBSDO,ICODE
          4,LOOP,NMOD,NWASTE,XSTRT,IEND,ISWBAD,ISW,TITLE,INITSW,ICDBUF,IRUNOF
          5,LNBODC,LNBODN,LNDO,LNC1,LNC2,LNC3,LNQ,DELTAQ,PTC1(2),PTC2(2),PTC3
          6(2),PTINC1(10),PTINC2(10),PTINC3(10),GRAPH,ITTIFO,LNORGN,LNAMON,LN
          7NO2,LNNO3,STCOLI,STCOLT,OBSORG,OBSAMN,OBSNO2,OBSNO3,LNCOLI,LNCOLT,
          8ICOLOP,OBSCOL,OBSCOT,XXSTR,MIPLOT,DEPTPT
0004       COMMON /LC2/ DELAMN,DELNO2
0005       DIMENSION SKORGN(50), SKAMON(50), SKNO2(50), AAKAT(50)
0006       COMMON /SINK/ SKORGN,SKAMON,SKNO2,AAKAT,SKORGT,SKAMNT,SKNO2T
      C     NITRIFICATION CALCULATIONS     REPROGRAMMED     JAN 26,1979
      C     N1= ORGNST       N10= ORGNO       K11= SKORGT     K12= AKORGT
      C     N2= AMONST       N20= AMONO       K22= SKAMNT     K23= AKAMNT
      C     N3= STNO2        N30= FNO20       K33= SKNO2T     K34= AKNO2T
      C     N4= STNO3        N40= FNO30       K44= AKNO3T
      C
0007       REAL K2MK1,K3MK1,K3MK2,K4MK1,K4MK2,K4MK3,KAMK1,KAMK2,KAMK3,
          *K1KA,K2KA,K3KA
      C
0008       K2MK1= SKAMNT-SKORGT
0009       K3MK1= SKNO2T-SKORGT
0010       K3MK2= SKNO2T-SKAMNT
0011       K4MK1= AKNO3T-SKORGT
0012       K4MK2= AKNO3T-SKAMNT
0013       K4MK3= AKNO3T-SKNO2T
      C
0014       A=AKORGT*ORGNO/K2MK1
0015       B=AMONO-A
0016       C=A*AKAMNT/K3MK1
0017       D=AMONO*AKAMNT/K3MK2-A*AKAMNT/K3MK2
0018       E=FNO20-AMONO*AKAMNT/K3MK2-C+A*AKAMNT/K3MK2
0019       F=C*AKNO2T/K4MK1
0020       G=AKAMNT*AKNO2T*B/(K3MK2*K4MK2)
0021       H=-AKNO2T/K4MK3*(-FNO20+C+AKAMNT/K3MK2*B)
0022       A1=FNO30-F-G-H
      C
0023       E1=EXP(-SKORGT*DELTT)
0024       E2=EXP(-SKAMNT*DELTT)
0025       E3=EXP(-SKNO2T*DELTT)
0026       E4=EXP(-AKNO3T*DELTT)
      C
      C     NITROGEN COMPONENTS CONCENTRATIONS
      C
0027       ORGNST=ORGNO*E1
0028       AMONST=A*E1+B*E2
0029       STNO2= C*E1+D*E2+E*E3
0030       STNO3= F*E1+G*E2+H*E3+A1*E4
      C
      C     NITRIFICATION DO DEFICIT
      C
0031       EA=EXP(-AKAT*DELTT)
```

```
0032          KAMK1=AKAT-SKORGT                                    K  57
0033          KAMK2=AKAT-SKAMNT                                    K  58
0034          KAMK3=AKAT-SKNO2T                                    K  59
0035          K1KA=(E1-EA)/KAMK1                                   K  60
0036          K2KA=(E2-EA)/KAMK2                                   K  61
0037          K3KA=(E3-EA)/KAMK3                                   K  62
        C                                                          K  63
0038          DELAMN=AKAMNT*(A*K1KA+B*K2KA)                        K  64
0039          DELNO2=AKNO2T*(C*K1KA+D*K2KA+E*K3KA)                 K  65
        C     TEST FOR VALUES .LT. ZERO                            K  66
0040          IF (STNO3.LT.0.0) STNO3=0.0                          K  67
0041          IF (STNO2.LT.0.0) STNO2=0.0                          K  68
0042          IF (AMONST.LT.0.0) AMONST=0.0                        K  69
0043          IF (ORGNST.LT.0.0) ORGNST=0.0                        K  70
0044          RETURN                                               K  71
0045          END                                                  K  72
```

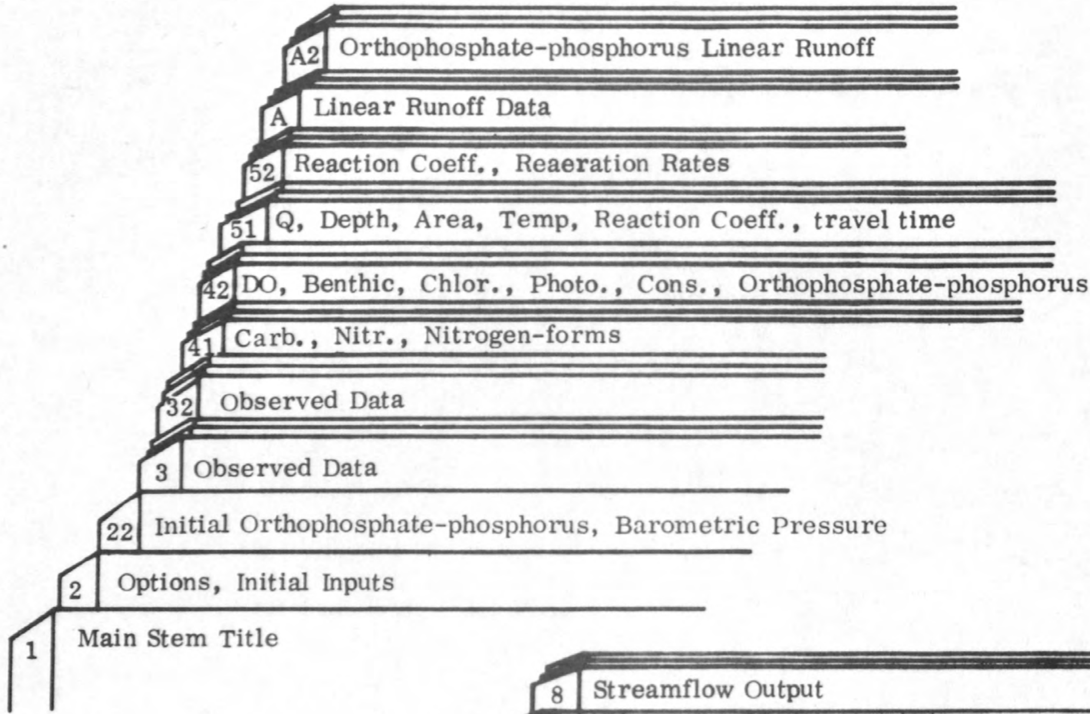
```
FORTRAN IV G LEVEL  21            PRPLOT            DATE = 78181          08/51/31              PAGE 0001
0001            SUBROUTINE PRPLOT
          C        16 MARCH 73
0002            IMPLICIT LOGICAL*1(W),LOGICAL*1(K)
0003            DIMENSION NSCALE(5), ABNOS(26), X(1), Y(1)
0004            LOGICAL*1 NOS(10)/'0','1','2','3','4','5','6','7','8','9'/
0005            LOGICAL*1 IMAGE(1),CH,LABEL(1),ERR1,ERR3,ERR5
0006            LOGICAL*1 VC,HC,FOR1(19),FOR2(15),FOR3(19),NC,BL,HF,HF1
0007            REAL*8 FOX1(3),FOX2(2),FOX3(3)
0008            INTEGER*2 VCR
0009            EQUIVALENCE (FOR1,FOX1), (FOR2,FOX2), (FOR3,FOX3), (VC,VCR)
0010            INTEGER FILE
0011            DATA HC/'-'/,NC/'+'/,BL/' '/,HF/'F'/,HF1/'.'/
0012            DATA FOX1/'(1XA1,F9','.2,  121','A1)      '/
0013            DATA FOX2/'(1XA1, 9','X121A1) '/
0014            DATA FOX3/'(1H0F  .',' ,  F   ','. )      '/
0015            DATA VCR/Z4F00/
0016            DATA KPLOT1/.FALSE./,KPLOT2/.FALSE./
0017            DATA KABSC,KORD,KBOTGL/3*.FALSE./
          C
0018            ENTRY PLOT1(NSCALE,NHL,NSBH,NVL,NSBV)
0019            IFL=FILE
0020            ERR1=.FALSE.
0021            ERR3=.FALSE.
0022            ERR5=.FALSE.
0023            KPLOT1=.TRUE.
0024            KPLOT2=.FALSE.
0025            NH=IABS(NHL)
0026            NSH=IABS(NSBH)
0027            NV=IABS(NVL)
0028            NSV=IABS(NSBV)
0029            NSCL=NSCALE(1)
0030            IF (NH*NSH*NV*NSV.NE.0) GO TO 10
0031            KPLOT=.FALSE.
0032            ERR1=.TRUE.
0033            RETURN
0034         10 KPLOT=.TRUE.
0035            IF (NV.LE.25) GO TO 20
0036            KPLOT=.FALSE.
0037            ERR3=.TRUE.
0038            RETURN
0039         20 CONTINUE
0040            NVM=NV-1
0041            NVP=NV+1
0042            NDH=NH*NSH
0043            NDHP=NDH+1
0044            NDV=NV*NSV
0045            NDVP=NDV+1
0046            NIMG=(NDHP*NDVP)
0047            IF (NDV.LE.120) GO TO 30
0048            KPLOT=.FALSE.
0049            ERR5=.TRUE.
0050            RETURN
0051         30 CONTINUE
0052            IF (NSCL.EQ.0) GO TO 40
0053            FSY=10.**NSCALE(2)
0054            FSX=10.**NSCALE(4)
```

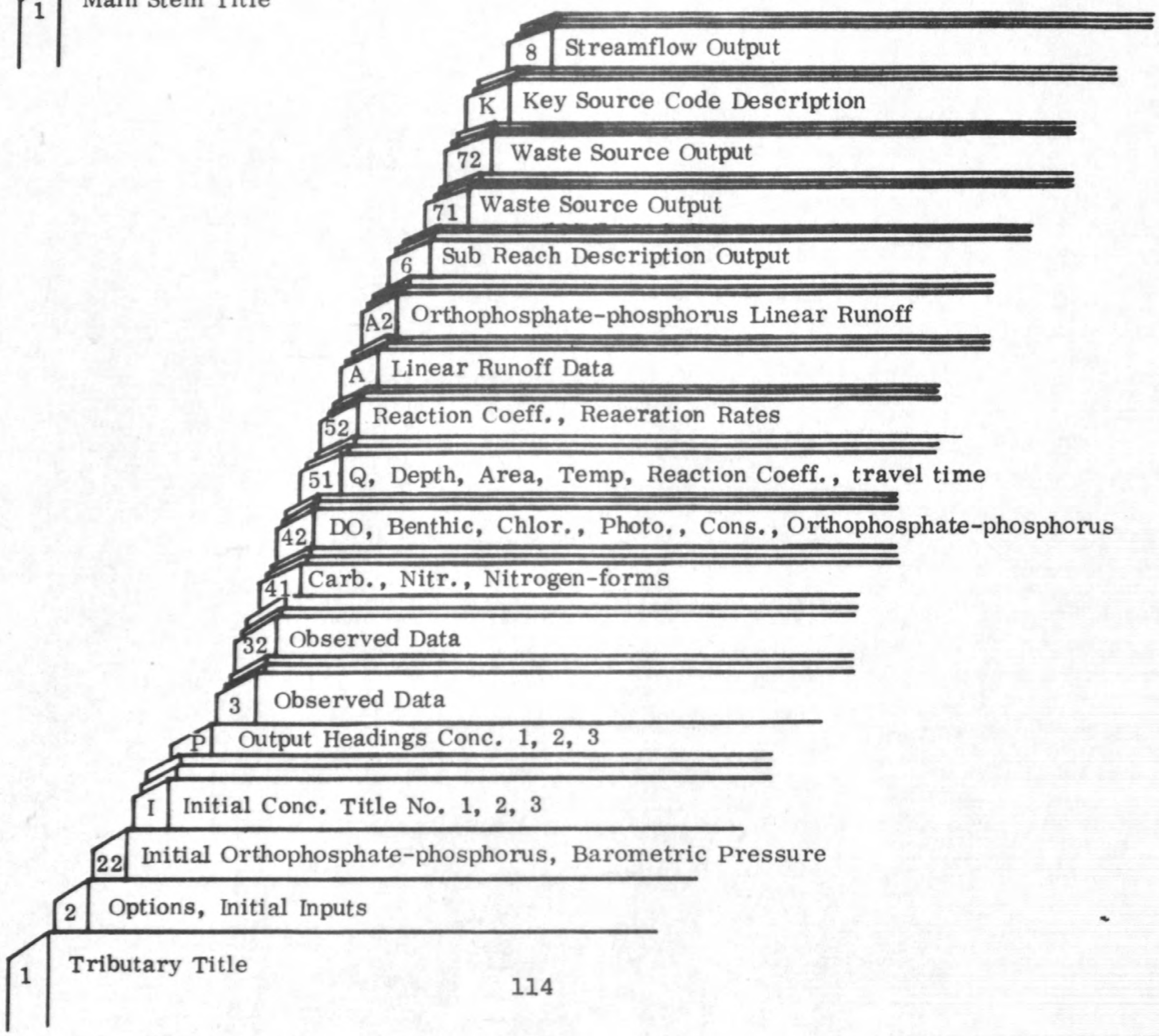
```
0055         IY=MINO(IABS(NSCALE(3)),7)+1
0056         IX=MINO(IABS(NSCALE(5)),9)+1
0057         GO TO 50
0058      40 FSY=1.
0059         FSX=1.
0060         IY=4
0061         IX=4
0062      50 FOR1(10)=NOS(IY)
0063         NA=MINO(IX,NSV)-1
0064         NS=NA-MINO(NA,120-NDV)
0065         NB=11-NS+NA
0066         I1=NB/10
0067         I2=NB-I1*10
0068         FOR3(6)=NOS(I1+1)
0069         FOR3(7)=NOS(I2+1)
0070         FOR3(9)=NOS(NA+1)
0071         IF (NV.GT.0) GO TO 70
0072         DO 60 J=11,18
0073      60 FOR3(J)=BL
0074         GO TO 80
0075      70 I1=NV/10
0076         I2=NV-I1*10
0077         FOR3(11)=NOS(I1+1)
0078         FOR3(12)=NOS(I2+1)
0079         FOR3(13)=HF
0080         I1=NSV/100
0081         I3=NSV-I1*100
0082         I2=I3/10
0083         I3=I3-I2*10
0084         FOR3(14)=NOS(I1+1)
0085         FOR3(15)=NOS(I2+1)
0086         FOR3(16)=NOS(I3+1)
0087         FOR3(17)=HF1
0088         FOR3(18)=FOR3(9)
0089      80 IF (KPLOT1) RETURN
0090         KPLOT1=.TRUE.
       C
0091         ENTRY PLOT2(IMAGE,XMAX,XMIN,YMAX,YMIN,FILE)
0092         IFL=FILE
0093         KPLOT2=.TRUE.
0094         IF (KPLOT1) GO TO 90
0095         NSCL=0
0096         NH=5
0097         NSH=10
0098         NV=10
0099         NSV=10
0100         GO TO 10
0101      90 CONTINUE
0102         IF (KPLOT) GO TO 100
0103         IF (ERR1) WRITE (IFL,300)
0104         IF (ERR3) WRITE (IFL,310)
0105         IF (ERR5) WRITE (IFL,320)
0106         RETURN
0107     100 YMX=YMAX
0108         DH=(YMAX-YMIN)/FLOAT(NDH)
0109         DV=(XMAX-XMIN)/FLOAT(NDV)
```

```
      DO 110 I=1,NVP
  110 ABNOS(I)=(XMIN+FLOAT((I-1)*NSV)*DV)*FSX
      DO 120 I=1,NIMG
  120 IMAGE(I)=BL
      DO 160 I=1,NDHP
      I2=I*NDVP
      I1=I2-NDV
      KNHOR=MOD(I-1,NSH).NE.0
      IF (KNHOR) GO TO 140
      DO 130 J=I1,I2
  130 IMAGE(J)=HC
  140 CONTINUE
      DO 160 J=I1,I2,NSV
      IF (KNHOR) GO TO 150
      IMAGE(J)=NC
      GO TO 160
  150 IMAGE(J)=VC
  160 CONTINUE
      XMIN1=XMIN-DV/2.
      YMIN1=YMIN-DH/2.
      RETURN
C
      ENTRY PLOT3(CH,X,Y,N3)
      IF (KPLOT2) GO TO 180
  170 WRITE (IFL,330)
  180 CONTINUE
      IF (.NOT.KPLOT) RETURN
      IF (N3.GT.0) GO TO 190
      KPLOT=.FALSE.
      WRITE (IFL,340)
      RETURN
  190 DO 260 I=1,N3
      IF (DV) 210,200,210
  200 DUM1=0
      GO TO 220
  210 CONTINUE
      DUM1=(X(I)-XMIN1)/DV
  220 IF (DH) 240,230,240
  230 DUM2=0
      GO TO 250
  240 CONTINUE
      DUM2=(Y(I)-YMIN1)/DH
  250 CONTINUE
      IF (DUM1.LT.0..OR.DUM2.LT.0.) GO TO 260
      IF (DUM1.GE.NDVP.OR.DUM2.GE.NDHP) GO TO 260
      NX=1+INT(DUM1)
      NY=1+INT(DUM2)
      J=(NDHP-NY)*NDVP+NX
      IMAGE(J)=CH
  260 CONTINUE
      RETURN
C
      ENTRY PLOT4(NL,LABEL)
      ENTRY FPLOT4(NL,LABEL)
      IF (.NOT.KPLOT) RETURN
      IF (.NOT.KPLOT2) GO TO 170
```

```
      DO 280 I=1,NDHP
      IF (I.EQ.NDHP.AND.KBOTGL) GO TO 280
      WL=BL
      IF (I.LE.NL) WL=LABEL(I)
      I2=I*NDVP
      I1=I2-NDV
      IF (MOD(I-1,NSH).EQ.0.AND..NOT.KORD) GO TO 270
      WRITE (IFL,FOR2) WL,(IMAGE(J),J=I1,I2)
      GO TO 280
  270 CONTINUE
      ORDNO=(YMX-FLOAT(I-1)*DH)*FSY
      IF (I.EQ.NDHP) ORDNO=YMIN
      WRITE (IFL,FOR1) WL,ORDNO,(IMAGE(J),J=I1,I2)
  280 CONTINUE
      IF (KABSC) GO TO 290
      WRITE (IFL,FOR3) (ABNOS(J),J=1,NVP)
  290 RETURN
C
      ENTRY OMIT(LSW)
      KABSC=MOD(LSW,2).EQ.1
      KORD=MOD(LSW,4).GE.2
      KBOTGL=LSW.GE.4
      RETURN
C
C
C
  300 FORMAT (T5,'SOME PLOT1 ARG. ILLEGALLY 0')
  310 FORMAT (T5,'NO. OF VERTICAL LINES >25')
  320 FORMAT (T5,'WIDTH OF GRAPH >121')
  330 FORMAT (T5,'PLOT2 MUST BE CALLED')
  340 FORMAT (T5,'PLOT3, ARG2 ) 0')
      END
```

C. SCHEMATIC OF PROGRAM DECK SETUP


A2 Orthophosphate-phosphorus Linear Runoff
A Linear Runoff Data
52 Reaction Coeff., Reaeration Rates
51 Q, Depth, Area, Temp, Reaction Coeff., travel time
42 DO, Benthic, Chlor., Photo., Cons., Orthophosphate-phosphorus
41 Carb., Nitr., Nitrogen-forms
32 Observed Data
3 Observed Data
22 Initial Orthophosphate-phosphorus, Barometric Pressure
2 Options, Initial Inputs
1 Main Stem Title


8 Streamflow Output
K Key Source Code Description
72 Waste Source Output
71 Waste Source Output
6 Sub Reach Description Output
A2 Orthophosphate-phosphorus Linear Runoff
A Linear Runoff Data
52 Reaction Coeff., Reaeration Rates
51 Q, Depth, Area, Temp, Reaction Coeff., travel time
42 DO, Benthic, Chlor., Photo., Cons., Orthophosphate-phosphorus
41 Carb., Nitr., Nitrogen-forms
32 Observed Data
3 Observed Data
P Output Headings Conc. 1, 2, 3
I Initial Conc. Title No. 1, 2, 3
22 Initial Orthophosphate-phosphorus, Barometric Pressure
2 Options, Initial Inputs
1 Tributary Title

D. PROGRAM DECK SETUP EXAMPLES

Program Deck Setup Example 1

Example illustrating the following options:

a. Linear runoff input,

b. conservative constituent input,

c. nitrogenous BOD input,

d. total- and fecal-coliform bacteria input, and

e. orthophosphate-phosphorus input.

```
1 TRIBUTARY TO EXAMPLE CREEK
2  4 2  11 01   7.6 .5   5.2 8.0                    9.0  .50  5. 16.     11.
22   12.   30.0
I TOTAL SUSPENDED SOLIDS
P TSS
3     6.8     4.5                                  3100  10900   11.5
3     6.8     5.1                                  2700   8100   11.8
3     5.5     3.5                                   700   2700   15.0
3     5.5     3.7                                   690   2900   15.5
3     2.3     5.4                                  1800   2800   34.4
3     2.3     5.5                                  1900   2700   34.9
32    5.0     6.5    11.0
32    5.2     7.0    11.5
32   13.5     5.0     2.2
32   14.0     5.5     2.4
32   10.2     7.3     1.0
32   10.6     7.5     1.1
41
41    15.          2.58
41    6.1          4.57
41    15.           11.
42                  2.     9.    2.
42    4.2    20     2.     9.    2.    15.               2.1
42    6.7    24     2.     9.    2.    64.                .5
42    4.2    28     2.     9.    2.    54.                .2
51         2.1  30. 24    6.2.005.005 .05                              .2   .2
51   2.2   2.3 102. 24    5.3.035.035 .07                .39   1.1    .2   .2
51   .25   2.3 102. 24    5.0.05 .05  .07               .011   .45    .2   .2
51   4.3   1.9  76. 24        .20 .20 .07               4.78  4.78    .2   .2
52   .01   .07
52   .02   .10
52   .01   .07
52   .01   .07
A
A    15.    11.                          2.     1.     5.    15.               3.
A
A
A2
A2   1.0
A2
A2
6   1 K TRIB TO EXAMPLE CR         7.6       6.2
6   2 K TRIB TO EXAMPLE CR         5.2       5.3
6   3 K TRIB TO EXAMPLE CR         5.3       5.0
6   4 K TRIB TO EXAMPLE CR         5.0       0.0
6   1 K EXAMPLE CREEK             16.0      14.5
6   2 K EXAMPLE CREEK             14.5       5.3
71  10677 AHEADWATERS
71  20677 ATRIB CREEK 1                6.2    2.2  16.0  2.68  4.8  20    16.
71  30677 ATRIB CREEK 2                5.3    .25   6.1  4.57  1.6  24    64.
71  40677 ACITY 1 STP                  5.0    4.3  15.0  11.0  3.5  28    54.
71  1         AHEADWATERS
71  2         ATRIB CREEK 1A         14.5    9.0   9.0  12.0  5.3  24   11.0
72
72                                 390      1100
72                                  11       450
72                                4779      4779
72
72                                 800      1900
KA U S GEOLOGICAL SURVEY
8 1         .5         2.1        .02         14.
```

```
8  2        4.2         2.3         .04         44.
8  3        6.0         2.3         .06         44.
8  4       10.3         1.9         .14         40.
8  1        3.0         1.7         .03         59.
8  2       22.3         2.5         .15         60.
1 EXAMPLE CREEK
2  2 0  01001    16.   .5 11. 13.                    5.6 3.00  .5  1.    15.
22   15.   30.0
3   15.0      5.6                                   100    200   14.0
3   15.0      5.9                                   150    300   15.0
3   13.0      4.7                                   600   1100   22.0
3   13.0      4.9                                   500   1200   23.0
3    8.5      6.6                                   100    300   23.1
3    8.5      6.7                                   200    400   22.5
32   7.0     11.5    14.0
32   7.2     11.5    14.5
32   4.8      8.7     2.6
32   5.0      9.0     2.7
32   1.0      7.3     2.1
32    .9      7.2     2.4
41
41    9.             12.
42                    1.    10.     2.
42   5.3     24       1.    10.     2.    11.                  1.
51        1.68 100.  22   14.5 .20 .20 .05                                   .8   .7
51   9.   2.5 150.  24    5.3 .70 .70 .07                      .5   1.9   .8   .7
52  .01  .10
52  .01  .10
//
```

Program Deck Setup Example 2

Example illustrating nitrogen cycle modeling input.

```
1 CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA
2 24 0100011 302.97 2.0  4.  0. .20 .02.007 .26 9.21150.  0.  0.
22    0. 29.92
I
I
I
P
3 302.97    8.6    .32    .00    .004    .27
3 302.97    8.3    .22    .01    .004    .29
3 302.97    8.2    .13    .06    .01     .29
3 302.97    8.3    .13    .06    .01     .29
3 302.97    9.7    .31    .00    .005    .30
3 302.97   10.2    .22    .00    .005    .27
3 302.97   11.2    .10    .01    .01     .26
3 302.97    9.7    .22    .03    .01     .26
3 302.97    9.4    .17    .03    .005    .25
3 302.97    8.8    .25    .04    .01     .26
3 302.97    8.8    .22    .02    .004    .28
3 302.97    9.6    .13    .02    .005    .27
3 302.97    8.8           .01    .01     .29
3 298.77    8.3    3.2    2.1    .04     .27
3 298.77    8.1    2.9    1.9    .03     .27
3 298.77    8.0    2.5    1.7    .04     .30
3 298.77    7.8    2.0    1.4    .03     .29
3 298.77    7.8    2.1    1.4    .03     .30
3 298.77    8.0    3.2    1.7    .04     .29
3 298.77    8.1    4.2    1.2    .05     .27
3 298.77    8.6    3.0    2.3    .04     .28
3 298.77    8.7    3.0    2.4    .04     .27
3 298.77    8.6    2.8    2.1    .04     .27
3 298.77    8.5    3.0    2.2    .04     .25
3 298.77    7.9    2.8    2.0    .04     .26
3 298.77    9.1    2.0    1.5    .03     .29
3 294.65    7.0    3.2    2.2    .14     .41
3 294.65    7.0    3.0    2.1    .13     .38
3 294.65    7.0    2.9    1.9    .14     .40
3 294.65    6.8    2.7    1.2    .13     .42
3 294.65    6.7    2.0    1.3    .11     .39
3 294.65    6.7    2.0    1.2    .11     .39
3 294.65    6.8    0.0    1.4    .12     .42
3 294.65    7.1    4.0    2.1    .16     .41
3 294.65    7.6    3.5    2.1    .15     .41
3 294.65    7.5    3.0    1.9    .15     .44
3 294.65    7.6    2.7    1.9    .13     .37
3 294.65    7.0    2.0    1.4    .10     .38
3 286.07    5.7    2.4    1.6    .13     .56
3 286.07    5.7    2.9    1.8    .12     .56
3 286.07    5.7    2.7    1.9    .13     .60
3 286.07    5.7    2.6    1.8    .12     .57
3 286.07    5.6    2.4    1.5    .11     .54
3 286.07    5.8    2.3    1.4    .10     .51
3 286.07    5.7    1.9    1.3    .09     .54
3 286.07    5.5    1.9    1.2    .10     .58
3 286.07    5.6    2.2    1.2    .11     .61
3 286.07    5.9    2.7    1.7    .13     .59
3 286.07    5.6    2.9    1.8    .14     .59
3 286.07    5.4    2.3    1.6    .12     .56
3 281.79    5.7    1.6    1.1    .09     .67
3 281.79    5.6    1.9    1.5    .11     .68
3 281.79    5.0    2.3    1.8    .12     .68
3 281.79    4.7    2.7    1.8    .12     .62
```

3	281.79	4.7	2.4	1.6	.11	.67
3	281.79	4.7	2.4	1.5	.10	.63
3	281.79	4.8	2.2	1.3	.10	.65
3	281.79	4.8	2.0	1.1	.09	.65
3	281.79	4.9	1.9	1.2	.10	.64
3	281.79	4.8	2.4	1.4	.11	.70
3	281.79	4.7	2.5	1.5	.12	.73
3	275.81	4.7	1.2	.82	.08	.75
3	275.81	4.8	1.6	1.0	.10	.78
3	275.81	4.6	2.0	1.3	.11	.78
3	275.81	4.4	2.3	1.5	.11	.79
3	275.81	4.3	2.5	1.6	.11	.76
3	275.81	4.2	2.2	1.4	.10	.75
3	275.81	4.4	2.0	1.3	.10	.74
3	275.81	4.4	1.9	1.1	.09	.76
3	275.81	4.4	1.8	1.0	.09	.76
3	275.81	4.4	1.8	1.0	.09	.78
3	271.19	5.3	1.0	1.1	.09	.85
3	271.19	4.6	1.4	.87	.08	.83
3	271.19	4.8	1.8	.75	.08	.82
3	271.19	4.7	2.1	.78	.08	.92
3	271.19	4.6	2.2	1.0	.10	1.0
3	271.19	4.2	1.9	1.3	.11	.83
3	271.19	4.5	2.0	1.3	.11	.76
3	271.19	4.3	1.9	1.3	.10	.77
3	271.19	4.4	1.5	1.2	.10	.84
3	271.19	4.5	1.6	1.1	.09	.87
3	271.19	4.2	1.3	.92	.09	.83
3	265.66	5.2	1.8	1.2	.13	.97
3	265.66	5.3	1.2	.86	.10	1.0
3	265.66	5.5	1.3	.73	.10	.90
3	265.66	6.1	1.1	.59	.09	.91
3	265.66	5.7	1.2	.63	.10	.90
3	265.66	5.6	1.3	.82	.12	.98
3	265.66	5.5	0.0	1.1	.12	.98
3	265.66	4.6	1.8	1.2	.13	.97
3	265.66	4.7	1.6	.88	.10	1.0
3	265.66	4.4	1.6	1.0	.12	.88
3	259.85	5.7	1.2	.60	.09	1.01
3	259.85	5.6	1.0	.74	.10	1.0
3	259.85	5.4	.86	.75	.10	1.0
3	259.85	5.4	.93	.70	.10	1.1
3	259.85	5.4	.97	.63	.09	1.11
3	259.85	5.8	1.0	.52	.09	.91
3	259.85	5.7	1.2	.50	.08	1.02
3	259.85	6.1	1.3	.45	.08	1.02
3	259.85	6.4	1.0	.59	.11	1.09
3	259.85	6.3	.96	.69	.12	1.08
3	259.85	6.1	1.2	.82	.12	.98
3	259.85	5.4	2.3	.94	.12	.98
3	259.85	4.5	1.3	.90	.11	.99
3	259.85	4.5		.80	.10	1.0
3	246.93	5.6	.79	.20	.07	1.13
3	246.93	5.5	.78	.22	.07	1.13
3	246.93	5.6	.78	.28	.08	1.32
3	246.93	5.8	.73	.35	.09	1.31
3	246.93	5.5	.59	.45	.09	1.21
3	246.93	5.5	.49	.41	.09	1.21
3	246.93	5.2	.86	.39	.09	1.31
3	246.93	5.3	.95	.34	.08	1.32
3	246.93	5.3	.96	.28	.08	1.22

3	235.46	7.7	.55	.24	.08	1.22
3	235.46	7.6	.54	.17	.07	1.23
3	235.46	8.1	.55	.15	.07	1.13
3	235.46	7.8	.63	.15	.08	1.13
3	235.46	7.9	.57	.16	.08	1.22
3	235.46	8.2	.62	.19	.09	1.22
3	235.46	7.7	.60	.24	.10	1.21
3	235.46	7.1	.63	.26	.10	1.20
3	235.46	6.3	.50	.27	.09	1.30
3	235.46	6.4		.24	.07	1.41
3	235.46	6.9				
32	3.3					
32	4.0					
32	5.0					
32	3.6					
32	4.4					
32	4.1					
32	3.8					
32	4.7					
32	3.5					
32	4.3					
32	4.0					
32	3.3					
32						
32	14.0					
32	15.0					
32	15.0					
32	9.6					
32	14.0					
32	17.6					
32	14.0					
32	15.5					
32	14.5					
32	16.0					
32	11.0					
32						
32						
32	12.4					
32	14.2					
32	14.5					
32	17.0					
32	11.0					
32	12.0					
32	11.4					
32	17.5					
32	15.5					
32	18.0					
32	12.0					
32						
32	11.5					
32	13.6					
32	13.0					
32	11.0					
32	9.0					
32	12.0					
32	10.0					
32	8.0					
32	10.5					
32	12.0					
32						
32						

32	8.5
32	11.4
32	9.5
32	10.0
32	8.8
32	10.2
32	11.5
32	14.5
32	
32	
32	
32	8.0
32	10.0
32	11.0
32	10.9
32	10.0
32	10.0
32	10.5
32	10.5
32	7.6
32	
32	9.8
32	9.5
32	7.7
32	6.7
32	
32	7.4
32	9.5
32	9.0
32	10.0
32	10.5
32	8.0
32	10.5
32	8.0
32	8.0
32	8.0
32	8.1
32	6.5
32	9.2
32	8.0
32	10.0
32	8.0
32	8.5
32	5.8
32	6.8
32	7.9
32	8.1
32	6.5
32	7.0
32	7.6
32	6.3
32	7.2
32	6.5
32	7.5
32	6.3
32	7.5
32	8.0
32	6.4
32	6.0
32	7.1
32	8.0

32	6.5						
32	7.5						
32	7.2						
32	5.1						
32	7.1						
32	4.7						
32	6.5						
32	4.2						
32	6.5						
32	7.2						
32	5.7						
32	4.8						
32	4.4						
32							
41	0.		0.	0.	0.	0.	0.
41	0.		0.	0.	0.	0.	0.
41	7.		0.	.41	.12	.02	.03
41	67.		0.	14.2	10.4	.02	.02
41	81.		0.	20.8	14.5	.01	0.
41	50.		0.	13.0	2.9	.04	.28
41	5.		0.	.45	.04	.01	.67
41	86.		0.	20.4	13.2	.08	.04
41	27.			16.00	14.0	.01	.01
41	6.			.54	.16	.02	.44
41	5.			.53	.05	.01	.28
41	11.			6.92	5.80	.07	.78
41	4.			.44	.08	.03	.67
41	4.			.36	.01	.01	.44
41	4.			.26	.02	.01	.44
41	4.			.15	.02	.01	.18
41	4.			.22	.01	.01	.37
41	4.			.00	.02	.01	.23
41	4.			.18	.02	.01	.18
41	4.			.19	.02	.01	.19
41	4.			.14	.06	.01	.21
41	3.			.13	.02	.01	.40
41	4.			.40	.03	.01	.50
41	3.			.21	.01	.01	.25
42	0.0	00					
42	0.0	00					
42	6.7	22					
42	.7	22					
42	1.2	24					
42	4.0	22					
42	8.8	22					
42	.7	21					
42	3.1	23					
42	7.5	22					
42	7.7	22					
42	3.8	22					
42	8.0	21					
42	8.6	20					
42	8.8	21					
42	9.2	20					
42	8.4	21					
42	9.0	21					
42	8.6	21					
42	8.8	21					
42	8.2	22					
42	8.9	22					
42	8.8	21					

```
42   8.4      22
51   0.  4.3 1045 21300.62 .00 .00   0. .30 .32 2.5.005                              3.35
51-110.  6.0 1212 21300.56 .00 .00   0. .30 .32 2.5.005                              .098
51  84.  5.6 1131 21300.52 .00 .00   0. .30 .32 2.5.005                              .062
51  16.  4.7 1316 21300.24 .00 .00   0. .30 .32 2.5.005                              .343
51 130.  3.1  648 21297.50 .13 .16   0. .30 .32 2.5.005                              3.34
51  7.4  5.5  880 27295.13 .13 .16   0. .30 .32 2.5.005                              2.36
51  21.  2.6  497 27294.28 .13 .16   0. .30 .32 2.5.005                              .737
51  14.  5.3  864 27291.60 .13 .16   0. .30 .32 2.5.005                              2.69
51 18.   5.4 880. 27291.57 .13 .16   0. .30 .32 2.5.005                              .029
51 16.5  6.3 995. 27288.58 .13 .16   0. .30 .32 2.5.005                              2.72
51214.   4.5 850. 26283.78 .19 .16   0. .30 .32 2.5.005                              5.05
51  7.3  6.81414. 26283.54 .19 .16   0. .30 .32 2.5.005                              .199
51 19.   5.71106. 26283.27 .19 .16   0. .30 .32 2.5.005                              .290
51 21.   5.71226. 26281.47 .19 .16   0. .30 .32 2.5.005                              1.84
51 26.   4.81157. 26275.95 .19 .16   0. .30 .32 2.5.005                              5.87
51 40.   5.01145. 26274.49 .19 .16   0. .30 .32 2.5.005                              1.60
51 16.5  5.61434. 25273.46 .19 .16   0. .30 .32 2.5.005                              1.14
51 95.   4.71199. 25267.34 .19 .16   0. .30 .32 2.5.005                              6.32
51 19.   2.8 832. 25261.72 .19 .16   0. .30 .32 2.5.005                              4.44
51 52.   4.71114. 24261.25 .19 .16   0. .30 .32 2.5.005                              .401
51 30.   3.0 755. 24250.87 .19 .16   0. .30 .32 2.5.005                              10.0
51 27.   3.9 991. 25244.89 .19 .16   0. .30 .32 2.5.005                              5.08
51 10.   4.31294. 26236.51 .19 .16   0. .30 .32 2.5.005                              10.4
51 65.   6.62185. 26235.46 .19 .16   0. .30 .32 2.5.005                              1.65
52            .30 .65 2.5 1.34
52            .30 .65 2.5 1.34
52            .30 .65 2.5 1.34
52            .30 .65 2.5 1.34
52            .30 .65 2.5 1.34
52            .30 .65 2.5 1.52
52            .30 .65 2.5 1.52
52            .30 .65 2.5 1.52
52            .30 .65 2.5 1.07
52            .30 .65 2.5 1.07
52            .30 .65 2.5 1.05
52            .30 .65 2.5 1.05
52            .30 .65 2.5  .86
52            .30 .65 2.5  .86
52            .30 .65 2.5  .47
52            .30 .65 2.5  .29
52            .30 .65 2.5  .31
52            .30 .65 2.5 2.03
52            .30 .65 2.5 2.99
52            .30 .65 2.5 1.76
52            .30 .65 2.5 2.36
52            .30 .65 2.5 2.73
52            .30 .65 2.5 1.91
52            .30 .65 2.5 1.50
6  1 GBEGINNING OF STUDY     302.97  300.62
6  2 GATLANTA WTR WITHDRW    300.62  300.56
6  3 GPEACHTREE CREEK        300.56  300.52
6  4 GCOBB COUNTY WTP        300.52  300.24
6  5 GR.M. CLAYTON WTP       300.24  297.50
6  6 GPROCTOR CREEK          297.50  295.13
6  7 GNICKAJACK CREEK        295.13  294.17
6  8 GSOUTH COBB WTP         294.28  291.60
6  9 GUTOY WTP               291.60  291.57
6 10 GUTOY CREEK             291.57  288.58
6 11 GSWEETWATER CREEK       288.58  283.58
6 12 GCAMP WTP               283.58  283.54
```

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6 13 GCAMP CREEK                 283.54   283.27
6 14 GDEEP CREEK                 283.27   281.47
6 15 GANNAWAKEE CREEK            281.47   275.95
6 16 GBEAR CREEK-166             275.95   274.49
6 17 GBEAR CREEK--70             274.49   273.46
6 18 GDOG CREEK                  273.46   267.34
6 19 GWOLF CREEK                 267.34   261.72
6 20 GSNAKE CREEK                261.72   261.25
6 21 GCEDAR CREEK                261.25   250.87
6 22 GWHOOPING CREEK             250.87   244.89
6 23 GPINK CREEK                 244.49   236.51
6 24 GCENTRALHACHEE CREEK        235.51   235.46
71  2 677GSATLANTA WTR WITHDRW 300.62  -110                           21
71  3 677GSPEACHTREE CREEK     300.56    84       7             6.7   22
71  4 677GSCOBB COUNTY WTP     300.52    16      57              .7   22
71  5 677GSR.M. CLAYTON WTP    300.24   130      81             1.2   24
71  6 677GSPROCTOR CREEK       297.50   7.4      50             4.0   22
71  7 677GSNICKAJACK CREEK     295.13    21       5             8.8   22
71  8 677GSSOUTH COBB WTP      294.28    14      85              .7   21
71  9 677GSUTOY WTP            291.60   18.     27.             3.1   23
71 10 677GSUTOY CREEK          291.57   15.5     6.             7.5   22
71 11 677GSSWEETWATER CREEK    288.58  214.      5.             7.7   22
71 12 677GSCAMP WTP            283.58   7.3     11.             3.8   22
71 13 677GSCAMP CREEK          283.54   19.      4.             8.0   21
71 14 677GSDEEP CREEK          283.27   21.      4.             8.6   20
71 15 677GSANNEEWAKEE CREEK    281.47   26.      4.             8.9   21
71 16 677GSBEAR CREEK-166      275.95   40.      4.             9.2   20
71 17 677GSBEAR CREEK--70      274.49   15.5     4.             8.4   21
71 18 677GSDOG CREEK           273.46   95.      4.             9.0   21
71 19 677GSWOLF CREEK          267.34   19.      4.             8.6   21
71 20 677GSSNAKE CREEK         261.72   52.      4.             9.3   21
71 21 677GSCEDAR CREEK         261.25   30.      4.             8.2   22
71 22 677GSWHOOPING CREEK      250.87   27.      3.             8.9   22
71 23 677GSPINK CREEK          244.89   10.      4.             8.8   21
71 24 677GSCENTRALHACHEE CREEK 236.51   65.      3.             8.4   22
72     0.      0.      0.      0.
72     0.      0.      0.      0.
72   .41     .12     .02     .03
72 14.2     10.4     .02     .02
72 20.8     14.5     .01      0.
72 13.0      2.9     .04     .28
72   .45     .04     .01     .67
72 20.4     13.2     .08     .04
72 16.00    14.0     .01     .01
72   .54     .16     .02     .44
72   .53     .05     .01     .28
72  6.92    5.80    1.75     .78
72   .44     .08     .03     .67
72   .36     .01     .01     .44
72   .26     .02     .01     .44
72   .15     .02     .01     .18
72   .22     .01     .01     .37
72   00.     .02     .01     .23
72   .18     .02     .01     .18
72   .19     .02     .01     .19
72   .14     .06     .01     .21
72   .13     .02     .01     .40
72   .40     .03     .01     .50
72   .21     .01     .01     .25
K6 US GEOLOGICAL SURVEY, WATER RESOURCES DIVISION.ATLANTA.GEORGIA
8 1      1150        4.3        1.10        243
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8	2	1040	6.0	.95	202
8	3	1124	5.6	1.02	202
8	4	1140	4.7	.57	280
8	5	1270	3.1	1.77	209
8	6	1277	5.5	1.31	690
8	7	1298	2.6	2.31	497
8	8	1312	5.3	1.33	864
8	9	1330	5.4	1.51	153
8	10	1346	6.3	1.35	142
8	11	1560	4.5	1.84	189
8	12	1568	6.8	1.11	203
8	13	1587	5.7	1.43	194
8	14	1608	5.7	1.31	215
8	15	1634	4.8	1.41	241
8	16	1674	5.0	1.46	229
8	17	1690	5.6	1.18	255
8	18	1785	4.7	1.49	255
8	19	1804	2.8	2.17	297
8	20	1856	4.7	1.67	237
8	21	1886	3.0	2.50	255
8	22	1913	3.9	1.93	254
8	23	1923	4.3	1.49	301
8	24	1988	6.6	.91	331

//

E. OUTPUT EXAMPLES

Output Example 1 showing model output

using program deck setup example 1.

Example illustrating the following options:

a. Linear runoff computations,

b. conservative constituent computations,

c. nitrogenous BOD computations,

d. total- and fecal-coliform bacteria computations, and

e. orthophosphate-phosphorus computations.

STEADY STATE WATER QUALITY MODEL

GULF COAST HYDROSCIENCE CENTER

U. S. GEOLOGICAL SURVEY

DATE OF LAST REVISION, FEBRUARY 1978

TRIBUTARY TO EXAMPLE CREEK

NUMBER OF SUBREACHES FOR THIS PROBLEM = 4

PRINTING INTERVAL (MILES) = 0.500

STARTING DISTANCE (MILES) = 7.600

INITIAL CBOD CONC (MG/L) AT STARTING DISTANCE = 5.200

INITIAL NBOD CONC (MG/L) AT STARTING DISTANCE = 8.000

INITIAL DO CONC (MG/L) AT STARTING DISTANCE = 9.000

INITIAL PHOSPHATE CONC (MG/L) AT STARTING DISTANCE = 12.000

INITIAL TOT. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE = 16000.

INITIAL FEC. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE = 5000.

STREAMFLOW (CFS) AT STARTING DISTANCE = 0.500

TOTAL SUSPENDED SOLIDS = 11.00

TRIBUTARY TO EXAMPLE CREEK

S U B R E A C H   L I N E A R   R U N O F F   D A T A

UBREACH	Q (CFS)	CBOD (MG/L)	NBOD (MG/L)	DO (MG/L)	TSS (MG/L)	(MG/L)	(MG/L)	PO4 (MG/L)
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3.00	15.0	11.0	2.0	15.0	0.0	0.0	1.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

R E A C H   D E S C R I P T I O N   D A T A   (MAJOR TRIBUTARIES AND MAIN STEM)

SUBREACH	CODE	NAME	BEGIN (MILE)	END (MILE)
1	K	TRIB TO EXAMPLE CR	7.60	6.20
2	K	TRIB TO EXAMPLE CR	6.20	5.30
3	K	TRIB TO EXAMPLE CR	5.30	5.00
4	K	TRIB TO EXAMPLE CR	5.00	0.0
1	K	EXAMPLE CREEK	16.00	14.50
2	K	EXAMPLE CREEK	14.50	5.30

KEY: CODE

- A ROCKY BOTTOM-POOL RIFFLE-LIGHT VEGETATION
- B ROCKY BOTTOM-POOL RIFFLE-MEDIUM VEGETATION
- C ROCKY BOTTOM-POOL RIFFLE-HEAVY VEGETATION
- D ROCKY BOTTOM-CHANNEL CONTROL-LIGHT VEGETATION
- E ROCKY BOTTOM-CHANNEL CONTROL-MEDIUM VEGETATION
- F ROCKY BOTTOM-CHANNEL CONTROL-HEAVY VEGETATION
- G MUD BOTTOM-POOL RIFFLE-LIGHT VEGETATION
- H MUD BOTTOM-POOL RIFFLE-MEDIUM VEGETATION
- I MUD BOTTOM-POOL RIFFLE-HEAVY VEGETATION
- J MUD BOTTOM-CHANNEL CONTROL-LIGHT VEGETATION
- K MUD BOTTOM-CHANNEL CONTROL-MEDIUM VEGETATION
- L MUD BOTTOM-CHANNEL CONTROL-HEAVY VEGETATION

WASTE SOURCE AND MINOR TRIBUTARY DATA

SUBREACH	DATE	CODE	NAME	MILE LOCATION	Q (CFS)	CBOD (MG/L)	NBOD (MG/L)	DO (MG/L)	TEMP (DEG. C)	TSS (MG/L)	(MG/L)	(MG/L)
1	06/77	A	HEADWATERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	06/77	A	TRIB CREEK 1	6.20	2.2	16.0	2.7	4.8	20.0	16.0	0.0	0.0
3	06/77	A	TRIB CREEK 2	5.30	0.3	6.1	4.6	1.6	24.0	64.0	0.0	0.0
4	06/77	A	CITY 1 STP	5.00	4.3	15.0	11.0	3.5	28.0	54.0	0.0	0.0
1	/	A	HEADWATERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	/	A	TRIB CREEK 1A	14.50	9.0	9.0	12.0	5.3	24.0	11.0	0.0	0.0

KEY: SOURCE CODE

A U S GEOLOGICAL SURVEY

AVERAGE REACH STREAMFLOW DATA (MAJOR TRIBUTARIES AND MAIN STEM)

SUBREACH	AVERAGE Q (CFS)	AVERAGE DEPTH (FEET)	AVERAGE VELOCITY (FEET/SEC)	AVERAGE WIDTH (FEET)
1	0.5	2.1	0.02	14.0
2	4.2	2.3	0.04	44.0
3	6.0	2.3	0.06	44.0
4	10.3	1.9	0.14	40.0
1	3.0	1.7	0.03	59.0
2	22.3	2.5	0.15	60.0

TRIBUTARY TO EXAMPLE CREEK

INPUT PARAMETERS

CONCENTRATIONS(MG/L) OF --

SUBREACH	CARBONACEOUS ULT. BOD	NITROGENOUS BOD	DO DEFICIT	PHOSPHATE	TOT.COLIF.	FEC.COLIF.
1	0.0	0.0	0.0	0.0	0.	0.
2	16.000	2.680	4.813	2.100	1100.	390.
3	6.100	4.570	1.610	0.500	460.	11.
4	15.000	11.000	3.480	0.200	4780.	4780.

DIRECT DISCHARGES(LB/DAY) OF --

SUBREACH	CARBONACEOUS ULT. BOD	NITROGENOUS BOD	DO DEFICIT	PHOSPHATE
1	0.0	0.0	0.0	0.0
2	0.0	0.0	4.813	0.0
3	0.0	0.0	1.610	0.0
4	0.0	0.0	3.480	0.0

TRIBUTARY TO EXAMPLE CREEK

SUBREACH	NET PHOTOSYNTHETIC DO PRODUCTION (MG/L/DAY)	BENTHIC DO DEMAND (G/SQ M/DAY)
1	2.000	2.000
2	2.000	2.000
3	2.000	2.000
4	2.000	2.000

G E O M E T R Y

SUBREACH	FLOW CHANGE (CFS)	AREA (SQFT)	DEPTH (FT)	TEMP (DEG.CENT)	END MI (MI)
1	0.0	30.	2.10	24.00	6.20
2	2.2	102.	2.30	24.00	5.30
3	0.3	102.	2.30	24.00	5.00
4	4.3	76.	1.90	24.00	0.0

TRIBUTARY TO EXAMPLE CREEK

R E A C T I O N   C O E F F I C I E N T S (/DAY)

SUBREACH	KR	KD	KN	KCOLF	KCOLT	KPO41	KPO42
1	0.005	0.005	0.050	0.200	0.200	0.010	0.070
2	0.035	0.035	0.070	0.200	0.200	0.020	0.100
3	0.050	0.050	0.070	0.200	0.200	0.010	0.070
4	0.200	0.200	0.070	0.200	0.200	0.010	0.070

TEMPERATURE CORRECTED REACTION COEFFICIENTS (/DAY)

SUBREACH	KR	KD	KN	KA	KPO41	KPO42
1	0.006	0.006	0.071	0.522	0.014	0.099
2	0.042	0.042	0.099	0.775	0.028	0.141
3	0.060	0.060	0.099	0.957	0.014	0.099
4	0.240	0.240	0.099	2.198	0.014	0.099

TRIBUTARY TO EXAMPLE CREEK

SUBREACH	DO SATURATION (MG/L)
1	8.310
2	8.310
3	8.310
4	8.310

TRIBUTARY TO EXAMPLE CREEK

O B S E R V E D   M E A S U R E M E N T S

DISTANCE (MI)	DO CONC (MG/L)	TSS (MG/L)	(MG/L)	(MG/L)	CBODU (MG/L)	NBODU (MG/L)	ORG-N (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	TOTAL COLIFORM	FECAL COLIFORM	PO4 (MG/L)
6.80	4.50	11.60	0.0	0.0	5.00	6.50	0.0	0.0	0.0	0.0	10900.	3100.	11.00
6.80	5.10	11.80	0.0	0.0	5.20	7.00	0.0	0.0	0.0	0.0	8100.	2700.	11.50
5.50	3.50	15.00	0.0	0.0	13.50	5.00	0.0	0.0	0.0	0.0	2700.	700.	2.20
5.50	3.70	15.50	0.0	0.0	14.00	5.50	0.0	0.0	0.0	0.0	2800.	690.	2.40
2.30	5.40	34.40	0.0	0.0	10.20	7.30	0.0	0.0	0.0	0.0	2800.	1800.	1.00
2.30	5.50	34.90	0.0	0.0	10.60	7.50	0.0	0.0	0.0	0.0	2700.	1900.	1.10

TRIBUTARY TO EXAMPLE CREEK

RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

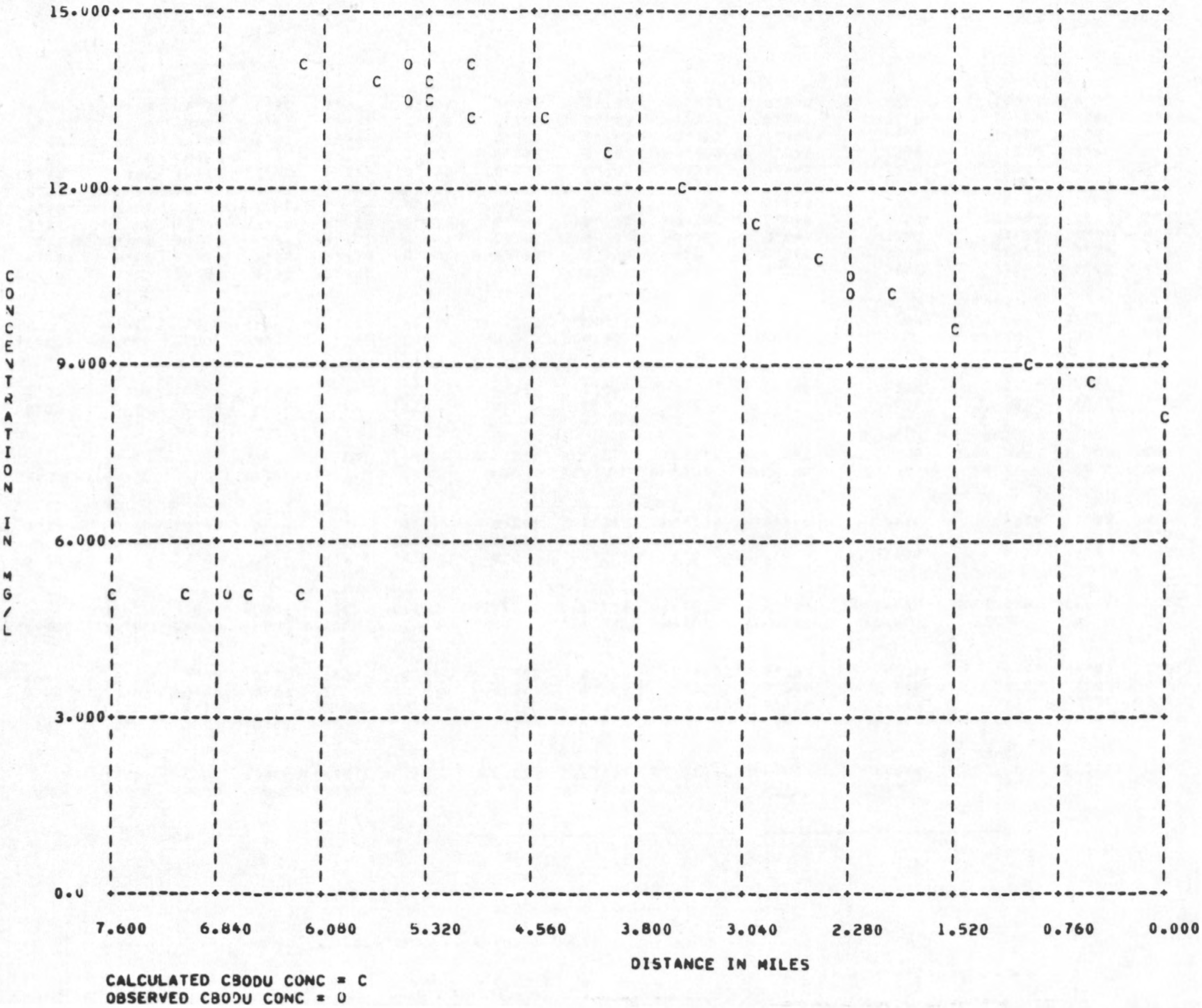
SUB-REACH	DISTANCE	TRAVEL TIME	CBODU CONC	NBOD CONC	INITIAL DEFICIT	CBOD DEFICIT	NBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC	PO4 CONC
1	7.60	0.0	5.20	8.00	-0.690	0.0	0.0	0.0	0.0	0.0	16000.	5000.	-0.69	9.00	12.00
1	7.10	1.83	5.14	7.03	-0.265	0.037	0.619	4.745	-2.361	0.266	11089.	3465.	3.04	5.27	11.55
1	6.60	3.67	5.09	6.18	1.168	0.036	0.544	4.745	-2.361	0.266	7685.	2402.	4.40	3.91	11.10
1	6.20	5.13	5.04	5.57	2.046	0.031	0.422	4.120	-2.050	0.231	5731.	1791.	4.80	3.51	10.76

SUB-REACH	DISTANCE	TRAVEL TIME	CBODU CONC	NBOD CONC	INITIAL DEFICIT	CBOD DEFICIT	NBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC	PO4 CONC
2	6.20	5.13	13.97	3.21	4.811	0.0	0.0	0.0	0.0	0.0	1958.	649.	4.81	3.50	3.70
2	5.70	5.85	13.94	5.77	3.056	0.324	0.321	2.000	-1.090	0.123	2704.	679.	4.73	3.58	2.50
2	5.30	6.28	13.93	6.69	3.394	0.212	0.242	1.318	-0.718	0.081	2970.	691.	4.53	3.78	2.04

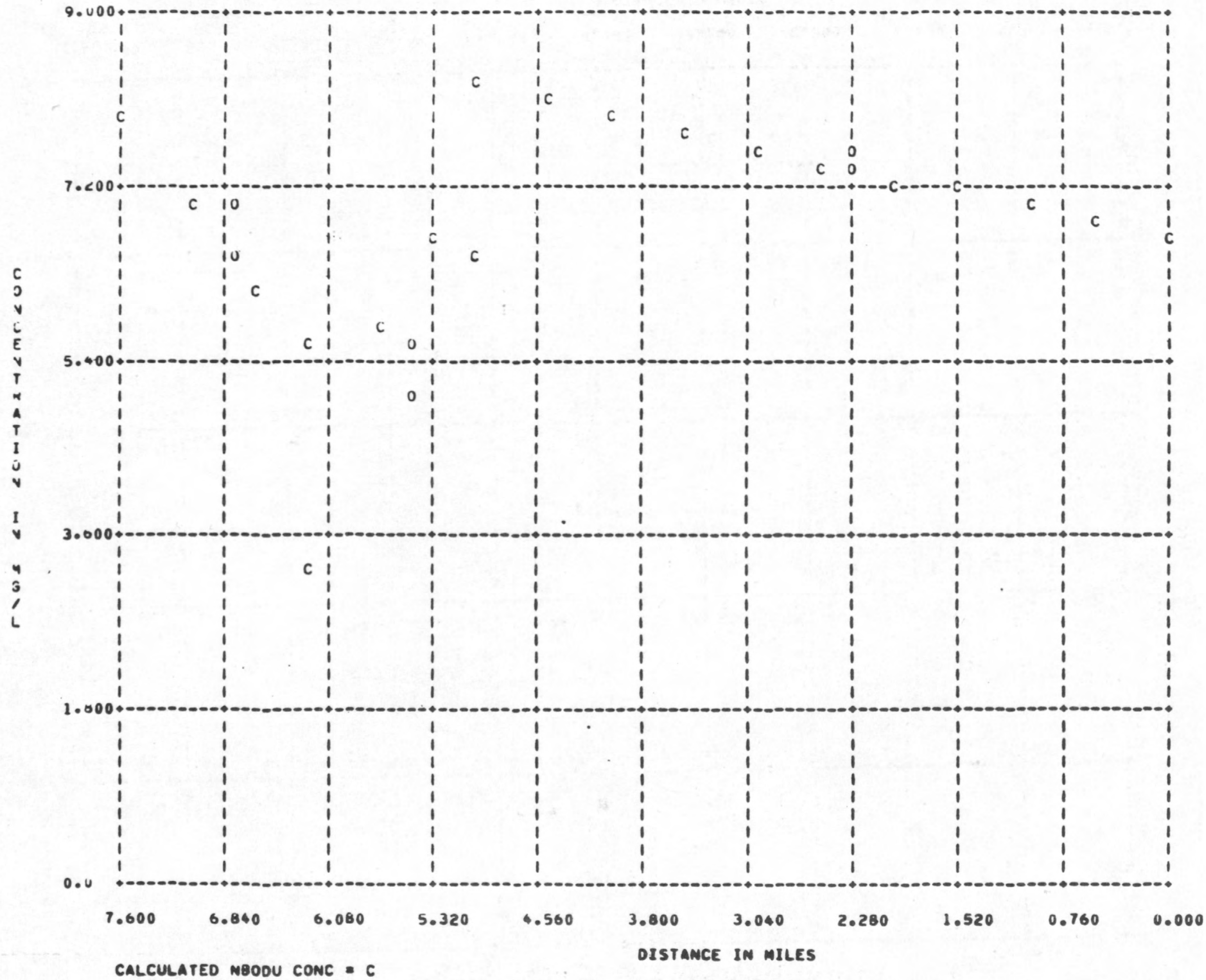
SUB-REACH	DISTANCE	TRAVEL TIME	CBODU CONC	NBOD CONC	INITIAL DEFICIT	CBOD DEFICIT	NBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC	PO4 CONC
3	5.30	6.28	13.60	6.60	4.407	0.0	0.0	0.0	0.0	0.0	2864.	662.	4.41	3.90	1.98
3	5.00	6.60	13.35	6.40	3.262	0.220	0.174	0.996	-0.543	0.061	2690.	622.	4.17	4.14	1.94

SUB-REACH	DISTANCE	TRAVEL TIME	CBODU CONC	NBOD CONC	INITIAL DEFICIT	CBOD DEFICIT	NBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC	PO4 CONC
4	5.00	6.60	14.04	8.33	3.881	0.0	0.0	0.0	0.0	0.0	3567.	2366.	3.88	4.43	1.21
4	4.50	6.83	13.30	8.15	2.359	0.585	0.145	0.793	-0.357	0.040	3409.	2262.	3.56	4.74	1.19
4	4.00	7.05	12.59	7.97	2.167	0.554	0.142	0.793	-0.357	0.040	3258.	2161.	3.34	4.97	1.16
4	3.50	7.28	11.92	7.79	2.029	0.524	0.139	0.793	-0.357	0.040	3113.	2066.	3.17	5.14	1.14
4	3.00	7.51	11.29	7.62	1.926	0.497	0.136	0.793	-0.357	0.040	2975.	1974.	3.03	5.28	1.12
4	2.50	7.73	10.69	7.45	1.844	0.470	0.133	0.793	-0.357	0.040	2844.	1887.	2.92	5.39	1.09
4	2.00	7.96	10.13	7.28	1.777	0.445	0.130	0.793	-0.357	0.040	2718.	1803.	2.83	5.48	1.07
4	1.50	8.18	9.59	7.12	1.719	0.422	0.127	0.793	-0.357	0.040	2597.	1723.	2.74	5.57	1.05
4	1.00	8.41	9.08	6.97	1.668	0.399	0.124	0.793	-0.357	0.040	2482.	1647.	2.67	5.64	1.03
4	0.50	8.64	8.60	6.81	1.621	0.378	0.121	0.793	-0.357	0.040	2372.	1574.	2.60	5.71	1.00
4	0.0	8.86	8.14	6.66	1.578	0.358	0.119	0.793	-0.357	0.040	2267.	1504.	2.53	5.78	0.98

TRIBUTARY TO EXAMPLE CREEK
CALCULATED AND OBSERVED CBOD CONCENTRATIONS VERSUS DISTANCE

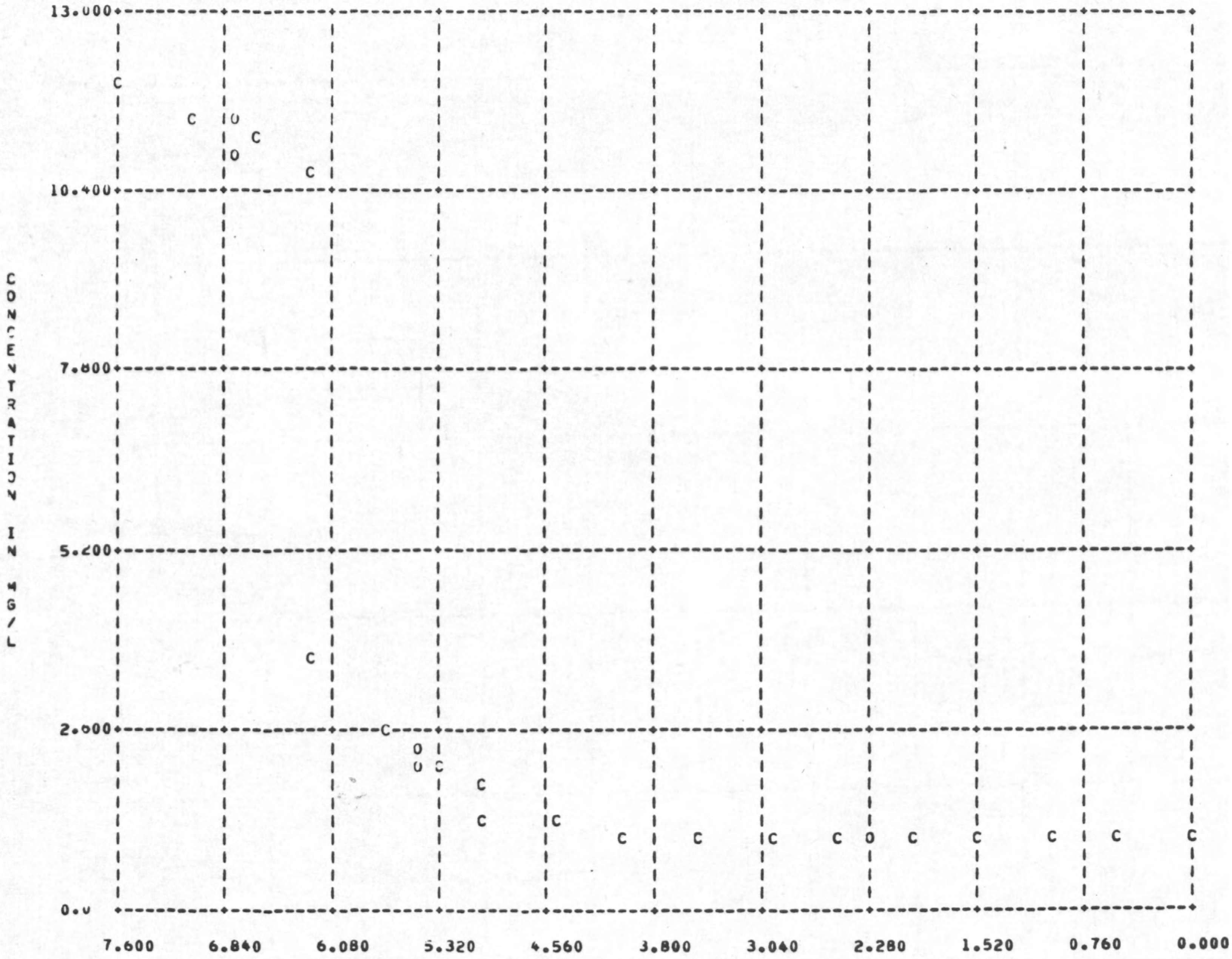


TRIBUTARY TO EXAMPLE CREEK
CALCULATED AND OBSERVED NBOD CONCENTRATIONS VERSUS DISTANCE



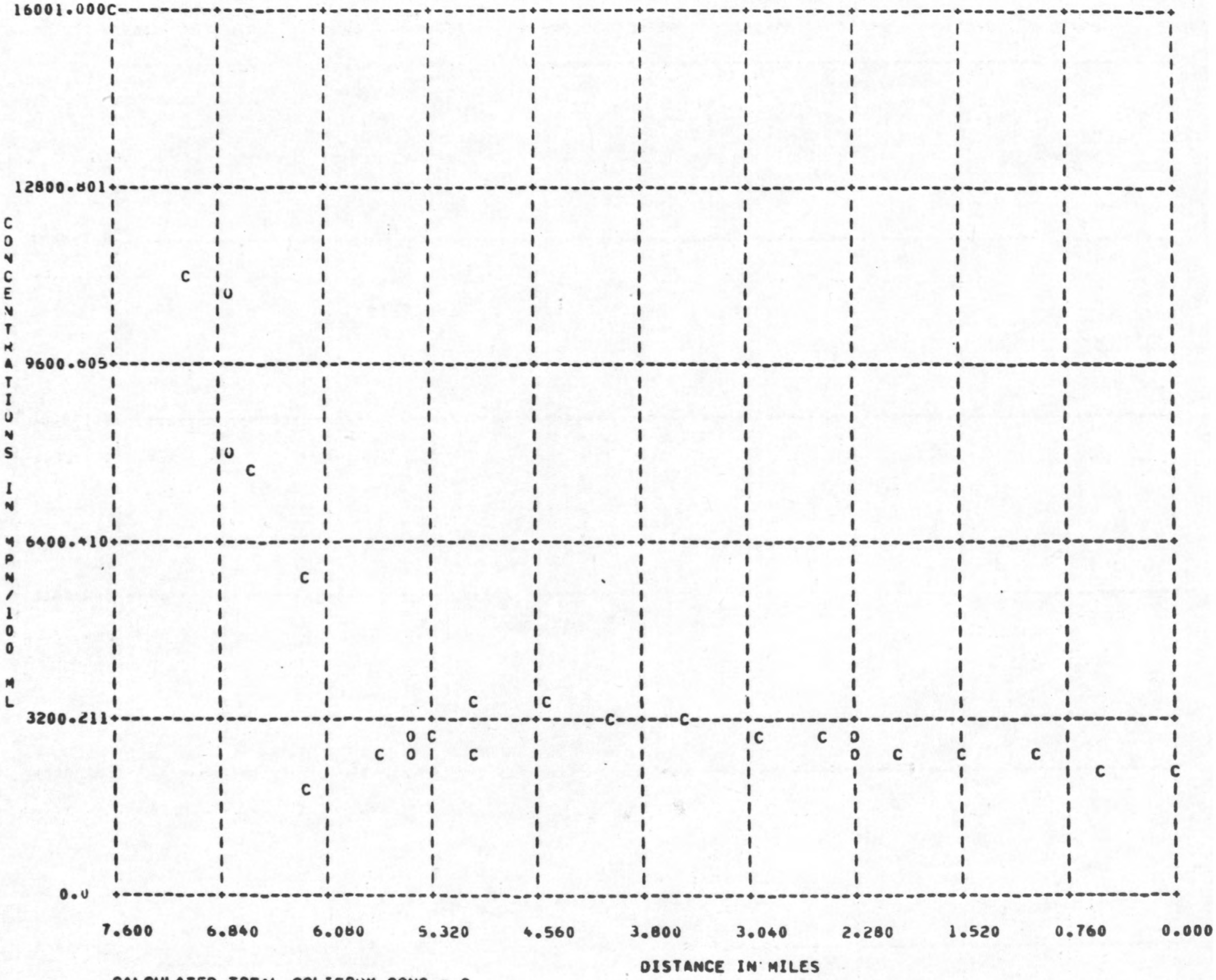
CALCULATED NBODU CONC = C
OBSERVED NBODU CONC = O

TRIBUTARY TO EXAMPLE CREEK
CALCULATED AND OBSERVED PO4 CONCENTRATIONS VERSUS DISTANCE

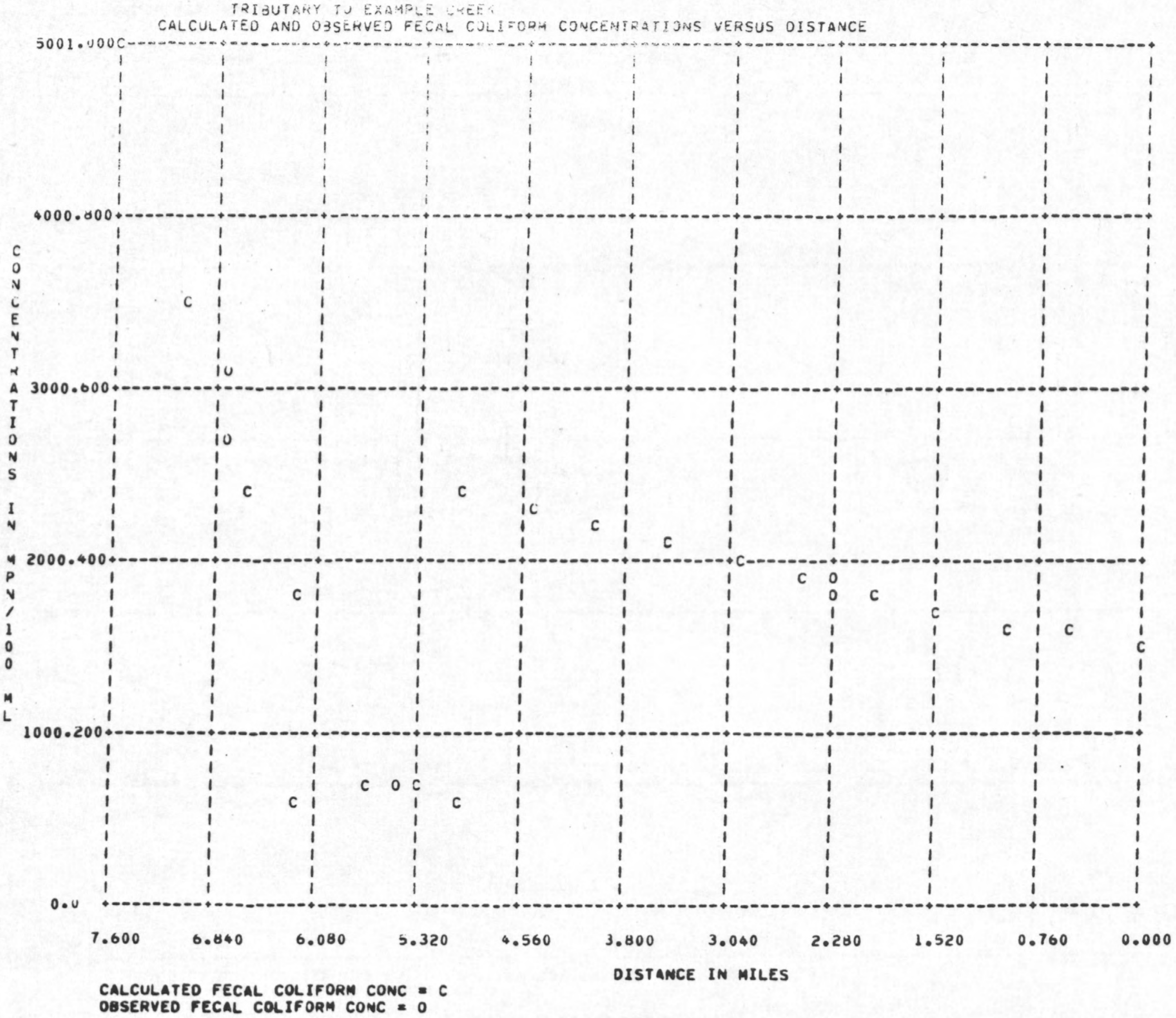


CALCULATED PO4 CONC = C
OBSERVED PO4 CONC = O

TRIBUTARY TO EXAMPLE CREEK
CALCULATED AND OBSERVED TOTAL COLIFORM CONCENTRATIONS VERSUS DISTANCE

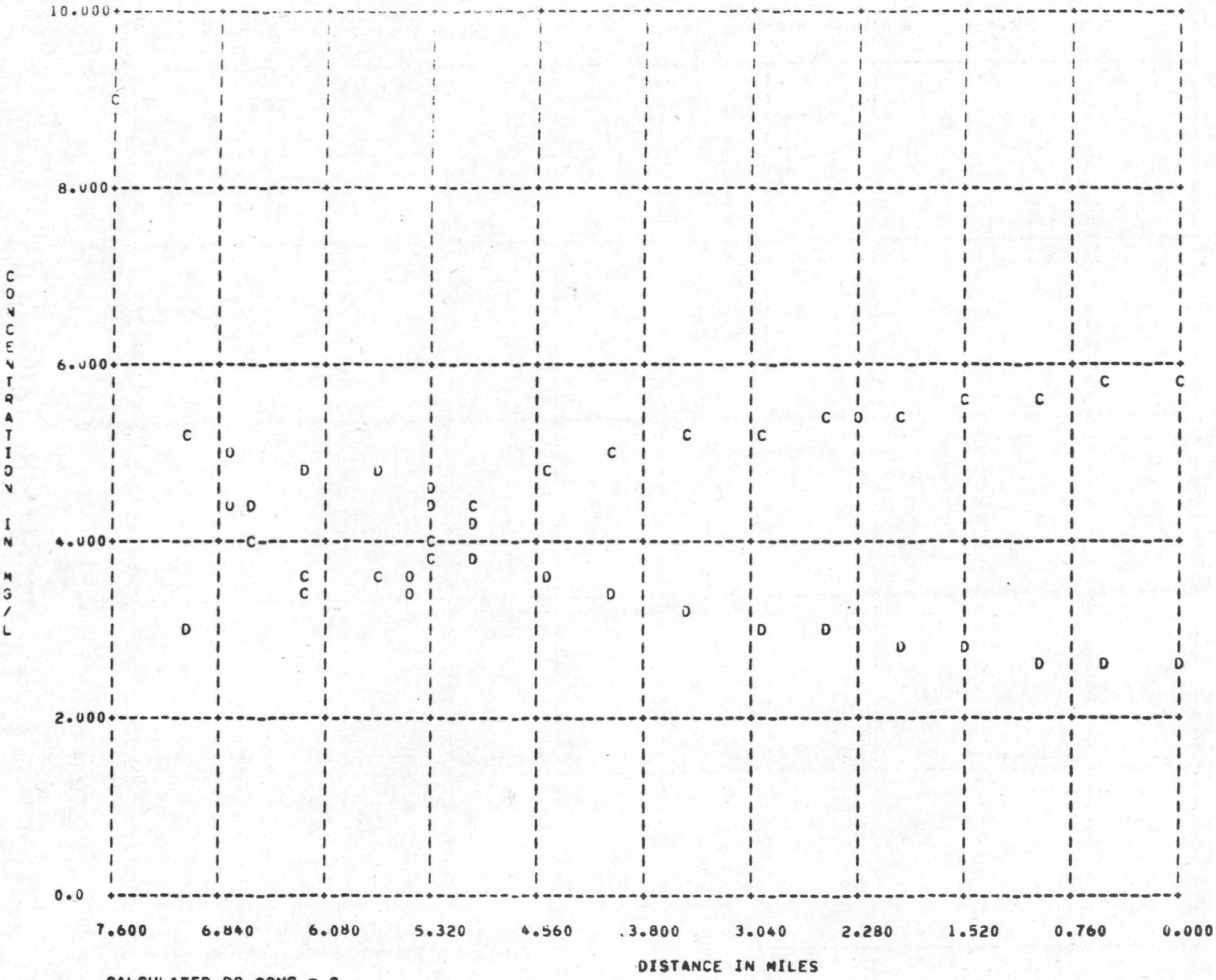


CALCULATED TOTAL COLIFORM CONC = C
OBSERVED TOTAL COLIFORM CONC = O

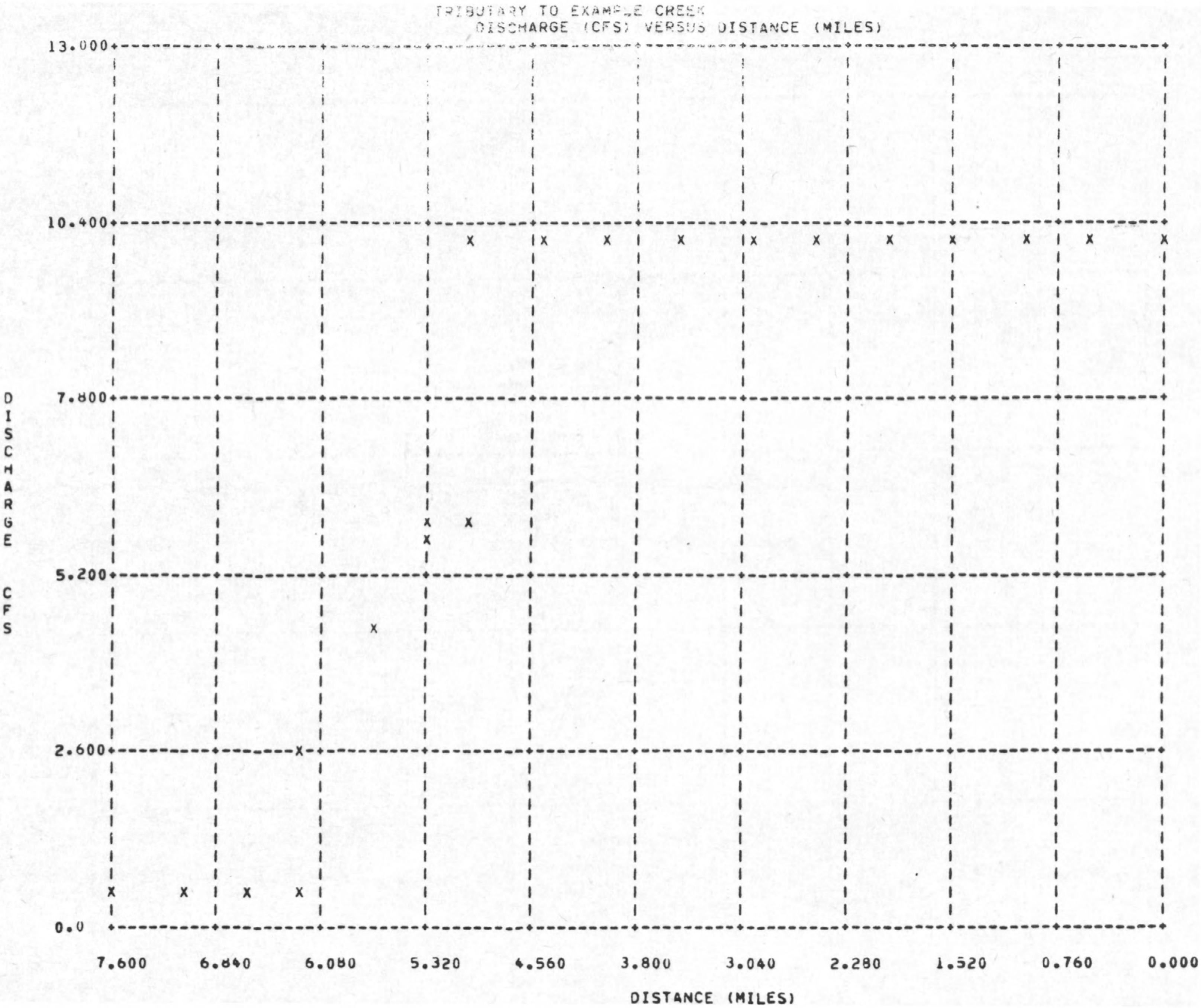


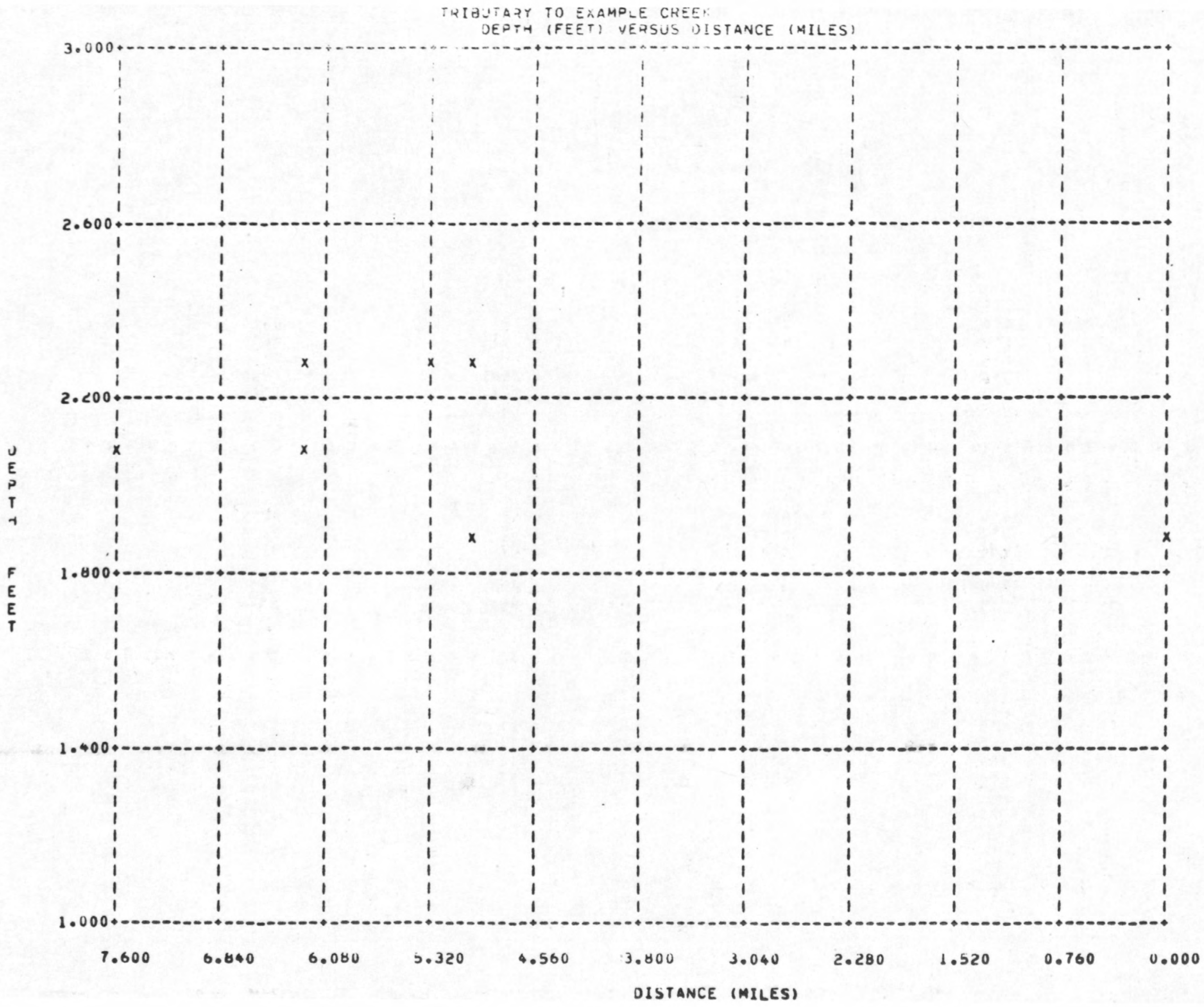
TRIBUTARY TO EXAMPLE CREEK
CALCULATED AND OBSERVED FECAL COLIFORM CONCENTRATIONS VERSUS DISTANCE
5001.000
4000.800
3000.600
2000.400
1000.200
0.0
CONCENTRATIONS IN MPN/100 ML
7.600
6.840
6.080
5.320
4.560
3.800
3.040
2.280
1.520
0.760
0.000
DISTANCE IN MILES
CALCULATED FECAL COLIFORM CONC = C
OBSERVED FECAL COLIFORM CONC = O

TRIBUTARY TO EXAMPLE CREEK
CALCULATED AND OBSERVED DO CONCENTRATIONS AND DO DEFICIT VERSUS DISTANCE



CALCULATED DO CONC = C
OBSERVED DO CONC = O
DO DEFICIT = D


TRIBUTARY TO EXAMPLE CREEK
DISCHARGE (CFS) VERSUS DISTANCE (MILES)
13.000
10.400
7.800
5.200
2.600
0.0
DISCHARGE CFS
7.600
6.840
6.080
5.320
4.560
3.800
3.040
2.280
1.520
0.760
0.000
DISTANCE (MILES)


TRIBUTARY TO EXAMPLE CREEK
DEPTH (FEET) VERSUS DISTANCE (MILES)
3.000
2.600
2.200
1.800
1.400
1.000
DEPTH FEET
7.600
6.840
6.080
5.320
4.560
3.800
3.040
2.280
1.520
0.760
0.000
DISTANCE (MILES)

TRIBUTARY TO EXAMPLE CREEK

CALCULATED CONSERVATIVE CONCENTRATION DATA SUBREACH 1

MILE LOCATION	TSS (MG/L)	(MG/L)	(MG/L)
7.60	11.0	0.0	0.0
7.10	11.0	0.0	0.0
6.60	11.0	0.0	0.0
6.20	11.0	0.0	0.0

CALCULATED CONSERVATIVE CONCENTRATION DATA SUBREACH 2

MILE LOCATION	TSS (MG/L)	(MG/L)	(MG/L)
6.20	15.1	0.0	0.0
5.70	15.1	0.0	0.0
5.30	15.0	0.0	0.0

CALCULATED CONSERVATIVE CONCENTRATION DATA SUBREACH 3

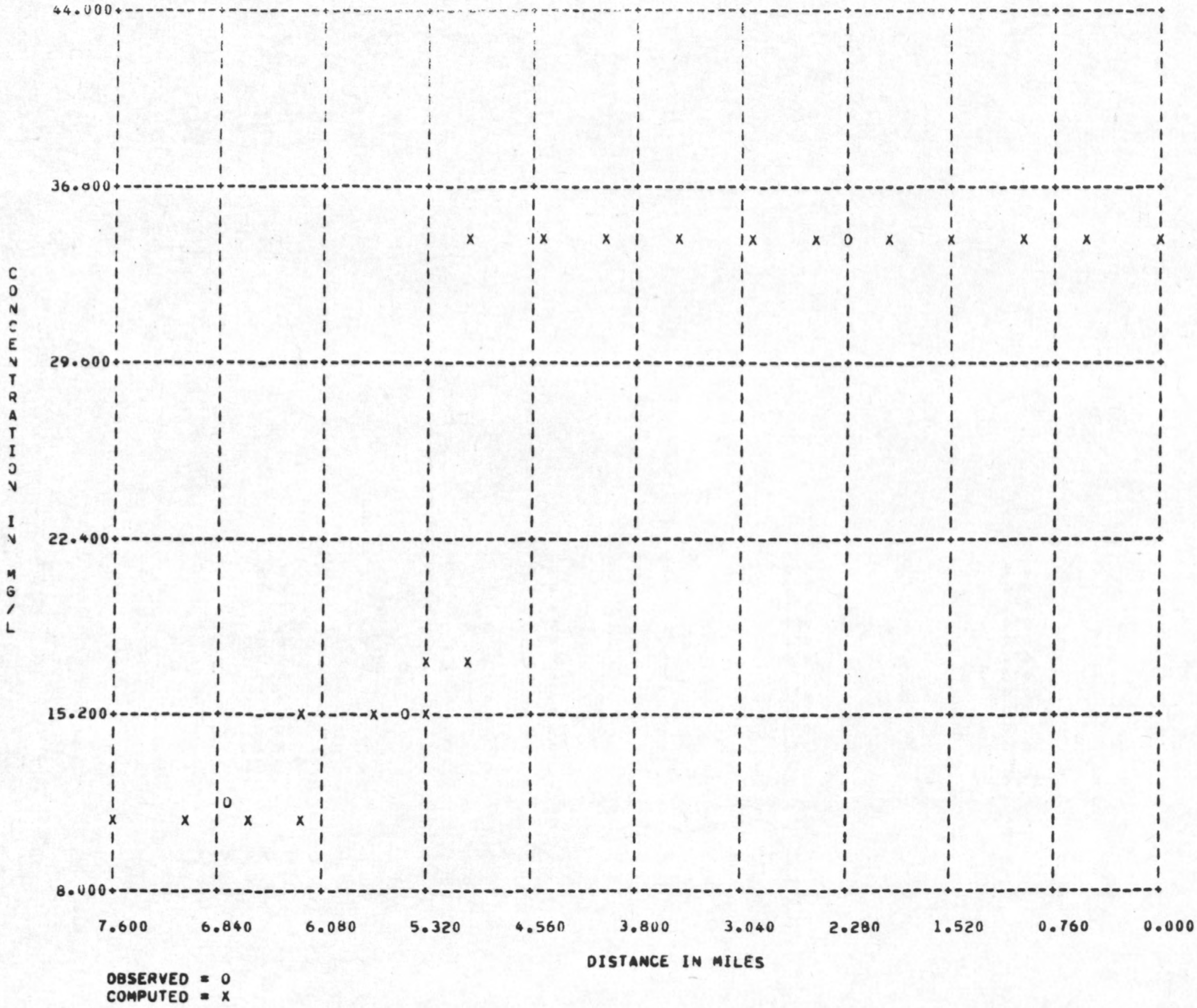
MILE LOCATION	TSS (MG/L)	(MG/L)	(MG/L)
5.30	17.6	0.0	0.0
5.00	17.6	0.0	0.0

TRIBUTARY TO EXAMPLE CREEK

C A L C U L A T E D   C O N S E R V A T I V E   C O N C E N T R A T I O N   D A T A   S U B R E A C H 4

MILE LOCATION	TSS (MG/L)	(MG/L)	(MG/L)
5.00	34.6	0.0	0.0
4.50	34.6	0.0	0.0
4.00	34.6	0.0	0.0
3.50	34.6	0.0	0.0
3.00	34.6	0.0	0.0
2.50	34.6	0.0	0.0
2.00	34.6	0.0	0.0
1.50	34.6	0.0	0.0
1.00	34.6	0.0	0.0
0.50	34.6	0.0	0.0
0.0	34.6	0.0	0.0

TRIBUTARY TO EXAMPLE CREEK
TSS VERSUS DISTANCE



STEADY STATE WATER QUALITY MODEL

GULF COAST HYDROSCIENCE CENTER

U. S. GEOLOGICAL SURVEY

DATE OF LAST REVISION, FEBRUARY 1978

EXAMPLE CREEK

NUMBER OF SUBREACHES FOR THIS PROBLEM = 2

PRINTING INTERVAL (MILES) = 0.500

STARTING DISTANCE (MILES) = 16.000

INITIAL CBOD CONC (MG/L) AT STARTING DISTANCE = 11.000

INITIAL NBOD CONC (MG/L) AT STARTING DISTANCE = 13.000

INITIAL DO CONC (MG/L) AT STARTING DISTANCE = 5.600

INITIAL PHOSPHATE CONC (MG/L) AT STARTING DISTANCE = 15.000

INITIAL TOT. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE = 1000.

INITIAL FEC. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE = 600.

STREAMFLOW (CFS) AT STARTING DISTANCE = 3.000

TOTAL SUSPENDED SOLIDS = 15.00

EXAMPLE CREEK

I N P U T   P A R A M E T E R S

CONCENTRATIONS(MG/L) OF --

SUBREACH	CARBONACEOUS ULT. BOD	NITROGENOUS BOD	DO DEFICIT	PHOSPHATE	TOT.COLIF.	FEC.COLIF.
1	0.0	0.0	0.0	0.0	0.	0.
2	9.000	12.000	3.010	1.000	1900.	800.

DIRECT DISCHARGES(LB/DAY) OF --

SUBREACH	CARBONACEOUS ULT. BOD	NITROGENOUS BOD	DO DEFICIT	PHOSPHATE
1	0.0	0.0	0.0	0.0
2	0.0	0.0	3.010	0.0

EXAMPLE CREEK

SUBREACH	NET PHOTOSYNTHETIC DO PRODUCTION (MG/L/DAY)	BENTHIC DO DEMAND (G/SQ M/DAY)
1	2.000	1.000
2	2.000	1.000

G E O M E T R Y

SUBREACH	FLOW CHANGE (CFS)	AREA (SQFT)	DEPTH (FT)	TEMP (DEG.CENT)	END MI (MI)
1	0.0	100.	1.68	22.00	14.50
2	9.0	150.	2.50	24.00	5.30

EXAMPLE CREEK

REACTION COEFFICIENTS (/DAY)

SUBREACH	KR	KD	KN	KCOLF	KCOLT	KPO41	KPO42
1	0.200	0.200	0.050	0.800	0.700	0.010	0.100
2	0.700	0.700	0.070	0.800	0.700	0.010	0.100

TEMPERATURE CORRECTED REACTION COEFFICIENTS (/DAY)

SUBREACH	KR	KD	KN	KA	KPO41	KPO42
1	0.219	0.219	0.059	1.042	0.012	0.119
2	0.841	0.841	0.099	1.524	0.014	0.141

EXAMPLE CREEK

SUBREACH	DO SATURATION (MG/L)
1	8.651
2	8.310

EXAMPLE CREEK

OBSERVED MEASUREMENTS

DISTANCE (MI)	DO CONC (MG/L)	TSS (MG/L)	(MG/L)	(MG/L)	CBODU (MG/L)	NBODU (MG/L)	ORG-N (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	TOTAL COLIFORM	FECAL COLIFORM	PO4 (MG/L)
15.00	5.60	14.00	0.0	0.0	7.00	11.50	0.0	0.0	0.0	0.0	200.	100.	14.00
15.00	5.90	15.00	0.0	0.0	7.20	11.50	0.0	0.0	0.0	0.0	300.	150.	14.50
13.00	4.70	22.00	0.0	0.0	4.80	8.70	0.0	0.0	0.0	0.0	1100.	600.	2.60
13.00	4.90	23.00	0.0	0.0	5.00	9.00	0.0	0.0	0.0	0.0	1200.	500.	2.70
8.50	6.60	23.10	0.0	0.0	1.00	7.30	0.0	0.0	0.0	0.0	300.	100.	2.10
8.50	6.70	22.50	0.0	0.0	0.90	7.20	0.0	0.0	0.0	0.0	400.	200.	2.40

EXAMPLE CREEK

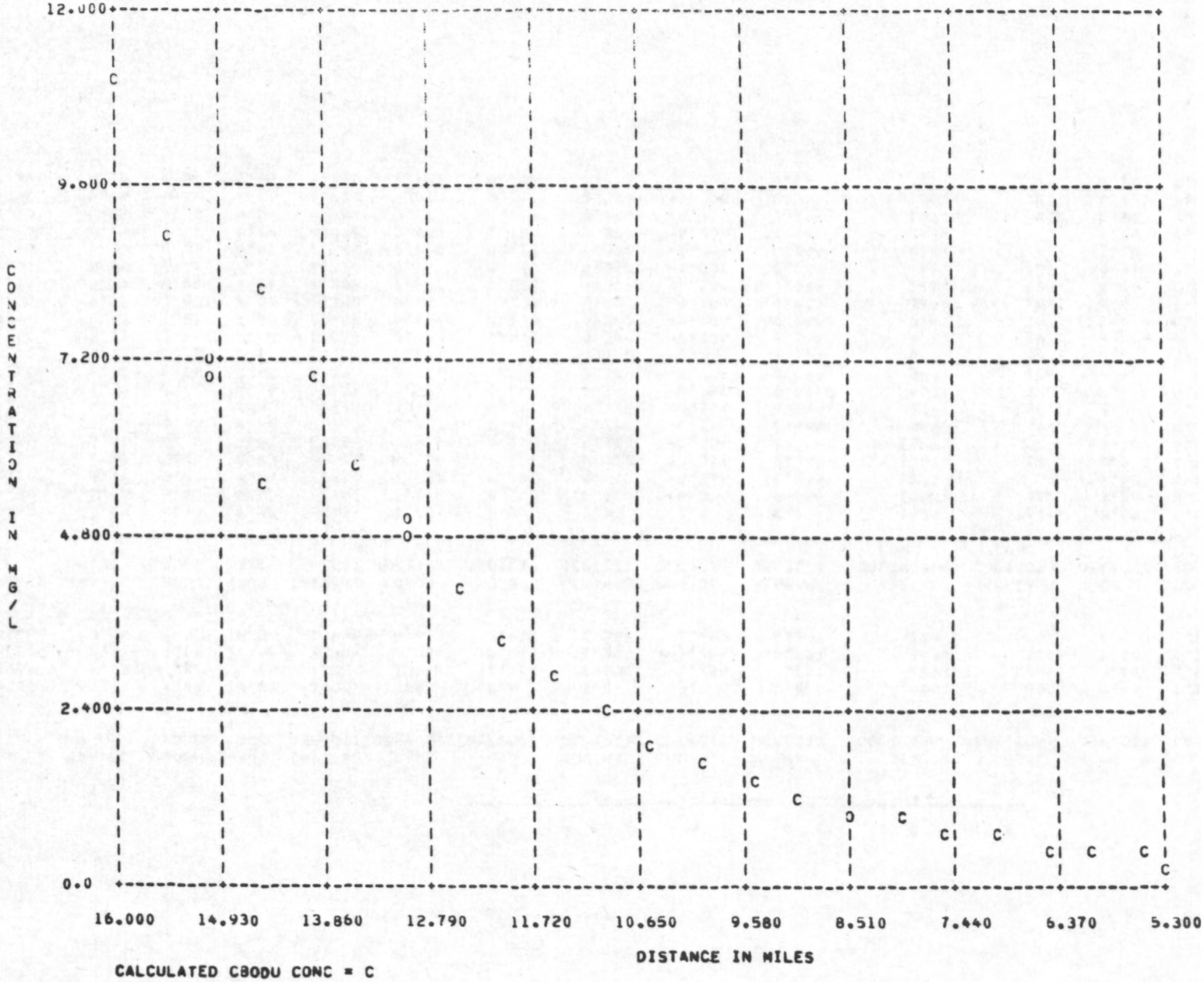
RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

SUB-REACH	DISTANCE	TRAVEL TIME	CBODU CONC	NBOD CONC	INITIAL DEFICIT	CBOD DEFICIT	NBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC	PO4 CONC
1	16.00	0.0	11.00	13.00	3.051	0.0	0.0	0.0	0.0	0.0	1000.	600.	3.05	5.60	15.00
1	15.50	1.02	8.80	12.24	1.055	1.330	0.468	1.390	-1.255	0.157	490.	266.	3.15	5.51	14.68
1	15.00	2.04	7.04	11.52	1.088	1.064	0.440	1.390	-1.255	0.157	240.	118.	2.88	5.77	14.37
1	14.50	3.06	5.63	10.84	0.998	0.851	0.415	1.390	-1.255	0.157	118.	52.	2.56	6.10	14.06

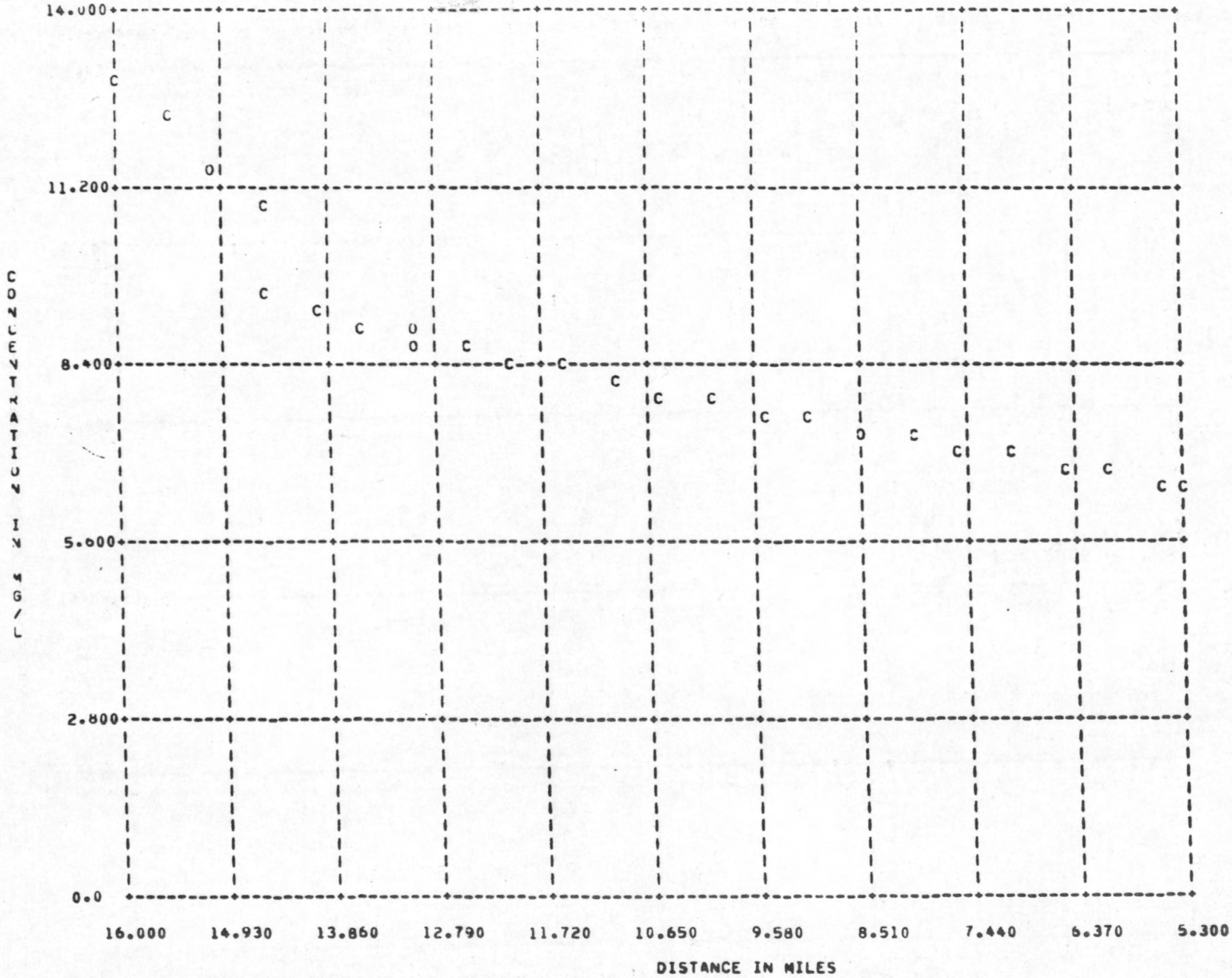
SUB-REACH	DISTANCE	TRAVEL TIME	CBODU CONC	NBOD CONC	INITIAL DEFICIT	CBOD DEFICIT	NBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC	PO4 CONC
2	14.50	3.06	8.15	9.38	2.682	0.0	0.0	0.0	0.0	0.0	1829.	1024.	2.68	5.63	2.75
2	14.00	3.26	6.85	9.19	1.984	1.115	0.163	0.300	-0.356	0.044	1583.	868.	3.25	5.06	2.70
2	13.50	3.47	5.76	9.01	2.404	0.937	0.160	0.300	-0.356	0.044	1371.	736.	3.49	4.82	2.66
2	13.00	3.67	4.85	8.83	2.581	0.788	0.157	0.300	-0.356	0.044	1187.	624.	3.51	4.79	2.61
2	12.50	3.88	4.08	8.65	2.600	0.663	0.153	0.300	-0.356	0.044	1027.	529.	3.40	4.91	2.56
2	12.00	4.09	3.43	8.48	2.518	0.557	0.150	0.300	-0.356	0.044	889.	449.	3.21	5.10	2.51
2	11.50	4.29	2.88	8.31	2.378	0.469	0.147	0.300	-0.356	0.044	770.	381.	2.98	5.33	2.46
2	11.00	4.50	2.42	8.14	2.206	0.394	0.144	0.300	-0.356	0.044	667.	323.	2.73	5.58	2.42
2	10.50	4.70	2.04	7.97	2.021	0.331	0.141	0.300	-0.356	0.044	577.	274.	2.48	5.83	2.37
2	10.00	4.91	1.71	7.81	1.837	0.279	0.139	0.300	-0.356	0.044	500.	232.	2.24	6.07	2.32
2	9.50	5.12	1.44	7.66	1.659	0.234	0.136	0.300	-0.356	0.044	432.	197.	2.02	6.29	2.27
2	9.00	5.32	1.21	7.50	1.492	0.197	0.133	0.300	-0.356	0.044	374.	167.	1.81	6.50	2.23
2	8.50	5.53	1.02	7.35	1.340	0.166	0.130	0.300	-0.356	0.044	324.	142.	1.62	6.68	2.18
2	8.00	5.73	0.86	7.20	1.202	0.139	0.128	0.300	-0.356	0.044	281.	120.	1.46	6.85	2.13
2	7.50	5.94	0.72	7.06	1.078	0.117	0.125	0.300	-0.356	0.044	243.	102.	1.31	7.00	2.09
2	7.00	6.15	0.61	6.91	0.969	0.099	0.123	0.300	-0.356	0.044	210.	86.	1.18	7.13	2.04
2	6.50	6.35	0.51	6.78	0.872	0.083	0.120	0.300	-0.356	0.044	182.	73.	1.06	7.25	1.99
2	6.00	6.56	0.43	6.64	0.787	0.070	0.118	0.300	-0.356	0.044	158.	62.	0.96	7.35	1.95
2	5.50	6.76	0.36	6.51	0.712	0.059	0.115	0.300	-0.356	0.044	136.	53.	0.88	7.43	1.90
2	5.30	6.85	0.34	6.45	0.776	0.023	0.050	0.131	-0.155	0.019	129.	49.	0.84	7.47	1.88

EXAMPLE CREEK
CALCULATED AND OBSERVED CBOD CONCENTRATIONS VERSUS DISTANCE



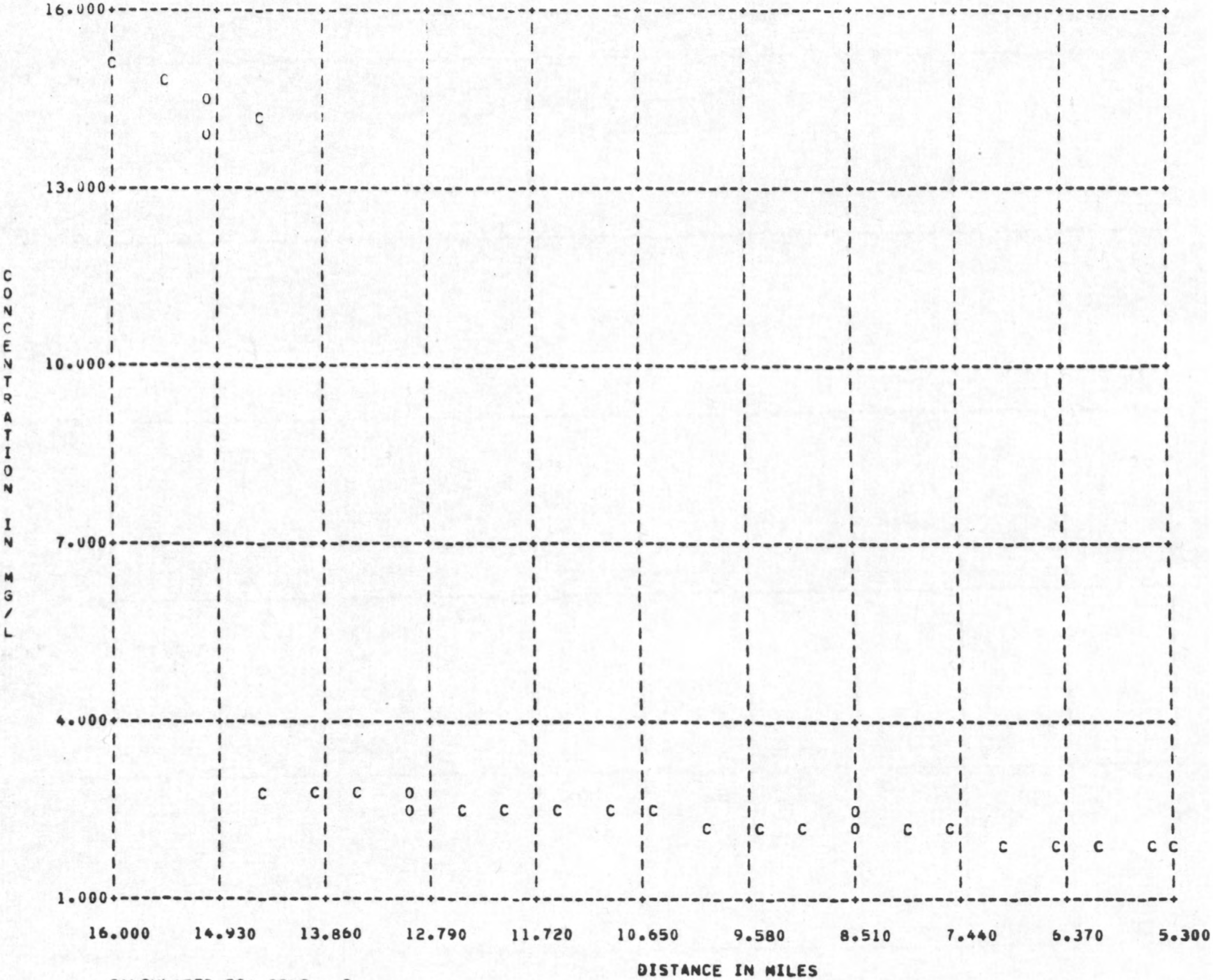
CALCULATED CBODU CONC = C
OBSERVED CBODU CONC = O

EXAMPLE CREEK
CALCULATED AND OBSERVED NBOD CONCENTRATIONS VERSUS DISTANCE



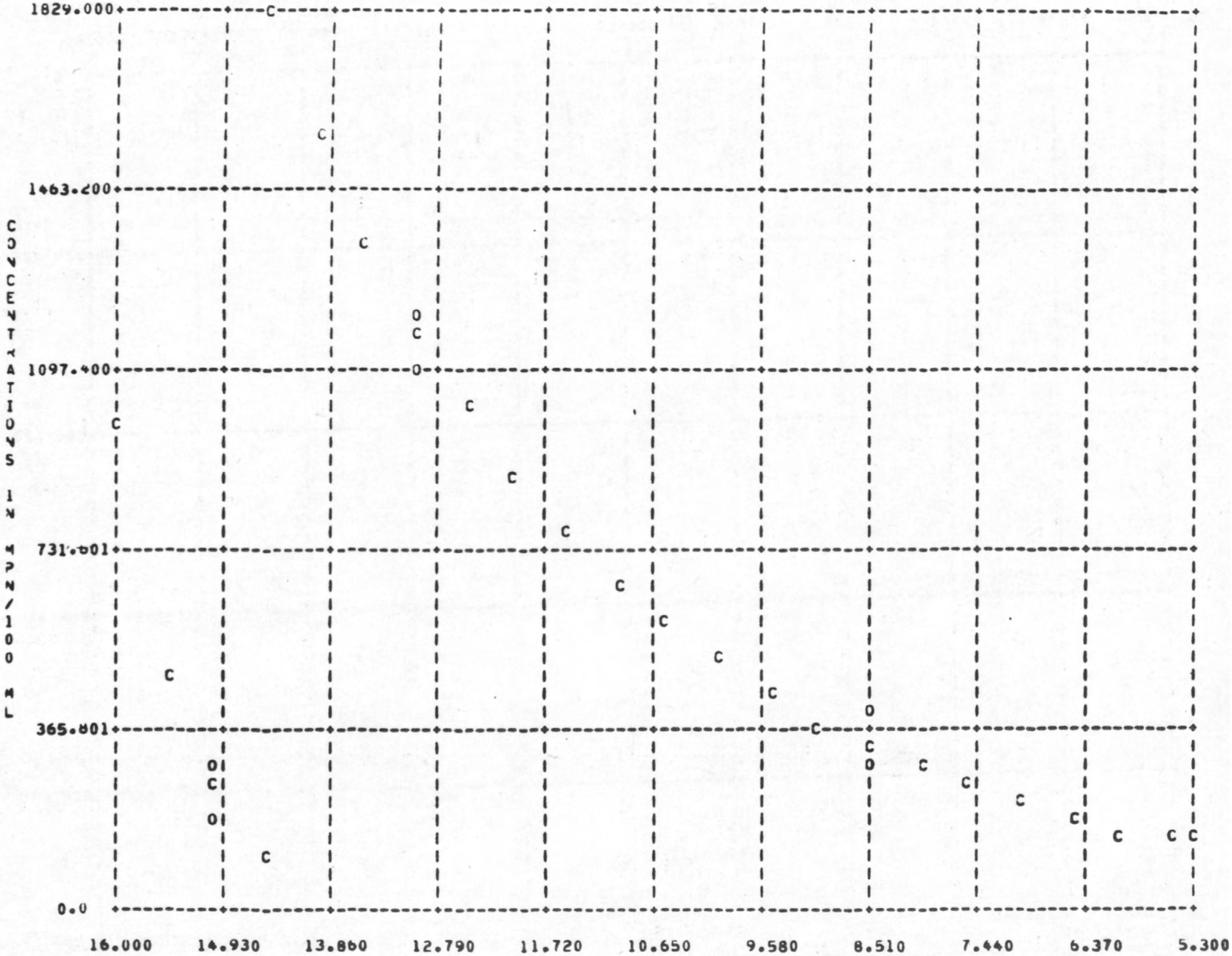
CALCULATED NBODU CONC = C
OBSERVED NBODU CONC = O

EXAMPLE CREEK
CALCULATED AND OBSERVED PO4 CONCENTRATIONS VERSUS DISTANCE



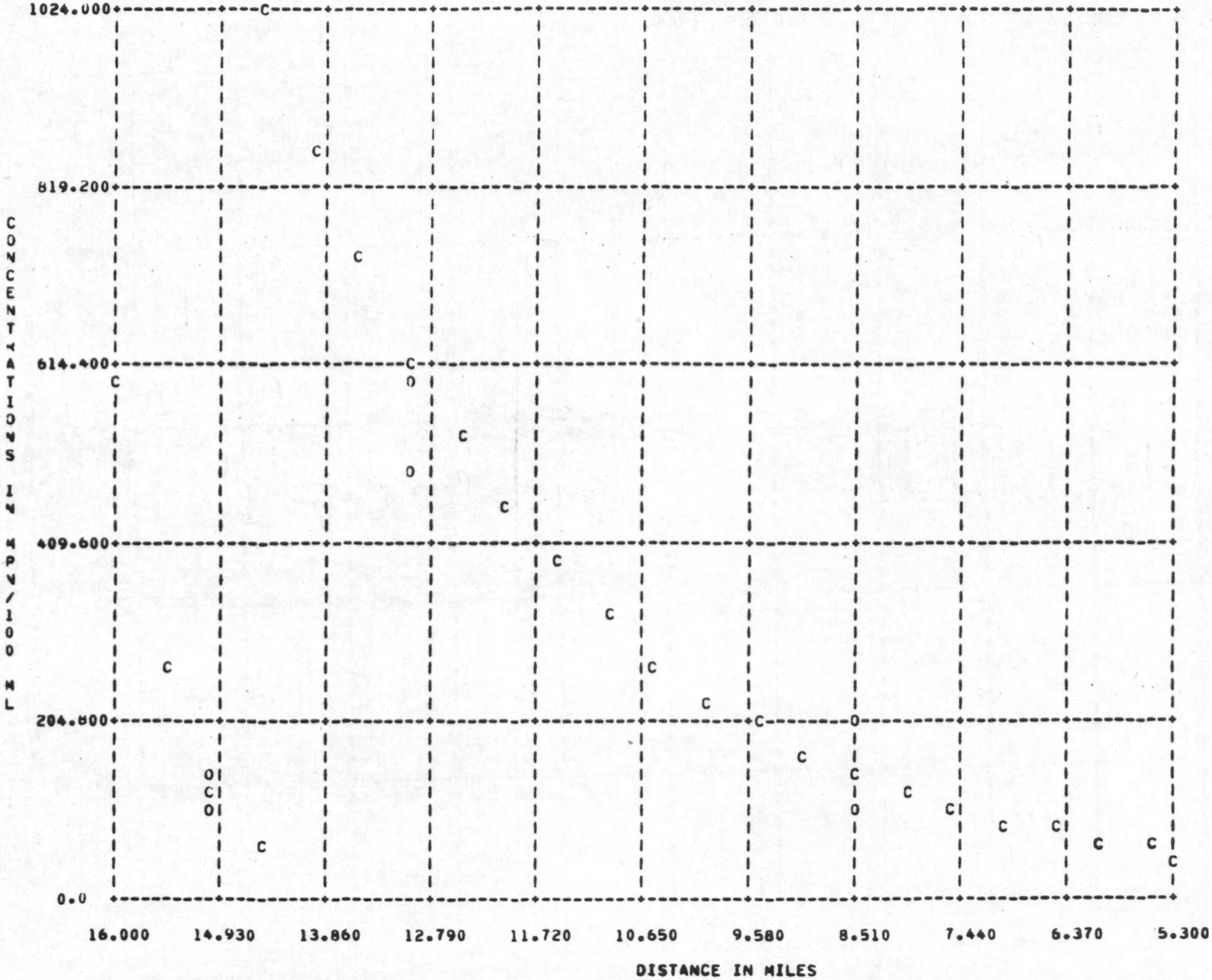
CALCULATED PO4 CONC = C
OBSERVED PO4 CONC = O

EXAMPLE CREEK
CALCULATED AND OBSERVED TOTAL COLIFORM CONCENTRATIONS VERSUS DISTANCE



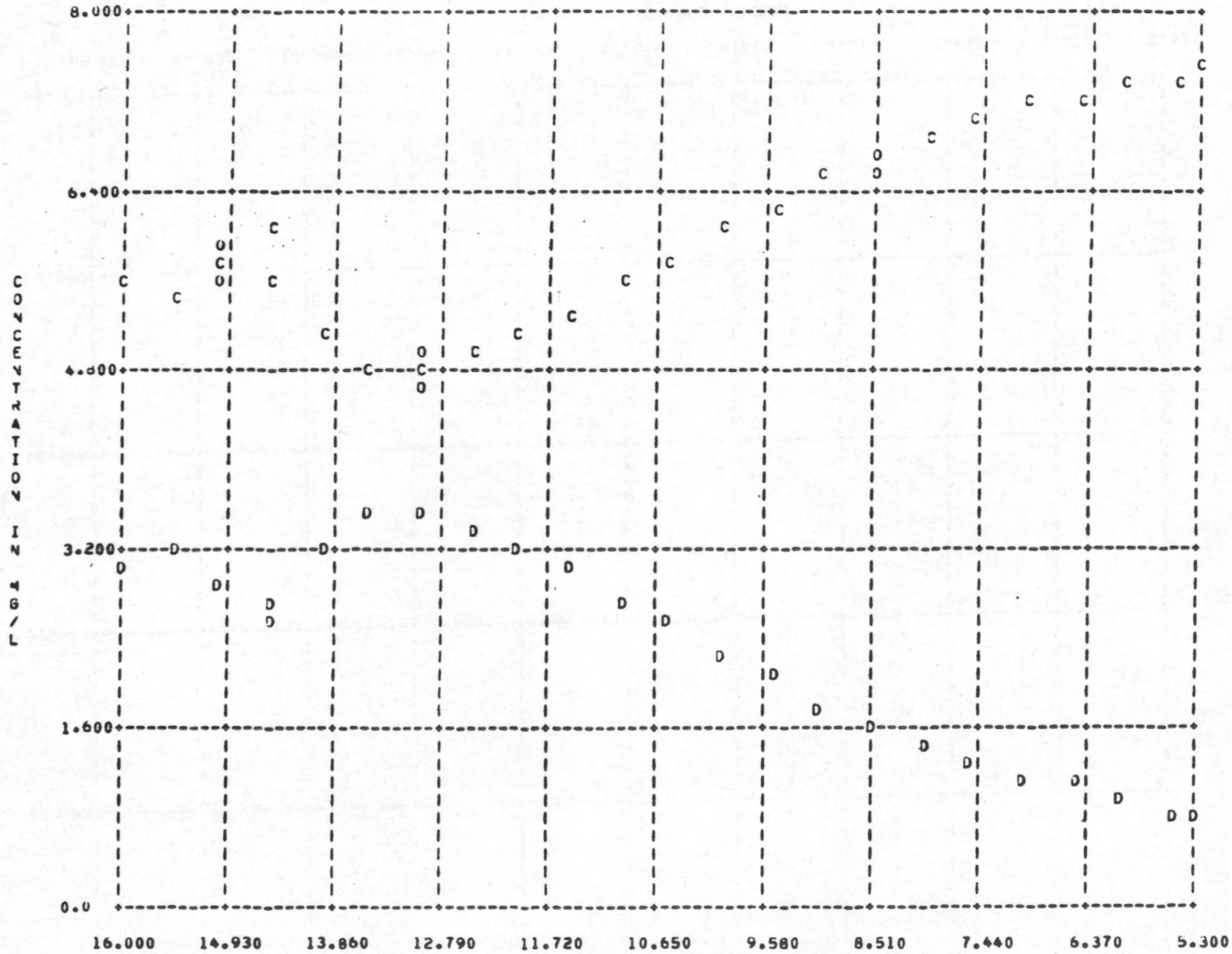
CALCULATED TOTAL COLIFORM CONC = C
OBSERVED TOTAL COLIFORM CONC = O

EXAMPLE CREEK
CALCULATED AND OBSERVED FECAL COLIFORM CONCENTRATIONS VERSUS DISTANCE



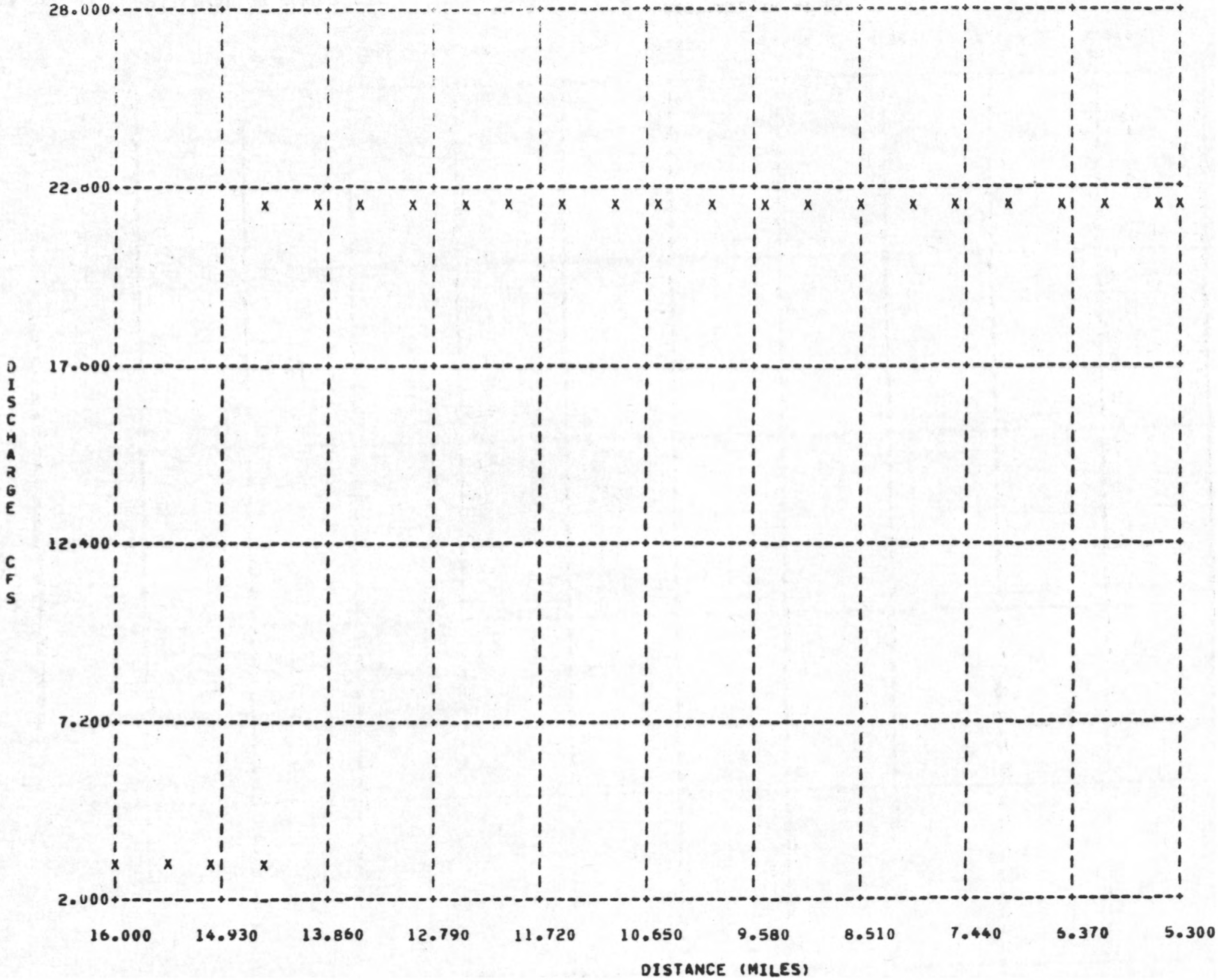
CALCULATED FECAL COLIFORM CONC = C
OBSERVED FECAL COLIFORM CONC = O

EXAMPLE CREEK
CALCULATED AND OBSERVED DO CONCENTRATIONS AND DO DEFICIT VERSUS DISTANCE

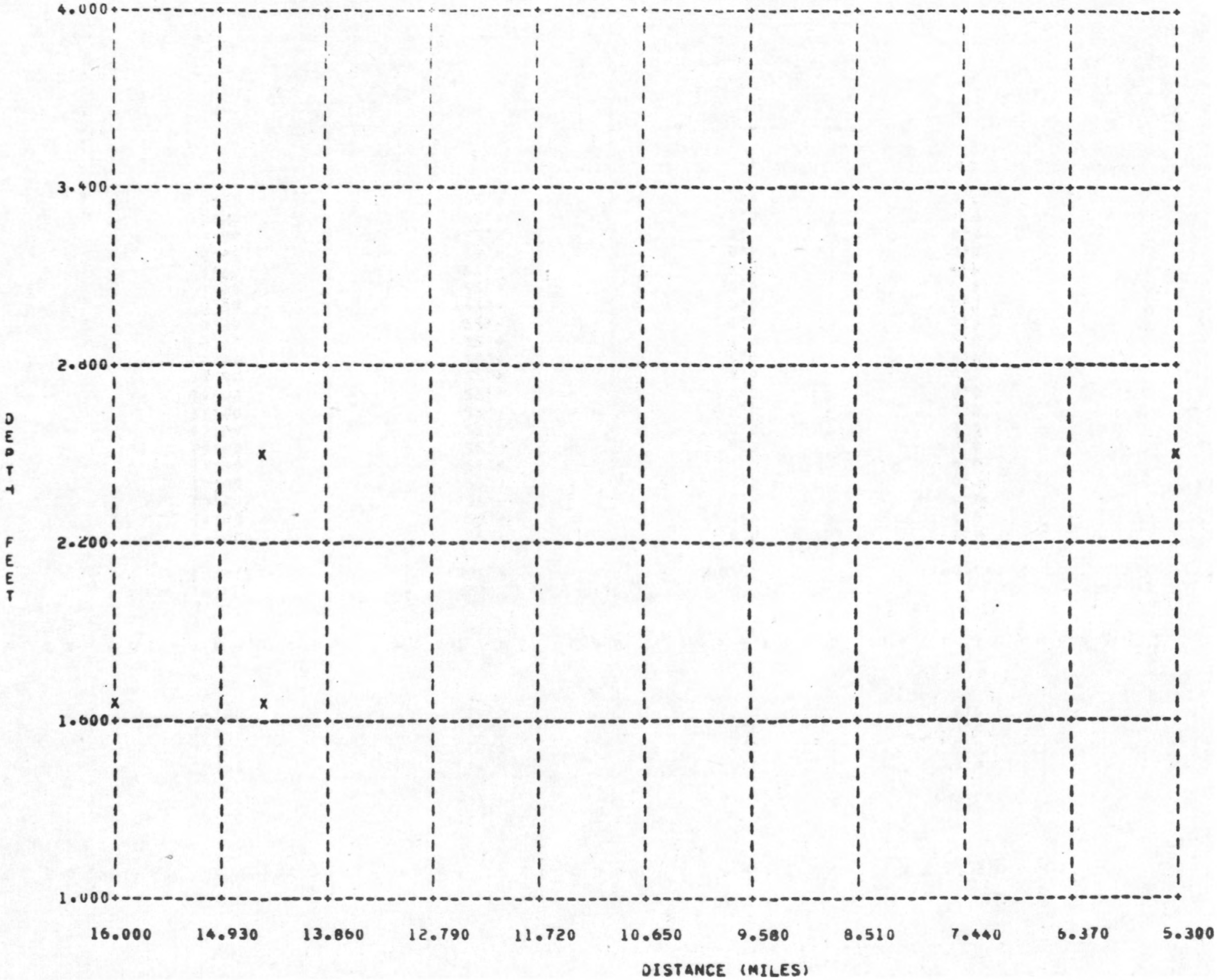


CALCULATED DO CONC = C
OBSERVED DO CONC = O
DO DEFICIT = D

EXAMPLE CREEK
DISCHARGE (CFS) VERSUS DISTANCE (MILES)



EXAMPLE CREEK
DEPTH (FEET) VERSUS DISTANCE (MILES)



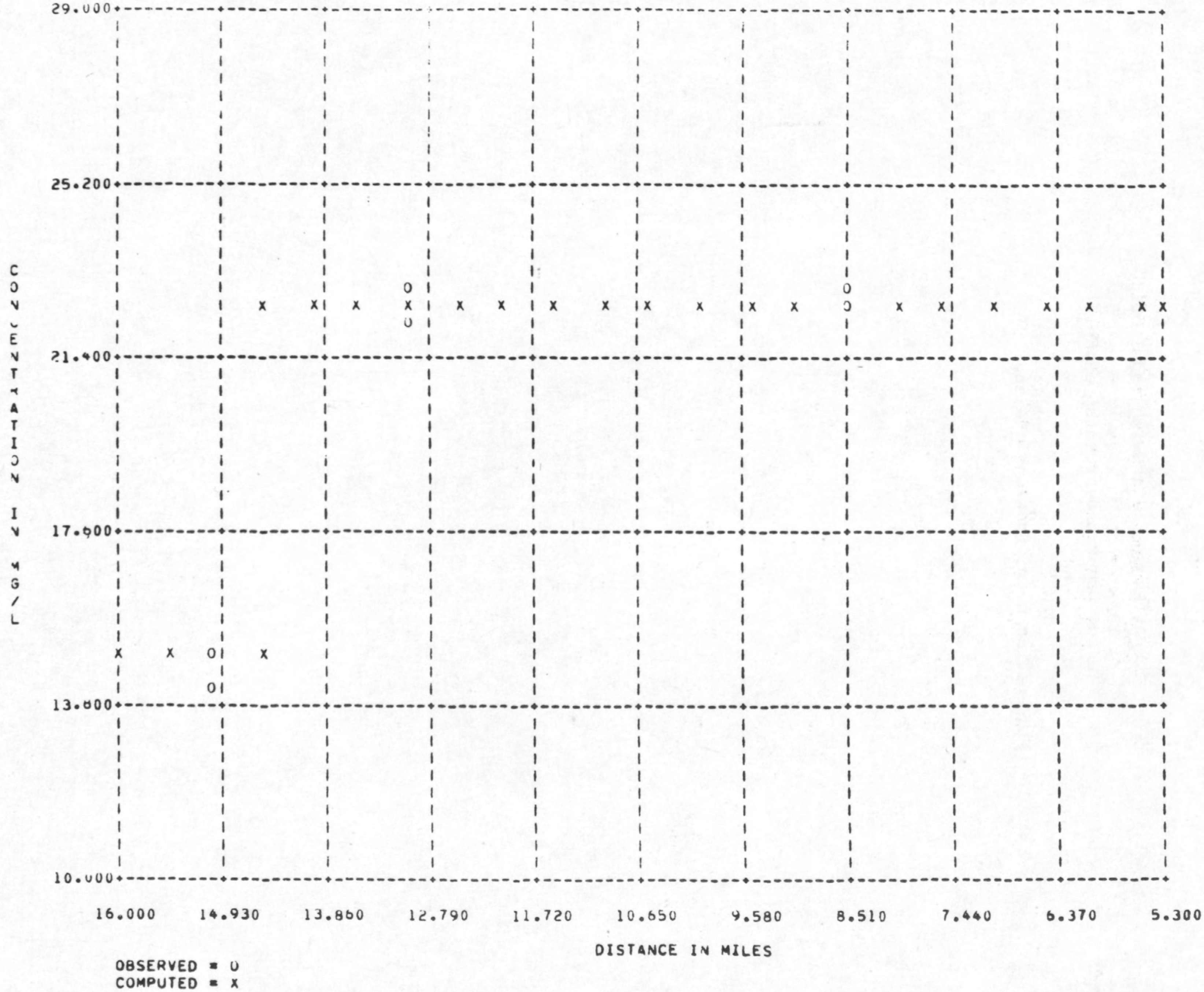
CALCULATED CONSERVATIVE CONCENTRATION DATA SUBREACH 1

MILE LOCATION	TSS (MG/L)	(MG/L)	(MG/L)
16.00	15.0	0.0	0.0
15.50	15.0	0.0	0.0
15.00	15.0	0.0	0.0
14.50	15.0	0.0	0.0

CALCULATED CONSERVATIVE CONCENTRATION DATA SUBREACH 2

MILE LOCATION	TSS (MG/L)	(MG/L)	(MG/L)
14.50	22.4	0.0	0.0
14.00	22.4	0.0	0.0
13.50	22.4	0.0	0.0
13.00	22.4	0.0	0.0
12.50	22.4	0.0	0.0
12.00	22.4	0.0	0.0
11.50	22.4	0.0	0.0
11.00	22.4	0.0	0.0
10.50	22.4	0.0	0.0
10.00	22.4	0.0	0.0
9.50	22.4	0.0	0.0
9.00	22.4	0.0	0.0
8.50	22.4	0.0	0.0
8.00	22.4	0.0	0.0
7.50	22.4	0.0	0.0
7.00	22.4	0.0	0.0
6.50	22.4	0.0	0.0
6.00	22.4	0.0	0.0
5.50	22.4	0.0	0.0
5.30	22.4	0.0	0.0

EXAMPLE CREEK
TSS VERSUS DISTANCE



Output Example 2 showing model output

using program deck setup example 2.

Example illustrating nitrification modeling.

STEADY STATE SEGMENTED DISSOLVED OXYGEN MODEL

GULF COAST HYDROSCIENCE CENTER

U. S. GEOLOGICAL SURVEY

DATE OF LAST REVISION. FEBRUARY 1978

CHATTAHOOCHEE RIVER NEAR ATLANTA.GEORGIA

NITRIFICATION CYCLE INCLUDED IN MODEL

NUMBER OF SUBREACHES FOR THIS PROBLEM = 24

PRINTING INTERVAL (MILES) = 2.000

STARTING DISTANCE (MILES) = 302.970

INITIAL CBOD CONC (MG/L) AT STARTING DISTANCE = 4.00

INITIAL ORGANIC NITROGEN CONC (MG/L) AT STARTING DISTANCE = 0.200

INITIAL AMMONIUM NITROGEN CONC (MG/L) AT STARTING DISTANCE = 0.020

INITIAL NITRITE NITROGEN CONC (MG/L) AT STARTING DISTANCE = 0.007

INITIAL NITRATE NITROGEN CONC (MG/L) AT STARTING DISTANCE = 0.260

INITIAL DO CONC (MG/L) AT STARTING DISTANCE = 9.200

INITIAL PHOSPHATE CONC (MG/L) AT STARTING DISTANCE = 0.0

INITIAL TOT. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE = 0.

INITIAL FEC. COLIF. CONC (MPN/100ML) AT STARTING DISTANCE = 0.

STREAMFLOW (CFS) AT STARTING DISTANCE = 1150.000

REACH DESCRIPTION DATA (MAJOR TRIBUTARIES AND MAIN STEM)

SUBREACH	CODE	NAME	BEGIN (MILE)	END (MILE)
1	G	BEGINNING OF STUDY	302.97	300.62
2	G	ATLANTA WTR WITHDRW	300.62	300.56
3	G	PEACHTREE CREEK	300.56	300.52
4	G	COBB COUNTY WTP	300.52	300.24
5	G	R.M. CLAYTON WTP	300.24	297.50
6	G	PROCTOR CREEK	297.50	295.13
7	G	NICKAJACK CREEK	295.13	294.17
8	G	SOUTH COBB WTP	294.28	291.60
9	G	UTOY WTP	291.60	291.57
10	G	UTOY CREEK	291.57	288.58
11	G	SWEETWATER CREEK	288.58	283.58
12	G	CAMP WTP	283.58	283.54
13	G	CAMP CREEK	283.54	283.27
14	G	DEEP CREEK	283.27	281.47
15	G	ANNAWAKEE CREEK	281.47	275.95
16	G	BEAR CREEK-166	275.95	274.49
17	G	BEAR CREEK--70	274.49	273.46
18	G	DOG CREEK	273.46	267.34
19	G	WOLF CREEK	267.34	261.72
20	G	SNAKE CREEK	261.72	261.25
21	G	CEDAR CREEK	261.25	250.87
22	G	WHOOPING CREEK	250.87	244.89
23	G	PINK CREEK	244.89	236.51
24	G	CENTRALHACHEE CREEK	236.51	235.46

KEY: CODE

- A ROCKY BOTTOM-POOL RIFFLE-LIGHT VEGETATION
- B ROCKY BOTTOM-POOL RIFFLE-MEDIUM VEGETATION
- C ROCKY BOTTOM-POOL RIFFLE-HEAVY VEGETATION
- D ROCKY BOTTOM-CHANNEL CONTROL-LIGHT VEGETATION
- E ROCKY BOTTOM-CHANNEL CONTROL-MEDIUM VEGETATION
- F ROCKY BOTTOM-CHANNEL CONTROL-HEAVY VEGETATION
- G MUD BOTTOM-POOL RIFFLE-LIGHT VEGETATION
- H MUD BOTTOM-POOL RIFFLE-MEDIUM VEGETATION
- I MUD BOTTOM-POOL RIFFLE-HEAVY VEGETATION
- J MUD BOTTOM-CHANNEL CONTROL-LIGHT VEGETATION
- K MUD BOTTOM-CHANNEL CONTROL-MEDIUM VEGETATION
- L MUD BOTTOM-CHANNEL CONTROL-HEAVY VEGETATION

WASTE SOURCE AND MINOR TRIBUTARY DATA

SUBREACH	DATE	CODE	NAME	MILE LOCATION	Q (CFS)	CBOD (MG/L)	NBOD (MG/L)	DO (MG/L)	TEMP (DEG. C)
2	6/77	GS	ATLANTA WTR WITHDRW	300.62	-110.0	0.0	0.0	0.0	21.0
3	6/77	GS	PEACHTREE CREEK	300.56	84.0	7.0	0.0	6.7	22.0
4	6/77	GS	COBB COUNTY WTP	300.52	15.0	67.0	0.0	0.7	22.0
5	6/77	GS	R.M. CLAYTON WTP	300.24	130.0	81.0	0.0	1.2	24.0
6	6/77	GS	PROCTOR CREEK	297.50	7.4	50.0	0.0	4.0	22.0
7	6/77	GS	NICKAJACK CREEK	295.13	21.0	5.0	0.0	9.8	22.0
8	6/77	GS	SOUTH COBB WTP	294.28	14.0	86.0	0.0	0.7	21.0
9	6/77	GS	UTOY WTP	291.60	19.0	27.0	0.0	3.1	23.0
10	6/77	GS	UTOY CREEK	291.57	15.5	6.0	0.0	7.5	22.0
11	6/77	GS	SWEETWATER CREEK	288.58	214.0	5.0	0.0	7.7	22.0
12	6/77	GS	CAMP WTP	283.58	7.3	11.0	0.0	3.8	22.0
13	6/77	GS	CAMP CREEK	283.54	19.0	4.0	0.0	8.0	21.0
14	6/77	GS	DEEP CREEK	283.27	21.0	4.0	0.0	9.6	20.0
15	6/77	GS	ANNEEWAKEE CREEK	281.47	25.0	4.0	0.0	8.8	21.0
16	6/77	GS	BEAR CREEK-166	275.95	40.0	4.0	0.0	9.2	20.0
17	6/77	GS	BEAR CREEK--70	274.49	16.5	4.0	0.0	9.4	21.0
18	6/77	GS	DOG CREEK	273.46	95.0	4.0	0.0	9.0	21.0
19	6/77	GS	WOLF CREEK	267.34	19.0	4.0	0.0	9.6	21.0
20	6/77	GS	SNAKE CREEK	261.72	52.0	4.0	0.0	8.8	21.0
21	6/77	GS	CEDAR CREEK	261.25	30.0	4.0	0.0	8.2	22.0
22	6/77	GS	WHOOPING CREEK	250.87	27.0	3.0	0.0	6.9	22.0
23	6/77	GS	PINK CREEK	244.89	10.0	4.0	0.0	8.8	21.0
24	6/77	GS	CENTRALHACHEE CREEK	236.51	65.0	3.0	0.0	8.4	22.0

KEY: SOURCE CODE

G US GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, ATLANTA, GEORGIA

A V E R A G E R E A C H S T R E A M F L O W D A T A (MAJOR TRIBUTARIES AND MAIN STEM)

SUBREACH	AVERAGE Q (CFS)	AVERAGE DEPTH (FEET)	AVERAGE VELOCITY (FEET/SEC)	AVERAGE WIDTH (FEET)
1	1150.0	4.3	1.10	243.0
2	1040.0	6.0	0.95	202.0
3	1124.0	5.6	1.02	202.0
4	1140.0	4.7	0.87	280.0
5	1270.0	3.1	1.77	209.0
6	1277.0	5.5	1.31	880.0
7	1298.0	2.6	2.31	497.0
8	1312.0	5.3	1.33	864.0
9	1330.0	5.4	1.51	163.0
10	1346.0	6.3	1.35	142.0
11	1560.0	4.5	1.84	189.0
12	1569.0	6.8	1.11	208.0
13	1587.0	5.7	1.43	194.0
14	1609.0	5.7	1.31	215.0
15	1634.0	4.8	1.41	241.0
16	1674.0	5.0	1.46	229.0
17	1690.0	5.6	1.18	256.0
18	1785.0	4.7	1.49	255.0
19	1804.0	2.8	2.17	297.0
20	1855.0	4.7	1.67	237.0
21	1885.0	3.0	2.50	255.0
22	1913.0	3.9	1.93	254.0
23	1923.0	4.3	1.49	301.0
24	1988.0	6.6	0.91	331.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

I N P U T   P A R A M E T E R S

SUBREACH	CARB BOD	ORG-N	NH3-N	NO2-N	NO3-N	DO DEFICIT	PO4	TOT.COLIF.	FEC.COLIF.
	CONCENTRATIONS(MG/L) OF --								
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	7.00	0.41	0.12	0.02	0.03	1.93	0.0	0.0	0.0
4	67.00	14.20	10.40	0.02	0.02	7.93	0.0	0.0	0.0
5	81.00	20.80	14.50	0.01	0.0	7.09	0.0	0.0	0.0
6	50.00	13.00	2.90	0.04	0.28	4.63	0.0	0.0	0.0
7	5.00	0.45	0.04	0.01	0.67	-0.17	0.0	0.0	0.0
8	86.00	20.40	13.20	0.08	0.04	8.11	0.0	0.0	0.0
9	27.00	16.00	14.00	0.01	0.01	5.36	0.0	0.0	0.0
10	6.00	0.54	0.16	0.02	0.44	1.13	0.0	0.0	0.0
11	5.00	0.53	0.05	0.01	0.28	0.93	0.0	0.0	0.0
12	11.00	6.92	5.40	0.07	0.78	4.83	0.0	0.0	0.0
13	4.00	0.44	0.08	0.03	0.67	0.81	0.0	0.0	0.0
14	4.00	0.35	0.01	0.01	0.44	0.39	0.0	0.0	0.0
15	4.00	0.25	0.02	0.01	0.44	0.01	0.0	0.0	0.0
16	4.00	0.15	0.02	0.01	0.16	-0.21	0.0	0.0	0.0
17	4.00	0.22	0.01	0.01	0.37	0.41	0.0	0.0	0.0
18	4.00	0.0	0.02	0.01	0.23	-0.19	0.0	0.0	0.0
19	4.00	0.18	0.02	0.01	0.18	0.21	0.0	0.0	0.0
20	4.00	0.19	0.02	0.01	0.19	0.01	0.0	0.0	0.0
21	4.00	0.14	0.06	0.01	0.21	0.43	0.0	0.0	0.0
22	3.00	0.13	0.02	0.01	0.40	-0.27	0.0	0.0	0.0
23	4.00	0.40	0.03	0.01	0.50	0.01	0.0	0.0	0.0
24	3.00	0.21	0.01	0.01	0.25	0.23	0.0	0.0	0.0

DIRECT DISCHARGES(LB/DAY) OF --

SUBREACH	CARBONACEOUS ULT. BOD	ORGANIC NITROGEN	AMMONIA NITROGEN	NITRITE NITROGEN	NITRATE NITROGEN	DO DEFICIT	PHOSPHATE
1	0.0	0.0	0.0	0.0	0.0	0.	0.
2	0.0	0.0	0.0	0.0	0.0	0.	0.
3	0.0	0.0	0.0	0.0	0.0	2.	0.
4	0.0	0.0	0.0	0.0	0.0	8.	0.
5	0.0	0.0	0.0	0.0	0.0	7.	0.
6	0.0	0.0	0.0	0.0	0.0	5.	0.
7	0.0	0.0	0.0	0.0	0.0	-0.	0.
8	0.0	0.0	0.0	0.0	0.0	8.	0.
9	0.0	0.0	0.0	0.0	0.0	5.	0.
10	0.0	0.0	0.0	0.0	0.0	1.	0.
11	0.0	0.0	0.0	0.0	0.0	1.	0.
12	0.0	0.0	0.0	0.0	0.0	5.	0.
13	0.0	0.0	0.0	0.0	0.0	1.	0.
14	0.0	0.0	0.0	0.0	0.0	0.	0.
15	0.0	0.0	0.0	0.0	0.0	0.	0.
16	0.0	0.0	0.0	0.0	0.0	-0.	0.
17	0.0	0.0	0.0	0.0	0.0	0.	0.
18	0.0	0.0	0.0	0.0	0.0	-0.	0.
19	0.0	0.0	0.0	0.0	0.0	0.	0.
20	0.0	0.0	0.0	0.0	0.0	0.	0.
21	0.0	0.0	0.0	0.0	0.0	0.	0.
22	0.0	0.0	0.0	0.0	0.0	-0.	0.
23	0.0	0.0	0.0	0.0	0.0	0.	0.
24	0.0	0.0	0.0	0.0	0.0	0.	0.

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

SUBREACH	NET PHOTOSYNTHETIC DO PRODUCTION (MG/L/DAY)	BENTHIC DO DEMAND (G/SQ M/DAY)
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0

GEOMETRY

SUBREACH	FLOW CHANGE (CFS)	AREA (SQFT)	DEPTH (FT)	TRAV.TIME (HRS)	TEMP (DEG.CENT)	END MI (MI)
1	0.0	1045.	4.30	3.3500	21.0	300.62
2	-110.0	1212.	6.00	0.0980	21.0	300.56
3	84.0	1131.	5.60	0.0620	21.0	300.52
4	16.0	1316.	4.70	0.3430	21.0	300.24
5	130.0	648.	3.10	3.3400	21.0	297.50
6	7.4	830.	5.50	2.3600	27.0	295.13
7	21.0	497.	2.60	0.7370	27.0	294.28
8	14.0	854.	5.30	2.6900	27.0	291.60
9	18.0	880.	5.40	0.0290	27.0	291.57
10	10.0	995.	6.30	2.7200	27.0	288.58
11	214.0	950.	4.50	5.0500	26.0	283.78
12	7.3	1414.	6.80	0.1990	26.0	283.54
13	19.0	1106.	5.70	0.2900	26.0	283.27
14	21.0	1226.	5.70	1.8400	26.0	281.47
15	26.0	1157.	4.80	5.8700	26.0	275.95
16	40.0	1145.	5.00	1.6000	26.0	274.49
17	16.5	1434.	5.60	1.1400	25.0	273.46
18	95.0	1199.	4.70	6.3200	25.0	267.34
19	19.0	832.	2.80	4.4400	25.0	261.72
20	52.0	1114.	4.70	0.4010	24.0	261.25
21	30.0	755.	3.00	10.0000	24.0	250.87
22	27.0	991.	3.90	5.0800	25.0	244.89
23	10.0	1294.	4.30	10.4000	26.0	236.51
24	65.0	2185.	6.60	1.6500	26.0	235.46

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

REACTION COEFFICIENTS (/DAY)

SUBREACH	KR	KD	KORG	SKORG	KNH3	SKNH3	KNO2	SKNO2	KNO3	KCOLF	KCOLT	KPO41	KPO42
1	0.0	0.0	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
2	0.0	0.0	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
3	0.0	0.0	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
4	0.0	0.0	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
5	0.13	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
6	0.13	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
7	0.13	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
8	0.13	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
9	[illegible]	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
10	0.13	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
11	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
12	0.19	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
13	[illegible]	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
14	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
15	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
16	0.19	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
17	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
18	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
19	0.19	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
20	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
21	0.19	0.15	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
22	0.19	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
23	0.19	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0
24	0.19	0.16	0.30	0.30	0.32	0.55	2.50	2.50	0.00	0.0	0.0	0.0	0.0

TEMPERATURE CORRECTED REACTION COEFFICIENTS (/DAY)

SUBREACH	KR	KD	KORG	SKORG	KNH3	SKNH3	KNO2	SKNO2	KNO3	KA	KPO41	KPO42
1	0.0	0.0	0.33	0.33	0.35	0.71	2.72	2.72	0.01	1.34	0.0	0.0
2	0.0	0.0	0.33	0.33	0.35	0.71	2.72	2.72	0.01	1.34	0.0	0.0
3	0.0	0.0	0.33	0.33	0.35	0.71	2.72	2.72	0.01	1.34	0.0	0.0
4	0.0	0.0	0.33	0.33	0.35	0.71	2.72	2.72	0.01	1.34	0.0	0.0
5	0.14	0.17	0.33	0.33	0.35	0.71	2.72	2.72	0.01	1.34	0.0	0.0
6	0.18	0.22	0.55	0.55	0.58	1.19	4.57	4.57	0.01	1.52	0.0	0.0
7	0.18	0.22	0.55	0.55	0.58	1.19	4.57	4.57	0.01	1.52	0.0	0.0
8	0.18	0.22	0.55	0.55	0.58	1.19	4.57	4.57	0.01	1.52	0.0	0.0
9	0.18	0.22	0.55	0.55	0.58	1.19	4.57	4.57	0.01	1.07	0.0	0.0
10	0.18	0.22	0.55	0.55	0.58	1.19	4.57	4.57	0.01	1.07	0.0	0.0
11	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	1.05	0.0	0.0
12	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	1.05	0.0	0.0
13	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	0.85	0.0	0.0
14	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	0.85	0.0	0.0
15	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	0.47	0.0	0.0
16	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	0.29	0.0	0.0
17	0.24	0.20	0.45	0.46	0.49	1.00	3.85	3.85	0.01	0.31	0.0	0.0
18	0.24	0.20	0.45	0.46	0.49	1.00	3.85	3.85	0.01	2.03	0.0	0.0
19	0.24	0.20	0.45	0.46	0.49	1.00	3.85	3.85	0.01	2.94	0.0	0.0
20	0.23	0.19	0.42	0.42	0.45	0.92	3.53	3.53	0.01	1.75	0.0	0.0
21	0.23	0.19	0.42	0.42	0.45	0.92	3.53	3.53	0.01	2.36	0.0	0.0
22	0.24	0.20	0.45	0.46	0.49	1.00	3.85	3.85	0.01	2.73	0.0	0.0
23	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	1.91	0.0	0.0
24	0.25	0.21	0.50	0.50	0.54	1.09	4.19	4.19	0.01	1.50	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

SUBREACH	DO SATURATION (MG/L)
1	8.805
2	8.805
3	8.805
4	8.805
5	8.805
6	7.812
7	7.812
8	7.812
9	7.812
10	7.812
11	7.966
12	7.966
13	7.966
14	7.966
15	7.966
16	7.966
17	8.125
18	8.125
19	8.125
20	8.288
21	8.288
22	8.125
23	7.966
24	7.966

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

OBSERVED MEASUREMENTS

DISTANCE (MI)	DO CONC (MG/L)	CBOD (MG/L)	NBOD (MG/L)	ORG-N (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	TOTAL COLIFORM	FECAL COLIFORM	PO4 (MG/L)
302.97	8.60	3.30	0.0	0.32	0.0	0.00	0.27	0.0	0.0	0.0
302.97	8.30	4.00	0.0	0.22	0.01	0.00	0.29	0.0	0.0	0.0
302.97	8.20	5.00	0.0	0.13	0.06	0.01	0.29	0.0	0.0	0.0
302.97	8.30	3.60	0.0	0.13	0.06	0.01	0.29	0.0	0.0	0.0
302.97	9.70	4.40	0.0	0.31	0.0	0.00	0.30	0.0	0.0	0.0
302.97	10.20	4.10	0.0	0.22	0.0	0.00	0.27	0.0	0.0	0.0
302.97	11.20	3.80	0.0	0.10	0.01	0.01	0.26	0.0	0.0	0.0
302.97	9.70	4.70	0.0	0.22	0.03	0.01	0.26	0.0	0.0	0.0
302.97	9.40	3.50	0.0	0.17	0.03	0.00	0.25	0.0	0.0	0.0
302.97	8.80	4.30	0.0	0.25	0.04	0.01	0.26	0.0	0.0	0.0
302.97	5.80	4.00	0.0	0.22	0.02	0.00	0.28	0.0	0.0	0.0
302.97	8.60	3.30	0.0	0.13	0.02	0.00	0.27	0.0	0.0	0.0
302.97	8.80	0.0	0.0	0.0	0.01	0.01	0.29	0.0	0.0	0.0
298.77	8.30	14.00	0.0	3.20	2.10	0.04	0.27	0.0	0.0	0.0
298.77	8.10	15.00	0.0	2.90	1.90	0.03	0.27	0.0	0.0	0.0
298.77	9.00	15.00	0.0	2.50	1.70	0.04	0.30	0.0	0.0	0.0
298.77	7.80	9.50	0.0	2.00	1.40	0.03	0.29	0.0	0.0	0.0
298.77	7.80	14.00	0.0	2.10	1.40	0.03	0.30	0.0	0.0	0.0
298.77	8.00	17.50	0.0	3.20	1.70	0.04	0.29	0.0	0.0	0.0
298.77	8.10	14.00	0.0	4.20	1.20	0.05	0.27	0.0	0.0	0.0
298.77	8.60	15.50	0.0	3.00	2.30	0.04	0.28	0.0	0.0	0.0
298.77	8.70	14.50	0.0	3.00	2.40	0.04	0.27	0.0	0.0	0.0
298.77	8.60	16.00	0.0	2.80	2.10	0.04	0.27	0.0	0.0	0.0
298.77	8.50	11.00	0.0	3.00	2.20	0.04	0.25	0.0	0.0	0.0
298.77	7.90	0.0	0.0	2.80	2.00	0.04	0.26	0.0	0.0	0.0
298.77	9.10	0.0	0.0	2.00	1.50	0.03	0.29	0.0	0.0	0.0
294.65	7.00	12.40	0.0	3.20	2.20	0.14	0.41	0.0	0.0	0.0
294.65	7.00	14.20	0.0	3.00	2.10	0.13	0.38	0.0	0.0	0.0
294.65	7.00	14.50	0.0	2.90	1.90	0.14	0.40	0.0	0.0	0.0
294.65	6.80	17.00	0.0	2.70	1.20	0.13	0.42	0.0	0.0	0.0
294.65	6.70	11.00	0.0	2.00	1.30	0.11	0.39	0.0	0.0	0.0
294.65	6.70	12.00	0.0	2.00	1.20	0.11	0.39	0.0	0.0	0.0
294.65	6.80	11.40	0.0	0.0	1.40	0.12	0.42	0.0	0.0	0.0
294.65	7.10	17.50	0.0	4.00	2.10	0.16	0.41	0.0	0.0	0.0
294.65	7.60	15.50	0.0	3.50	2.10	0.15	0.41	0.0	0.0	0.0
294.65	7.50	18.00	0.0	3.00	1.90	0.15	0.44	0.0	0.0	0.0
294.65	7.60	12.00	0.0	2.70	1.90	0.13	0.37	0.0	0.0	0.0
294.65	7.00	0.0	0.0	2.00	1.40	0.10	0.38	0.0	0.0	0.0
286.07	5.70	11.50	0.0	2.40	1.60	0.13	0.56	0.0	0.0	0.0
286.07	5.70	13.50	0.0	2.90	1.80	0.12	0.56	0.0	0.0	0.0
286.07	5.70	13.00	0.0	2.70	1.90	0.13	0.60	0.0	0.0	0.0
286.07	5.70	11.00	0.0	2.60	1.80	0.12	0.57	0.0	0.0	0.0
286.07	5.60	9.00	0.0	2.40	1.50	0.11	0.54	0.0	0.0	0.0
286.07	5.80	12.00	0.0	2.30	1.40	0.10	0.51	0.0	0.0	0.0
286.07	5.70	10.00	0.0	1.90	1.30	0.09	0.54	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

O B S E R V E D   M E A S U R E M E N T S

DISTANCE (MI)	DO CONC (MG/L)	CBODU (MG/L)	NBODU (MG/L)	ORG-N (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	TOTAL COLIFORM	FECAL COLIFORM	PO4 (MG/L)
286.07	5.50	8.00	0.0	1.90	1.20	0.10	0.58	0.0	0.0	0.0
286.07	5.60	10.50	0.0	2.20	1.20	0.11	0.61	0.0	0.0	0.0
286.07	5.90	12.00	0.0	2.70	1.70	0.13	0.59	0.0	0.0	0.0
286.07	5.60	0.0	0.0	2.90	1.80	0.14	0.59	0.0	0.0	0.0
286.07	5.40	0.0	0.0	2.30	1.60	0.12	0.56	0.0	0.0	0.0
281.79	5.70	8.50	0.0	1.60	1.10	0.09	0.67	0.0	0.0	0.0
281.79	5.60	11.40	0.0	1.90	1.50	0.11	0.68	0.0	0.0	0.0
281.79	5.00	9.50	0.0	2.30	1.80	0.12	0.68	0.0	0.0	0.0
281.79	4.70	10.00	0.0	2.70	1.80	0.12	0.62	0.0	0.0	0.0
281.79	4.70	8.80	0.0	2.40	1.60	0.11	0.67	0.0	0.0	0.0
281.79	4.70	10.20	0.0	2.40	1.50	0.10	0.63	0.0	0.0	0.0
281.79	4.80	11.50	0.0	2.20	1.30	0.10	0.65	0.0	0.0	0.0
281.79	4.80	14.50	0.0	2.00	1.10	0.09	0.65	0.0	0.0	0.0
281.79	4.90	0.0	0.0	1.90	1.20	0.10	0.64	0.0	0.0	0.0
281.79	4.80	0.0	0.0	2.40	1.40	0.11	0.70	0.0	0.0	0.0
281.79	4.70	0.0	0.0	2.50	1.50	0.12	0.73	0.0	0.0	0.0
275.81	4.70	8.00	0.0	1.20	0.82	0.08	0.76	0.0	0.0	0.0
275.81	4.80	10.00	0.0	1.60	1.00	0.10	0.78	0.0	0.0	0.0
275.81	4.60	11.00	0.0	2.00	1.30	0.11	0.78	0.0	0.0	0.0
275.81	4.40	10.00	0.0	2.30	1.50	0.11	0.79	0.0	0.0	0.0
275.81	4.30	10.00	0.0	2.50	1.60	0.11	0.76	0.0	0.0	0.0
275.81	4.20	10.00	0.0	2.20	1.40	0.10	0.75	0.0	0.0	0.0
275.81	4.40	10.50	0.0	2.00	1.30	0.10	0.74	0.0	0.0	0.0
275.81	4.40	10.50	0.0	1.90	1.10	0.09	0.76	0.0	0.0	0.0
275.81	4.40	7.50	0.0	1.80	1.00	0.09	0.76	0.0	0.0	0.0
275.81	4.40	0.0	0.0	1.80	1.00	0.09	0.78	0.0	0.0	0.0
271.19	5.30	9.50	0.0	1.00	1.10	0.09	0.85	0.0	0.0	0.0
271.19	4.60	9.50	0.0	1.40	0.87	0.08	0.83	0.0	0.0	0.0
271.19	4.80	7.70	0.0	1.80	0.75	0.08	0.82	0.0	0.0	0.0
271.19	4.70	6.78	0.0	2.10	0.78	0.08	0.92	0.0	0.0	0.0
271.19	4.50	0.0	0.0	2.20	1.00	0.10	1.00	0.0	0.0	0.0
271.19	4.20	7.40	0.0	1.90	1.30	0.11	0.83	0.0	0.0	0.0
271.19	4.50	9.50	0.0	2.00	1.30	0.11	0.76	0.0	0.0	0.0
271.19	4.30	9.00	0.0	1.90	1.30	0.10	0.77	0.0	0.0	0.0
271.19	4.40	10.00	0.0	1.50	1.20	0.10	0.84	0.0	0.0	0.0
271.19	4.50	10.50	0.0	1.60	1.10	0.09	0.87	0.0	0.0	0.0
271.19	4.20	8.00	0.0	1.30	0.92	0.09	0.83	0.0	0.0	0.0
265.66	5.20	10.50	0.0	1.80	1.20	0.13	0.97	0.0	0.0	0.0
265.66	5.30	8.00	0.0	1.20	0.86	0.10	1.00	0.0	0.0	0.0
265.66	5.50	8.00	0.0	1.30	0.73	0.10	0.90	0.0	0.0	0.0
265.56	5.10	8.00	0.0	1.10	0.59	0.09	0.91	0.0	0.0	0.0
266.66	5.70	8.10	0.0	1.20	0.63	0.10	0.90	0.0	0.0	0.0
265.66	5.60	6.50	0.0	1.30	0.82	0.12	0.98	0.0	0.0	0.0
265.66	5.50	9.20	0.0	0.0	1.10	0.12	0.98	0.0	0.0	0.0
265.66	4.60	8.00	0.0	1.80	1.20	0.13	0.97	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

OBSERVED MEASUREMENTS

DISTANCE (MI)	DO CONC (MG/L)	CBODU (MG/L)	NBODU (MG/L)	ORG-N (MG/L)	NH3-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	TOTAL COLIFORM	FECAL COLIFORM	PO4 (MG/L)
265.66	4.70	10.00	0.0	1.60	0.88	0.10	1.00	0.0	0.0	0.0
265.66	4.40	8.00	0.0	1.60	1.00	0.12	0.88	0.0	0.0	0.0
259.85	5.70	8.50	0.0	1.20	0.60	0.09	1.01	0.0	0.0	0.0
259.85	5.60	5.80	0.0	1.00	0.74	0.10	1.00	0.0	0.0	0.0
259.85	5.40	6.80	0.0	0.86	0.75	0.10	1.00	0.0	0.0	0.0
259.85	5.40	7.90	0.0	0.93	0.70	0.10	1.10	0.0	0.0	0.0
259.85	5.40	8.10	0.0	0.97	0.63	0.09	1.11	0.0	0.0	0.0
259.85	5.80	6.50	0.0	1.00	0.52	0.09	0.91	0.0	0.0	0.0
259.85	5.70	7.00	0.0	1.20	0.50	0.08	1.02	0.0	0.0	0.0
259.85	5.10	7.50	0.0	1.30	0.45	0.08	1.02	0.0	0.0	0.0
259.85	6.40	6.30	0.0	1.00	0.59	0.11	1.09	0.0	0.0	0.0
259.85	5.30	7.20	0.0	0.95	0.69	0.12	1.08	0.0	0.0	0.0
259.85	6.10	6.50	0.0	1.20	0.82	0.12	0.98	0.0	0.0	0.0
259.85	5.40	7.50	0.0	2.30	0.94	0.12	0.98	0.0	0.0	0.0
259.85	4.50	6.30	0.0	1.30	0.90	0.11	0.99	0.0	0.0	0.0
259.85	4.50	7.50	0.0	0.0	0.80	0.10	1.00	0.0	0.0	0.0
246.93	5.60	8.00	0.0	0.79	0.20	0.07	1.13	0.0	0.0	0.0
246.93	5.50	6.40	0.0	0.78	0.22	0.07	1.13	0.0	0.0	0.0
246.93	5.60	6.00	0.0	0.78	0.28	0.08	1.32	0.0	0.0	0.0
246.93	5.80	7.10	0.0	0.73	0.35	0.09	1.31	0.0	0.0	0.0
246.93	5.50	8.00	0.0	0.59	0.45	0.09	1.21	0.0	0.0	0.0
246.93	5.50	6.50	0.0	0.49	0.41	0.09	1.21	0.0	0.0	0.0
246.93	5.20	7.50	0.0	0.86	0.39	0.09	1.31	0.0	0.0	0.0
246.93	5.30	7.20	0.0	0.95	0.34	0.08	1.32	0.0	0.0	0.0
246.93	5.30	5.10	0.0	0.96	0.28	0.08	1.22	0.0	0.0	0.0
235.46	7.70	7.10	0.0	0.55	0.24	0.08	1.22	0.0	0.0	0.0
235.46	7.60	4.70	0.0	0.54	0.17	0.07	1.23	0.0	0.0	0.0
235.46	8.10	6.50	0.0	0.55	0.15	0.07	1.13	0.0	0.0	0.0
235.46	7.80	4.20	0.0	0.63	0.15	0.08	1.13	0.0	0.0	0.0
235.46	7.90	6.50	0.0	0.57	0.16	0.08	1.22	0.0	0.0	0.0
235.46	8.20	7.20	0.0	0.62	0.19	0.09	1.22	0.0	0.0	0.0
235.46	7.70	5.70	0.0	0.60	0.24	0.10	1.21	0.0	0.0	0.0
235.46	7.10	4.80	0.0	0.63	0.26	0.10	1.20	0.0	0.0	0.0
235.46	6.30	4.40	0.0	0.50	0.27	0.09	1.30	0.0	0.0	0.0
235.46	5.40	0.0	0.0	0.0	0.24	0.07	1.41	0.0	0.0	0.0
235.46	6.90	0.25	0.25	0.0	0.0	0.0	0.0	0.0	0.0	0.25

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

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SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
1	302.97	0.0	4.00	-0.39	0.0	0.0	0.0	0.0	0.0
1	300.97	0.12	4.00	-0.34	0.0	0.0	0.0	0.0	0.0
1	300.62	0.14	4.00	-0.32	0.0	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
1	302.97	0.0	0.20	0.02	0.01	0.25	0.0	0.0	0.	0.	-0.39	9.20
1	300.97	0.12	0.19	0.03	0.01	0.25	0.003	0.002	0.	0.	-0.33	9.14
1	300.62	0.14	0.19	0.03	0.01	0.25	0.001	0.000	0.	0.	-0.32	9.13

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
2	300.62	0.14	4.00	-0.32	0.0	0.0	0.0	0.0	0.0
2	300.56	0.14	4.00	-0.32	0.0	0.0	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

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NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
2	300.62	0.14	0.19	0.03	0.01	0.25	0.0	0.0	0.	0.	-0.32	9.13
2	300.56	0.14	0.19	0.03	0.01	0.25	0.000	0.000	0.	0.	-0.32	9.12

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
3	300.56	0.14	4.22	-0.15	0.0	0.0	0.0	0.0	0.0
3	300.52	0.15	4.22	-0.15	0.0	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
3	300.56	0.14	0.21	0.03	0.01	0.24	0.0	0.0	0.	0.	-0.15	8.96
3	300.52	0.15	0.21	0.03	0.01	0.24	0.000	0.000	0.	0.	-0.15	8.96

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

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SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
4	300.52	0.15	5.11	-0.04	0.0	0.0	0.0	0.0	0.0
4	300.24	0.16	5.11	-0.04	0.0	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
4	300.52	0.15	0.40	0.18	0.01	0.24	0.0	0.0	0.	0.	-0.04	8.84
4	300.24	0.16	0.40	0.18	0.01	0.24	0.003	0.000	0.	0.	-0.03	8.84

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
5	300.24	0.15	12.87	0.70	0.0	0.0	0.0	0.0	0.0
5	298.24	0.26	12.70	0.61	0.20	0.0	0.0	0.0	0.0
5	297.50	0.30	12.63	0.96	0.08	0.0	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

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NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
5	300.24	0.16	2.49	1.65	0.01	0.22	0.0	0.0	0.	0.	0.70	8.11
5	298.24	0.26	2.41	1.61	0.05	0.23	0.196	0.002	0.	0.	1.01	7.80
5	297.50	0.30	2.38	1.60	0.07	0.23	0.072	0.006	0.	0.	1.12	7.69

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
6	297.50	0.30	12.85	0.15	0.0	0.0	0.0	0.0	0.0
6	295.50	0.38	12.65	0.13	0.22	0.0	0.0	0.0	0.0
6	295.13	0.40	12.62	0.62	0.04	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
6	297.50	0.30	2.44	1.60	0.07	0.23	0.0	0.0	0.	0.	0.15	7.66
6	295.50	0.38	2.33	1.56	0.11	0.27	0.261	0.025	0.	0.	0.64	7.18
6	295.13	0.40	2.31	1.55	0.12	0.28	0.048	0.009	0.	0.	0.72	7.09

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

RESULTS OF COMPUTATIONS

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SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
7	295.13	0.40	12.50	0.71	0.0	0.0	0.0	0.0	0.0
7	294.28	0.43	12.43	0.67	0.08	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

BREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
7	295.13	0.40	2.26	1.52	0.12	0.28	0.0	0.0	0.	0.	0.71	7.11
7	294.28	0.43	2.24	1.51	0.13	0.30	0.093	0.017	0.	0.	0.87	6.95

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
8	294.28	0.43	13.22	0.94	0.0	0.0	0.0	0.0	0.0
8	292.28	0.51	13.02	0.83	0.23	0.0	0.0	0.0	0.0
8	291.60	0.54	12.95	1.31	0.08	0.0	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

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NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
8	294.28	0.43	2.44	1.63	0.13	0.30	0.0	0.0	0.	0.	0.94	6.87
8	292.28	0.51	2.33	1.58	0.15	0.35	0.267	0.046	0.	0.	1.37	6.44
8	291.60	0.54	2.29	1.56	0.16	0.37	0.089	0.021	0.	0.	1.50	6.31

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
9	291.60	0.54	13.14	1.56	0.0	0.0	0.0	0.0	0.0
9	291.57	0.54	13.14	1.55	0.00	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
9	291.60	0.54	2.48	1.73	0.16	0.36	0.0	0.0	0.	0.	1.56	6.26
9	291.57	0.54	2.48	1.73	0.16	0.37	0.004	0.001	0.	0.	1.56	6.25

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

RESULTS OF COMPUTATIONS

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SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
10	291.57	0.54	13.05	1.55	0.0	0.0	0.0	0.0	0.0
10	289.57	0.62	12.88	1.44	0.21	0.0	0.0	0.0	0.0
10	288.58	0.66	12.79	1.87	0.10	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
10	291.57	0.54	2.45	1.71	0.15	0.37	0.0	0.0	0.	0.	1.56	6.26
10	289.57	0.62	2.35	1.66	0.17	0.42	0.255	0.051	0.	0.	1.95	5.86
10	288.58	0.66	2.30	1.63	0.18	0.45	0.124	0.031	0.	0.	2.13	5.68

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
11	288.58	0.66	11.72	2.10	0.0	0.0	0.0	0.0	0.0
11	286.58	0.74	11.47	1.92	0.20	0.0	0.0	0.0	0.0
11	284.58	0.83	11.22	2.19	0.20	0.0	0.0	0.0	0.0
11	283.78	0.87	11.12	2.56	0.08	0.0	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

RESULTS OF COMPUTATIONS

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NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
11	288.58	0.66	2.06	1.42	0.16	0.43	0.0	0.0	0.	0.	2.10	5.87
11	286.58	0.74	1.97	1.37	0.16	0.49	0.223	0.054	0.	0.	2.40	5.57
11	284.58	0.83	1.89	1.33	0.17	0.55	0.216	0.057	0.	0.	2.66	5.31
11	283.78	0.87	1.55	1.31	0.17	0.57	0.085	0.026	0.	0.	2.76	5.21

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
12	283.78	0.87	11.12	2.77	0.0	0.0	0.0	0.0	0.0
12	283.54	0.87	11.10	2.74	0.02	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
12	283.78	0.87	1.88	1.33	0.17	0.57	0.0	0.0	0.	0.	2.77	5.20
12	283.54	0.87	1.87	1.33	0.17	0.58	0.020	0.006	0.	0.	2.79	5.18

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

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SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
13	283.54	0.87	11.01	2.75	0.0	0.0	0.0	0.0	0.0
13	283.27	0.89	10.98	2.74	0.03	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
13	283.54	0.87	1.55	1.31	0.15	0.58	0.0	0.0	0.	0.	2.76	5.20
13	283.27	0.89	1.54	1.31	0.16	0.59	0.029	0.009	0.	0.	2.80	5.16

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
14	283.27	0.89	10.89	2.77	0.0	0.0	0.0	0.0	0.0
14	281.47	0.96	10.68	2.59	0.17	0.0	0.0	0.0	0.0

RESULTS OF COMPUTATIONS

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NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
14	283.27	0.89	1.82	1.29	0.15	0.59	0.0	0.0	0.	0.	2.77	5.20
14	281.47	0.96	1.75	1.25	0.16	0.64	0.178	0.051	0.	0.	2.99	4.98

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
15	281.47	0.96	10.58	2.94	0.0	0.0	0.0	0.0	0.0
15	279.47	1.05	10.34	2.92	0.19	0.0	0.0	0.0	0.0
15	277.47	1.14	10.12	3.13	0.19	0.0	0.0	0.0	0.0
15	275.95	1.21	9.95	3.46	0.14	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
15	281.47	0.96	1.73	1.23	0.16	0.63	0.0	0.0	0.	0.	2.94	5.02
15	279.47	1.05	1.65	1.19	0.16	0.69	0.196	0.057	0.	0.	3.27	4.70
15	277.47	1.14	1.58	1.15	0.16	0.75	0.190	0.056	0.	0.	3.57	4.40
15	275.95	1.21	1.53	1.12	0.15	0.79	0.140	0.044	0.	0.	3.78	4.19

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

RESULTS OF COMPUTATIONS

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	S U B R E A C H D E F I C I T S: INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
16	275.95	1.21	9.81	3.69	0.0	0.0	0.0	0.0	0.0
16	274.49	1.27	9.64	3.61	0.14	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
16	275.95	1.21	1.50	1.09	0.15	0.78	0.0	0.0	0.	0.	3.69	4.28
16	274.49	1.27	1.45	1.06	0.15	0.82	0.132	0.042	0.	0.	3.92	4.04

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
17	274.49	1.27	9.59	4.05	0.0	0.0	0.0	0.0	0.0
17	273.46	1.32	9.48	3.99	0.09	0.0	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

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NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
17	274.49	1.27	1.44	1.05	0.15	0.82	0.0	0.0	0.	0.	4.05	4.08
17	273.46	1.32	1.40	1.04	0.14	0.84	0.084	0.028	0.	0.	4.19	3.94

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
18	273.45	1.32	9.19	3.96	0.0	0.0	0.0	0.0	0.0
18	271.45	1.41	9.00	3.32	0.14	0.0	0.0	0.0	0.0
18	269.46	1.49	8.82	3.05	0.14	0.0	0.0	0.0	0.0
18	267.46	1.58	8.64	2.84	0.14	0.0	0.0	0.0	0.0
18	267.34	1.58	8.63	3.12	0.01	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
18	273.46	1.32	1.33	0.98	0.14	0.81	0.0	0.0	0.	0.	3.96	4.17
18	271.46	1.41	1.28	0.95	0.13	0.85	0.140	0.044	0.	0.	3.65	4.48
18	269.46	1.49	1.23	0.92	0.13	0.90	0.135	0.043	0.	0.	3.38	4.74

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
18	267.46	1.58	1.18	0.89	0.13	0.94	0.131	0.041	0.	0.	3.15	4.97
18	267.34	1.58	1.18	0.89	0.13	0.94	0.008	0.003	0.	0.	3.14	4.99

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
19	267.34	1.58	8.54	3.11	[illegible]	0.0	0.0	0.0	0.0
19	255.34	1.55	8.45	2.55	0.10	0.0	0.0	0.0	0.0
19	263.34	1.72	8.31	2.29	0.10	0.0	0.0	0.0	0.0
19	261.72	1.77	8.21	2.14	0.08	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
19	267.34	1.58	1.17	0.88	0.12	0.93	0.0	0.0	0.	0.	3.11	5.02
19	265.34	1.65	1.13	0.86	0.12	0.96	0.096	0.032	0.	0.	2.78	5.34
19	263.34	1.72	1.10	0.83	0.12	0.99	0.094	0.031	0.	0.	2.51	5.61
19	261.72	1.77	1.07	0.82	0.12	1.02	0.074	0.025	0.	0.	2.32	5.80

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
20	261.72	1.77	8.09	2.42	0.0	0.0	0.0	0.0	0.0
20	261.25	1.79	8.05	2.35	0.03	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
20	261.72	1.77	1.05	0.79	0.11	0.99	0.0	0.0	0.	0.	2.42	5.87
20	261.25	1.79	1.04	0.79	0.11	1.00	0.021	0.007	0.	0.	2.40	5.89

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
21	261.25	1.79	7.99	2.37	0.0	0.0	0.0	0.0	0.0
21	259.25	1.87	7.85	1.96	0.11	0.0	0.0	0.0	0.0
21	257.25	1.95	7.71	1.82	0.11	0.0	0.0	0.0	0.0
21	255.25	2.03	7.57	1.70	0.11	0.0	0.0	0.0	0.0
21	253.25	2.11	7.43	1.59	0.11	0.0	0.0	0.0	0.0
21	251.25	2.19	7.29	1.50	0.10	0.0	0.0	0.0	0.0
21	250.87	2.20	7.27	1.65	0.02	0.0	0.0	0.0	0.0

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
21	261.25	1.79	1.02	0.78	0.11	0.99	0.0	0.0	0.	0.	2.37	5.92
21	259.25	1.87	0.99	0.76	0.11	1.02	0.095	0.031	0.	0.	2.20	6.09
21	257.25	1.95	0.96	0.73	0.10	1.05	0.092	0.030	0.	0.	2.05	6.24
21	255.25	2.03	0.93	0.71	0.10	1.08	0.090	0.029	0.	0.	1.92	6.37
21	253.25	2.11	0.89	0.69	0.10	1.10	0.087	0.029	0.	0.	1.81	6.48
21	251.25	2.19	0.86	0.67	0.10	1.13	0.085	0.028	0.	0.	1.71	6.57
21	250.87	2.20	0.86	0.67	0.10	1.13	0.016	0.006	0.	0.	1.70	6.59

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
22	250.87	2.20	7.21	1.51	0.0	0.0	0.0	0.0	0.0
22	248.87	2.27	7.09	1.24	0.09	0.0	0.0	0.0	0.0
22	246.87	2.34	6.97	1.19	0.09	0.0	0.0	0.0	0.0
22	244.89	2.41	6.85	1.14	0.09	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
22	250.87	2.20	0.85	0.66	0.09	1.12	0.0	0.0	0.	0.	1.51	6.62

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA

RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
22	[illegible]	2.27	0.82	0.64	0.09	1.15	0.077	0.026	0.	0.	1.44	6.69
22	246.87	2.34	0.80	0.62	0.09	1.17	0.075	0.025	0.	0.	1.38	6.75
22	244.89	2.41	0.77	0.60	0.09	1.20	0.072	0.024	0.	0.	1.32	6.80

SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
23	244.89	2.41	6.84	1.16	0.0	0.0	0.0	0.0	0.0
23	242.89	2.52	6.65	0.95	0.13	0.0	0.0	0.0	0.0
23	240.89	2.52	6.49	1.01	0.13	0.0	0.0	0.0	0.0
23	238.89	2.73	6.33	1.05	0.13	0.0	0.0	0.0	0.0
23	236.89	2.83	6.17	1.07	0.12	0.0	0.0	0.0	0.0
23	236.51	2.85	6.14	1.28	0.03	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
23	244.89	2.41	0.77	0.60	0.09	1.19	0.0	0.0	0.	0.	1.16	6.81
23	242.89	2.52	0.73	0.57	0.08	1.23	0.111	0.035	0.	0.	1.23	6.74

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

RESULTS OF COMPUTATIONS

S U B R E A C H   D E F I C I T S

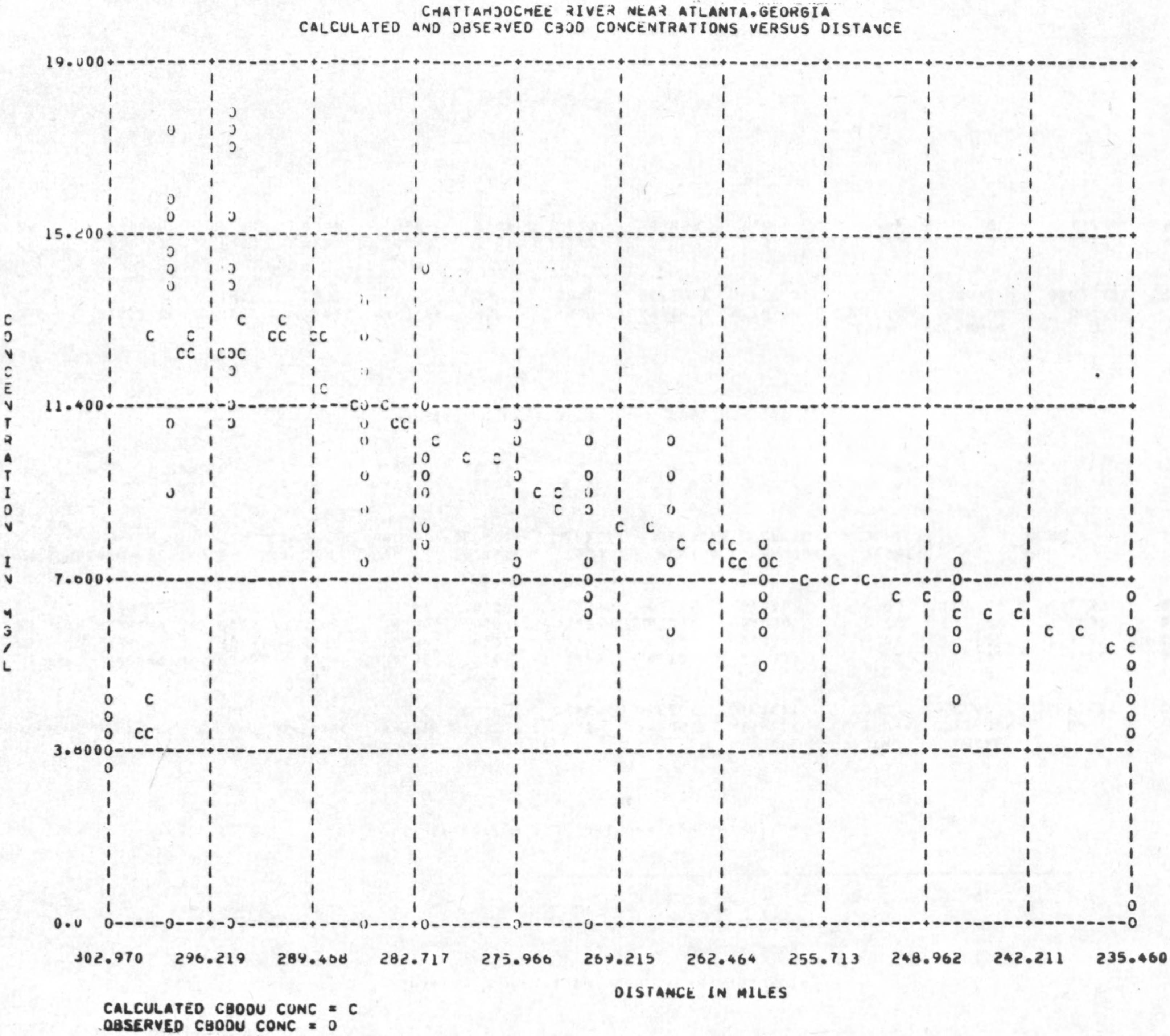
NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
23	240.89	2.62	0.69	0.55	0.08	1.25	0.106	0.033	0.	0.	1.28	6.69
23	238.89	2.73	0.56	0.52	0.07	1.29	0.101	0.031	0.	0.	1.31	6.66
23	236.89	2.83	0.62	0.50	0.07	1.32	0.097	0.030	0.	0.	1.32	6.64
23	236.51	2.85	0.62	0.49	0.07	1.33	0.018	0.006	0.	0.	1.33	6.64

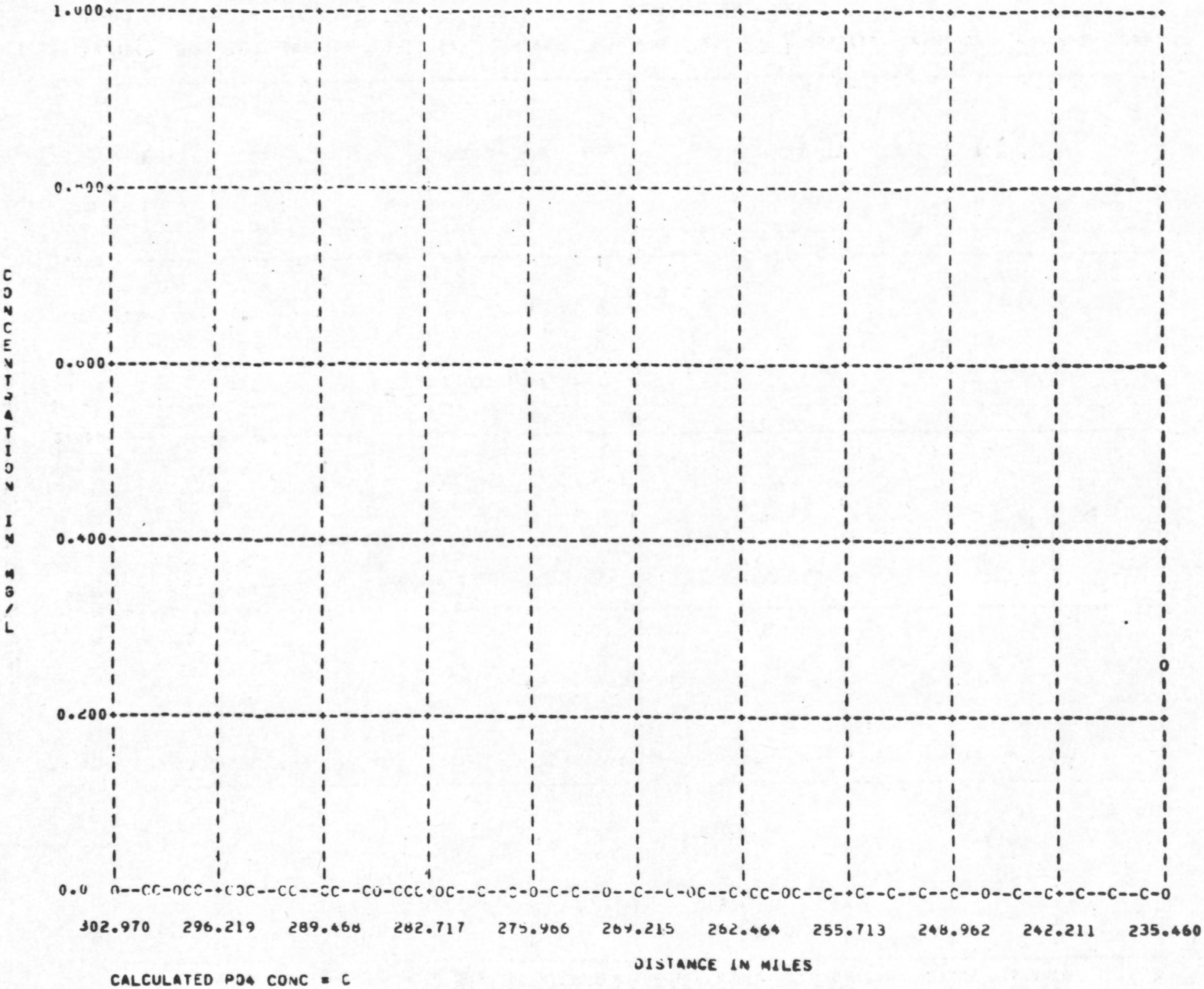
SUBREACH	DISTANCE	TRAVEL TIME	CBODU CONC	INITIAL DEFICIT	CBOD DEFICIT	BENTHAL DEFICIT	PHOTO. DEFICIT	RESPIRE DEFICIT	PO4 CONC
24	236.51	2.85	6.03	1.29	0.0	0.0	0.0	0.0	0.0
24	235.46	2.92	5.93	1.16	0.08	0.0	0.0	0.0	0.0

NITRIFICATION AND COLIFORM CONCENTRATIONS

SUBREACH	DISTANCE	TRAVEL TIME	ORGANIC CONC	AMMONIA CONC	NO2 CONC	NO3 CONC	AMMONIA DEFICIT	NITRITE DEFICIT	TOTAL COLIFORM CONC	FECAL COLIFORM CONC	DO DEFICIT	DO CONC
24	236.51	2.85	0.60	0.48	0.07	1.29	0.0	0.0	0.	0.	1.29	6.68
24	235.46	2.92	0.58	0.46	0.07	1.31	0.059	0.020	0.	0.	1.32	6.64

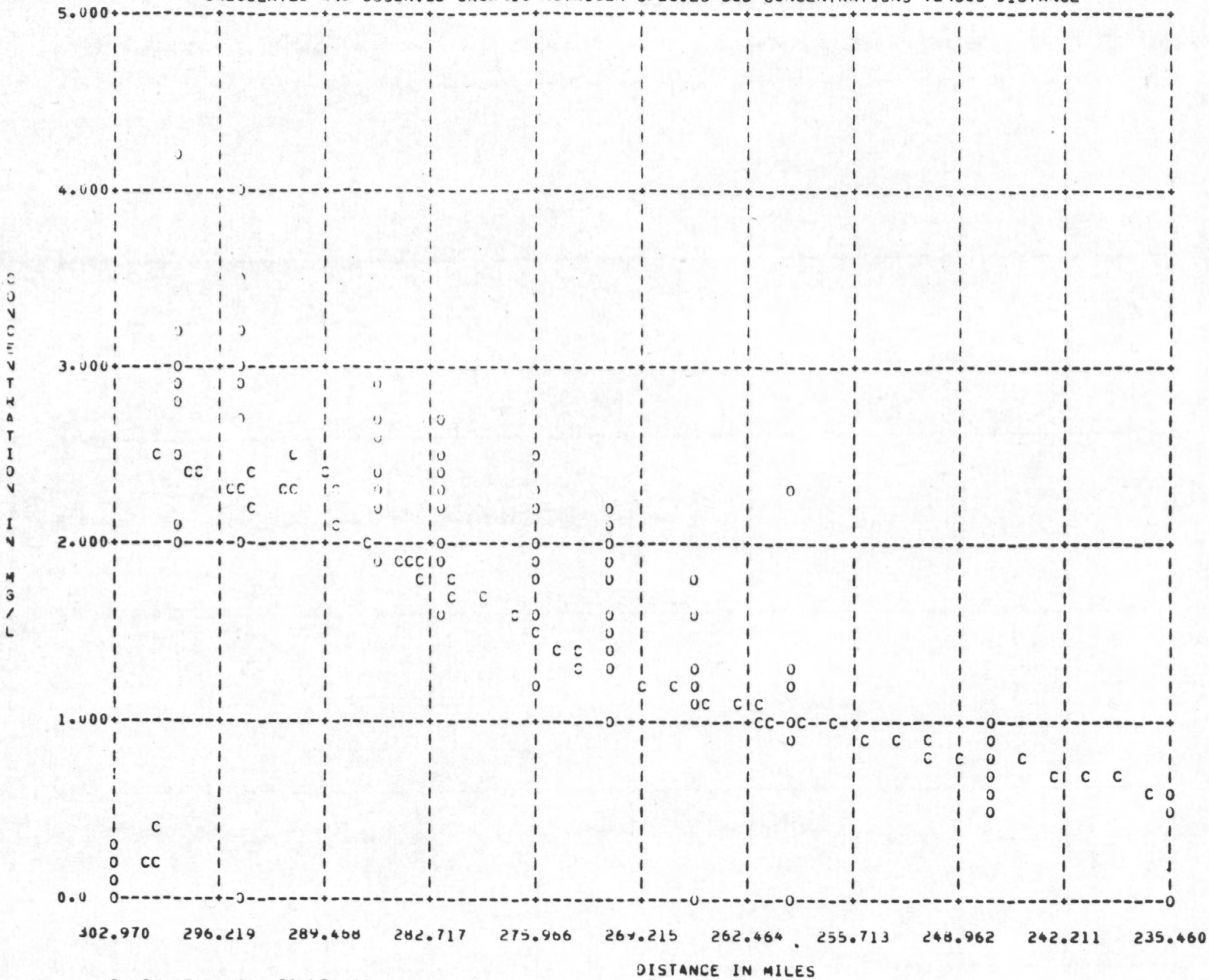

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA
CALCULATED AND OBSERVED CBOD CONCENTRATIONS VERSUS DISTANCE
19.000
15.200
11.400
7.600
3.8000
0.0
CONCENTRATION MG/L
302.970
296.219
289.468
282.717
275.966
269.215
262.464
255.713
248.962
242.211
235.460
DISTANCE IN MILES
CALCULATED CBODU CONC = C
OBSERVED CBODU CONC = O

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA
CALCULATED AND OBSERVED PO4 CONCENTRATIONS VERSUS DISTANCE



CALCULATED PO4 CONC = C
OBSERVED PO4 CONC = O

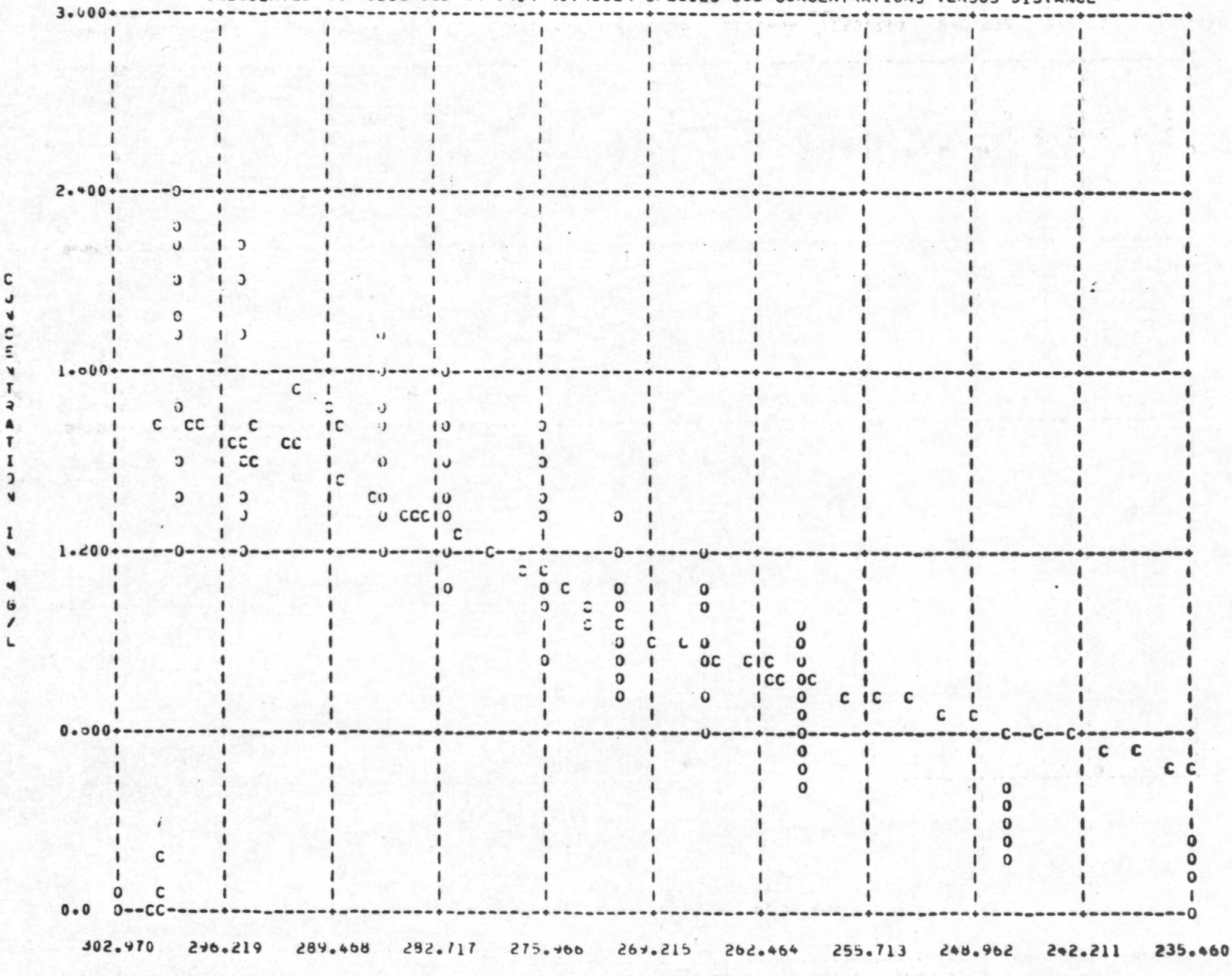
CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA
CALCULATED AND OBSERVED ORGANIC NITROGEN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE



CALCULATED ORGANIC NITROGEN CONC = C
OBSERVED ORGANIC NITROGEN CONC = O

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA

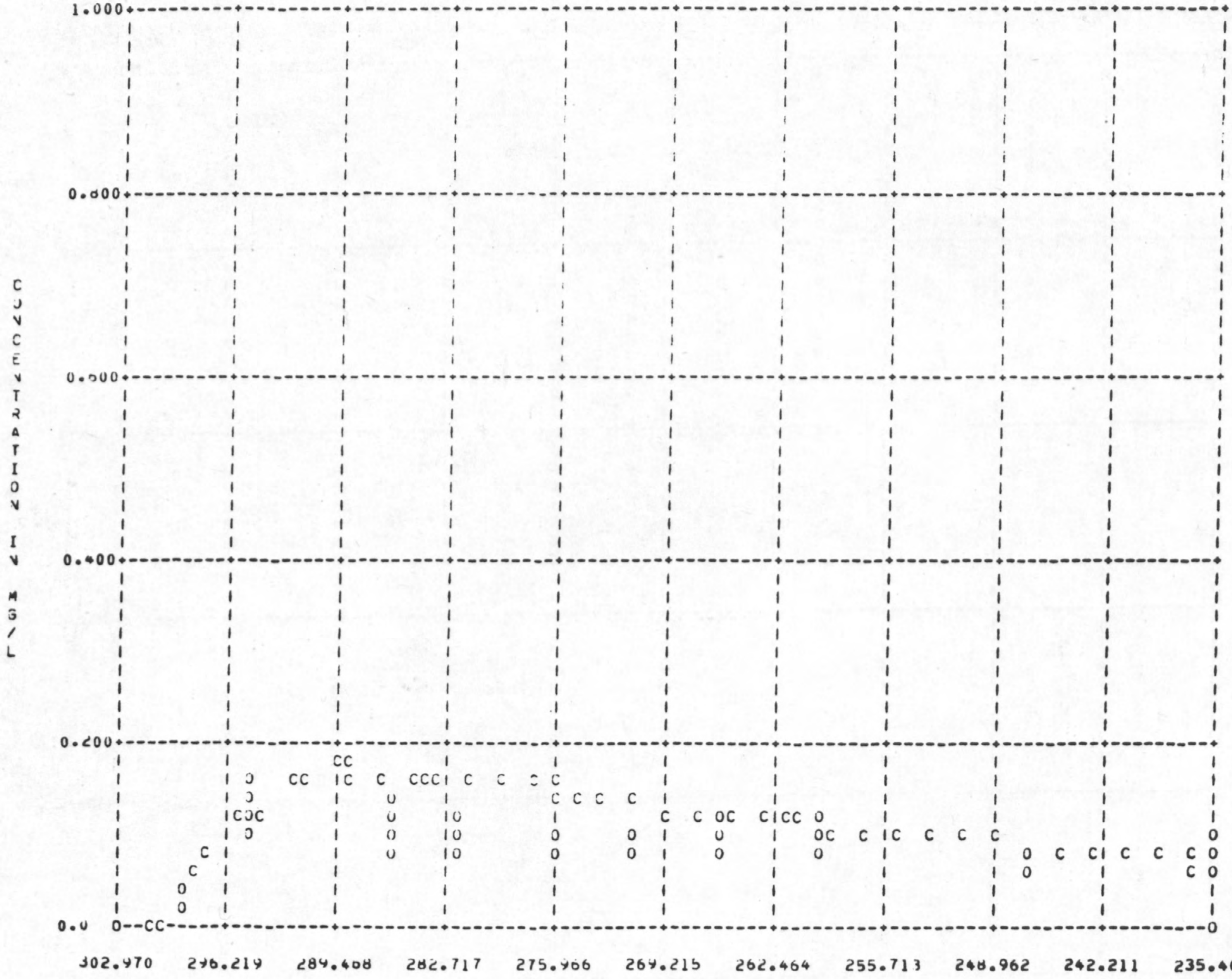
CALCULATED AND OBSERVED AMMONIA NITROGEN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE



CALCULATED AMMONIA NITROGEN CONC = C

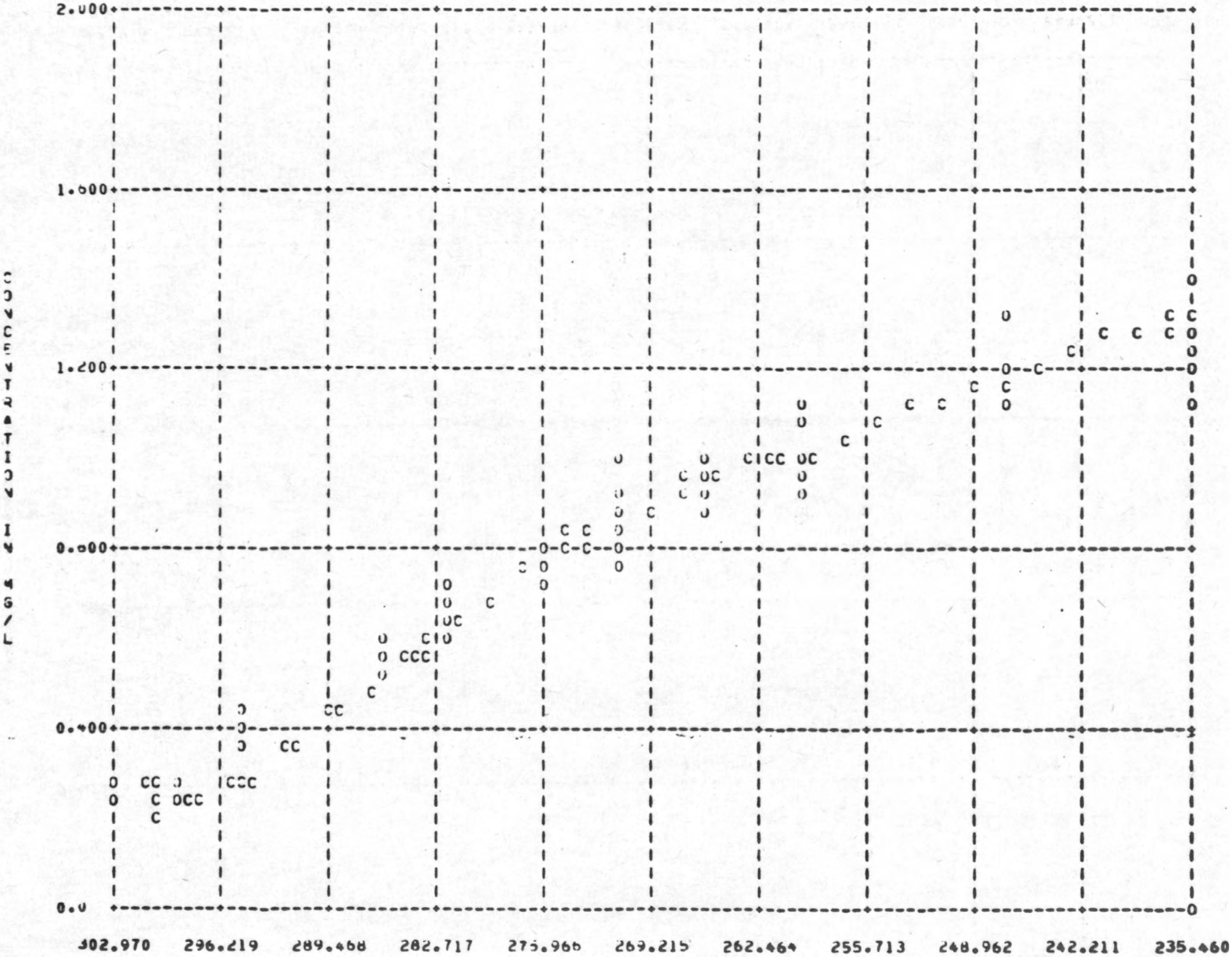
OBSERVED AMMONIA NITROGEN CONC = O

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA
CALCULATED AND OBSERVED NITRITE NITROGEN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE



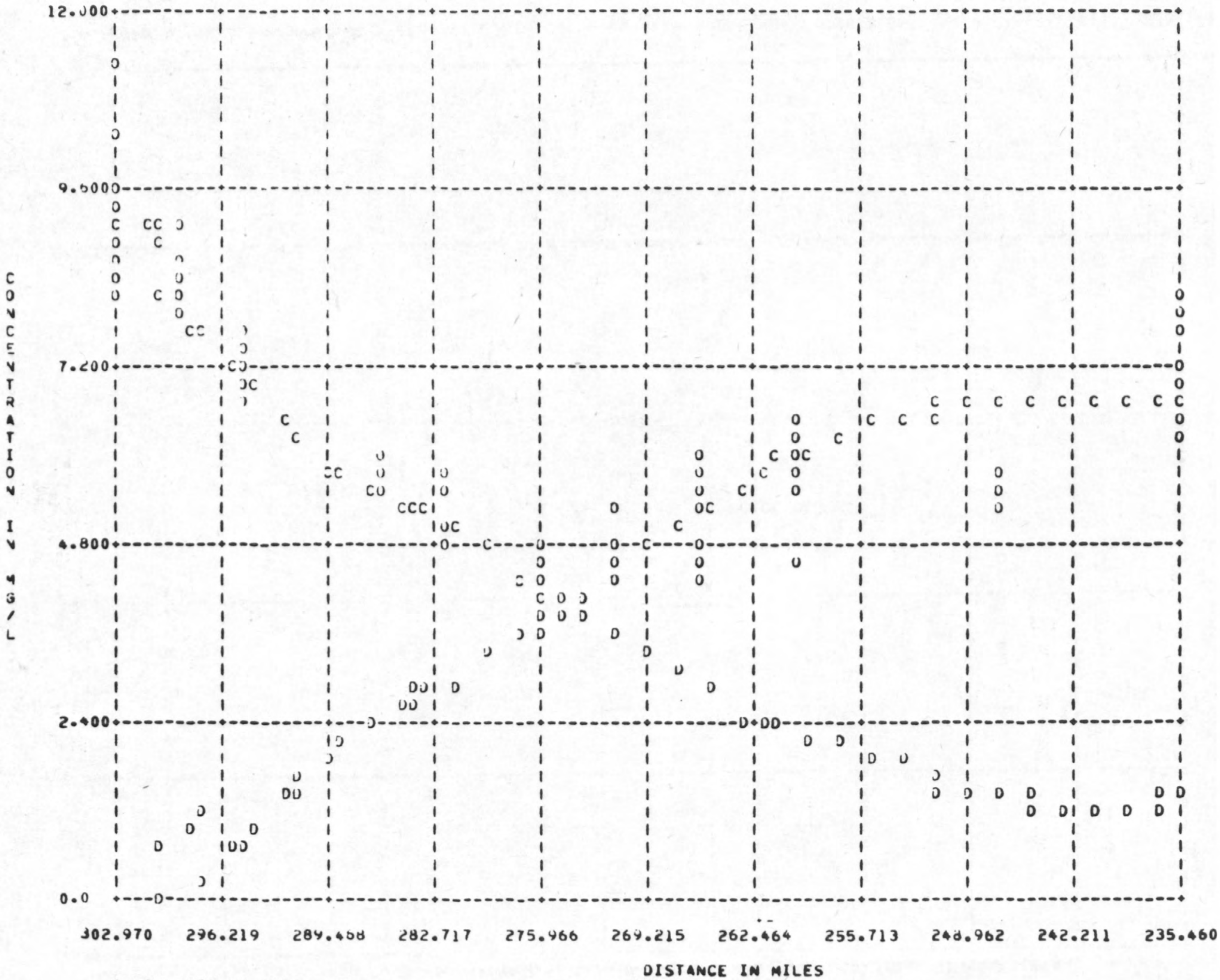
CALCULATED NITRITE NITROGEN CONC = C
OBSERVED NITRITE NITROGEN CONC = O

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA
CALCULATED AND OBSERVED NITRATE NITROGEN SPECIES BOD CONCENTRATIONS VERSUS DISTANCE



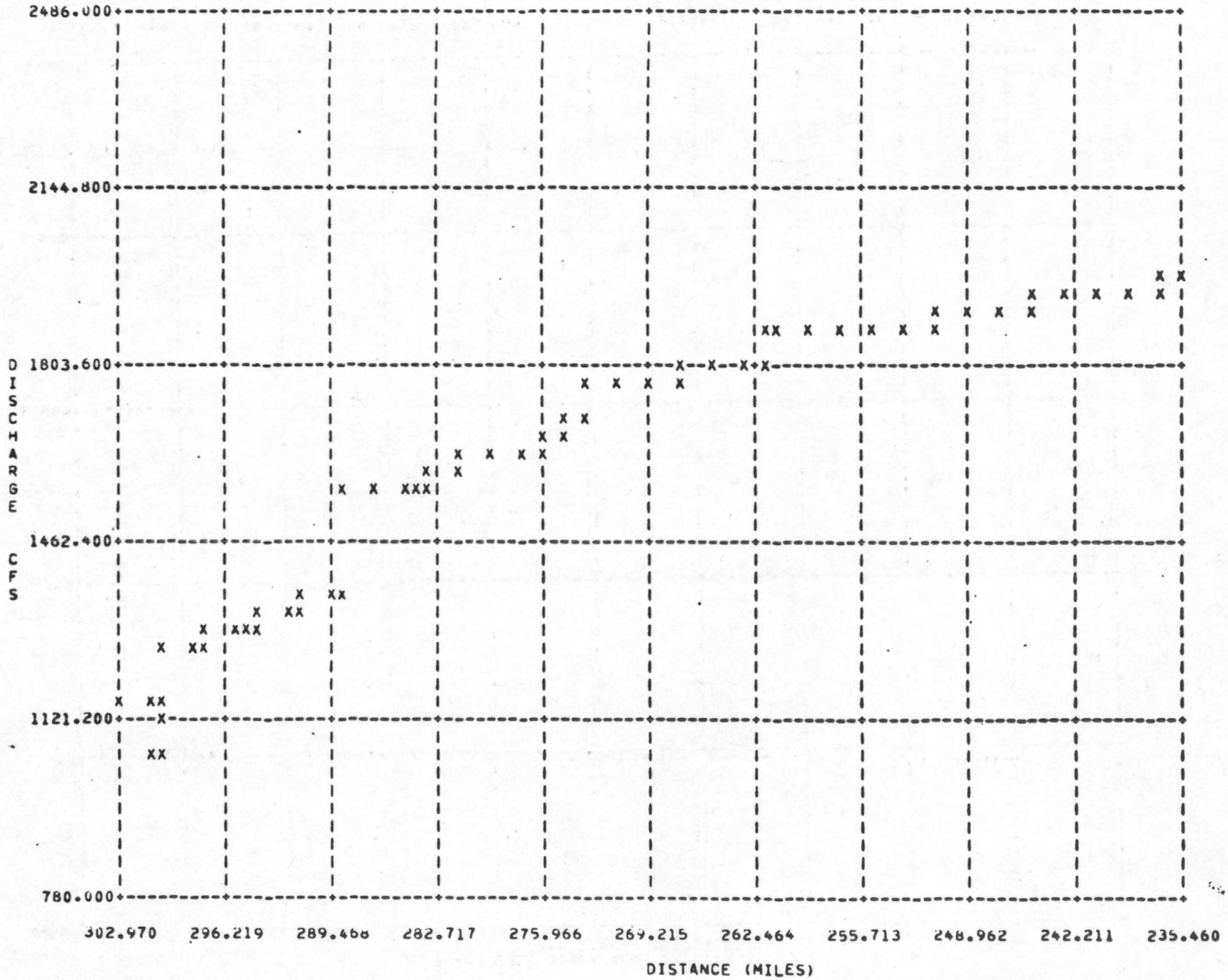
CALCULATED NITRATE NITROGEN CONC = C
OBSERVED NITRATE NITROGEN CONC = O

CHATTAHOOCHEE RIVER NEAR ATLANTA, GEORGIA
CALCULATED AND OBSERVED DO CONCENTRATIONS AND DO DEFICIT VERSUS DISTANCE

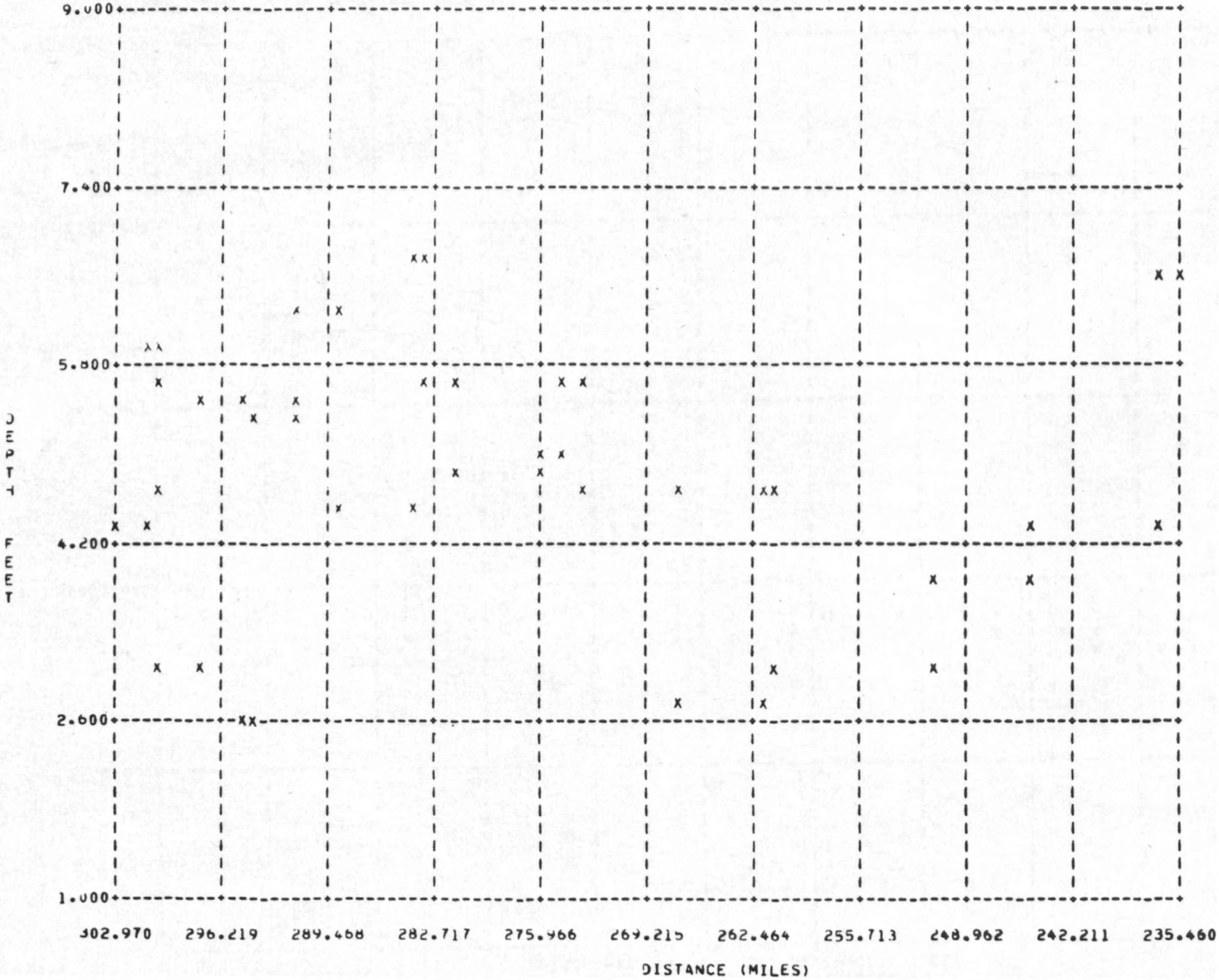


CALCULATED DO CONC = C
OBSERVED DO CONC = O
DO DEFICIT = D

CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA
DISCHARGE (CFS) VERSUS DISTANCE (MILES)



CHATTAHOOCHEE RIVER NEAR ATLANTA,GEORGIA
DEPTH (FEET) VERSUS DISTANCE (MILES)



F. PROCEDURE FOR DETERMINATION OF CERTAIN REACTION COEFFICIENTS

Reaction coefficients for CBOD, NBOD, organic nitrogen, and total- and fecal-coliform bacteria can be estimated from field data for use in this model. The equations describing the concentrations of the above constituents are all of the same general form, as follows:

$$\mathrm{Conc}_2 = \mathrm{Conc}_1\ e^{-K\left(\frac{x}{U}\right)} \qquad (26)$$

where

Conc_1 = concentration of constituent at some initial time t_1,

Conc_2 = concentration of constituent at some time t_2 later than t_1,

K = reaction coefficient, and

$\frac{x}{U}$ = traveltime = $t_2 - t_1$.

Equation 26 can be rearranged to solve for K as follows:

$$ln\left(\frac{\mathrm{Conc}_2}{\mathrm{Conc}_1}\right) = -K(t_2 - t_1) \qquad (27)$$

$$K = \frac{2.3}{t_1 - t_2}\ \log\left(\frac{\mathrm{Conc}_2}{\mathrm{Conc}_1}\right) \qquad (28)$$

where

ln = natural logarithm, base e, and

log = base 10 logarithm.

Reaction coefficients can be estimated by the following procedure:

(1) Observed concentrations are plotted versus traveltime (days) on semi-log paper scaled according to common base 10 logs, as shown in the following example.

(2) Best fit straight lines are drawn through the points. The line slope characteristics will vary depending on stream waste characteristics.

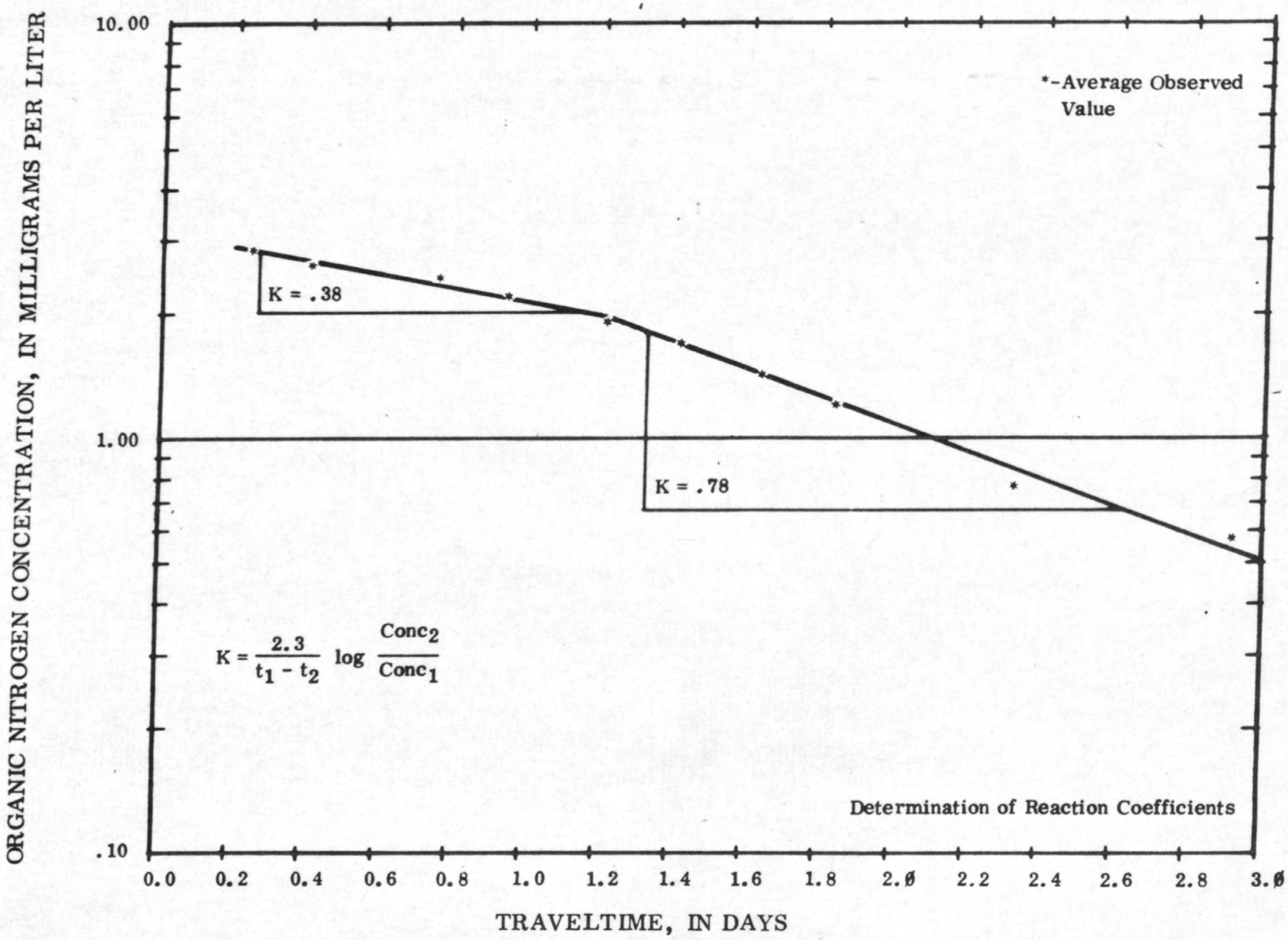
(3) The reaction coefficients to base e are computed using equation 28 for each line or line segment.

In the following example, lines of two different slopes have been drawn. Values for K are determined as follows:

$$K = \frac{2.3}{.25-1.13}\ \log\frac{2.0}{2.8} = .38$$

$$K = \frac{2.3}{1.30-2.60} \log \frac{.65}{1.80} = .78$$

Streamflow and water-quality data for the constituent of interest should be collected at sufficient points downstream of a major waste discharge or tributary so that the slope of the line defining the reaction coefficient can be estimated. In instances where other major discharges enter the stream, the slope of the reaction coefficient line must be redefined.


ORGANIC NITROGEN CONCENTRATION, IN MILLIGRAMS PER LITER
10.00
1.00
.10
*-Average Observed Value
K = .38
K = .78
$K = \frac{2.3}{t_1 - t_2} \log \frac{Conc_2}{Conc_1}$
Determination of Reaction Coefficients
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.Ø
2.2
2.4
2.6
2.8
3.Ø
TRAVELTIME, IN DAYS

UNITED STATES GEOLOGICAL SURVEY

WATER
RESOURCES
DIVISION

Gulf Coast Hydroscience Center
NSTL Station, Mississippi