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**CHNTRN: A CHaNNel TRaNsport
Model for Simulating Sediment
and Chemical Distribution
in a Stream/River Network**

G. T. Yeh

Environmental Sciences Division
Publication No. 1914

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CHNTRN: A CHaNNel TRaNsport Model for Simulating Sediment
and Chemical Distribution in a Stream/River Network

by

G. T. Yeh

Environmental Sciences Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

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Project Officer

Dr. Joan Lefler
Exposure Evaluation Division
Office of Toxic Substances
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Prepared for
Office of Pesticides and Toxic Substances
U.S. Environmental Protection Agency
Washington, D.C. 20460

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
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ABSTRACT

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This report presents the development of a CHaNnel TRaNsport model for simulating sediment and chemical distribution in a stream/river network. A particular feature of the model is its capability to deal with the network system that may consist of any number of joined and branched streams/ivers of comparable size. The model employs a numerical method--an integrated compartment method (ICM)--which greatly facilitates the setup of the matrix equation for the discrete field approximating the corresponding continuous field.

Most of the possible boundary conditions that may be anticipated in real-world problems are considered. These include junctions, prescribed concentration, prescribed dispersive flux, and prescribed total flux. The use of ICM makes the implementation of these four types of boundary conditions relatively easy.

The model is applied to two case studies: (1) a single river and (2) a five-segment river in a watershed. Results indicate that the model can realistically simulate the behavior of the sediment and chemical variations in a stream/river network.

I. INTRODUCTION

One of the critical issues involving existing chemicals and new chemical production is the safe use of potentially hazardous materials. Risk assessments are needed to evaluate the consequences of chemical releases into the environment. Assessments would inevitably include the transport, transfer, transformation, fate, and pathway of the chemicals. They would also be concerned with exposure and the resulting health and ecological effects.

Environmental releases of chemicals may occur to aquifers, surface waters, oceans/estuaries, the atmosphere, or even directly to biota. However, following the release there will be a redistribution of the chemical(s) into all media. One of the important pathways will be the stream/river network. The ability to simulate the chemical concentration and distribution as function of space, time, and the system parameters provides one important link in assessing the consequences of environmental releases. This report presents the development of a CHaNel TRaNsport model (CHNTRN) that simulates the behavior of sediment and chemicals in a stream/river network. The model, combined with CHNHYD (Yeh 1982) which provides the hydrodynamic computations of flows and water depths, constitutes a software package for predicting the transport, transfer, and transformation of chemicals in the stream/river system.

The basic complete set of governing equations for CHNTRN is derived from three-dimensional mass balance equations. Four types of boundary conditions are considered: the Dirichlet, Neumann, Cauchy, and junction boundaries. An integrated compartment method (ICM)

(Yeh 1981) is used to simulate the behavior of the resulting equations. In this method, the link matrices are derived based on the fluxes of mass along each of the links that intertwine the compartments of the river system. The global matrix associated with spatial derivatives is assembled from these link matrices. This results in a system of ordinary differential equations with respect to time governing the dynamic evolution of suspended sediment, bed sediment, dissolved chemical concentration, particulate chemical concentration, and bed sediment chemical concentration. Two time-integration schemes are used: one is the split explicit and the other is the split implicit.

II. MATHEMATICAL FORMULATION

Most of the derivations of the governing equations for chemical transport in a river start with a small control volume between two cross sections at a distance of Δx . The conservation principle of mass is then applied to this slice of control volume. With this approach, many assumptions are lost and boundary conditions on the transverse and vertical directions are not stated in the process of derivation. Instead, this report begins with the basic principles of conservation of mass in three-dimensional space. A formal mathematical model is then developed for transient, cross-sectionally integrated chemical transport in the longitudinal direction.

A. Three-Dimensional Transport Equations

The mathematical formulation of the conservation of mass for three-dimensional transport was previously derived in a Eulerian framework using a Cartesian x-y-z coordinate system (Bird et al. 1960, Sayre 1966). The operation consists of balancing mass flux for a small cube $dx \cdot dy \cdot dz$, as shown in Figure 1, and then taking the theoretical limit as the volume of the cube approaches zero. The three-dimensional equations of sediment and chemical transport can be written in the following manner (Sayre 1966, Onishi 1981).

For sediment:

$$\frac{\partial s_m}{\partial t} + \nabla \cdot [(\vec{V} - \vec{V}_{sm}) s_m] = \nabla \cdot (\vec{E} \cdot \nabla s_m) + Q_{sm} ; \quad (1)$$

Fig. 1. A differential volume $dx \cdot dy \cdot dz$.

For dissolved chemical:

$$\frac{\partial c_w}{\partial t} + \nabla \cdot (\vec{V} c_w) = \nabla \cdot (\vec{\epsilon} \cdot \nabla c_w) + Q_{cw} - K_w c_w + \sum_{n=1} K_{an} s_n (c_n - K_{dn} c_w) ; \quad (2)$$

For particulate chemical:

$$\begin{aligned} \frac{\partial s_m c_m}{\partial t} + \nabla \cdot [(\vec{V} - \vec{V}_{sm}) s_m c_m] &= \nabla \cdot (\vec{\epsilon} \cdot \nabla s_m c_m) + Q_{cm} \\ &- K_m s_m c_m - K_{am} s_m (c_m - K_{dm} c_m) , \end{aligned} \quad (3)$$

where s_m is the concentration of sediment of m-th size fraction or type; Q_{sm} is the source strength of m-th sediment fraction size; $\vec{V}$ is the fluid velocity vector; $\vec{V}_{sm}$ is the settling velocity of m-th sediment; $\bar{\epsilon}$ is the eddy diffusion coefficient tensor; t is the time; c_w is the dissolved chemical concentration in weight of chemical per unit volume of water mixture; Q_{cw} is the source strength of dissolved chemical; K_w and K_m are the first-order rate constants of dissolved and adsorbed chemical, respectively; K_{am} is the rate of sorption of sediment of m-th type; K_{dm} is the distribution coefficient of m-th sediment; c_m is the m-th particulate chemical concentration in weight of chemical per unit weight of m-th sediment; and Q_{cm} is the source strength of adsorbed chemical in m-th sediment. The values of K_w and K_m may result from hydrolysis, oxidation, photolysis, biolysis, and precipitation (Burns and Cline 1981, Browman et al. 1982).

Boundary conditions on the transport equations of sediment and chemical, Eqs. (1) to (3), must be written down to complete the specification of the problem. Three types of boundary conditions can be specified from the mathematical point of view. These are the Dirichlet boundary on which the functional value is prescribed, the Neumann boundary on which the diffusive flux is known, and the Cauchy boundary on which the total flux (advective and diffusive fluxes) is given. From the physical point of view, the boundary may be considered as a water-soil, water-air, or a water-water interface. From a dynamic point of view, a segment of boundary may be classified as flow-through or zero normal flow.

Whatever the point of view, all boundary conditions must be eventually transformed into mathematical equations for quantitative simulation. Thus we will specify the boundary condition from the mathematical point of view in concert with dynamic and physical considerations. The boundary conditions imposed on any segment of the boundary are taken to be Dirichlet, Neumann, or Cauchy for s_m , c_w , or c_m , independent of each other. Thus for a function f , where f represents s_m , c_w , or $s_m c_m$, the boundary may be split into three parts, B_D , B_N , and B_C (Figure 2), denoting Dirichlet, Neumann, and Cauchy boundaries, respectively. The conditions imposed on these types of boundaries are given as follows:

$$f = f_D \quad \text{on} \quad B_D, \quad (4)$$

$$-\vec{n} \cdot (\vec{\epsilon} \cdot \nabla f) = q_N \quad \text{on} \quad B_N, \quad (5)$$

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Fig. 2. Boundary segments to represent various types of boundary conditions.

and

$$\vec{n} \cdot \vec{q} = q_C \quad \text{on } B_C, \quad (6)$$

where f_D , q_N , and q_C are the prescribed Dirichlet functional value, Neumann flux and Cauchy flux, respectively. $\vec{q}$ appears in the following type of equation:

$$\frac{\partial f}{\partial t} = -\nabla \cdot \vec{q} + b. \quad (7)$$

It should be recognized that $\vec{q}$ represents the following quantities:

$$\vec{q} = (\vec{V} - \vec{V}_{sm}) s_m - \vec{\epsilon} \cdot \nabla s_m \quad \text{for suspended sediment}, \quad (8)$$

$$\vec{q} = \vec{V} c_w - \vec{\epsilon} \cdot \nabla c_w \quad \text{for dissolved chemical}, \quad (9)$$

and

$$\vec{q} = (\vec{V} - \vec{V}_{sm}) s_m c_m - \vec{\epsilon} \cdot \nabla (s_m c_m) \quad \text{for particulate chemical}. \quad (10)$$

In this report, the Cauchy boundary condition, Eq. (6), is applied to the water-soil interfaces with q_C given by

$$q_C = R_m - D_m \quad \text{for } m\text{-th sediment}, \quad (11)$$

$$q_C = \sum_{n=1} K_{bn} M_n (C_{bn} - K_{dn} c_w) \quad \text{for dissolved chemical}, \quad (12)$$

and

$$q_C = R_m c_{hpi} - D_m c_{mr} \quad \text{for } m\text{-th particulate chemicals}, \quad (13)$$

where R_m is the erosion rate of m-th sediment; D_m is the deposition rate of m-th sediment; K_{bn} is the sorption rate by bed sediment of n-th size fraction; M_n is the sediment mass per unit bed area of n-th size fraction; and C_{bm} is the particulate concentration in m-th size fraction bed sediment, in weight of chemical per unit weight of m-th size fraction sediment. The Cauchy boundary will also be applied to the water-air interface with q_C given by

$$q_C = 0 \quad \text{for sediment} \quad , \quad (14)$$

$$q_C = K_v C_w \quad \text{for dissolved chemical} \quad , \quad (15)$$

and

$$q_C = 0 \quad \text{for particulate chemical} \quad , \quad (16)$$

where K_v is the volatilization rate constant.

Any of the three types of the boundary conditions may be applied to water-water, flow-through interfaces. When the Cauchy boundary is applied to such interfaces, two cases are treated separately. In the case of flow directed into the region, the total flux must be prescribed. On the other hand, in the case of flow directed out of the region, the gradient of the concentration will be assumed zero, thus resulting in a concentration-dependent boundary condition.

B. Cross-Sectional Integration

In the river system, the concentration variation through the cross section is often less significant than that in the longitudinal direction. In general, cross-sectionally integrated equations and

variables may adequately describe such cases. This approach yields estimates for transport along the dominant flow direction. However, detailed information on the concentration variations over the river cross section is lost. For a stratified river system, the cross-sectionally integrated approach may be modified by considering the layer flows.

Let the x -coordinate be aligned with the flow direction in the river system and the y - z plane be perpendicular to the x -axis. The governing equations, Eqs. (1) to (3), are integrated over the cross-sectional plane y - z , as shown in Figure 3, to eliminate the y and z dependence. Incorporating the boundary conditions, Eqs. (6) through (16), these integrations will yield the following transient one-dimensional equations for the transport of sediments, dissolved chemical, and particulate chemical.

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Fig. 3. Channel cross-sections.

For suspended sediment:

$$\frac{\partial(AS_m)}{\partial t} + \frac{\partial(QS_m)}{\partial x} = \frac{\partial}{\partial x} (K_{xx} A \frac{\partial S_m}{\partial x}) + M_{sm} + R_m P - D_m P ; \quad (17)$$

For bed sediment:

$$\frac{\partial M_m}{\partial t} = D_m - R_m ; \quad (18)$$

For dissolved chemical:

$$\begin{aligned} \frac{\partial AC_w}{\partial t} + \frac{\partial QC_w}{\partial x} = & \frac{\partial}{\partial x} (K_{xx} A \frac{\partial C_w}{\partial x}) + M_{cw} - (K_w + K_v) A C_w \\ & + \sum_{n=1} K_{an} S_n A (C_n - K_{dn} C_w) + \sum_{n=1} K_{bn} M_n (C_{bn} - K_{dn} C_w) ; \end{aligned} \quad (19)$$

For particulate chemical in suspended sediments:

$$\begin{aligned} \frac{\partial AS_m C_m}{\partial t} + \frac{\partial QS_m C_m}{\partial x} = & \frac{\partial}{\partial x} (AK_{xx} \frac{\partial S_m C_m}{\partial x}) + M_{cm} - K_m AS_m C_m \\ & - K_{am} S_m A (C_m - K_{dm} C_w) + R_m BC_{bm} - D_m BC_m ; \end{aligned} \quad (20)$$

For particulate chemical in bed sediment:

$$\frac{\partial M_m C_{bm}}{\partial t} = (D_m C_m - R_m C_{bm}) - K_m M_m C_{bm} - K_{bm} (C_{bm} - K_{dm} C_w) , \quad (21)$$

where K_{xx} is the longitudinal dispersion coefficient; A is the cross-sectional area; B is the top width (Figure 3); P is the wet perimeter (Figure 3); and Q is the flow rate. The variables A , B , P ,

and Q are obtained by executing the CHNHYD code (Yeh 1982) and K_{xx} is assumed to be given by

$$K_{xx} = a_L * (Q/A) , \quad (22)$$

where a_L is defined as the longitudinal diffusivity. It should be noted that K_{xx} results from the eddy diffusion coefficient and the nonuniform flow and concentration distribution over the cross section. Additional variables M_{sm} , M_{cw} , and M_{cm} in Eqs. (17), (19), and (20) are the source strength of sediment, dissolved chemical, and particulate chemical, respectively, per unit river length. They represent

$$M_{sm} = \int_A Q_{sm} dA , \quad (23)$$

$$M_{cw} = \int_A Q_{cw} dA , \quad (24)$$

and

$$M_{cm} = \int_A Q_{cm} dA , \quad (25)$$

respectively. The state variables S_m , C_w , and C_m are the averaged values of s_m , c_w , and c_m , respectively, over the cross section. Thus they are given by

$$S_m = \frac{1}{A} \int s_m dA , \quad (26)$$

$$C_w = \frac{1}{A} \int c_w dA , \quad (27)$$

and

$$C_m = \frac{1}{A} \int c_m dA, \quad (28)$$

respectively. Equations (17), (19), and (20) constitute a system of equations for the unknowns S_m , C_w , and C_m . To complete the description, R_m and D_m must be expressed in terms of the hydrodynamic variables Q , A , B , and P and the state variables. Following a recent publication (Onishi 1981), it is assumed that D_m and R_m are given by

$$D_m = W_{sm} S_m \left(1 - \frac{\tau_b}{\tau_{CDm}} \right) \quad \text{for cohesive sediment} \quad (29)$$

$$R_m = E_m \left(\frac{\tau_b}{\tau_{CRm}} - 1 \right)$$

and

$$D_m = \frac{Q_{sA} - Q_s}{\Delta L} \quad \text{for noncohesive sediment} \quad (30)$$

$$R_m = \frac{Q_s - Q_{sA}}{\Delta L}$$

Here W_{sm} is the settling speed of the m -th sediment; τ_b is the bottom shear stress; τ_{CDm} is the critical shear stress for deposition of the m -th sediment; τ_{CRm} is the critical shear stress for erosion of the m -th sediment; Q_{sA} is the actual sediment amount per unit width at an upper-stream point; Q_s is the sediment capacity per unit width at a downstream point that is ΔL apart from its upstream point.

As in the case of three-dimensional transport, three types of boundary conditions, namely Dirichlet, Neumann, and Cauchy, can be specified for one-dimensional transport represented in Eqs. (17), (19), and (20):

III. NUMERICAL ALGORITHM

A. Spatial Approximation

Analytical solutions of Eqs. (17) through (21) do not exist for general problems. Numerical methods are thus needed to simulate the behavior of the sediment and chemical transport and sediment-chemical interaction. The integrated compartment method (ICM) (Yeh 1981) solves Eqs. (17) through (21) in successive order utilizing the concept of connectivity from finite element methods and flux laws from the finite difference approximation.

As an example, a one-dimensional compartment i with length Δx_i may be joined on any of its two ends by a compartment j with length Δx_j as shown in Figure 4. Applying the principle of ICM to Eq. (17), we obtain the following equation for the discrete value of the sediment concentration S_{mi} at compartment i :

$$\begin{aligned} \frac{dA(S_m)_i}{dt} \Delta x_i = & - \sum_{j \in N_i} (n_{ij} \cdot Q_{ij}) (S_m)_{ij} + 2(K_{xx})_{ij} \frac{(S_m)_j - (S_m)_i}{\Delta x_i + \Delta x_j} \\ & + [(R_m)_i P_i - (D_m)_i P_i + (M_{sm})_i] \Delta x_i, \end{aligned} \quad (31)$$

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Fig. 4. Compartments and links.

where N_i is the set of compartments that adjoins compartment i , the subscript ij denotes the value at the interface of compartments i and j , and the subscript i represents the compartmental (node) value of the variables. To close Eq. (31), $(S_m)_{ij}$ must be interpolated in terms of $(S_m)_i$ and $(S_m)_j$. In this report it is proposed that:

$$(S_m)_{ij} = \theta \frac{\Delta x_j (S_m)_i - \Delta x_i (S_m)_j}{\Delta x_i + \Delta x_j} + 0.5(1-\theta) \cdot [(1+\gamma)(S_m)_i + (1-\gamma)(S_m)_j] \quad , \quad (32)$$

where θ is a real number ranging from 0.0 to 1.0 and γ is given by:

$$\gamma = 1.0 \quad \text{if } (n_{ij} \cdot Q_{ij}) \geq 0 \quad , \quad (33a)$$

and

$$\gamma = -1.0 \quad \text{if } (n_{ij} \cdot Q_{ij}) < 0 \quad . \quad (33b)$$

The value of θ is determined by the time-integration scheme for Eq. (31). The value of θ is 0.0 for the explicit scheme (forward difference), 0.5 for the Crank-Nicolson central difference, and 1.0 for the implicit scheme (backward difference). The rationale of using Eq. (32) is heuristically described here. For the explicit scheme ($\theta = 0.0$), upstream interpolation is required for the advection transport to have a stable solution. However, it is well known that upstream interpolation introduces numerical dispersion thus reducing the accuracy of the numerical computation. On the other hand, for the implicit scheme ($\theta = 1.0$) an unconditionally stable solution can be obtained with respect to the centrally differenced advection term. The

central difference has second-order error; thus it is more accurate than the upstream-difference which has first-order error. Hence, a linear weighting based on the value of θ is used to obtain the combination of upstream difference and central difference with respect to spatial derivatives.

Substituting Eq. (32) into Eq. (31), we obtain the following matrix equation for $\{S_m\}$:

$$[M] \left\{ \frac{dS_m}{dt} \right\} + [H] \{S_m\} = \{F\} , \quad (34)$$

where $[M]$ is the global diagonal matrix whose ij -th entry, M_{ij} , is given by

$$M_{ij} = (A_i \Delta x_i) \quad \text{if } j = i \quad (35a)$$

and

$$M_{ij} = 0 \quad \text{if } j \neq i , \quad (35b)$$

$\{F\}$ is the column vector whose i -th entry F_i is

$$F_i = [(R_m)_i P_i - (D_m) P_i + (M_{sm})_i] \Delta x_i , \quad (36)$$

and $[H]$ is the global banded matrix resulting from hydrodynamic advection and dispersion. This banded matrix is obtained by assembling the link matrix of the interface i - j . The assembling procedure is similar to that of assembling the element matrices to form the global matrix in the finite-element method (Huebner 1975). There are two major differences: (i) the element matrices are obtained by the integration of basis functions and their derivatives, whereas the link

matrices are obtained by simple interpolation formulas given by Eqs. (32) and (33), (ii) the size of the element matrices depends on the type of element used whereas the size of link matrices is always 2×2 . Having stated these salient differences between the element and link matrices, we now turn our attention to the procedure for obtaining the link matrices for our particular problem.

Referring to Figure 4, the link i - j has its end points with global nodes i and j , respectively. Let us denote global node i as local node number 1 and global node j as local node number 2. Then the link matrix, $[_l H]$, will have four entries:

$$[_l H]_{11} = (n_{12} \cdot Q_{12}) \{ \theta [\Delta x_2 / (\Delta x_1 + \Delta x_2)] + 0.5 (1-\theta) (1+\gamma) \} + 2(K_{xx})_{12} A_{12} / (\Delta x_1 + \Delta x_2) , \quad (37a)$$

$$[_l H]_{12} = (n_{12} \cdot Q_{12}) \{ \theta [\Delta x_1 / (\Delta x_1 + \Delta x_2)] + 0.5 (1-\theta) (1-\gamma) \} - 2(K_{xx})_{12} A_{12} / (\Delta x_1 + \Delta x_2) , \quad (37b)$$

and

$$[_l H]_{21} = -[_l H]_{11} , \quad [_l H]_{22} = -[_l H]_{12} . \quad (37c)$$

These four entries constitute the partial sum of their corresponding global entries, H_{ii} , H_{ij} , H_{ji} , and H_{jj} , respectively, in the global matrix, $[H]$. In Eq. (37), the lower left-hand subscript l denotes the link.

Similarly, if we apply the ICM techniques to Eqs. (19) and (20), we obtain:

$$[M] \left\{ \frac{dC_w}{dt} \right\} + [H] \{C_w\} + [G] \{C_w\} = \{W\} \quad (38)$$

and

$$[N] \left\{ \frac{dC_m}{dt} \right\} + [E] \{C_m\} + [D] \{C_m\} = \{Y\} \quad , \quad (39)$$

respectively. The global matrices $[G]$, $[N]$, and $[D]$ are defined as

$$G_{ij} = \{[(K_w)_i + (K_v)_i] A_i + \sum_{n=1} (K_{an})_i (S_n)_i A_i (K_{dn})_i + \sum_{n=1} [(K_{bn})_i (M_n)_i (K_{dn})_i] \Delta x_i \quad \text{if } j = i \quad , \quad (40a)$$

$$G_{ij} = 0 \quad \text{if } j \neq i \quad , \quad (40b)$$

$$N_{ij} = A_i (S_m)_i \Delta x_i \quad \text{if } j = i \quad , \quad (41a)$$

$$N_{ij} = 0 \quad \text{if } j \neq i \quad , \quad (41b)$$

and

$$D_{ij} = (K_m)_i A_i (S_m)_i + (K_{am})_i (S_m)_i A_i + (D_m)_i (B)_i \quad \text{if } j = i \quad . \quad (42a)$$

$$D_{ij} = 0 \quad \text{if } j \neq i \quad . \quad (42b)$$

respectively. The column vectors $\{W\}$ and $\{Y\}$ are given by

$$W_i = (M_{cw})_i + \sum_{n=1} (K_{an})_i (S_n)_i A_i (C_n)_i + \sum_{n=1} (K_{bn})_i (M_n)_i (C_{bn})_i \quad (43)$$

and

$$Y_i = (M_{cm})_i + (K_{am})_i (S_m)_i A_i (K_{dm})_i (C_w)_i + (R_m)_i B_i (C_{bm})_i , \quad (44)$$

respectively. The global matrix $[E]$ in Eq. (39) is obtained by assembling the link matrices each of which has the following four entries:

$$\begin{aligned} {}_L E_{11} = & (n_{12} \cdot Q_{12})(S_m)_{12} \{ \theta [\Delta x_2 / (\Delta x_1 + \Delta x_2)] + 0.5(1 - \theta)(1 + \gamma) \} \\ & + 2A_{12}(K_{xx})_{12}(S_m)_1 / (\Delta x_1 + \Delta x_2) , \end{aligned} \quad (45a)$$

$$\begin{aligned} {}_L E_{12} = & (n_{12} \cdot Q_{12})(S_m)_{12} \{ \theta [\Delta x_1 / (\Delta x_1 + \Delta x_2)] + 0.5(1 - \theta)(1 - \gamma) \} \\ & - 2A_{12}(K_{xx})_{12}(S_m)_2 / (\Delta x_1 + \Delta x_2) , \end{aligned} \quad (45b)$$

and

$${}_L E_{21} = -{}_L E_{11}, \quad {}_L E_{22} = -{}_L E_{12} . \quad (45c)$$

B. Temporal Integration

By using the ICM method (Yeh 1981), the original continuous problem [Eqs. (17), (19), and (20)] is reduced to a system of ordinary differential equations in time [Eqs. (34), (38) and (39)]. To complete the model, an effective technique must be developed to advance the solution in time from given initial conditions. The choice of scheme depends on the accuracy, stability, programming ease, and computational efficiency required. A thorough discussion of the time-integration schemes has been made elsewhere on the system of equations derived by finite difference methods (Richtmeyer and Morton 1967, Roache 1972) and

by finite element methods (Wang and Connor 1975). Among the most commonly used schemes are the (i) Euler's method, (ii) trapezoidal rule, (iii) improved trapezoidal rule, (iv) iterative predictor-corrector method, (v) Runge-Kutta methods, (vi) other stiff matrix solvers such as GEAR and EPSODE, (vii) time split method, and (viii) implicit method.

From the standpoint of stability, the implicit method offers the best advantage as it yields unconditionally a linear stable solution. For the present study, the time split scheme is used because it offers advantages in computer storage, computational efficiency, easy programming, and a satisfactory degree of accuracy. Two options are provided: one is the time split explicit scheme and the other is the time split implicit scheme.

According to the time split explicit scheme, the marching of $\{S_m\}$, $\{C_w\}$, and $\{C_m\}$ from time $n\Delta t$ to $(n+1)\Delta t$ is accomplished through three steps. First, Eq. (34) is used to compute the suspended sediment concentration at the new time $\{S_m^{n+1}\}$ as

$$(S_m^{n+1})_i = (S_m^n)_i - \frac{\Delta t}{M_{ii}} \left(\sum_{k=1} H_{ik} (S_m^n)_k - F_i \right) \text{ for } i = 1, 2, \dots \quad (46)$$

where $(S_m^{n+1})_i$ is the value of $(S_m)_i$ evaluated at time $(n+1)\Delta t$ and Δt is the time step size. Second, Eq. (38) is used to compute the new dissolved concentration field $\{C_w^{n+1}\}$ as follows:

$$(C_w^{n+1})_i = (C_w^n)_i - \frac{\Delta t}{M_{ii}} \left\{ \sum_{k=1} (H_{ik} + G_{ik})(C_w^n)_k - W_i \right\} \text{ for } i = 1, 2, \dots \quad (47)$$

Third, Eq. (39) is used to calculate the new particulate concentration field $\{C_m^{n+1}\}$ based on the newly obtained $\{C_w^{n+1}\}$ and old $\{C_m^n\}$ by

$$(C_m^{n+1})_i = (C_m^n)_i - \frac{\Delta t}{N_{ii}} \left\{ \sum_{k=1} (E_{ik} + D_{ik})(C_m^n)_k - Y_i \right\} \text{ for } i = 1, 2, \dots \quad (48)$$

In evaluating the global matrices $[G]$, $[E]$, and $[D]$ and the column vectors $\{W\}$ and $\{Y\}$ in Eqs. (47) and (48), the most recent $\{C_m\}$ and $\{C_w\}$ must be used.

When the option of the time split implicit scheme is used, the advancement of $\{S_m\}$, $\{C_w\}$, and $\{C_m\}$ from time $t^{(n)}$ to time $t^{(n+1)}$ is also accomplished through three steps. However, in the first step the field $\{S_m^{n+1}\}$ is obtained by solving the following simultaneous equations.

$$\left(\frac{[M]}{\Delta t} + [H] \right) \{S_m^{n+1}\} = \frac{[M]}{\Delta t} \{S_m^n\} + \{F\} \quad (49)$$

In the second step, the field of $\{C_w^n\}$ is obtained by inverting the matrix equation:

$$([M]/\Delta t + [H] + [G]) \{C_w^{n+1}\} = \frac{[M]}{\Delta t} \{C_w^n\} + \{W\} \quad (50)$$

and in the third step, the new particulate concentration field, $\{C_m^{n+1}\}$ is obtained from the matrix equation:

$$\left(\frac{[N]}{\Delta t} + [E] + [D] \right) \{C_m^{n+1}\} = \frac{[N]}{\Delta t} \{C_m^n\} + \{Y\} \quad (51)$$

C. Computation of Boundary Values

Four types of boundary conditions are considered in this report, namely Dirichlet, Neumann, Cauchy, and junction. For the Dirichlet boundary, f_2^{n+1} is prescribed (where f_2^{n+1} denotes the boundary value at time $(n+1)\Delta t$). Thus it is used to obtain the normal flux contribution to its corresponding interior node f_1^{n+1} with

$$\vec{n} \cdot K_{xx} \nabla f = K_{xx}(f_2 - f_1)/d_{IB} \quad , \quad (52)$$

in which d_{IB} is the distance from the interior node to the boundary and f may represent S_m , C_w , or $S_m C_m$. For the Neumann boundary, the normal derivative flux (dispersive flux) is prescribed. It is used directly to obtain the load function of the equation for f_1^{n+1} , and f_2^{n+1} is obtained by

$$f_2^{n+1} = (q_N/K_{xx}) \cdot d_{IB} + f_1^{n+1} \quad . \quad (53)$$

Thus f_2^{n+1} may be used in other equations demanding this quantity.

For the Cauchy boundary, the quantity $(\vec{n} \cdot \vec{q})$ is prescribed. It may be used directly to obtain the total flux contribution to the node f_1^{n+1} . Then f_2^{n+1} may be obtained by using the relationships

$$\vec{n} \cdot \vec{q} = q_C \quad (54)$$

and

$$\vec{n} \cdot \Delta f^{n+1} = (f_2^{n+1} - f_1^{n+1})/d_{IB} \quad . \quad (55)$$

In Equations (52) through (55), the subscripts 1 and 2 denote the interior and exterior nodes, respectively. For the junction boundary the principle of conservation is applied to the volume of the junction directly. Considering a junction as shown in Figure 5, the continuity of mass (sediment or chemical) may be written:

$$\frac{d(fv_j)}{dt} = f_1Q_1 + f_2Q_2 - f_3Q_3 \quad , \quad (56)$$

where v_j is the volume of the junction; Q_1 , Q_2 , and Q_3 are the flow rates from river branches 1, 2, and 3, respectively; and f_1 , f_2 , and f_3 are the concentration of sediment or chemical at nodes neighboring the junction from river branches 1, 2, and 3, respectively. It is noted that Eq. (56) is a special case of Eq. (31) without the dispersion term.

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Fig. 5. Junction and river branches.

IV. COMPUTER PROGRAM DESCRIPTION

The computational algorithms [Eqs. (46) through (56)] are coded in basic FORTRAN language. The code consists of a main program and fifteen subroutines linked as shown in Figure 6. The short main program is used to initialize all arrays and to specify the maximum dimension in each of the arrays. The MAIN routine then calls subroutines DATAIO and SENBCD to read the time-independent data input and transient data input, respectively. Detailed procedures of preparing input are given in APPENDIX A and two examples can be found in APPENDIX B. It is then passed to the subroutine CHNTRN to perform transient computational schedules for the successful execution of the problem.

Subroutine CHNTRN is used to read in time-dependent hydrodynamic variables and perform transient computations. For each time step it calls subroutines TSENB, ERODEP, SEDTRN, CHEMK, DISCON, and PARCON, and OUTPUT if required. The main function of CHNTRN is to advance solution through time by six major computations: (i) computing the sources, environmental parameters, and boundary conditions at the time, (ii) computing sediment erosion and deposition rate, (iii) computing suspended sediment concentration and bed sediment mass, (iv) calculating combined rate constants through dissolved and absorbed phases, (v) computing dissolved chemical concentration, and (vi) computing the particulate chemical concentration in both suspended and bed sediments.

Subroutine TSENB is called to obtain the source strength, environmental parameters, and boundary conditions by interpolating the inputting table. This interpolation is performed by calling the

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Fig. 6. Computer program structure of CHNTRN.

subroutine INTERP. The environmental parameters include air temperature, solar radiation, wind speed, vapor pressure, water temperature, extinction coefficient, pH, POH, oxidation radicals, bacterial population density, biotemperature for activation energy, and the proportion of bacteria that participates in chemical degradation.

Subroutine ERODEP is used to compute the erosion and deposition rate given by Eqs. (29) and (30). It has to call the subroutine INTP11 to interpolate the sediment load capacity given the hydrodynamic conditions at the time. Subroutine CHEMK computes the combined

degradation rate constants through both dissolved and adsorbed phases resulting from volatilization, photolysis, hydrolysis, oxidation, and biolysis. The computational equations used are taken from Burns and Cline (1981).

Subroutines SEDTRN, DISCON, and PARCON form the hard core of the CHNTRN model. SEDTRN computes the suspended sediment concentration and the amount of bed sediment remaining in a unit bed area. It computes those values at every compartment using Eqs. (46) and (18) with Euler's method, or it solves Eq. (49) by calling the subroutine SOLVE, which is a banded matrix equation solver. It first accumulates the contribution of sediment flux to every interior compartment through interior and junction links. It then adds the contribution from boundary links. Subsequently, it adds the contribution from source inputs. It finally computes the suspended sediment concentration and bed sediment amount. Before it returns to the subroutine CHNTRN, computation at boundary nodes using Eqs. (52) through (56) is performed.

Subroutine DISCON calculates the dissolved chemical concentration $(C_w^{n+1})_i$ in Eq. (47) at every compartment i and at new time $(n + 1)\Delta t$ or it solves for $\{C_w^{n+1}\}$ simultaneously by matrix inversion of Eq. (50) with subroutine SOLVE. The computational procedure is similar to that in the subroutine SEDTRN. It first computes the contribution of dissolved chemical flux by advection and dispersion to all interior and junction compartments through all links. It then adds the contribution of artificial sources/sinks, degradation, and absorption by suspended and bed sediments. It finally computes the dissolved chemical concentration at the boundaries using Eqs. (52) through (56).

The computation of particulate concentrations in both suspended and bed sediment by subroutine PARCON is accomplished similarly to that in subroutines SEDTRN and DISCON. The calculations in the three major subroutines SEDTRN, DISCON, and PARCON are achieved by the time split scheme. Two options are provided: one is the explicit scheme for fast computation while the other is the implicit scheme to generate stable solutions for large time steps. The complete source listing of the program is given in APPENDIX C. Numerous comment cards are included in the program to help the user understand the program structure and its functions. With those comment cards, users should be able to modify the code if required.

V. APPLICATIONS

The applications of the CHNTRN model to a river network are demonstrated by two sample problems: a single river system and a network consisting of five rivers. The validation of CHNTRN is a subject of future research. This report deals mainly with the development of the computer code and the demonstration of the model. These two sample cases typify real-world problems.

A. A Single River Problem

To test the internal consistency of the computer code, a single river 98 km long is used (Figure 7). The width of the river is assumed to be 200 m. Many of the large rivers in the United States fall in this category of size, such as the Hudson River and the Ohio River. The river is divided into 100 compartments as shown in Figure 7. Compartments 1 through 98 are the interior nodes. Compartments 99 and 100 are the boundary nodes. Before the execution of CHNTRN, hydrodynamic variables--mainly the flow rate, water depth, cross-sectional area, top width, and wet perimeter--must be obtained by executing the CHNHYD (Yeh 1982). For the CHNHYD simulation, a constant flow rate of $160 \text{ m}^3 \text{ s}^{-1}$ is imposed at the boundary node 100 and a constant water depth of 4 m is maintained at boundary node 99. The steady-state solutions that yield the profiles of water depth, top width, cross-sectional area, and wet perimeter along the river and, of course, a constant flow rate of $160 \text{ m}^3 \text{ s}^{-1}$ throughout the river are written on logical unit 1 for use in the CHNTRN.

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Fig. 7. Spatial discretization of the single river problem with compartments and links.

The preparation guide of input data is given in Appendix A. The physicochemical parameters used for both this example and the next one are given in Table 1. Chemical and environmental parameters used for computing the rate constants are given in Tables 2 and 3, respectively. To start the simulation, it is assumed that the water is clear and clean initially. In other words, initially the concentrations of suspended sediment, dissolved chemical, and particulate chemicals are all assumed to be zero. Initial conditions for the bed sediment and bed chemicals

Table 1. List of Physicochemical Parameters

Parameters	Associated with		
	Clay	Silt	Sand
Suspended sediment adsorption rate, K_{am} (s^{-1})	$2.5 \cdot 10^{-5}$	$2.5 \cdot 10^{-5}$	$2.5 \cdot 10^{-5}$
Distribution coefficient K_{dm} (m^3/kg)	0.1	0.02	0.002
Settling velocity, V_{sm} ($m s^{-1}$)	$1.2 \cdot 10^{-6}$	$1.5 \cdot 10^{-4}$	$4.5 \cdot 10^{-2}$
Critical deposition shear stress, τ_{cDm} (Newton/ m^2)	0.6	0.7	0.8
Critical erosion shear stress, τ_{cRm} (Newton/ m^2)	1.7	1.5	1.3
50% diameter (m)	$1.4 \cdot 10^{-6}$	$1.6 \cdot 10^{-5}$	$3.5 \cdot 10^{-4}$

are: 255 kg/ m^2 of clay, 255 kg/ m^2 of silt, 340 kg/ m^2 of sand, 1.0 g/ m^2 of chemical in clay, 0.5 g/ m^2 of chemical in silt and 0.2 g/ m^2 of chemical in sand. These initial conditions transform into the initial particulate bed chemical concentrations of 3.92, 1.96, and 0.59 $\mu g/g$, respectively, in clay, silt, and sand.

The boundary conditions are specified by assuming the Dirichlet boundary at the upstream end and a Neumann boundary at the downstream end with zero dispersive flux. In other words, at the downstream end the chemical will seek its own concentration. The Dirichlet concentration at the upstream end is maintained at 10 $\mu g/g$ for clay, silt, sand, and dissolved chemical throughout the simulation. The

Table 2. Chemical Parameters used to Compute Rate Constants (7H-Dibenzo-C. O. Carboyle)

Parameters	Associated with:	Size fraction 1, clay	Size fraction 2, silt	Size fraction 3, sand	Water
Molecular weight of the chemical, (g/mol)		267.3	267.3	267.3	267.3
Henry constant, (atm-m ³ /mol)		0.0	0.0	0.0	0.0
Near surface photo rate, (s ⁻¹)		0.0	0.0	0.0	0.0
Reaction quantum yield, (dimensionless)		0.0	0.0	0.0	0.008
Second-order rate constant of acid hydrolysis, (l/mol of H ⁺ /s)		0.0	0.0	0.0	0.0
First-order rate constant of neutral hydrolysis (s ⁻¹)		0.0	0.0	0.0	0.0
Second-order rate constant of base hydrolysis (l/mol of OH/s)		0.0	0.0	0.0	0.0
Arrhenius activation energy of acid hydrolysis (Kcal/mol)		0.0	0.0	0.0	0.0
Arrhenius activation energy of neutral hydrolysis (Kcal/mol)		0.0	0.0	0.0	0.0
Arrhenius activation energy of base hydrolysis (Kcal/mol)		0.0	0.0	0.0	0.0
Second-order rate constant of oxidation, or Log ₁₀ (frequency factor)		0.0	0.0	0.0	14.19
Arrhenius activation energy of oxidation, (Kcal/mol)		0.0	0.0	0.0	13.22
Second-order rate constant of biolysis for dissolved chemicals, KBACWG [1/(cell/m ³)/s]					0.0
Q-10 value for KBACWG					0.0
Second-order rate constant of biolysis for particulate chemicals, KBACWG [1/(cell/m ³)/s]		0.0	0.0	0.0	
Q-10 value for KBACWG		0.0	0.0	0.0	

Table 3. Environmental Parameters used for Computing Rate Constants

Parameters	Time			
	0.0 d	1.0 d	2.0 d	3.0 d
Air temperature, T_a ($^{\circ}\text{C}$)	20.0	20.0	20.0	20.0
Solar radiation, S_r ($\text{J}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	555.6	555.6	555.6	555.6
Vapor pressure, V_a (Pa)	$4.66\cdot 10^{-2}$	$4.66\cdot 10^{-2}$	$4.66\cdot 10^{-2}$	$4.66\cdot 10^{-2}$
Wind speed, W_s (m s^{-1})	1.0	1.0	1.0	1.0
Water temperature, T_w ($^{\circ}\text{C}$)	21.0	21.0	21.0	21.0
Extinction coefficient, E_c (m^{-1})	2.0	2.0	2.0	2.0
pH	7.0	7.0	7.0	7.0
pOH	7.0	7.0	7.0	7.0
Oxidation radical (mol)	10^{-9}	10^{-9}	10^{-9}	10^{-9}
Bacterial population density (cell/m^3)	1000	1000	1000	1000
Biotope temperature ($^{\circ}\text{C}$)	15.0	15.0	15.0	15.0
Proportion of bacterial active in biolysis	1.0	1.0	1.0	1.0

incoming particulate concentration is assumed to be in the equilibrium state with the dissolved chemical concentration. A transient source of dissolved chemical is added to compartment 11. This transient source starts with 0.0 g/m and increases linearly to a maximum value of 1.0 g/m at time equal to 4 h. It then decreases linearly to 0.0 g/m at time equal to 8.0 h and thereafter is maintained at 0.0 g/m. These system parameters, initial and boundary conditions are coded in Appendix B.

Figures 8a through 8g, respectively, depict the concentration history of the suspended clay, silt, and sand; dissolved chemical; and the particulate chemical in clay, silt, and sand. Each figure contains

four curves: one for the upstream boundary--compartment 100 ($\square$), one for compartment 11 ($\circ$), one for compartment 50 (Δ), and the other for the downstream end--compartment 99 (+).

Because erosion does not occur for clay and silt due to the high critical erosion shear stress used and because the fluid particles originating at the upstream boundary travel a distance of about 17.3 km in 24-h, the sediment concentrations of clay and silt are almost zero at compartments 50 (49.5 km from upstream boundary) and 99 (98 km from upstream boundary) as indicated in Figures 8a and 8b. On the other hand, the sediment concentrations of sand at compartments 99 and 50 are larger than that at compartment 11 because erosion indeed takes place along the river (Figure 8c).

It should be noted that this particular set of parameters for computing the erosion rate R_m and deposition rate D_m yields seemingly unrealistic results that erosion occurs for sand but not for silt and clay. Had a lower value of the critical shear stress τ_{CRm} been used for silt and clay, the erosion would have taken place also for silt and clay. In reality, whether the erosion of silt and clay will occur before sand depends on the critical shear stress for silt and clay and on the sediment capacity Q_s for sand. In other words, it depends on how sticky the silt and clay are and on the transporting capacity of the sand by water. In most of the real-world problems, it is probable that silt and clay will erode before sand. Under such circumstances, one should use a lower value of critical stress for both silt and clay and a smaller sediment capacity for sand. If for nothing

Fig. 8. Concentration distribution as a function of time at nodes 1, 11, 99, and 100 for (a) clay, (b) silt, (c) sand, (d) dissolved chemicals, (e) clay-absorbed chemical, (f) silt-absorbed chemical, and (g) sand-absorbed chemical.

Fig. 8 (continued)

Fig. 8 (continued)

Fig. 8 (continued)

Fig. 8 (continued)

Fig. 8 (continued)

Fig. 8 (continued)

else, this bad example illustrates the importance of correct and appropriate input to the model. Thus, the intended user should be aware of the GIGO (garbage in garbage out).

The dissolved concentration in compartment 11 shows a peak at about 5.0 h which reflects the effect of an artificial source added to the compartment (Figure 8d). The dissolved concentration at node 11 has not approached that at the upper boundary even though the fluid particles originating at the upstream end have long passed this point. This is due to the removal of dissolved chemical by the bottom sediment which has a particulate chemical concentration far less than that of the equilibrium value of the incoming fluid. The particulate chemical concentrations at node 11 for clay (Figure 8e), silt (Figure 8f), and sand (Figure 8g) have not approached the particulate chemical concentrations of the incoming sediment because of deposition and removal of particulate chemicals to the bottom sediment indirectly via the dissolved phase.

B. A River Network Problem

One of the advantages of this model is its ability to deal with a river network that may consist of any number of joined and branched rivers/streams. To illustrate this point, a river network consisting of five reaches with two junctions is used (Figure 9). For the simulation, the whole river network is divided into 36 compartments, four of which (compartment numbers 33, 34, 35, and 36) are the boundary compartments and two of which (compartments numbers 14 and 25) are the junction. Each interior compartment has dimensions of 1 km length by

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Fig. 9. Spatial discretization of the river network problem with compartments and links.

200 m width. The hydrodynamic variables--flow rates, water depths, top width, and wet perimeter--required by the CHNTRN code are obtained by executing the CHNHYD programs (Yeh 1981). For the CHNHYD simulation, a constant flow rate of $160 \text{ m}^3 \text{ s}^{-1}$ is imposed at the upstream boundary nodes (compartments 33, 34, and 35) and a constant water depth of 4 m is maintained at the downstream boundary node 36. The steady-state solution of the equations of continuity and momentum yielded the hydrodynamic variables mentioned above at all compartments. The flow rates at nodes 1 through 13, 20 through 24, and 33 through 35 are $160 \text{ m}^3 \text{ s}^{-1}$ which is equivalent to a velocity of about $0.2 \text{ m}^3 \text{ s}^{-1}$. The flow rates at compartments 14 through 19 are $320 \text{ m}^3 \text{ s}^{-1}$ giving a velocity $\approx 0.4 \text{ m}^3 \text{ s}^{-1}$. The flow rates at compartments 25 through 36 are $480 \text{ m}^3 \text{ s}^{-1}$, which gives a velocity of approximately $0.6 \text{ m}^3 \text{ s}^{-1}$. Flow rates by the CHNHYD model are as expected because constant flow rates of $160 \text{ m}^3 \text{ s}^{-1}$ are maintained at the three upstream compartments.

To start the CHNTRN simulation, physicochemical and environmental parameters must be read. These parameters are assumed the same as those given in the first example. Initial conditions for sediment, dissolved chemical, and particulate chemical concentrations are also assumed to be the same as those in the single-river problem.

The upstream boundaries at compartments 33, 34, and 35 will be given as Dirichlet nodes with 10 g/m^3 of clay, silt, and sand, and dissolved chemicals. The particulate chemical concentrations in clay, silt, and sand are in equilibrium with the dissolved chemical. The downstream boundary node 36 is maintained by a Neumann condition with

zero dispersive flux. This will allow the material (sediment and chemical) to flow out of the river system at the concentration computed to be at the boundary node. A transient source with the same profile of time as that in the above example is given at the compartments 5, 11, and 16.

The concentration profiles as functions of time are plotted in Figures 10a through 10g for the clay, silt, sand, dissolved chemical, clay-adsorbed chemical, silt-adsorbed chemical, and sand-adsorbed chemical, respectively. Each figure contains four curves, one each for compartments 5, 16, 32, and 33. All curves show patterns similar to those given in Figure 8. However, since the fluid particles originating at all three upstream boundaries have long passed the downstream end, the concentration profile at compartment 32 has risen in response to the boundary imposed on the upstream ends.

Because no analytical solutions are available, it is not possible to assess the accuracy of the results presented in both examples by comparing them with those of analytical results. The only confidence one has is that these results behave qualitatively as one would intuitively expect. The ultimate judgment on the model will have to be done by comparing the simulations with laboratory experiments or field data. Because the main purpose of this report is to document the construction of the model, the validation will have to be deferred to later studies.

Fig. 10. Concentration distribution as a function of time at nodes 5, 16, 32, and 33 for (a) clay, (b) silt, (c) sand, (d) dissolved chemical, (e) clay-absorbed chemical, (f) silt-absorbed chemical, and (g) sand-absorbed chemical.

Fig. 10 (continued)

Fig. 10 (continued)

Fig. 10 (continued)

Fig. 10 (continued)

Fig. 10 (continued)

Fig. 10 (continued)

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VII. NOTATIONS

A = channel cross-section area (L^2)

A_i = value of A evaluated at compartment i (L^2)

A_{ij} = value of A evaluated at the interface of compartments i and j (L^2)

a_L = longitudinal diffusivity (L)

B = top width of the channel cross section (L)

B_C = Cauchy boundary

B_D = Dirichlet boundary

B_N = Neumann boundary

C_{bn} = particulate concentration in n -th size fraction bed sediment (M/M)

C_m = cross-sectionally averaged particulate concentration in m -th size fraction sediment (M/M)

c_m = particulate concentration in m -th fraction size sediment (M/M)

C_w = cross-sectionally averaged dissolved concentration (M/L^3)

c_w = dissolved chemical concentration (M/L^3)

$\{C_w\}$ = a column vector representing the discrete field of dissolved chemical concentration (M/L^3)

$(C_m^{n+1})_i$ = the value of $(C_m)_i$ at time $(n+1)\Delta t$ (M/M)

$(C_w^{n+1})_i$ = the value of $(C_w)_i$ at time $(n+1)\Delta t$ (M/L^3)

$[D]$ = a global matrix associated with the degradation suspended sediment, and deposition term in the particulate chemical concentration equation, whose ij -th entry is defined by Eq. (42)

d_{IB} = the distance from the interior point to the boundary

D_m = deposition rate of m-th size fraction sediment ($M/L^2/T$)

$(D_m)_i$ = value of D_m at compartment i ($M/L^2/T$)

$\bar{\epsilon}$ = eddy diffusivity tensor (L^2/T)

E_m = erodibility of m-th size fraction sediment M/L^2

$\ell^{E_{11}}, \ell^{E_{12}}, \ell^{E_{21}}, \ell^{E_{22}}$ = four entries of the link matrix $[\ell^E]$ as given by Eq. (45)

f = a generalized variable which may denote $s_m, c_w, s_m c_m,$

$s_m, c_w,$ or $s_m c_m$

$\{F\}$ = a column vector representing the load function of Eq. (34)

whose i-th entry is given by Eq. (36)

f_D = described value of f on the Dirichlet boundary

f_1 = the value of f interior to the boundary

f_2 = the value of f at the boundary

f_1^{n+1} = the value of f_1 at time $(n+1)\Delta t$

f_2^{n+1} = the value of f_2 at time $(n+1)\Delta t$

$[G]$ = a global matrix associated with the degradation, suspended sediment, and bed sediment terms in the dissolved chemical concentration equation whose ij-th entry is given by Eq. (40)

H = water surface elevation (L)

h = water depth (L)

$[H]$ = a stiff matrix resulting from terms associated with advection and dispersion in sediment transport and dissolved chemical distribution equation

$[\ell^H]$ = a link matrix whose four entries are given by Eq. (37)

K_{an} = absorption-desorption rate constant of n-th fraction size sediment (1/T)

K_{bn} = sorption rate constant of sediment (1/T)

K_{dn} = equilibrium distribution coefficient of n-th fraction size sediment (L^3/M)

K_m = combined degradation rate constant of particulate chemical in m-th fraction size (1/T)

K_v = volatilization rate constant (1/T)

K_w = combined rate constant of dissolved chemical (1/L)

K_{xx} = longitudinal dispersion coefficient (L^2/T)

$[M]$ = a mass matrix, whose ij-th entry is given by Eqs. (35a) and (35b)

M_{cm} = source of particulate chemicals of m-th size fraction sediment (M/L/T)

M_{cw} = source of dissolved chemicals (M/L/T)

M_n = amount of chemicals in n-th size fraction bed sediment (M/L^3)

M_{sm} = source of m-th size fraction sediment (M/L/T)

$[N]$ = a mass matrix in Eq. (39) whose ij-th entry is given by Eq. (41)

$\vec{n}$ = outward unit vector normal to the boundary

N_i = number of compartments that link to i-th compartment

n_{ij} = directional sign from compartment i to compartment j

$$n_{ji} = -n_{ij}$$

P = wet perimeter of channel cross section (L)

$(M_{sm})_i$ = value of M_{sm} at compartment i (M/L/T)

Q = flow rate (L^3/T)

q = a generalized flux as defined by Eqs. (8), (9), or (10)
($M/L^2/T$)

q_C = total flux of sediment or chemicals ($M/L^2/T$)

Q_{cm} = source of particulate chemical of m-th fraction size
sediment ($M/L^3/T$)

Q_{GW} = source of dissolved chemical ($M/L^3/T$)

Q_{ij} = value of Q evaluated at the interface of compartments i
and j (L^3/T)

q_N = described Neumann flux of sediment or chemical ($M/L^2/T$)

Q_S = sediment load capacity (M/L)

Q_{SA} = actual sediment load (M/L)

Q_{sm} = source of m-th fraction size sediment ($M/L^3/T$)

R_m = erosion rate of m-th size fraction sediment ($M/L^2/T$)

$(R_m)_i$ = value of R_m at compartment i ($M/L^2/T$)

S_m = cross-sectionally averaged sediment concentration of m-th
size fraction (M/L^3)

s_m = sediment concentration of m-th fraction size (M/L^3)

$\{S_m\}$ = a column vector representing the discrete field of S_m

$(S_m)_i$ = value of S_m at i-th node (M/L^3)

$(S_m)_{ij}$ = value of S_m evaluated at the interface of compartments i
and j (M/L^3)

$(S_m^{n+1})_i$ = the value of $(S_m)_i$ at time $(n + 1)\Delta t$ (M/L^3)

t = time (T)

τ_b = bottom shear stress ($M/T^2/L$)

τ_{CDm} = critical shear stress for the deposition of m-th size
fraction sediment ($M/T^2/L$)

τ_{CRm} = critical shear stress for the erosion of m-th size fraction
sediment ($M/T^2/L$)

$\vec{V}$ = flow velocity vector (OL/T)

v_J = volume of the junction J (L^3)

$\vec{V}_{sm}$ = settling velocity vector (L/T)

$\{W\}$ = a column vector representing the load function of Eq. (38)
whose i-th entry is given by Eq. (43)

w_{sm} = vertical setting velocity (L/T)

x = longitudinal coordinate (L)

y = lateral coordinate (L)

$\{Y\}$ = a column vector representing the load function of Eq. (39)
whose i-th entry is given by Eq. (44)

z = coordinate perpendicular to x-y plane (L)

z_0 = channel bottom elevation (L)

Δt = time step size (T)

Δx_i = delta x of i-th compartment (L)

θ = an integration parameter

γ = -1.0 or 1.0

APPENDIX A

Input Data Guide of CHNTRN

1. PROBLEM DESCRIPTION: FORMAT(20A4) - ONE CARD PER PROBLEM.

```

-----
TITLE
-----
80

```

TITLE = AN ARRAY TO DESCRIBE THE PROBLEM TITLE. IT MAY CONTAIN UP TO 80 CHARACTERS.

2. BASIC INTEGER PARAMETERS: FORMAT(16I5) - ONE CARD PER PROBLEM.

```

-----
NODES  NCONS  NGRND  NTI  KVI  KSS  NEQS  IMPL
-----
5      10     15     20     25     30     35     40
-----
NSURS  NSPY
-----
45     50
-----
80

```

NODES = NO. OF TOTAL NODES (COMPARTMENTS).

NCONS = NO. OF TOTAL LINKS (INTERFACES).

NGRND = NO. OF GIVEN-BOUNDARY-VALUE LINKS.

NTI = NO. OF TIME STEPS.

KVI = AN INTEGER TO CONTROL THE TYPE AND DEVICE FOR INPUTTING HYDRODYNAMIC VARIABLES;
 .LE.0 = STEADY STATE INPUT VIA CARDS.
 1 = STEADY STATE INPUT VIA LOGICAL UNIT 1.
 2 = TRANSIENT INPUT VIA LOGICAL UNIT 1.

KSS = STEADY STATE SOLUTION DESIRED? 0 = NO.
 1 = YES.

NEQS = NO. OF EQUATIONS TO BE SOLVED. USUALLY EQUAL TO THE SUM OF INTERIOR NODES AND JUNCTIONS.

IMPL = IMPLICIT SCHEME? 0 = NO. 1 = YES.

NSURS = NO. OF SEDIMENT FRACTION.

NSPY = NO. OF CHEMICAL SPECIES FOR A TOXICANT.

Appendix A (continued)

3. PRINTING CONTROL INTEGERS: FORMAT(1615) - ONE CARD PER PROBLEM.

KPRD	KPRBS	KPRSI	KPRK	KPRCW	KPRBC	KPRCI	NREAD
5	10	15	20	25	30	35	40
NSTOR							
45							80

KPRD = TO PRINT EROSION AND DEPOSITION RATE? 0 = NO.
.GT. 0 EVERY KPRD TIME STEPS LINE-PRINT ONCE.

KPRBS = TO PRINT BED SEDIMENT? 0 = NO. .GT. 0 EVERY
KPRBS TIME STEPS LINE-PRINT ONCE.

KPRSI = TO PRINT SUSPENDED SEDIMENT CONCENTRATION?
C = NO. .GT. 0 EVERY KPRSI TIME STEPS LINE-
PRINT ONCE.

KPRK = TO PRINT RATE CONSTANT? 0 = NO. .GT. 0 EVERY
KPRK TIME STEPS LINE-PRINT ONCE.

KPRCW = TO PRINT DISSOLVED CONCENTRATION? 0 = NO.
.GT. 0 EVERY KPRCW TIME STEPS LINE-PRINT
ONCE.

KPRBC = TO PRINT BED CHEMICALS? 0 = NO. .GT. 0 EVERY
KPRBC TIME STEPS LINE-PRINT ONCE.

KPRCI = TO PRINT PARTICULATE CONCENTRATION? 0 = NO.
.GT. 0 EVERY KPRCI TIME STEPS LINE-PRINT ONCE.

NREAD = EVERY NREAD TIME STEPS READ HYDRODYNAMIC
VARIABLES VIA LOGICAL UNIT 1 ONCE. IF NREAD
EQUAL TO ZERO, READING OF HYDRODYNAMIC
VARIABLES AFTER FIRST TIME STEP IS NOT NEEDED.

NSTOR = EVERY NSTOR TIME STEPS, STORE THE RESULTS ON
LOGICAL UNIT 2.

Appendix A (continued)

4. BASIC REAL PARAMETERS: FORMAT(8F10.0) - ONE CARD PER PROBLEM.

DELT	CHNG	EDDY	THETA
10	20	30	40
			80

DELT = INITIAL TIME STEP SIZE, (T).

CHNG = PERCENTAGE CHANGE IN TIME STEP SIZE IN EACH OF THE SUBSEQUENT TIME STEPS, (T).

EDDY = EDDY DIFFUSIVITY, (L).

THETA = TIME INTEGRATION PARAMETER, 0.0 = EXPLICIT SCHEME, 0.5 = CRANK-NICOLSON SCHEME, 1.0 = IMPLICIT SCHEME.

5. NODE DATA: FORMAT(4I5,3D10.3) - THIS DATA SET IS REQUIRED ONLY IF KVI.LE.0. NORMALLY ONE CARD PER NODE IS NEEDED, I.E. A TOTAL OF NODES CARDS. HOWEVER, IF A GROUP OF NODES APPEARS IN REGULAR PATTERN, AUTOMATIC GENERATION CAN BE MADE.

CARD N -

NI	NSEQ	NTYPE	NAD	CNNI	DXNI	DXAD
5	10	15	20	30	40	50
						80

NI = GLOBAL NODE NUMBER OF THE FIRST NODE IN THE SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES, EACH WITH AN INCREMENT OF NAD, WILL BE GENERATED AUTOMATICALLY.

NTYPE = NODE TYPE OF NODE NI;
 0 = INTERIOR NODE,
 1 = DIRICHLET NODE,
 2 = NEUMANN NODE,
 3 = CAUCHY NODE,
 4 = VARIABLE NODE.

NAD = NODE INCREMENT FOR EACH OF THE NSEQ SUBSEQUENT NODES.

CNNI = MANNING-N FOR NODE NI AND ALL NSEQ SUBSEQUENT NODES

DXNI = DELTA X FOR COMPARTMENT NI, (L).

DXAD = INCREMENT OF DELTA X FOR EACH OF THE NSEQ SUBSEQUENT NODES.

Appendix A (continued)

6. LINK DATA: FORMAT(8I5,2D10.2) - THIS DATA SET IS NEEDED ONLY IF KVI IS LESS THAN OR EQUAL TO 75PC. NORMALLY ONE CARD PER LINK IS REQUIRED. HOWEVER, IF A GROUP OF LINKS APPEARS IN A REGULAR PATTERN, AUTOMATIC GENERATION CAN BE MADE.

CARD K -

```

-----
KI  NO1  NO2  KTYP  NSEQ  ND1  ND2  KSGN  D1K  D2K
-----
  5   10   15   20   25   30   35   40   50   60   70   80
-----

```

KI = GLOBAL LINK NUMBER OF THE FIRST LINK IN THE SEQUENCE.

NO1 = GLOBAL NODE NUMBER OF THE FIRST NODE OF LINK KI.

NO2 = GLOBAL NODE NUMBER OF THE SECOND NODE OF LINK KI.

KTYP = LINK TYPE OF THE LINK KI AND THE NSEQ LINKS;
 0 = INTERIOR LINK, 1 = LINK TO DIRICHLET NODE,
 2 = LINK TO NEUMANN NODE, 3 = LINK TO CAUCHY NODE,
 4 = LINK TO JUNCTIONS.

NSEQ = NSEQ SUBSEQUENT LINKS WILL BE MADE AUTOMATICALLY.

ND1 = NODE INCREMENT OF THE FIRST NODE IN EACH OF THE NSEQ SUBSEQUENT LINKS.

ND2 = NODE INCREMENT OF THE SECOND NODE IN EACH OF THE NSEQ SUBSEQUENT LINKS.

KSGN = DIRECTIONAL SIGN FOR THE LINK KI AND ALL THE NSEQ SUBSEQUENT LINKS.

D1K = DISTANCE FROM THE FIRST NODE TO THE INTERFACE OF LINK KI AND IS USED FOR ALL THE NSEQ SUBSEQUENT LINKS. (L)

D2K = DISTANCE FROM THE SECOND NODE TO THE INTERFACE OF LINK KI AND IS USED FOR ALL THE NSEQ SUBSEQUENT LINKS. (L).

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS DATA SET.

Appendix A (continued)

7. BOUNDARY LINK DATA: FORMAT(16I5) - THE NUMBER OF CARDS FOR THIS DATA SET DEPENDS ON NGBND. EACH CARD WILL CONTAIN INFORMATION FOR EIGHT LINKS. THUS THE NUMBER OF CARDS REQUIRED IS (NGBND/8+1).

```

-----
KGBND(1) IGBTYP(1) KGBND(2) IGBTYP(2) ---
-----
      5          10          15          20          80
      .
-----
KGBND(I) IGBTYP(I) --- KGBND(NGBND) IGBTYP(NGBND)
-----
      5          10          80

```

KGBND(I) = GLOBAL LINK NUMBER OF I-TH BOUNDARY LINK.

IGBTYP(I) = LINK TYPE OF I-TH BOUNDARY LINK.

8. SEDIMENT-CHEMICAL INTERACTION PARAMETERS: THREE GROUP OF CARDS ARE REQUIRED FOR THIS DATA SET. ONE GROUP IS FOR THE ADSORPTION RATE CONSTANT OF THE SUSPENDED SEDIMENT, ONE FOR THE DISTRIBUTION COEFFICIENT, AND THE OTHER FOR THE ADSORPTION RATE CONSTANT OF BED SEDIMENT.

- (A) SUSPENDED SEDIMENT RATE CONSTANT - FORMAT(8F10.0).

```

-----
ABSOPK(1) ABSOPK(2) --- ABSOPK(I) --- ABSOPK(NSUBS)
-----
      10          20          80

```

ABSOPK(I) = ADSORPTION RATE CONSTANT OF SUSPENDED SEDIMENT OF I-TH FRACTION SIZE OR I-TH SUBSTANCE, (L**3/M/T).

- (B) EQUILIBRIUM DISTRIBUTION COEFFICIENT - FORMAT(8F10.0).

```

-----
EQILKD(1) EQILKD(2) --- EQILKD(I) --- EQILKD(NSUBS)
-----
      10          20          80

```

EQILKD(I) = DISTRIBUTION COEFFICIENT OF I-TH FRACTION SIZE SEDIMENT OR I-TH SUBSTANCE, (L**3/M).

- (C) BED SEDIMENT RATE CONSTANT - FORMAT(8F10.0).

```

-----
ABSOPB(1) ABSOPB(2) --- ABSOPB(I) --- ABSOPB(NSUBS)
-----
      10          20          80

```

ABSOPB(I) = ADSORPTION RATE CONSTANT OF BED SEDIMENT OF I-TH FRACTION SIZE OR I-TH SUBSTANCE, (L/T).

Appendix A (continued)

9. EROSION AND DEPOSITION PARAMETERS: FOUR GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ IN THE SETTLING VELOCITY OF SEDIMENT. THE SECOND, THIRD, AND FOURTH GROUPS ARE FOR THE CRITICAL SHEAR STRESS OF DEPOSITION, CRITICAL SHEAR STRESS OF EROSION, AND SEDIMENT DIAMETER, RESPECTIVELY.

(A) SETTLING VELOCITY: FORMAT(8D10.3)

```
-----
WSK(1) WSK(2) --- WSK(I) --- WSK(NSUBS)
-----
10      20      80
```

WSK(I) = SETTLING VELOCITY OF I-TH SEDIMENT SIZE FRACTION, (L).

(B) CRITICAL SHEAR STRESS OF DEPOSITION: FORMAT(8D10.3)

```
-----
TAUCD(1) TAUCD(2) --- TAUCD(I) --- TAUCD(NSUBS)
-----
10      20      80
```

TAUCD(I) = CRITICAL SHEAR STRESS OF DEPOSITION FOR I-TH SEDIMENT SIZE FRACTION, (F/L**2).

(C) CRITICAL SHEAR STRESS OF EROSION: FORMAT(8D10.3)

```
-----
TAUCR(1) TAUCR(2) --- TAUCR(I) --- TAUCR(NSUBS)
-----
10      20      80
```

TAUCR(I) = CRITICAL SHEAR STRESS OF EROSION FOR I-TH SEDIMENT SIZE FRACTION, (F/L**2).

(D) DIAMETER: FORMAT(8D10.3)

```
-----
DIAMS(1) DIAMS(2) --- DIAMS(I) --- DIAMS(NSUBS)
-----
10      20      80
```

DIAMS(I) = DIAMETER OF I-TH SEDIMENT SIZE FRACTION, (L).

Appendix A (continued)

10. PARAMETERS FOR COMPUTING VOLATILIZATION RATE CONSTANTS: TWO GROUPS OF CARDS ARE NEEDED: ONE FOR THE MOLECULAR WEIGHT AND THE OTHER FOR HENRY'S CONSTANT. THE NUMBER OF CARDS IN EACH GROUP DEPENDS ON NSUBSP AND NSPY (WHERE NSUBSP = NSUBS + 1).

(A) MOLECULAR WEIGHT: FORMAT(8D10.3)

```

-----MOLEW(1,1) MOLEW(1,2) ---- MOLEW(1,NSUBSP) MOLEW(2,1)-----
-----10      20      -----80
-----MOLEW(2,2) ---- MOLEW(2,NSUBSP) ---- MOLEW(1,1) MOLEW(1,2)-----
-----10      20      -----80
-----MOLEW(1,NSUBSP) ---- MOLEW(NSPY,NSUBSP)-----
-----80

```

MOLEW(I,J) = MOLECULAR WEIGHT OF CHEMICAL ASSOCIATED WITH I-TH SPECIES, J-TH SEDIMENT SIZE, (GRAM/MOLE).

(B) HENRY'S CONSTANT: FORMAT(8D10.3)

```

-----HENRY(1,1) HENRY(1,2) ---- HENRY(1,NSUBSP) HENRY(2,1)-----
-----10      20      -----80
-----HENRY(2,2) ---- HENRY(2,NSUBSP) ---- HENRY(1,1) HENRY(1,2)-----
-----10      -----80
-----HENRY(1,NSUBSP) ---- HENRY(NSPY,NSUBSP)-----
-----80

```

HENRY(I,J) = HENRY'S CONSTANT ASSOCIATED WITH I-TH CHEMICAL SPECIES, J-TH SEDIMENT SIZE, (ATM-M**3/MOLE).

Appendix A (continued)

11. PARAMETERS FOR COMPUTING PHOTOLYSIS RATE CONSTANTS: FIVE GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP CONTAINS ONE CARD. THE SECOND THROUGH FOURTH GROUPS EACH CONTAIN SEVERAL CARDS. THE NUMBER OF WHICH DEPENDS ON NSPY AND NSUBSP. THE FIFTH GROUP ALSO CONTAINS SEVERAL CARDS, THE NUMBER OF WHICH DEPENDS ON NSPY. THE SECOND THROUGH FIFTH GROUPS ARE READ SIMILARLY TO THAT IN SUB-DATA SET 10.(A) OR 10.(B).

(A) CLOUD AND LATITUDE INFORMATION: FCRMAT(8D10.3)

```

-----
CLOUDG  FLATG  -----
  10      20
-----
CLOUDG = AVERAGE CLOUDINESS OF FULL SKY COVER IN TENTHS.
FLATG  = GEOGRAPHICAL LATITUDE OF THE REGION OF INTERET,
        (DEGREE).
  
```

(B) NEAR-SURFACE PHOTOLYSIS RATE CONSTANT: FORMAT(8D10.3)

```

-----
KDPG(I,1) KDPG(I,2) --- KDPG(I,J) --- KDPG(I,NSUBSP) ---
  10      20                                     80
-----
--- KDPG(I,1) KDPG(I,2) --- KDPG(NSPY,NSUBSP)
-----
                                     80
KDPG(I,J) = NEAR-SURFACE PHOTOLYSIS CONSTANT THROUGH
             J-TH SEDIMENT SIZE FOR I-TH CHEMICAL SPECIES
             OF THE TOXICANT, (1/HR).
  
```

(C) REFERENCE LATITUDE: FCRMAT(8D10.3)

```

-----
RFLAG(I,1) RFLAG(I,2) --- RFLAG(I,J) --- RFLAG(I,NSUBSP) ---
  10      20                                     80
-----
--- RFLAG(I,1) RFLAG(I,2) --- RFLAG(NSPY,NSUBSP)
-----
                                     80
RFLAG(I,J) = REFERENCE LATITUDE FOR THE CORRESPONDING
             DIRECT PHOTOLYSIS RATE CONSTANT, (DEGREE).
  
```

Appendix A (continued)

(D) REACTION QUANTUM YIELD: FORMAT(8D10.3)

```

QUANTG(1,1) QUANTG(1,2) -- QUANTG(1,J) -- QUANTG(1,NSJBSP) --
      10      20                                     80
-- QUANTG(1,1) QUANTG(1,2) -- QUANTG(NSPY,NSUBSP)
                                     80

```

QUANTG(I,J) = REACTION QUANTUM YIELD THROUGH J-TH SEDIMENT
SIZE FRACTION OF I-TH CHEMICAL SPECIES OF
THE TOXICANT IN PHOTOLYTIC TRANSFORMATION.
(DIMENSIONLESS).

(E) ABSORPTION SPECTRUM: FORMAT(8D10.3)

```

ABSG(1,1) ABSG(1,2) ABSG(1,3) ----- ABSG(1,8)
      10      20      30                                     80
      :
ABSG(1,33) ABSG(1,34) ----- ABSG(1,39) ABSG(2,1)
      10      20                                     80
ABSG(2,2) ABSG(2,3) ----- ABSG(2,9)
      10      20                                     80
      :
----- ABSG(NSPY,1) ABSG(NSPY,2) ABSG(NSPY,3) -----
                                     80
      :
----- ABSG(NSPY,39)
                                     80

```

ABSG(I,J) = J-TH ABSORPTION SPECTRUM (MOLAR EXTINCTION
COEFFICIENT) FOR THE I-TH CHEMICAL SPECIES.
(1/CM/(MOLE/LITER)).

Appendix A (continued)

12. PARAMETERS FOR COMPUTING HYDROLYSIS RATE CONSTANTS: SIX GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST, SECOND, AND THIRD GROUPS OF CARDS CONTAIN SECOND ORDER, FIRST ORDER, AND SECOND ORDER RATE CONSTANTS FOR ACID, NEUTRAL, AND BASE HYDROLYSIS, RESPECTIVELY. THE FOURTH, FIFTH, AND SIXTH GROUPS OF CARDS CONTAIN ARRHENIUS ACTIVITY ENERGY FOR ACID, NEUTRAL, AND BASE HYDROLYSIS, RESPECTIVELY. THE NUMBER OF CARDS IN EACH GROUP DEPENDS ON NSPY AND NSUBSP. EACH GROUP IS READ IN SIMILARLY TO THAT IN SUR-DATA SET 10.(A) OR 10.(B).

(A) SECOND-ORDER ACID HYDROLYSIS RATE CONSTANT: FORMAT(3D10.3)

```

KAHG(1,1) KAHG(1,2) --- KAHG(1,NSUBSP) KAHG(2,1) ---
-----
      10      20      30                                     80
      :
KAHG(2,NSUBSP) --- KAHG(1,1) --- KAHG(1,J) ---
-----
                                     80
      :
KAHG(1,NSUBSP) --- KAHG(NSPY,1) --- KAHG(NSPY,NSUBSP) ---
-----
                                     80

```

KAHG(I,J) = SECOND ORDER RATE CONSTANTS FOR ACID
HYDROLYSIS OF I-TH CHEMICAL SPECIES
THROUGH J-TH SEDIMENT, (/MOLE OF H⁺/T).

(B) FIRST-ORDER RATE CONSTANT FOR NEUTRAL HYDROLYSIS

```

KNHG(1,1) KNHG(1,2) --- KNHG(1,NSUBSP) KNHG(2,1) ---
-----
      10      20                                     80
      :
KNHG(2,NSUBSP) --- KNHG(1,1) --- KNHG(1,J) ---
-----
                                     80
      :
KNHG(1,NSUBSP) --- KNHG(NSPY,1) --- KNHG(NSPY,NSUBSP) ---
-----
                                     80

```

KNHG(I,J) = FIRST ORDER RATE CONSTANTS FOR NEUTRAL
HYDROLYSIS OF I-TH CHEMICAL SPECIES
THROUGH J-TH SEDIMENT, (/T).

Appendix A (continued)

```

-----
ENHG(2,NSUBSP) ---- ENHG(I,I) --- ENHG(I,J) ---
-----
:
-----
ENHG(1,NSUBSP) ---- ENHG(NSPY,I) --- ENHG(NSPY,NSUBSP) ---
-----

```

ENHG(I,J) = ARRHENIUS ACTIVITY ENERGY FOR NEUTRAL
HYDROLYSIS OF I-TH CHEMICAL SPECIES
THROUGH J-TH SEDIMENT, (KCAL/MOLE).

(F) ARRHENIUS ACTIVITY ENERGY FOR BASE HYDROLYSIS

```

-----
EBHG(1,1) EBGH(1,2) --- EBGH(1,NSUBSP) EBGH(2,1) ---
-----
10      20
:
-----
EBHG(2,NSUBSP) ---- EBGH(I,I) --- EBGH(I,J) ---
-----
:
-----
EBHG(1,NSUBSP) ---- EBGH(NSPY,I) --- EBGH(NSPY,NSUBSP) ---
-----

```

EBHG(I,J) = ARRHENIUS ACTIVITY ENERGY OF I-TH CHEMICAL
SPECIES THROUGH J-TH SEDIMENT FOR BASE
HYDROLYSIS, (KCAL/MOLE)

13. PARAMETERS FOR COMPUTING OXIDATION RATE CONSTANTS.
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP
IS TO READ SECOND ORDER RATE CONSTANT FOR OXIDATION AND THE SECOND
GROUP IS TO READ ARRHENIUS ACTIVITY ENERGY FOR OXIDATION. THE
NUMBER OF CARDS IN EACH GROUP DEPENDS ON NSPY AND NSUBSP. EACH
GROUP IS READ IN SIMILARLY TO THAT IN SUB-DATA SET 10.(B) OR 10.(C).

(A) SECOND-ORDER RATE CONSTANT FOR OXIDATION

```

-----
KOXG(1,1) KOXG(1,2) --- KOXG(1,NSUBSP) KOXG(2,1) ---
-----
10      20
-----

```


Appendix A (continued)

```

-----KDXG(2,NSUBSP)-----KDXG(1,1)---KDXG(1,J)---
-----80

```

```

-----KDXG(1,NSUBSP)-----KDXG(NSPY,1)---KDXG(NSPY,NSUBSP)---
-----80

```

KDXG(I,J) = SECOND ORDER RATE CONSTANT OF I-TH CHEMICAL SPECIES THROUGH J-TH SEDIMENT FOR OXIDATION (/MOLE OF OXIDANT/T).

(B) ARPHENIUS ACTIVITY ENERGY FOR OXIDATION

```

-----EOXG(1,1)EOXG(1,2)---EOXG(1,NSUBSP)EOXG(2,1)---
-----10      20      80

```

```

-----EOXG(2,NSUBSP)-----EOXG(1,1)---EOXG(1,J)---
-----80

```

```

-----EOXG(1,NSUBSP)-----EOXG(NSPY,1)---EOXG(NSPY,NSUBSP)---
-----80

```

EOXG(I,J) = ARREHENIUS ACTIVITY ENERGY OF I-TH CHEMICAL SPECIES THROUGH J-TH SEDIMENT FOR OXIDATION (KCAL/MOLE).

14. PARAMETERS FOR COMPUTING RATE CONSTANTS FOR BIOLYSIS
FOUR GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ IN SECOND ORDER RATE CONSTANTS OF BIOLYSIS THROUGH DISSOLVED PHASE, THE SECOND GROUP IS TO READ SECOND-ORDER RATE CONSTANT OF BIOLYSIS THROUGH SORBED PHASE, THE THIRD GROUP IS TO READ IN Q-10 VALUE FOR THE FIRST GROUP, AND THE FOURTH GROUP IS TO READ IN Q-10 VALUE FOR THE SECOND GROUP. THE NUMBER OF CARDS IN EACH GROUP DEPENDS ON NSPY AND NSUBSP. EACH GROUP IS READ IN SIMILARLY TO THAT OF SUB-DATA SET 10.(B) AND 10.(C).

(A) SECOND-ORDER RATE CONSTANT OF BIOLYSIS THROUGH DISSOLVED PHASE

```

-----KBACWG(1,1)KBACWG(1,2)---KBACWG(1,NSUBSP)KBACWG(2,1)---
-----10      20      80

```

Appendix A (continued)

KBACWG(2,NSUBSP) ---- KBACWG(I,I) --- KBACWG(I,J) ---

80

KBACWG(I,NSUBSP) ---- KBACWG(NSPY,I) --- KBACWG(NSPY,NSJBSP)

80

KBACWG(I,J) = SECOND-ORDER RATE CONSTANT OF I-TH CHEMICAL
SPECIES THROUGH J-TH SEDIMENT BY WATER-BORNE
BACTERIALS, (/ (CELL/L**3)/T).

(B) SECOND ORDER RATE CONSTANT OF BIOLYSIS THROUGH SORBED PHASE

KBACSG(1,1) KBACSG(1,2) --- KBACSG(1,NSUBSP) KBACSG(2,1) ---

10

20

80

KBACSG(2,NSUBSP) ---- KBACSG(I,I) --- KBACSG(I,J) ---

80

KBACSG(I,NSUBSP) ---- KBACSG(NSPY,I) --- KBACSG(NSPY,NSJBSP)

80

KBACSG(I,J) = SECOND-ORDER RATE CONSTANT OF I-TH CHEMICAL
SPECIES THROUGH J-TH SEDIMENT BY SEDIMENT-
BORNE BACTERIALS, (/ (CELL/M)/T).

(C) Q-10 VALUES FOR KBACWG

QTBWAG(1,1) QTBWAG(1,2) --- QTBWAG(1,NSUBSP) QTBWAG(2,1) ---

10

20

80

QTBWAG(2,NSUBSP) ---- QTBWAG(I,I) --- QTBWAG(I,J) ---

80

QTBWAG(I,NSUBSP) ---- QTBWAG(NSPY,I) --- QTBWAG(NSPY,NSJBSP)

80

QTBWAG(I,J) = Q-10 VALUES FOR KBACWG(I,J), (DIMENSIONLESS)

Appendix A (continued)

(D) 0-10 VALUES FOR KBACSG

```

-----
QTBASG(I,1) QTBASG(I,2) --- QTBASG(I,NSUBSP) QTBASG(2,1) ---
-----
10 20 : 80
:
QTBASG(2,NSUBSP) --- QTBASG(I,1) --- QTBASG(I,J) ---
-----
80
:
QTBASG(I,NSUBSP) --- QTBASG(NSPY,1) --- QTBASG(NSPY,NSUBSP)
-----
80
QTBASG(I,J) = 0-10 VALUES FOR KBACSG(I,J). (DIMENSIONLESS)

```

15. INITIAL CONDITIONS FOR SUSPENDED SEDIMENTS
 NSUBS GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. ONE GROUP EACH FOR ONE SUSPENDED SEDIMENT FRACTION. NORMALLY EACH GROUP WILL HAVE NODES CARDS. HOWEVER, AUTOMATIC GENERATION MAY BE MADE IF A GROUP OF INITIAL SEDIMENT CONCENTRATION APPEAR IN REGULAR PATTERN.

FOR J-TH SEDIMENT FRACTION - FORMAT(3I5,5X,2F10:0).

```

-----
NI  NSEQ  NIAD  SEDCN(NI,J)  FAD
-----
5   10   15   20   30   40

```

NI = NODE (COMPARTMENT) NUMBER OF THE FIRST NODE IN A SEQUENCE OF NODES TO BE GENERATED AUTOMATICALLY.

NSEQ = NSEQ SUBSEQUENT NODES (COMPARTMENTS) WILL BE GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

SEDCN(NI,J) = INITIAL SEDIMENT CONCENTRATION OF J-TH FRACTION FOR COMPARTMENT NI. (M/L**3).

FAD = INCREMENT OF INITIAL SEDIMENT CONCENTRATION OF J-TH SEDIMENT FRACTION FOR EACH OF THE NSEQ SUBSEQUENT COMPARTMENTS. (M/L**3).

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUB-DATA SET.

Appendix A (continued)

16. INITIAL DISSOLVED CONCENTRATION - FORMAT(3I5,5X,2F10.0).
THIS DATA SET IS READ IN SIMILARLY TO THAT IN DATA SET 15. HOWEVER,
ONLY ONE GROUP OF CARDS IS NEEDED.

NI	NSEQ	NIAD	DCN(NI)		FAD	
5	10	15	20	30	40	80

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL BE AUTOMATICALLY GENERATED.

NIAD = INCREMENT OF NODES FOR EACH THE NSEQ SUBSEQUENT NODES.

DCN(NI) = DISSOLVED INITIAL CHEMICAL CONCENTRATION AT NODE NI,
(M/L**3).

FAD = INCREMENT OF DCN FOR EACH OF THE NSEQ SUBSEQUENT
NODES, (M/L**3).

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF
THIS SUB-DATA SET

17. INITIAL PARTICULATE CONCENTRATION - FORMAT(3I5,5X,2F10.0).
NSUBS GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET, ONE GROUP EACH
FOR ONE OF THE NSUBS FRACTION INITIAL PARTICULATE CONCENTRATIONS
EACH GROUP IS READ IN SIMILAR TO THAT IN DATA SET 15.

FOR J-TH PARTICULATE INITIAL CONCENTRATION.

NI	NSEQ	NIAD	PCN(NI,J)		FAD	
5	10	15	20	30	40	80

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR INITIAL
PARTICULATE CONCENTRATION GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ
SUBSEQUENT NODES.

PCN(NI,J) = INITIAL PARTICULATE CONCENTRATION OF J-TH FRACTION
AT NODE NI, (M/M).

FAD = INCREMENT OF PCN FOR EACH OF THE NSEQ SUBSEQUENT
NODES, (M/M).

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS
SUB-DATA SET.

Appendix A (continued)

18. INITIAL BED SEDIMENT - FORMAT(3I5,5X,2F10.0).
NSUBS GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. ONE GROUP FOR
EACH OF THE NSUBS BED SEDIMENT FRACTIONS. EACH GROUP IS READ IN
SIMILAR TO THAT OF DATA SET 15.

FOR J-TH SEDIMENT FRACTION

NY	NSEQ	NIAO	BEDSD(NY, J)			FAO
5	10	15	20	30	40	50

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUP-DATA SET.

19. INITIAL RED CHEMICALS - FORMAT(315,5X,2F10.0).
NSUBS GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. ONE GROUP EACH
FOR ONE OF THE NSUBS RED CHEMICAL FRACTIONS. EACH GROUP IS READ IN
SIMILARLY TO THAT OF DATA SET 15.

FOR J-TH BED CHEMICALS

NI	NSEQ	NYAD	BDSCHM(NY, J)			FAO
5	10	15	20	30	40	80

Appendix A (continued)

FAD = INCREMENT OF RDCHW FOR EACH OF THE NSEQ
SUBSEQUENT NODES, (N/L**2).

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF
THIS SUB-DATA SET.

20. SEDIMENT SOURCES/SINKS
THE FOLLOWING GROUPS OF DATA SHOULD BE REPEATED FOR EACH SEDIMENT
SIZE FRACTION. IN OTHER WORD, FOR EACH SEDIMENT FRACTION SIZE,
TWO GROUPS OF CARDS PLUS ONE BLANK CARD ARE REQUIRED.
- (A) SOURCE/SINK PROFILE FOR M-TH SEDIMENT FRACTION -
THE NUMBER OF CARDS IN THIS GROUP DEPENDS ON NSPR AND NSDP.
THIS GROUP OF CARDS IS READ IN NSPR-WISELY. FOR EACH OF THE
NSPR PROFILES, A NUMBER OF CARDS ARE NEEDED DEPENDING ON
NSDP. EACH CARD CONTAINS FOUR DATA POINTS, THUS EACH PROFILE
WILL REQUIRE (NSDP/4 + 1) CARDS.
- FIRST PROFILE - FORMAT(8D10.3)
TSSTAB(1,1,M)	SSTAB(1,1,M)	TSSTAB(1,2,M)	SSTAB(1,2,M)	---
10	20	30	40	80
:				

TSSTAB(1,NSDP,M)				SSTAB(1,NSDP,M)

80				
- SECOND PROFILE - FORMAT(8D10.3)
TSSTAB(2,1,M)	SSTAB(2,1,M)	TSSTAB(2,2,M)	SSTAB(2,2,M)	---
10	20	30		80
:				

TSSTAB(2,NSDP,M)				SSTAB(2,NSDP,M)

80				
- :
- NSPR-TH PROFILE - FORMAT(8D10.3)
TSSTAB(NSPR,1,M)	SSTAB(NSPR,2,M)	TSSTAB(NSPR,2,M)	---
10	20		80

Appendix A (continued)

```

-----TSSTAB(NSPR,NSDP,M) SSTAB(NSPR,NSDP,M)-----
-----80

```

TSSTAB(I,J,M) = TIME OF J-TH DATA POINT ON I-TH SOURCE/
SINK PROFILE OF M-TH FRACTION. (T).

SSTAB(I,J,M) = SOURCE/SINK VALUE OF J-TH DATA POINT ON
I-TH PROFILE OF M-TH FRACTION. (M/L).

- (B) SOURCE/SINK TYPE OF EACH NODE FOR M-TH FRACTION - FORMAT(4I5).
NORMALLY, ONE CARD PER NODE IS REQUIRED. HOWEVER, IF THE
SOURCE/SINK APPEARS IN REGULAR PATTERN, AUTOMATIC GENERATION
MAY BE MADE.

```

-----NI NSEQ NIAD ISSTYP(NI,M)-----
-----5 10 15 20-----80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR
SOURCE/SINK TYPE GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE
NSEQ SUBSEQUENT NODES.

ISSTYP(NI,M) = SOURCE TYPE TO BE APPLIED TO NODE NI AND
THE NSEQ SUBSEQUENT NODES FOR M-TH
SEDIMENT FRACTION.

*** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END
OF THIS SUB-DATA SET.

21. SOURCES/SINKS OF DISSOLVED CHEMICALS
THIS DATA SET IS READ IN SIMILAR TO THAT IN 20.(A) AND 20.(B).

(A) SOURCE/SINK PROFILE FOR DISSOLVED CHEMICALS

FIRST PROFILE - FORMAT(8D10.3)

```

-----TSWTAB(1,1) SWTAB(1,1) TSWTAB(1,2) SWTAB(1,2)-----
-----10 20 30 40 80-----
:
-----TSWTAB(1,NSDP) SWTAB(1,NSDP)-----
-----80

```

Appendix A (continued)

SECOND PROFILE

```

-----
TSWTAB(2,1)  SWTAB(2,1)  TSWTAB(2,2)  SWTAB(2,2)  ----
-----
      10      20      30      40      80
      .
-----
--- TSWTAB(2,NSDP)  SWTAB(2,NSDP)
-----
                                     80

```

NSPR-PROFILE

```

-----
TSWTAB(NSPP,1)  SWTAB(NSPP,1)  TSWTAB(NSPP,2)  ----
-----
      10      20      30      80
      .
-----
--- TSWTAB(NSPP,NSDP)  SWTAB(NSPP,NSDP)
-----
                                     80

```

TSWTAB(I,J) = TIME OF J-TH DATA POINT ON I-TH SOURCE/SINK PROFILE, (T).

SWTAB(I,J) = VALUE OF SOURCE/SINK OF J-TH DATA POINT ON I-TH PROFILE, (N/L) OR (N/L**2) FOR JUNCTION.

(9) TYPE OF SOURCE/SINK PROFILE AT EACH NODE FOR DISSOLVED CHEMICALS

```

-----
NI  NSEQ  NIAD  ISWTYP(NI)
-----
  5    10    15    20    80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR SOURCE/SINK PROFILE TYPE GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

ISWTYP(NI) = TYPE OF SOURCE/SINK PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL END OF THIS SUB-DATA SET.

Appendix A (continued)

22. PARTICULATE CHEMICAL SOURCES/SINKS
THE FOLLOWING GROUPS OF DATA SHOULD BE REPEATED FOR EACH PARTICULATE CHEMICALS. IN OTHER WORDS, FOR EACH PARTICULATE CHEMICALS, TWO GROUPS OF CARDS PLUS ONE PLANK CARD ARE REQUIRED.

(A) SOURCE/SINK PROFILE FOR M-TH PARTICULATE CHEMICALS
THE NUMBER OF CARDS IN THIS GROUP DEPENDS ON NSPP AND NSDP.
THIS GROUP OF CARDS IS READ IN NSPP-WISELY. FOR EACH OF THE
NSPP PROFILES, A NUMBER OF CARDS ARE NEEDED DEPENDING ON
NSDP. EACH CARD CONTAINS FOUR DATA POINTS, THUS EACH PROFILE
WILL REQUIRE $(NSDP/4 + 1)$ CARDS.

FIRST PROFILE - FORMAT(8D10.3)

```

-----
TSPTAB(1,1,M) SPTAB(1,1,M) TSPTAB(1,2,M) SPTAB(1,2,M) ----
-----
10          20          30          40          80
          :
-----
TSPTAB(1,NSDP,M) SPTAB(1,NSDP,M)
-----
80

```

SECOND PROFILE - FORMAT(8D10.3)

```

-----
TSPTAB(2,1,M) SPTAB(2,1,M) TSPTAB(2,2,M) SPTAB(2,2,M) ----
-----
10          20          30          80
          :
-----
TSPTAB(2,NSDP,M) SPTAB(2,NSDP,M)
-----
80

```

NSPP-TH PROFILE - FORMAT(8D10.3)

```

-----
TSPTAB(NSPP,1,M) SPTAB(NSPP,1,M) TSPTAB(NSPP,2,M) SPTAB(NSPP,2,M) ----
-----
10          20          80
          :
-----
TSPTAB(NSPP,NSDP,M) SPTAB(NSPP,NSDP,M)
-----
80

```

TSPTAB(I,J,M) = TIME OF J-TH DATA POINT ON I-TH SOURCE/

Appendix A (continued)

SINK PROFILE OF M-TH PARTICULATE
CHEMICALS. (T)

SPTAB(I,J,M) = SOURCE/SINK VALUE OF J-TH DATA POINT ON
I-TH PROFILE OF M-TH PARTICULATE CHEMICALS,
(M/L) OR (M/L**2) FOR JUNCTION.

- (B) SOURCE/SINK TYPE OF EACH NODE FOR M-TH PARTICULATE CHEMICALS.
NORMALLY, ONE CARD PER NODE IS REQUIRED. HOWEVER, IF THE
SOURCE/SINK APPEARS IN REGULAR PATTERN, AUTOMATIC GENERATION
MAY BE MADE.

```
-----
NI      NSEQ      NIAD      ISPTYP(NI,M)
-----
5        10        15        20                80
-----
```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR
SOURCE/SINK TYPE GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE
NSEQ SUBSEQUENT NODES.

ISPTYP(NI,M) = SOURCE TYPE TO BE APPLIED TO NODE NI AND
THE NSEQ SUBSEQUENT NODES FOR M-TH
PARTICULATE CHEMICALS.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END
OF THIS SUB-DATA SET.

DATA SETS 23 THROUGH 34 ARE THE TRANSIENT ENVIRONMENTAL DATA.
THEY ARE TO BE USED IN CONJUNCTION WITH DATA SETS 10 THROUGH 14
FOR COMPUTING RATE CONSTANTS OF VOLATILIZATION, PHOTOLYSIS,
HYDROLYSIS, OXIDATION, AND BIOLYSIS.

23. AIR TEMPERATURE

TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP
IS TO READ THE PROFILES OF AIR TEMPERATURE VS TIME. THE SECOND
GROUP IS TO READ THE TYPE OF AIR TEMPERATURE VS TIME PROFILE ASSIGNED
TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ
IN NATPR-WISELY, WHERE NATPR IS THE NUMBER OF AIR TEMPERATURE
PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON
NTADP WHERE NTADP IS THE NUMBER OF AIR TEMPERATURE DATA POINT.
EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES
(NTADP/4 + 1) CARDS.

Appendix A (continued)

(A) AIR TEMPERATURE VS TIME PROFILES

FIRST PROFILE

```

-----
TTATAB(1,1) TATAB(1,2) TTATAB(1,2) TATAB(1,2) ---
-----
10          20          30          40          80

```

```

-----
- TTATAB(1,J) TATAB(1,J) --- TTATAB(1,NTAB) TATAB(1,NTAB)
-----
80

```

SECOND PROFILE

```

-----
TTATAB(2,1) TATAB(2,1) TTATAB(2,2) TATAB(2,2) ---
-----
10          20          30          40          80

```

```

-----
- TTATAB(2,J) TATAB(2,J) --- TTATAB(2,NTAB) TATAB(2,NTAB)
-----
80

```

NTAB-TH PROFILE

```

-----
TTATAB(NTAB,1) TTATAB(NTAB,1) TTATAB(NTAB,2) ---
-----
10          20          80

```

```

-----
- TTATAB(NTAB,J) TATAB(NTAB,J) --- TATAB(NTAB,NTAB)
-----
80

```

TTATAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH AIR
TEMPERATURE PROFILE, (T).

TATAB(I,J) = AIR TEMPERATURE OF J-TH DATA POINT FOR
I-TH PROFILE, (DEGREE C).

- (B) TYPE OF AIR TEMPERATURE PROFILE ASSIGNED TO THE NODES.
NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES
CARDS ARE NEEDED. HOWEVER, IF THE AIR TEMPERATURE APPEAR
IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI  NSEQ  NIAD  ITATYP(NI)
-----
5    10    15    20          80

```

Appendix A (continued)

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR AIR TEMPERATURE PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

ITATYP(NI) = TYPE OF AIR TEMPERATURE PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

24. SOLAR RADIATION
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF SOLAR RADIATION VS TIME. THE SECOND GROUP IS TO READ THE TYPE OF SOLAR RADIATION VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NSRPR-WISELY, WHERE NSRPR IS THE NUMBER OF SOLAR RADIATION PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NSRDP WHERE NSRDP IS THE NUMBER OF SOLAR RADIATION DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NSRDP/4 + 1)$ CARDS.

(A) SOLAR RADIATION VS TIME PROFILES

FIRST PROFILE

```

-----
TSRTAB(1,1) SRTAB(1,2) TSRTAB(1,2) SRTAB(1,2) ---
-----
10          20          30          40          80
-----
:
-----
TSRTAB(1,J) SRTAB(1,J) --- TSRTAB(1,NSRDP) SRTAB(1,NSRDP) ---
-----
80

```

SECOND PROFILE

```

-----
TSRTAB(2,1) SRTAB(2,1) TSRTAB(2,2) SRTAB(2,2) ---
-----
10          20          30          40          80
-----
:
-----
TSRTAB(2,J) SRTAB(2,J) --- TSRTAB(2,NSRDP) SRTAB(2,NSRDP) ---
-----
80

```

Appendix A (continued)

NSRPR-TH PROFILE

```

-----
TSRTAB(NSRPR,1) SRTAB(NSRPR,1) TSRTAB(NSRPR,2) ----
-----
10 20 80

```

```

-----
- TSRTAB(NSRPR,J) SRTAB(NSRPR,J) --- SRTAB(NSRPR,NSRDP)
-----
80

```

TSRTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH SOLAR RADIATION PROFILE, (T).

SRTAB(I,J) = SOLAR RADIATION OF J-TH DATA POINT FOR I-TH PROFILE, (J/N**2/T).

- (B) TYPE OF SOLAR RADIATION PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE SOLAR RADIATION APPEAR IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI NSEQ NIAD TSRTYP(NI)
-----
5 10 15 20 80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR SOLAR RADIATION PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

TSRTYP(NI) = TYPE OF SOLAR RADIATION PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

25. WIND SPEED

TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF WIND SPEED VS TIME. THE SECOND GROUP IS TO READ THE TYPE OF WIND SPEED VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NWSPP-WISELY, WHERE NWSPP IS THE NUMBER OF WIND SPEED PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NWSPP WHERE NWSPP IS THE NUMBER OF WIND SPEED DATA POINT.

Appendix A (continued)

EACH CARD CONTAINS FOUR DATA POINT. THUS EACH PROFILE REQUIRES
(NWSDP/4 + 1) CARDS.

(A) WIND SPEED VS TIME PROFILES

FIRST PROFILE

```

TWSTAB(1,1) WSTAB(1,1) TWSTAB(1,2) WSTAB(1,2) ---
      10      20      30      40      80
      :
      :
TWSTAB(1,J) WSTAB(1,J) --- TWSTAB(1,NWSDP) WSTAB(1,NWSDP) ---
      80

```

SECOND PROFILE

```

TWSTAB(2,1) WSTAB(2,1) TWSTAB(2,2) WSTAB(2,2) ---
      10      20      30      40      80
      :
      :
TWSTAB(2,J) WSTAB(2,J) --- TWSTAB(2,NWSDP) WSTAB(2,NWSDP) ---
      80

```

NWSPR-TH PROFILE

```

TWSTAB(NWSPR,1) WSTAB(NWSPR,1) TWSTAB(NWSPR,2) ---
      10      20      80
      :
      :
TWSTAB(NWSPR,J) WSTAB(NWSPR,J) --- TWSTAB(NWSPR,NWSDP) ---
      80

```

TWSTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH WIND
SPEED PROFILE, (T).

WSTAB(I,J) = WIND SPEED OF J-TH DATA POINT FOR
I-TH PROFILE, (L/T).

- (B) TYPE OF WIND SPEED PROFILE ASSIGNED TO THE NODES.
NORMALLY ONE CARD PER NODE IS REQUIRED. I.E., A TOTAL OF NODES
CARDS ARE NEEDED. HOWEVER, IF THE WIND SPEED APPEAR
IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

Appendix A (continued)

NI	NSEQ	NIAD	IWSTYP(NI)
5	10	15	20

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR WIND SPEED PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

IWSTYP(NI) = TYPE OF WIND SPEED PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

26. VAPOR PRESSURE

TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF VAPOR PRESSURE VS TIME. THE SECOND GROUP IS TO READ THE TYPE OF VAPOR PRESSURE VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NVPPR-WISELY, WHERE NVPPR IS THE NUMBER OF VAPOR PRESSURE PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NVPPR WHERE NVPPR IS THE NUMBER OF VAPOR PRESSURE DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NVPPR/4 + 1)$ CARDS.

(A) VAPOR PRESSURE VS TIME PROFILES

FIRST PROFILE

TVPTAB(1,1)	VPTAB(1,2)	TVPTAB(1,2)	VPTAB(1,2)
10	20	30	40
:			
:			
TVPTAB(1,J)	VPTAB(1,J)	TVPTAB(1,NVPPR)	VPTAB(1,NVPPR)

SECOND PROFILE

TVPTAB(2,1)	VPTAB(2,1)	TVPTAB(2,2)	VPTAB(2,2)
10	20	30	40

Appendix A (continued)

```

-----TVPTAB(2,J) VPTAB(2,J) --- TVPTAB(2,NVPPR) VPTAB(2,NVPPR)-----

```

80

```

      .
      .
      .
NVPPR-TH PROFILE

```

```

-----TVPTAB(NVPPR,1) VPTAB(NVPPR,1) TVPTAB(NVPPR,2) ---

```

10

20

80

```

-----TVPTAB(NVPPR,J) VPTAB(NVPPR,J) --- VPTAB(NVPPR,NVPPR)-----

```

80

TVPTAB(I,J) = TIME OF J-TH DATA FCINT FOR I-TH VAPOR
PRESSURE PROFILE, (T).

VPTAB(I,J) = VAPOR PRESSURE OF J-TH DATA FCINT FOR
I-TH PROFILE, (PA).

- (9) TYPE OF VAPOR PRESSURE PROFILE ASSIGNED TO THE NODES.
NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES
CARDS ARE NEEDED. HOWEVER, IF THE VAPOR PRESSURE APPEAR
IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----NI NSEQ NIAD IVPTYP(NI)-----
      5      10      15      20

```

80

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR VAPOR
PRESSURE PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE
NSEQ SUBSEQUENT NODES.

IVPTYP(NI) = TYPE OF VAPOR PRESSURE PROFILE ASSIGNED
TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

*** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END
OF THIS SUBDATA SET.

27. WATER TEMPERATURE
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP
IS TO READ THE PROFILES OF WATER TEMPERATURE VS TIME. THE SECOND

Appendix A (continued)

GROUP IS TO READ THE TYPE OF WATER TEMPERATURE VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NTWPR-WISELY, WHERE NTWPR IS THE NUMBER OF WATER TEMPERATURE PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NTWDP WHERE NTWDP IS THE NUMBER OF WATER TEMPERATURE DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NTWDP/4 + 1)$ CARDS.

(A) WATER TEMPERATURE VS TIME PROFILES

FIRST PROFILE

```

-----
TTWTAB(1,1) TWTAB(1,2) TTWTAB(1,2) TWTAB(1,2) ---
-----
10          20          30          40          80
-----
:
-----
TTWTAB(1,J) TWTAB(1,J) --- TTWTAB(1,NTWDP) TWTAB(1,NTWDP)
-----
80

```

SECOND PROFILE

```

-----
TTWTAB(2,1) TWTAB(2,1) TTWTAB(2,2) TWTAB(2,2) ---
-----
10          20          30          40          80
-----
:
-----
TTWTAB(2,J) TWTAB(2,J) --- TTWTAB(2,NTWDP) TWTAB(2,NTWDP)
-----
80

```

NTWPR-TH PROFILE

```

-----
TTWTAB(NTWPR,1) TWTAB(NTWPR,1) TTWTAB(NTWPR,2) ---
-----
10          20          80
-----
:
-----
TTWTAB(NTWPR,J) TWTAB(NTWPR,J) --- TWTAB(NTWPR,NTWDP)
-----
80

```

TTWTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH WATER TEMPERATURE PROFILE, (T).

TWTAB(I,J) = WATER TEMPERATURE OF J-TH DATA POINT FOR I-TH PROFILE, (PA).

Appendix A (continued)

- (B) TYPE OF WATER TEMPERATURE PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE WATER TEMPERATURE APPEAR IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI      NSEQ      NIAD      ITWTYP(NI)
-----
5        10        15        20                      80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR WATER TEMPERATURE PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

ITWTYP(NI) = TYPE OF WATER TEMPERATURE PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

29. EXTINCTION COEFFICIENT
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF EXTINCTION COEFFICIENT VS TIME. THE SECOND GROUP IS TO READ TYPE OF EXTINCTION COEFFICIENT VS TIME PROFILE GIVEN TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NECPR-WISELY, WHERE NECPR IS THE NUMBER OF EXTINCTION COEFFICIENT PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NECDP WHERE NECDP IS THE NUMBER OF EXTINCTION COEFFICIENT DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NECDP/4 + 1)$ CARDS.

(A) EXTINCTION COEFFICIENT VS TIME PROFILES

FIRST PROFILE

```

-----
TECTAB(1,1) ECTAB(1,2) TECTAB(1,2) ECTAB(1,2) ---
-----
10          20          30          40          80
:
- TECTAB(1,J) ECTAB(1,J) --- TECTAB(1,NECDP) ECTAB(1,NECDP) ---
-----
80

```

SECOND PROFILE

```

-----
TECTAB(2,1) ECTAB(2,1) TECTAB(2,2) ECTAB(2,2) ---
-----
10          20          30          40          80

```

Appendix A (continued)

```

      :
      :
----- TECTAB(2,J) ECTAB(2,J) --- TECTAB(2,NECDP) ECTAB(2,NECDP) -----
-----

```

NECPR-TH PROFILE

```
-----TCTAB(NECP,1) ECTAB(NECP,1) TCTAB(NECP,2)-----
-----10                20                30-----
```

```
-----ECTAB(NECPB,J) ECTAB(NECPB,J)----- ECTAB(NECPB,NECPB)-----
```

TECTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH EXTINCTION
COEFFICIENT PROFILE, (T).

ECTAB(I,J) = EXTINCTION COEFFICIENT OF J-TH DATA POINT FOR
I-TH PROFILE, (L/L).

- (B) TYPE OF EXTINCTION COEFFICIENT PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE EXTINCTION COEFFICIENT APPEAR IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

NY	NSEO	NTAD	TECTYP(NI)
5	10	15	20
			80

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR EXTINCTION
COEFFICIENT PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE
NSEQ SUBSEQUENT NODES.

IECTYP(NI) = TYPE OF EXTINCTION COEFFICIENT PROFILE ASSIGNED
TO NODE NI AND ITS NSEC SURSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END
OF THIS SUBDATA SET.

Appendix A (continued)

29. PH VALUE
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF PH VALUE VS TIME. THE SECOND GROUP IS TO READ TYPE OF PH VALUE VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NPHPR-WISELY, WHERE NPHPR IS THE NUMBER OF PH VALUE PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NPHDP WHERE NPHDP IS THE NUMBER OF PH VALUE DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NPHDP/4 + 1)$ CARDS.

(A) PH VALUE VS TIME PROFILES

FIRST PROFILE

```

-----
TPHTAB(1,1) PHTAB(1,2) TPHTAB(1,2) PHTAB(1,2) ---
-----
10          20          30          40          80
-----
:
:
-----
TPHTAB(1,J) PHTAB(1,J) --- TPHTAB(1,NPHDP) PHTAB(1,NPHDP) ---
-----
80

```

SECOND PROFILE

```

-----
TPHTAB(2,1) PHTAB(2,1) TPHTAB(2,2) PHTAB(2,2) ---
-----
10          20          30          40          80
-----
:
:
-----
TPHTAB(2,J) PHTAB(2,J) --- TPHTAB(2,NPHDP) PHTAB(2,NPHDP) ---
-----
80

```

NPHPR-TH PROFILE

```

-----
TPHTAB(NPHPR,1) PHTAB(NPHPR,1) TPHTAB(NPHPR,2) ---
-----
10          20          80
-----
:
:
-----
TPHTAB(NPHPR,J) PHTAB(NPHPR,J) --- PHTAB(NPHPR,NPHDP) ---
-----
80

```

TPHTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH PH VALUE PROFILE, (T).

PHTAB(I,J) = PH VALUE OF J-TH DATA POINT FOR

Appendix A (continued)

I-TH PROFILE. (DIMENSIONLESS).

- (8) TYPE OF PH VALUE PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE PH VALUE APPEAR IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```
-----
NI      NSEQ      NIAD  IPHTYP(NI)
-----
5        10        15        20
-----
```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR PH VALUE PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

IPHTYP(NI) = TYPE OF PH VALUE PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUPDATA SET.

30. POH VALUE
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF POH VALUE VS TIME. THE SECOND GROUP IS TO READ TYPE OF POH VALUE VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NPOPR-WISELY, WHERE NPOPR IS THE NUMBER OF POH VALUE PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NPODP WHERE NPODP IS THE NUMBER OF POH VALUE DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NPODP/4 + 1)$ CARDS.

(A) POH VALUE VS TIME PROFILES

FIRST PROFILE

```
-----
TPOTAB(1,1) POTAB(1,2) TPOTAB(1,2) POTAB(1,2) ==
-----
10          20          30          40          80
-----
:
:
-----
TPOTAB(1,J) POTAB(1,J) --- TPOTAB(1,NPODP) POTAB(1,NPODP) ---
-----
80
```

Appendix A (continued)

SECOND PROFILE

```

-----
TPOTAB(2,1) POTAB(2,1) TPOTAB(2,2) PCTAB(2,2) ---
-----
10      20      30      40      80
-----
:
- TPOTAB(2,J) POTAB(2,J) --- TPOTAB(2,NPODP) POTAB(2,NPODP) ---
-----
80

```

NPOPR-TH PROFILE

```

-----
TPOTAB(NPOPR,1) POTAB(NPOPR,1) TPOTAB(NPOPR,2) ---
-----
10      20      80
-----
:
- TPOTAB(NPOPR,J) POTAB(NPOPR,J) --- POTAB(NPOPR,NPODP) ---
-----
80

```

TPOTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH POH VALUE PROFILE, (T).

POTAB(I,J) = POH VALUE OF J-TH DATA POINT FOR I-TH PROFILE, (DIMENSIONLESS).

- (B) TYPE OF POH VALUE PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE POH VALUE APPEAR IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI  NSEQ  NIAD  IPOTYP(NI)
-----
5   10    15    20      80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR POH VALUE PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

IPOTYP(NI) = TYPE OF POH VALUE PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

*** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

Appendix A (continued)

21. OXIDATION RADICALS

TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF OXIDATION RADICAL VS TIME. THE SECOND GROUP IS TO READ TYPE OF OXIDATION RADICAL VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NORPR-WISELY, WHERE NORPR IS THE NUMBER OF OXIDATION RADICAL PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NORDP WHERE NORDP IS THE NUMBER OF OXIDATION RADICAL DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(\text{NORDP}/4 + 1)$ CARDS.

(A) OXIDATION RADICALS VS TIME PROFILES

FIRST PROFILE

```

TORTAB(1,1) ORTAB(1,2) TORTAB(1,2) ORTAB(1,2) ---
-----
      10      20      30      40      80
      :
      :
- TORTAB(1,J) ORTAB(1,J) --- TORTAB(1,NORDP) ORTAB(1,NORDP) ---
-----
                                         80

```

SECOND PROFILE

```

TORTAB(2,1) ORTAB(2,1) TORTAB(2,2) ORTAB(2,2) ---
-----
      10      20      30      40      80
      :
      :
- TORTAB(2,J) ORTAB(2,J) --- TORTAB(2,NORDP) ORTAB(2,NORDP) ---
-----
                                         80
      :
      :

```

NORPR-TH PROFILE

```

TORTAB(NORPR,1) ORTAB(NORPR,1) TORTAB(NORPR,2) ---
-----
      10      20      80
      :
      :
- TORTAB(NORPR,J) ORTAB(NORPR,J) --- TORTAB(NORPR,NORDP) ---
-----
                                         80

```

TORTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH OXIDATION

Appendix A (continued)

RADICALS PROFILE. (T).

ORTAB(I,J) = OXIDATION RADICAL VALUE OF J-TH DATA POINT FOR I-TH PROFILE. (MOLE).

- (B) TYPE OF OXIDATION RADICAL PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE OXIDATION RADICAL APPEARS IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI      NSEQ      NIAO      IORTYP(NI)
-----
5        10        15        20        80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR OXIDATION RADICAL PROFILES GENERATED AUTOMATICALLY.

NIAO = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

IORTYP(NI) = TYPE OF OXIDATION RADICAL PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

32. POPULATION DENSITY
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF POPULATION DENSITY VS TIME. THE SECOND GROUP IS TO READ TYPE OF POPULATION DENSITY VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ IN NPDP-WISELY, WHERE NPDP IS THE NUMBER OF POPULATION DENSITY PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NPDP WHERE NPDP IS THE NUMBER OF POPULATION DENSITY DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES (NPDP/4 + 1) CARDS.

(A) POPULATION DENSITY VS TIME PROFILES

FIRST PROFILE

```

-----
TPDTAB(1,1) PDTAB(1,2) TPDTAB(1,2) PDTAB(1,2) ---
-----
10        20        30        40        80
:
-----
- TPDTAB(1,J) PDTAB(1,J) --- TPDTAB(1,NPDDP) PDTAB(1,NPDDP) ---
-----
80

```


Appendix A (continued)

SECOND PROFILE

```

-----
TPDTAB(2,1) PDTAB(2,1) TPDTAB(2,2) PDTAB(2,2) ---
-----
10      20      30      40      80
:
:
-----
TPDTAB(2,J) PDTAB(2,J) --- TPDTAB(2,NPDDP) PDTAB(2,NPDDP)
-----
80

```

NPDDP-TH PROFILE

```

-----
TPDTAB(NPDDP,1) PDTAB(NPDDP,1) TPDTAB(NPDDP,2) ---
-----
10      20      80
:
:
-----
TPDTAB(NPDDP,J) PDTAB(NPDDP,J) --- PDTAB(NPDDP,NPDDP)
-----
80

```

TPDTAB(I,J) = TIME OF J-TH DATA POINT FOR I-TH POPULATION DENSITY PROFILE, (T).

PDTAB(I,J) = POPULATION DENSITY VALUE OF J-TH DATA POINT FOR I-TH PROFILE, (CELLS/L**3).

- (B) TYPE OF POPULATION DENSITY PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE POPULATION DENSITY APPEARS IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI  NSEQ  NIAD  IPDTYP(NI)
-----
5   10    15    20      80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR POPULATION DENSITY PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

IPDTYP(NI) = TYPE OF POPULATION DENSITY PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

Appendix A (continued)

33. BIO-TEMPERATURE
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP IS TO READ THE PROFILES OF BIO-TEMPERATURE VS TIME. THE SECOND GROUP IS TO READ TYPE OF BIO-TEMPERATURE VS TIME PROFILE ASSIGNED TO EACH OF THE NODES COMPARTMENTS (NCDES). THE FIRST GROUP IS READ IN NBTPR-WISELY, WHERE NBTPR IS THE NUMBER OF BIO-TEMPERATURE PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON NBTDI WHERE NBTDI IS THE NUMBER OF BIO-TEMPERATURE DATA POINT. EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES $(NBTDI/4 + 1)$ CARDS.

(A) BIO-TEMPERATURE VS TIME PROFILES

FIRST PROFILE

```

TBTAB(1,1) BTAB(1,2) TBTAB(1,2) BTAB(1,2) ---
      10      20      30      40      80
      .
      .
- TBTAB(1,J) BTAB(1,J) --- TBTAB(1,NBTDI) BTAB(1,NBTDI) ---
      80

```

SECOND PROFILE

```

TBTAB(2,1) BTAB(2,2) TBTAB(2,2) BTAB(2,2) ---
      10      20      30      40      80
      .
      .
- TBTAB(2,J) BTAB(2,J) --- TBTAB(2,NBTDI) BTAB(2,NBTDI) ---
      80
      .
      .

```

NBTPR-TH PROFILE

```

TBTAB(NBTPR,1) BTAB(NBTPR,1) TBTAB(NBTPR,2) ---
      10      20      80
      .
      .
- TBTAB(NBTPR,J) BTAB(NBTPR,J) --- BTAB(NBTPR,NBTDI) ---
      80

```

TBTAB(1,1) = TIME OF J-TH DATA POINT FOR 1-TH BIO-

Appendix A (continued)

TEMPERATURE PROFILE, (T).

BTAB(I,J) = BIO-TEMPERATURE VALUE OF J-TH DATA POINT FOR
I-TH PROFILE, (DEGREE C).

- (B) TYPE OF BIO-TEMPERATURE PROFILE ASSIGNED TO THE NODES.
NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES
CARDS ARE NEEDED. HOWEVER, IF THE BIO-TEMPERATURE APPEARS
IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI  NSEQ  NIAD  IBTTYP(NI)
-----
5    10    15    20                      80

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR BIO-
TEMPERATURE PROFILES GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE
NSEQ SUBSEQUENT NODES.

IBTTYP(NI) = TYPE OF BIO-TEMPERATURE PROFILE ASSIGNED
TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END
OF THIS SUBDATA SET.

24. PROPORTIONAL BACTERIALS
TWO GROUPS OF CARDS ARE NEEDED FOR THIS DATA SET. THE FIRST GROUP
IS TO READ THE PROFILES OF PROPORTION BACTERIALS VS TIME. THE SECOND
GROUP READS THE TYPE OF PROPORTION BACTERIALS VS TIME PROFILE ASSIGNED
TO EACH OF THE NODES COMPARTMENTS (NODES). THE FIRST GROUP IS READ
IN NPBPR-WISELY, WHERE NPBPR IS THE NUMBER OF PROPORTION BACTERIALS
PROFILES. EACH PROFILE WILL REQUIRE A NUMBER OF CARDS DEPENDING ON
NPBDP WHERE NPBDP IS THE NUMBER OF PROPORTION BACTERIALS DATA POINT.
EACH CARD CONTAINS FOUR DATA POINT, THUS EACH PROFILE REQUIRES
(NPBDP/4 + 1) CARDS.

(A) PROPORTIONAL BACTERIALS VS TIME PROFILES

FIRST PROFILE

```

-----
TPBTAB(1,1) PB TAB(1,2) TPBTAB(1,2) PB TAB(1,2) ---
-----
10          20          30          40          80
:
:
-----
TPBTAB(1,J) PB TAB(1,J) --- TPBTAB(1,NPBDP) PB TAB(1,NPBDP) ---
-----
80

```

Appendix A (continued)

SECOND PROFILE

```

-----
TPBTAB(2,1) PBTAB(2,1) TPBTAB(2,2) PBTAB(2,2) ---
-----
10          20          30          40          80
-----
:
- TPBTAB(2,J) PBTAB(2,J) --- TPBTAB(2,NPBDP) PBTAB(2,NPBDP) ---
-----
80

```

NPBPR-TH PROFILE

```

-----
TPBTAB(NPBPR,1) PBTAB(NPBPR,1) TPBTAB(NPBPR,2) ---
-----
10          20          80
-----
:
- TPBTAB(NPBPR,J) PBTAB(NPBPR,J) --- PBTAB(NPBPR,PBTDJ) ---
-----
80

```

TPBTAB(I,J) = TIME OF J-TH DATA PCINT FOR I-TH PROPORTIONAL BACTERIALS PROFILE, (T).

PBTAB(I,J) = PROPORTIONAL BACTERIALS VALUE OF J-TH DATA PCINT FOR I-TH PROFILE, (DIMENSIONLESS IN DECIMAL PONT).

- (8) TYPE OF PROPORTIONAL BACTERIALS PROFILE ASSIGNED TO THE NODES. NORMALLY ONE CARD PER NODE IS REQUIRED, I.E., A TOTAL OF NODES CARDS ARE NEEDED. HOWEVER, IF THE PROPORTIONAL BACTERIALS APPEAR IN A REGULAR PATTERN, AUTOMATIC GENERATION MAY BE MADE.

```

-----
NI  NSEQ  NIAD  IPBTYP(NI)
-----
5    10    15    20          80
-----

```

NI = NODE NUMBER OF THE FIRST NODE IN A SEQUENCE.

NSEQ = NSEQ SUBSEQUENT NODES WILL HAVE THEIR PROPORTIONAL BACTERIALS PROFILE GENERATED AUTOMATICALLY.

NIAD = INCREMENT OF NODE NUMBER FOR EACH OF THE NSEQ SUBSEQUENT NODES.

IPBTYP(NI) = TYPE OF PROPORTIONAL BACTERIALS PROFILE ASSIGNED TO NODE NI AND ITS NSEQ SUBSEQUENT NODES.

**** NOTE: A BLANK CARD MUST BE USED TO SIGNAL THE END OF THIS SUBDATA SET.

Appendix A (continued)

DATA SETS 35 THROUGH 37 READ THE TRANSIENT BOUNDARY CONDITIONS FOR SEDIMENT, DISSOLVED CHEMICALS, AND PARTICULATE CHEMICALS, RESPECTIVELY.

35. BOUNDARY VALUES OF SEDIMENTS.
THIS DATA SET SHOULD BE REPEATED FOR EACH SEDIMENT SIZE FRACTION. THE NUMBER OF CARDS IN THIS DATA SET DEPENDS ON NBVPR AND NBVDP. THE DATA SET IS READ-IN NBVPR-WISELY. FOR EACH OF THE NBVPR PROFILES, A NUMBER OF CARDS ARE NEEDED, DEPENDING ON NBVDP. EACH CARD CONTAINS FOUR DATA POINTS, THUS EACH PROFILE WILL REQUIRE $(NBVDP/4 + 1)$ CARDS.

FIRST PROFILE FOR M-TH SEDIMENT FRACTION SIZE - FORMAT (8D10.3).

```

TGSITB(1,1,M) GSI TB(1,1,M) TGSITB(1,2,M) GSI TB(1,2,M) ---
-----
10          20          30          40          80
:
:
-- TGSITB(1,J,M) GSI TB(1,J,M) --- GSI TB(1,NBVDP,M)
-----
80

```

SECOND PROFILE FOR M-TH SEDIMENT FRACTION SIZE - FORMAT (8D10.3)

```

TGSITB(2,1,M) GSI TB(2,1,M) TGSITB(2,2,M) GSI TB(2,2,M) ---
-----
10          20          30          40          80
:
:
-- TGSITB(2,J,M) GSI TB(2,J,M) --- GSI TB(2,NBVDP,M)
-----
80

```

NBVPR-TH PROFILE FOR M-TH SEDIMENT FRACTION - FORMAT (8D10.3)

```

TGSITB(NBVPR,1,M) GSI TB(NBVPR,1,M) TGSITB(NBVPR,2,M) ---
-----
10          20          30          80
:
:
-- TGSITB(NBVPR,J,M) GSI TB(NBVPR,J,M) --- GSI TB(NBVPR,NBVDP,M)
-----
80

```

TGSITB(I,J,M) = TIME OF J-TH DATA POINT IN I-TH BOUNDARY VALUE

Appendix A (continued)

PROFILE FOR M-TH SEDIMENT FRACTION SIZE, (T).

GSITB(I,J,M) = GIVEN SEDIMENT CONCENTRATION OF J-TH DATA POINT
IN I-TH PROFILE FOR M-TH SEDIMENT FRACTION
SIZE, (M/L**3) FOR DIRICHLET CONDITIONS AND
(M/T) FOR NEUMANN AND/OR CAUCHY CONDITIONS.

36. BOUNDARY VALUES OF DISSOLVED CHEMICALS
THE NUMBER OF CARDS IN THIS DATA SET DEPENDS ON NBVPR AND NBVDP.
THE DATA SET IS READ-IN NBVPR-WISELY. FOR EACH OF THE NBVPR PROFILES,
A NUMBER OF CARDS ARE NEEDED, DEPENDING ON NBVDP. EACH CARD CONTAINS
FOUR DATA POINTS, THUS EACH PROFILE WILL REQUIRE (NBVDP/4 + 1) CARDS.

FIRST PROFILE - FORMAT(8D10.3).

TGCWTB(1,1)	GCWTB(1,1)	TGCWTB(1,2)	GCWTB(1,2)	---
10	20	30	40	80
:				
-- TGCWTB(1,J) GCWTB(1,J) --		TGCWTB(1,NBVDP) GCWTB(1,NBVDP)		---
80				

SECOND PROFILE - FORMAT(8D10.3)

TGCWTB(2,1)	GCWTB(2,1)	TGCWTB(2,2)	GCWTB(2,2)	---
10	20	30	40	80
:				
-- TGCWTB(2,J) GCWTB(2,J) --		TGCWTB(2,NBVDP) GCWTB(2,NBVDP)		---
80				

NBVPR-TH PROFILE - FORMAT(8D10.3)

TGCWTB(NBVPR,1)	GCWTB(NBVPR,1)	TGCWTB(NBVPR,2)	GCWTB(NBVPR,2)	---
10	20	30	40	80
:				
-- TGCWTB(NBVPR,J) GCWTB(NBVPR,J) --		TGCWTB(NBVPR,NBVDP) GCWTB(NBVPR,NBVDP)		---
80				

Appendix A (continued)

TGCWTB(I,J) = TIME OF J-TH DATA POINT IN I-TH BOUNDARY VALUE PROFILE FOR DISSOLVED CHEMICALS, (T).

GCWTB(I,J) = GIVEN DISSOLVED CHEMICAL CONCENTRATION OF J-TH DATA POINT IN I-TH PROFILE, (M/L**3) FOR DIRICHLET CONDITIONS AND (M/T) FOR NEUMANN AND CAUCHY CONDITIONS.

37. BOUNDARY VALUES OF PARTICULATE CHEMICALS
THIS DATA SET SHOULD BE REPEATED FOR EACH PARTICULATE CHEMICALS.
THE NUMBER OF CARDS IN THIS DATA SET DEPENDS ON NBVPR AND NBVDP.
THE DATA SET IS READ-IN NBVPR-WISELY. FOR EACH OF THE NBVPR PROFILES,
A NUMBER OF CARDS ARE NEEDED, DEPENDING ON NBVDP. EACH CARD CONTAINS
FLUX DATA POINTS, THUS EACH PROFILE WILL REQUIRE (NBVDP/4 + 1) CARDS.

FIRST PROFILE FOR M-TH PARTICULATE CHEMICALS - FORMAT(8D10.3).

```

TGCITB(1,1,M) GCITB(1,1,M) TGCITB(1,2,M) GCITB(1,2,M) ---
-----
10          20          30          40          80
:
-- TGCITB(1,J,M) GCITB(1,J,M) --- GCITB(1,NBVDP,M)
-----
80

```

SECOND PROFILE FOR M-TH PARTICULATE CHEMICALS- FORMAT(8D10.3)

```

TGCITB(2,1,M) GCITB(2,1,M) TGCITB(2,2,M) GCITB(2,2,M) ---
-----
10          20          30          40          80
:
-- TGCITB(2,J,M) GCITB(2,J,M) --- GCITB(2,NBVDP,M)
-----
80
:

```

NBVPR-TH PROFILE FOR M-TH PARTICULATE CHEMICALS- FORMAT(8D10.3)

```

TGCITB(NBVPR,1,M) GCITB(NBVPR,1,M) TGCITB(NBVPR,2,M) ---
-----
10          20          30          80
:
-- TGCITB(NBVPR,J,M) GCITB(NBVPR,J,M) --- GCITB(NBVPR,NBVDP,M)
-----
80

```

TGCITB(I,J,M) = TIME OF J-TH DATA POINT IN I-TH BOUNDARY VALUE PROFILE FOR M-TH PARTICULATE CHEMICALS, (T).

GCITB(I,J,M) = GIVEN PARTICULATE CHEMICAL CONCENTRATION OF J-TH DATA POINT IN I-TH PROFILE M-TH PARTICULATE CHEMICALS, (M/M) FOR DIRICHLET CONDITIONS AND (M/T) FOR NEUMANN AND CAUCHY CONDITIONS.

B.1 INPUT DATA FOR THE SINGLE RIVER PROBLEM

[illegible]

0.0	1	9	0.0000	14400.0	0.0000	28800.00	0.0000	259200.0	0.0000
11	0	1	2						
12	88	1	1						
0									
0.0	1	99	20.0	86400.0	20.0	172800.0	20.0	END OF SP DATA	3 DATA
0			1	1				259200.0	20.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	END OF TA DATA	
0			1	1				259200.0	0.0
0.0	1	99	1.0	86400.0	1.0	172800.0	1.0	END OF SR DATA	
0			1	1				259200.0	1.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	END OF WS DATA	
0			1	1				259200.0	0.0
0.0	1	99	21.0	86400.0	21.0	172800.0	21.0	END OF VP DATA	
0			1	1				259200.0	21.0
0.0	1	99	2.0	86400.0	2.0	172800.0	2.0	END OF TW DATA	
0			1	1				259200.0	2.0
0.0	1	99	7.0	86400.0	7.0	172800.0	7.0	END OF EC DATA	
0			1	1				259200.0	7.0
0.0	1	99	7.0	86400.0	7.0	172800.0	7.0	END OF PH DATA	
0			1	1				259200.0	7.0
0.0	1	99	0.1D-8	86400.0	0.1D-8	172800.0	0.1D-8	END OF PQH DATA	
0			1	1				259200.0	0.1D-8
0.0	1	99	1000.0	86400.0	1000.0	172800.0	1000.0	END OF OR DATA	
0			1	1				259200.0	1000.0
0.0	1	99	15.0	86400.0	15.0	172800.0	15.0	END OF PD DATA	
0			1	1				259200.0	15.0
0.0	1	99	0.1	86400.0	0.1	172800.0	0.1	END OF ST DATA	
0			1	1				259200.0	0.1
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	END OF PB DATA	
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0D-2	172800.0	1.0D-2	259200.0	0.0
0.0	1	99	0.0	86400.0	0.0	172800.0	0.0	259200.0	1.0D-2
0			1.0D-2	86400.0	1.0				

Appendix B (continued)

2.2 INPUT DATA FOR THE RIVER NETWORK PROBLEM

[illegible]

[illegible]

Appendix B (continued)

0.0		0.0000	14400.0	1.00-3	28800.00	0.0000	259200.0	0.0000
1	3	1	1					
5	0	1	2					
6	4	1	1					
11	0	1	2					
12	3	1	1					
16	0	1	2					
17	4	1	1					
22	0	1	2					
23	13	1	1					
0.0		0.0	96400.0	0.0	172800.0	0.0	END OF SW DATA	
0.0		0.0000	14400.0	0.0	0.0000	28800.00	0.0000	259200.0 0.0
1	3	1	1					0.0000
5	0	1	2					
6	4	1	1					
11	0	1	2					
12	3	1	1					
16	0	1	2					
17	4	1	1					
22	0	1	2					
23	13	1	1					
0.0		0.0	86400.0	0.0	172800.0	0.0	END OF SP 1 DATA	
0.0		0.0000	14400.0	0.0	0.0000	28800.00	0.0000	259200.0 0.0
1	3	1	1					0.0000
5	0	1	2					
6	4	1	1					
11	0	1	2					
12	3	1	1					
16	0	1	2					
17	4	1	1					
22	0	1	2					
23	13	1	1					
0.0		0.0	86400.0	0.0	172800.0	0.0	END OF SP 2 DATA	
0.0		0.0000	14400.0	0.0	0.0000	28800.00	0.0000	259200.0 0.0
1	3	1	1					0.0000
5	0	1	2					
6	4	1	1					
11	0	1	2					
12	3	1	1					
16	0	1	2					
17	4	1	1					
22	0	1	2					
23	13	1	1					
0.0		0.0	86400.0	0.0	172800.0	0.0	END OF SP 3 DATA	
0.0		0.0000	14400.0	0.0	0.0000	28800.00	0.0000	259200.0 0.0
1	3	1	1					0.0000
5	0	1	2					
6	4	1	1					
11	0	1	2					
12	3	1	1					
16	0	1	2					
17	4	1	1					
22	0	1	2					
23	13	1	1					
0.0		20.0	86400.0	20.0	172800.0	20.0	END OF TA DATA	
1	35	1	1				259200.0 20.0	
0.0		0.0	86400.0	0.0	172800.0	0.0	END OF SR DATA	
1	35	1	1				259200.0 0.0	
0.0		1.0	86400.0	1.0	172800.0	1.0	END OF SR DATA	
1	35	1	1				259200.0 1.0	

Appendix B (continued)

0.0		0.0		86400.0	0.0	172800.0	0.0	END OF WS DATA	
1	35	1	1					259200.0	0.0
0.0		21.0		86400.0	21.0	172800.0	21.0	END OF VP DATA	
1	35	1	1					259200.0	21.0
0.0		2.0		86400.0	2.0	172800.0	2.0	END OF TW DATA	
1	35	1	1					259200.0	2.0
0.0		7.0		86400.0	7.0	172800.0	7.0	END OF EC DATA	
1	35	1	1					259200.0	7.0
0.0		7.0		86400.0	7.0	172800.0	7.0	END OF PH DATA	
1	35	1	1					259200.0	7.0
0.0		0.1D-8		86400.0	0.1D-8	172800.0	0.1D-8	END OF PJH DATA	
1	35	1	1					259200.0	0.1D-8
0.0		1000.0		86400.0	1000.0	172800.0	1000.0	END OF OR DATA	
1	35	1	1					259200.0	1000.0
0.0		15.0		86400.0	15.0	172800.0	15.0	END OF PD DATA	
1	35	1	1					259200.0	15.0
0.0		0.1		86400.0	0.1	172800.0	0.1	END OF BT DATA	
1	35	1	1					259200.0	0.1
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	END OF P3 DATA	
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0	0.0	1.0D-2		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0	0.0	1.0D-2		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0	0.0	1.0D-2		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0	0.0	1.0D-2		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0		1.0D-2		86400.0	1.0D-2	172800.0	1.0D-2	259200.0	1.0D-2
0.0	0.0	1.0D-2		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		1.0D-3		86400.0	1.0D-3	172800.0	1.0D-3	259200.0	1.0D-3
0.0		1.0D-3		86400.0	1.0D-3	172800.0	1.0D-3	259200.0	1.0D-3
0.0		1.0D-3		86400.0	1.0D-3	172800.0	1.0D-3	259200.0	1.0D-3
0.0	0.0	1.0D-3		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		2.0D-4		86400.0	2.0D-4	172800.0	2.0D-4	259200.0	2.0D-4
0.0		2.0D-4		86400.0	2.0D-4	172800.0	2.0D-4	259200.0	2.0D-4
0.0		2.0D-4		86400.0	2.0D-4	172800.0	2.0D-4	259200.0	2.0D-4
0.0	0.0	2.0D-4		86400.0	0.0	172800.0	0.0	259200.0	0.0
0.0		2.0D-5		86400.0	2.0D-5	172800.0	2.0D-5	259200.0	2.0D-5
0.0		2.0D-5		86400.0	2.0D-5	172800.0	2.0D-5	259200.0	2.0D-5
0.0		2.0D-5		86400.0	2.0D-5	172800.0	2.0D-5	259200.0	2.0D-5
0.0	0.0	2.0D-5		86400.0	0.0	172800.0	0.0	259200.0	0.0

APPENDIX C

Listing of FORTRAN IV Source Program

```

C *****
C *
C *                               CHNTRN
C *
C *****
C
C YEH, G. T., 1981. "CHNTRN: A CHANNEL TRANSPORT MODEL FOR SIMULATING
C SEDIMENT AND CHEMICAL FATES IN A STREAM/RIVER NETWORK," ORNL-
C OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TN. 37830
C
C *****
C *
C * VARIABLE DEFINITIONS
C *
C * MAXNOD = MAXIMUM NO. OF NODES INCLUDING BOUNDARY NODES
C * MAXCON = MAXIMUM NO. OF LINKS INCLUDING BOUNDARY LINKS
C * MXBND = MAXIMUM NO. OF BOUNDARY LINKS
C * MXEOS = MAXIMUM NO. OF EQUATIONS
C * MXBWD = MAXIMUM NO. OF BAND WIDTH OF THE MATRIX CMATRX
C * MXSUB = MAXIMUM NO. OF SUBSTANCES THAT THAT SORP CHEMICALS
C * MXSUBP = MXSUB + 1
C * MXSPY = MAXIMUM NO. OF CHEMICAL SPECIES IN ONE TOXIN
C
C * NODS = NO. OF NODES (COMPARTMENTS) INCLUDING BOUNDARY NODES
C * NCONS = NO. OF LINKS (INTERFACES) INCLUDING BOUNDARY LINKS
C * NGBND = NO. OF GIVEN BOUNDARY LINKS
C * NTL = NO. OF TIME INCREMENTS (TIME STEPS)
C
C * KVI = CONTROL OF HYDRODYNAMIC VARIABLE INPUT
C *       .LE.0 = CARD INPUT
C *       1 = STEADY STATE INPUT VIA DISK
C *       2 = TRANSIENT INPUT VIA DISK
C
C * KSS = CONTROL STEADY STATE SIMULATION, 0=NO, 1=YES
C * NSURS = NO. OF SUBSTANCES THAT SORP CHEMICALS
C * NSPY = NO. OF CHEMICAL SPECIES CONSIDERED IN ONE TOXIN
C * NEQS = NO. OF EQUATIONS TO BE SOLVED
C * IBAND = BAND WIDTH OF THE MATRIX CMATRX
C * IHBP = NO. OF HALF BAND WITH PLUS ONE
C * IHALFB = NO. OF HALF BAND WIDTH
C * IMPL = IMPLICIT SCHEME CONTROL, 0=NO, 1=YES
C * KPRED = CONTROL TO PRINT EROSION AND DEPOSITION RATES, 0=NO
C *       >0 EVERY KPPED TIME STEPS PRINT EROSION AND DEPOSITION
C * KPRBS = CONTROL TO LINE-PRINT BED SEDIMENT, 0=NO PRINT
C *       >0 EVERY KPRSS TIME STEPS PRINT BED SEDIMENT ONCE
C * KPRSI = CONTROL TO LINE-PRINT SEDIMENT CONCENTRATION, 0=NO PRINT
C *       >0 EVERY KPRSI TIME STEPS PRINT SEDIMENT CONCENTRATION
C * KPRK = CONTROL TO LINE-PRINT RATE CONSTANT, 0=NO PRINT
C *       >0 EVERY KPRK TIME STEPS PRINT RATE CONSTANT ONCE
C * KPRCW = CONTROL TO LINE-PRINT DISSOLVED CONCENTRATION, 0=NO
C *       >0 EVERY KPRCW TIME STEPS PRINT DISSOLVED CONCENTRATION
C * KPRBC = CONTROL TO LINE-PRINT BED CHEMICALS, 0=NO PRINT
C *       >0 EVERY KPPBC PRINT CHEMICAL AMOUNT AND CONCENTRATION
C * KPRCI = CONTROL TO LINE-PRINT PARTICULATE CONCENTRATION, 0=NO
C *       >0 EVERY KPRCI PRINT PARTICULATE CONCENTRATION ONCE
C * NREAD = EVERY NREAD TIME STEPS READ HYDRODYNAMICS VIA DISK
C * NSTOR = EVERY NSTOR TIME STEPS STORE RESULTS ON UNIT 2
C
C * DELT = TIME STEP SIZE
C * CHNG = PERCHANGE OF INCREASE IN TIME STEP SIZE FOR EACH TIME
C * THETA = TIME INTEGRATION PARAMETER, 0.0=FORWARD, 1.0=BACKWARD
C
C * WLMG = TEMPORALLY AVERAGE SPECTRAL IRRADIANCE IMMEDIATELY BELOW
C *       WATER SURFACE, WLMG(39), PHOTONS/(CM**2)/S/(N NANOMETER)
C * WATETA = SPECTRAL DIFFUSE ATTENUATION COEFFICIENT FOR PURE WATER
C *       WATETA(39), IN (/METER)
C * PIGETA = SPECTRAL SPECIFIC DIFFUSE ATTENUATION COEFFICIENT FOR
C *       CHLOROPHYLL AND CHLOROPHYLL-LIKE PIGMENTS, PIGETA(39),
C *       IN (/METER/(MILI-GRAM/LITER))
C * DOCETA = SPECTRAL SPECIFIC DIFFUSE ATTENUATION COEFFICIENTS FOR
C *       DISSOLVED ORGANIC CARBON, DOCETA(39), IN
C *       (/METER/(MILI-GRAM/LITER))
C * CLOUDG = AVERAGE CLOUDINESS IN TENTHS OF FULL SKY COVER
C * ELATG = GEOGRAPHIC LATITUDE OF THE ECOSYSTEM
C
C * MXSPR = MAXIMUM NO. OF SOURCE PROFILES
C * MXSDP = MAXIMUM NO. OF SOURCE DATA POINTS
C * NSPR = NO. OF SOURCE PROFILES
C * NSDP = NO. OF SOURCE DATA POINTS
C
C * MXTAPR = MAXIMUM NO. OF AIR TEMPERATURE (TA) PROFILES
C * MXTADP = MAXIMUM NO. OF AIR TEMPERATURE DATA POINTS IN TA-T TABLE
C * NTAPR = NO. OF AIR TEMPERATURE PROFILES
C * NTADP = NO. OF AIR TEMPERATURE DATA POINTS IN TA-T TABLE
C * MXSRPR = MAXIMUM NO. OF SOLAR RADIATION (SR) PROFILES
C * MXSRDP = MAXIMUM NO. OF SOLAR RADIATION DATA POINTS IN SR-T TABLE
C * NSRPR = NO. OF SOLAR RADIATION PROFILES
C * NSRDP = NO. OF SOLAR RADIATION DATA POINTS IN SR-T TABLE
C * MXWSPR = MAXIMUM NO. OF WIND SPEED (WS) PROFILES

```

Appendix C (continued)

C	* MXWSDP = MAXIMUM NO. OF WIND SPEED DATA POINTS IN WS-T TABLE	*	MAIN	460
C	* NWSPPR = NO. OF WIND SPEED PROFILES	*	MAIN	465
C	* NWSDP = NO. OF WIND SPEED DATA POINTS IN WS-T TABLE	*	MAIN	470
C	* MXVPPR = MAXIMUM NO. OF VAPOR PRESSURE (VP) PROFILES	*	MAIN	475
C	* MXVPDP = MAXIMUM NO. OF VAPOR PRESSURE DATA POINTS IN VP-T TABLE	*	MAIN	480
C	* NVOPR = NO. OF VAPOR PRESSURE PROFILES	*	MAIN	485
C	* NVDPDP = NO. OF VAPOR PRESSURE DATA POINTS IN VP-T TABLE	*	MAIN	490
C	*	*	MAIN	495
C	* MXTWPR = MAXIMUM NO. OF WATER TEMPERATURE (TW) PROFILES	*	MAIN	500
C	* MXTWDP = MAXIMUM NO. OF WATER TEMP. DATA POINTS IN TW-T TABLE	*	MAIN	505
C	* NTWPR = NO. OF WATER TEMPERATURE PROFILES	*	MAIN	510
C	* NTWDP = NO. OF WATER TEMPERATURE DATA POINTS IN TW-T TABLE	*	MAIN	515
C	* MXECPR = MAXIMUM NO. OF EXTINCTION COEFF. (EC) PROFILES	*	MAIN	520
C	* MXECDP = MAXIMUM NO. OF EXTIN. COEFF. DATA POINTS IN EC-T TABLE	*	MAIN	525
C	* NECPR = NO. OF EXTINCTION COEFFICIENT PROFILES	*	MAIN	530
C	* NECDP = NO. OF EXTINCTION COEFF. DATA POINTS IN EC-T TABLE	*	MAIN	535
C	*	*	MAIN	540
C	* MXPHPR = MAXIMUM NO. OF PH (PH) PROFILES	*	MAIN	545
C	* MXPHDP = MAXIMUM NO. OF PH DATA POINTS IN PH-T TABLE	*	MAIN	550
C	* NPHPR = NO. OF PH PROFILES	*	MAIN	555
C	* NPHDP = NO. OF PH DATA POINTS IN PH-T TABLE	*	MAIN	560
C	* MXPOPR = MAXIMUM NO. OF POH (PO) PROFILES	*	MAIN	565
C	* MXPODP = MAXIMUM NO. OF POH DATA POINTS IN PO-T TABLE	*	MAIN	570
C	* NPOPR = NO. OF POH PROFILES	*	MAIN	575
C	* NPODP = NO. OF POH DATA POINTS IN PO-T TABLE	*	MAIN	580
C	* MXOR = MAXIMUM NO. OF OXIDATION RADICAL (OR) PROFILES	*	MAIN	585
C	* MXORDP = MAXIMUM NO. OF OXIDATION RAD. DATA POINTS IN OR-T TABLE	*	MAIN	590
C	* NORPR = NO. OF OXIDATION RADICAL PROFILES	*	MAIN	595
C	* NORDP = NO. OF OXIDATION DATA POINTS IN OR-T TABLE	*	MAIN	600
C	*	*	MAIN	605
C	* MXPDPR = MAXIMUM NO. OF BACTERIAL POPULATION DENSITY (PD) PROFILES	*	MAIN	610
C	* MXPDDP = MAXIMUM NO. OF POPULA. DENSITY DATA POINTS IN PD-T TABLE	*	MAIN	615
C	* NPDPR = NO. OF BACTERIAL POPULATION DENSITY PROFILES	*	MAIN	620
C	* NPDPDP = NO. OF POPULATION DENSITY DATA POINTS IN PD-T TABLE	*	MAIN	625
C	* MXBTPR = MAXIMUM NO. OF BIOTA TEMPERATURE (BT) PROFILES	*	MAIN	630
C	* MXBTDP = MAXIMUM NO. OF BIOTA TEMP. DATA POINTS IN BT-T TABLE	*	MAIN	635
C	* NBTPR = NO. OF BIOTA TEMPERATURE PROFILES	*	MAIN	640
C	* NBTDP = NO. OF BIOTA TEMPERATURE DATA POINTS IN BT-T TABLE	*	MAIN	645
C	* MXPBPR = MAXIMUM NO. OF PROPOR. BACTERIAL (PB) TO DEGRADE PROFILE	*	MAIN	650
C	* MXPBDP = MAXIMUM NO. OF PB DATA POINTS IN PB-T TABLE	*	MAIN	655
C	* NPBP = NO. OF PROPORTIONAL BACTERIAL TO DEGRADE PROFILES	*	MAIN	660
C	* NPBDP = NO. OF PB DATA POINTS IN PB-T TABLE	*	MAIN	665
C	*	*	MAIN	670
C	* MXBVPR = MAXIMUM NO. OF BOUNDARY VALUE (BV) PROFILES	*	MAIN	675
C	* MXBVDP = MAXIMUM NO. OF BOUNDARY VALUE DATA POINT IN BV-T TABLE	*	MAIN	680
C	* NBVPR = NO. OF BOUNDARY VALUE PROFILES	*	MAIN	685
C	* NBVDP = NO. OF BOUNDARY VALUE DATA POINTS IN BV-T TABLE	*	MAIN	690
C	*	*	MAIN	695
C	*	*	MAIN	700
C	* DCN(N) = DISSOLVED CHEMICAL CONCENTRATION IN N-TH COMPARTMENT,	*	MAIN	705
C	(M/L**3)	*	MAIN	710
C	* SEDCN(N,M) = SEDIMENT CONCEN. IN N-TH COMPART. OF M-TH MATERIAL,	*	MAIN	715
C	(M/M)	*	MAIN	720
C	* PCN(N,M) = PARTICULATE CHEMICAL CONCEN. IN N-TH COMPART. OF M-TH	*	MAIN	725
C	MATERIAL, (M/M)	*	MAIN	730
C	*	*	MAIN	735
C	* DCNP(N) = DISSOLVED CONCEN. AT PREVIOUS TIME OF N-TH COMPARTMENT	*	MAIN	740
C	* SEDCNP(N,M) = SEDIMENT CONCEN. AT PREVIOUS TIME AT N-TH COMPART.	*	MAIN	745
C	OF M-TH MATERIAL (OR M-TH SIZE FRACTION)	*	MAIN	750
C	* PCNP(N,M) = PARTICULATE CHEMICAL CONCEN. AT PREVIOUS TIME AT N-TH	*	MAIN	755
C	COMPARTMENT OF M-TH MATERIAL	*	MAIN	760
C	*	*	MAIN	765
C	* BEDSD(N,M) = BED SEDIMENT AT N-TH COMPARTMENT OF M-TH MATERIAL,	*	MAIN	770
C	(M/L**2)	*	MAIN	775
C	* BEDSDP(N,M) = BED SEDIMENT AT PREVIOUS TIME AT N-TH COMPARTMENT OF	*	MAIN	780
C	M-TH MATERIAL (OR M-TH SIZE FRACTION)	*	MAIN	785
C	* BDCHM(N,M) = AMOUNT OF CHEMICAL PER UNIT BED AREA AT N-TH COMPART.	*	MAIN	790
C	ADSORBED IN M-TH SIZE FRACTION, (M/L**2)	*	MAIN	795
C	* BDCHMP(N,M) = AMOUNT OF CHEMICAL PER UNIT BED AREA AT PREVIOUS	*	MAIN	800
C	AT N-TH COMPARTMENT OF ADSORBED IN M-TH MATERIAL	*	MAIN	805
C	* CNBED(N,M) = PARTICULATE CONCEN. IN BED SEDIMENT AT N-TH COMPART.	*	MAIN	810
C	OF M-TH SIZE FRACTION, (M/M)	*	MAIN	815
C	* CNBEDP(N,M) = PARTICULATE CONCEN. OF PREVIOUS TIME STEP IN BED	*	MAIN	820
C	SEDIMENT AT N-TH COMPARTMENT OF M-TH SIZE FRACTION	*	MAIN	825
C	*	*	MAIN	830
C	* ERSN(N,M) = EROSION RATE AT N-TH COMPARTMENT OF M-TH MATERIAL,	*	MAIN	835
C	(M/L**2)	*	MAIN	840
C	* DPOSN(N,M) = DEPOSITION RATE AT N-TH COMPARTMENT OF M-TH MATERIAL,	*	MAIN	845
C	(M/L**2)	*	MAIN	850
C	* OS(N,M) = SEDIMENT TRANSPORT CAPACITY AT THE N-TH COMPARTMENT OF	*	MAIN	855
C	M-TH SEDIMENT FRACTION SIZE, (M/L**2)	*	MAIN	860
C	*	*	MAIN	865
C	* DX(N) = DELTA X (ONE-DIMENSIONAL VOLUME SIZE) OF N-TH COMPART.,(L)	*	MAIN	870
C	* CN(N) = MANNING'S N AT N-TH COMPARTMENT	*	MAIN	875
C	* NODTYP(N) = NODE TYPE OF N-TH COMPARTMENT	*	MAIN	880
C	0=INTERIOR NODES	*	MAIN	885
C	1=BOUNDARY NODES WITH DIRICHLET CONDITIONS	*	MAIN	890
C	2=BOUNDARY NODES WITH NEUMANN CONDITIONS	*	MAIN	895
C	3=BOUNDARY NODES WITH CAUCHY CONDITIONS	*	MAIN	900
C	4=BOUNDARY NODES OF JUNCTION	*	MAIN	905
C	*	*	MAIN	910
C	* Q(N) = FLOW RATE AT N-TH COMPARTMENT, (L**3/T)	*	MAIN	915
C	* A(N) = CROSS-SECTIONAL AREA AT N-TH COMPARTMENT, (L**2)	*	MAIN	920
C	FOR A JUNCTION COMPARTMENT, A(N) IS THE VOLUME (L**3)	*	MAIN	925
C	* B(N) = TOP WIDTH AT N-TH COMPARTMENT, (L). FOR A JUNCTION, B(N)	*	MAIN	930
C	IS THE SURFACE AREA, (L**2).	*	MAIN	935
C	* P(N) = WET PERIMETER OF N-TH COMPARTMENT, (L). FOR A JUNCTION	*	MAIN	940
C	P(N) IS THE WETTED AREA ON ALL ITS SIDES AND BOTTOM, (L**2)	*	MAIN	945

Appendix C (continued)

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C * H(N) = WATER DEPTH OF N-TH COMPARTMENT, (L) * MAIN 950
C * * * * * MAIN 955
C * OP(N) = FLOW RATE OF N-TH COMPARTMENT AT PREVIOUS TIME STEP * MAIN 960
C * AP(N) = CROSS-SECTIONAL AREA OF N-TH COMPARTMENT AT PREVIOUS TIME * MAIN 965
C * BP(N) = TOP WIDTH OF N-TH COMPARTMENT AT PREVIOUS TIME * MAIN 970
C * PP(N) = WET PERIMETER OF N-TH COMPARTMENT AT PREVIOUS TIME STEP * MAIN 975
C * HP(N) = WATER DEPTH OF N-TH COMPARTMENT AT PREVIOUS TIME STEP * MAIN 980
C * * * * * MAIN 985
C * NOD1(K) = GLOBAL NODE NUMBER OF FIRST NODE OF K-TH CONNECTOR * MAIN 990
C * NOD2(K) = GLOBAL NODE NUMBER OF SECOND NODE OF K-TH CONNECTOR * MAIN 995
C * KSIGN(N) = DIRECTIONAL SIGN OF K-TH CONNECTOR (LINK) * MAIN1000
C * D1IC(K) = DISTANCE FROM FIRST NODE TO INTERFACE OF K-TH LINK, (L) * MAIN1005
C * D2IC(K) = DISTANCE FROM SECOND NODE TO INTERFACE OF K-TH LINK, (L) * MAIN1010
C * ICNTYP(K) = LINK TYPE OF K-TH CONNECTOR * MAIN1015
C * * * * * MAIN1020
C * 0=INTERIOR LINKS (CONNECTORS) * MAIN1025
C * 1=LINK TO NODES WITH DIRICHLET CONDITIONS * MAIN1030
C * 2=LINK TO NODES WITH NEUMANN CONDITIONS * MAIN1035
C * 3=LINK TO NODES WITH CAUCHY CONDITIONS * MAIN1040
C * 4=LINK TO JUNCTIONS * MAIN1045
C * * * * * MAIN1050
C * KGBND(I) = CONNECTOR NUMBER OF I-TH BOUNDARY CONNECTOR (LINK) * MAIN1055
C * IGBTYP(I) = BOUNDARY TYPE OF I-TH GIVEN BOUNDARY LINK * MAIN1060
C * * * * * MAIN1065
C * ABSOPK(I) = ABSORPTION RATE CONSTANT OF I-TH SEDIMENT, (1/T) * MAIN1070
C * FOILKD(I) = EQUILIBRIUM DISTRIBUTION COEFFICIENT OF I-TH SEDIMENT, * MAIN1075
C * (L**3/M) * MAIN1080
C * ABSOPB(I) = ABSORPTION RATE CONSTANT OF I-TH BED SEDIMENT, (1/T) * MAIN1085
C * * * * * MAIN1090
C * WSK(I) = SETTLING VELOCITY OF I-TH SEDIMENT, (L/T) * MAIN1095
C * ERODITY(I) = ERODIBILITY OF I-TH BED SEDIMENT, (M/L**2) * MAIN1100
C * TAUCD(I) = CRITICAL SHEAR STRESS FOR DEPOSITION OF I-TH SEDIMENT, * MAIN1105
C * (M/T**2/L) * MAIN1110
C * TAUCR(I) = CRITICAL SHEAR STRESS FOR EROSION OF I-TH SEDIMENT, * MAIN1115
C * (M/T**2/L) * MAIN1120
C * DIAMS(I) = DIAMETER OF I-TH SEDIMENT, (L) * MAIN1125
C * * * * * MAIN1130
C * * * * * MAIN1135
C * RATKV(N,M) = RATE CONSTANT FOR VOLATILIZATION AT N-TH COMPARTMENT * MAIN1140
C * THROUGH M-TH MATERIAL, (1/T) * MAIN1145
C * * * * * MAIN1150
C * RATH(N,M) = RATE CONSTANT OF HYDROLUSIS AT N-TH COMPARTMENT * MAIN1155
C * THROUGH M-TH MATERIAL, (1/T) * MAIN1160
C * * * * * MAIN1165
C * PATKO(N,M) = RATE CONSTANT FOR OXIDATION AT N-TH COMPARTMENT * MAIN1170
C * THROUGH M-TH MATERIAL, (1/T) * MAIN1175
C * * * * * MAIN1180
C * RATKP(N,M) = RATE CONSTANT FOR PHOTOLYSIS AT N-TH COMPARTMENT * MAIN1185
C * THROUGH M-TH MATERIAL, (1/T) * MAIN1190
C * * * * * MAIN1195
C * RATE(N,M) = RATE CONSTANT FOR BIOLYSIS AT N-TH COMPARTMENT * MAIN1200
C * THROUGH M-TH MATERIAL, (1/T) * MAIN1205
C * * * * * MAIN1210
C * RATEK(N,M) = COMBINED RATE CONSTANT AT N-TH COMPARTMENT * MAIN1215
C * THROUGH M-TH MATERIAL, (1/T) * MAIN1220
C * * * * * MAIN1225
C * * * * * MAIN1230
C * MOLEW(I,M) = MOLECULAR WEIGHT USED FOR COMPUTING VOLATILIZATION * MAIN1235
C * OF I-TH CHEMICAL SPECIES THROUGH M-TH MATERIAL, * MAIN1240
C * (GRAM/MOLE) * MAIN1245
C * * * * * MAIN1250
C * HENRY(I,M) = HENRY CONSTANT USED FOR COMPUTING VOLATILIZATION * MAIN1255
C * OF I-TH CHEMICAL SPECIES THROUGH M-TH MATERIAL, * MAIN1260
C * ATM-METER**3/MOLF) * MAIN1265
C * * * * * MAIN1270
C * * * * * MAIN1275
C * KDPG(I,J) = NEAR SURFACE PHOTOLYSIS RATE CONSTANT THROUGH J-TH * MAIN1280
C * MATERIAL FOR I-TH CHEMICAL SPECIES OF THE TOXICANT * MAIN1285
C * ( /HR) * MAIN1290
C * * * * * MAIN1295
C * RFLATG(I,J) = REFERENCE LATITUDE FOR THE CORRESPONDING DIRECT * MAIN1300
C * PHOTOLYSIS RATE CONSTANT, (DEGREE) * MAIN1305
C * * * * * MAIN1310
C * * * * * MAIN1315
C * QUANTG(I,J) = REACTION QUANTUM YIELD THROUGH J-TH MATERIAL OF I-TH * MAIN1320
C * CHEMICAL SPECIES OF THE TOXICANT IN PHOTOLYTIC * MAIN1325
C * TRANSFORMATION (DIMENSIONLESS) * MAIN1330
C * * * * * MAIN1335
C * ABSG(I,39) = 39 ABSORPTION SPECTRUM (MOLAR EXTINCTION COEFF.) * MAIN1340
C * FOR THE I-TH CHEMICAL SPECIES, ( /CM/(MOLE/LITER)) * MAIN1345
C * * * * * MAIN1350
C * WLAMG(39) = 39 TEMPORALLY AVERAGED SPECTRAL IRRADIANCE (SOLAR + * MAIN1355
C * SKY SIGHT) IMMEDIATELY BELOW THE WATER SURFACE, * MAIN1360
C * (PHOTON/CM**2/SEC/(N-NANOMETER)) * MAIN1365
C * * * * * MAIN1370
C * WATETA(39) = 39 SPECTRAL DIFFUSE ATTENUATION COEFFICIENT FOR PURE * MAIN1375
C * WATER, ( /METER) * MAIN1380
C * * * * * MAIN1385
C * PIGETA(39) = 39 SPECTRAL SPECIFIC DIFFUSE ATTENUATION COEFFICIENTS * MAIN1390
C * FOR CHLOROPHYLL AND CHLOROPHYLL-LIKE PIGMENTS, * MAIN1395
C * ( /METER/(MILLI-GRAM/LITER)) * MAIN1400
C * * * * * MAIN1405
C * * * * * MAIN1410
C * DOCETA(39) = 39 SPECTRAL SPECIFIC DIFFUSE ATTENUATION COEFFICIENTS * MAIN1415
C * FOR DISSOLVED ORGANIC CARBON, * MAIN1420
C * ( /METER/(MILLIGRAM/LITER)) * MAIN1425
C * * * * * MAIN1430
C * * * * * MAIN1435
C * KAHG(I,J) = SECOND RATE CONSTANT FOR ACID HYDROLYSIS OF I-TH * MAIN1440
C * CHEMICAL SPECIES THROUGH J-TH SEDIMENT, *
C * ( /MOLE OF H+/T) *
C * * * * *
C * KNHG(I,J) = FIRST ORDER RATE CONSTANT FOR NEUTRAL HYDROLYSIS OF *
C * I-TH CHEMICAL SPECIES THROUGH J-TH SEDIMENT, ( /HOUR) *
C * * * * *
C * KBHG(I,J) = SECOND ORDER RATE CONSTANT FOR BASE HYDROLYSIS OF I-TH

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Appendix C (continued)

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C *      CHEMICAL SPECIES THROUGH J-TH SEDIMENT, *      MAIN1445
C *      ( /MOLE OF OH-/T) *      MAIN1450
C *      EAHG(I,J) = ARRHENIUS ACTIVATING ENRGY FOR ACID HYDROLYSIS OF *      MAIN1455
C *      I-TH CHEMICAL SPECIES THROUGH J-TH SEDIMENT, *      MAIN1460
C *      (KCAL/MOLE) *      MAIN1465
C *      ENHG(I,J) = ARRHENIUS ACTIVATING ENERGY FOR NEUTRAL HYDROLYSIS *      MAIN1470
C *      OF I-TH CHEMICAL SPECIES THROUGH J-TH SEDIMENT, *      MAIN1475
C *      (KCAL/MOLE) *      MAIN1480
C *      EBHG(I,J) = ARRHENIUS ACTIVATING ENERGY FOR BASE HYDROLYSIS OF *      MAIN1485
C *      I-TH CHEMICAL SPECIES THROUGH J-TH SEDIMENT, *      MAIN1490
C *      (KCAL/MOLE) *      MAIN1495
C *      *      MAIN1500
C *      *      MAIN1505
C *      KOXG(I,J) = SECOND OPDER RATE CONSTANT FOR OXIDATION OF I-TH *      MAIN1510
C *      CHEMICAL SPECIES THROUGH J-TH SEDIMENT, *      MAIN1515
C *      ( /MOLE OF OXIDENT/T) *      MAIN1520
C *      ENXG(I,J) = APPHENIUS ACTIVATING ENERGY FOR OXIDATION OF I-TH *      MAIN1525
C *      CHEMICAL SPECIES THROUGH J-TH SEDIMENT, (KCAL/MOLE) *      MAIN1530
C *      *      MAIN1535
C *      *      MAIN1540
C *      KBACWG(I,J) = SECOND ORDER RATE CONSTANT OF I-TH CHEMICAL SPECIES *      MAIN1545
C *      THROUGH J-TH SEDIEMNT BY WATER-BORNE BACTERIAL'S *      MAIN1550
C *      BIOLYSIS, (L**3/CELL/T) *      MAIN1555
C *      KBACSG(I,J) = SECOND ORDER RATE CONSTANT OF I-TH CHEMICAL SPECIES *      MAIN1560
C *      THROUGH J-TH SEDIMENT BY SEDIMENT-BORNE BACTERIAL'S *      MAIN1565
C *      BIOLYSIS, (M/CELL/T) *      MAIN1570
C *      OTBAWG(I,J) = 0-10 VALUE FOR KBACWG(I,J), (DIMENSIONLESS) *      MAIN1575
C *      QTBASG(I,J) = 0-10 VALUE FOR KBACSG(I,J), (DIMENSIONLESS) *      MAIN1580
C *      *      MAIN1585
C *      *      MAIN1590
C *      TSSTAB(I,J,M) = TIME OF J-TH DATA POINT IN I-TH PROFILE OF M-TH *      MAIN1595
C *      SEDIMENT SOURCE IN SS-T TABLE, (T) *      MAIN1600
C *      SSTAB(I,J,M) = VALUE OF SS OF J-TH DATA POINT IN I-TH PROFILE OF *      MAIN1605
C *      M-TH SEDIMENT SOURCE IN SS-T TABLE, (M/T/L) *      MAIN1610
C *      IF THE PROFILE IS TO BE APPLIED TO JUNCTION, THEN *      MAIN1615
C *      SSTAB(I,J,M) HAS THE UNIT OF (M/T/L**2) *      MAIN1620
C *      SS(I,M) = SOURCE OF SEDIMENT OF I-TH PROFILE, M-TH MATERIAL AT *      MAIN1625
C *      THE GIVEN TIME, (M/T/L) OR (M/T/L**2) *      MAIN1630
C *      ISSTYP(N,M) = SOURCE TYPE OF M-TH MATERIAL ASSIGNED TO N-TH *      MAIN1635
C *      COMPARTMENT *      MAIN1640
C *      *      MAIN1645
C *      TSWTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH PROFILE FORSOURCE OF *      MAIN1650
C *      WATER DISSOLVED CHEMICALS, (T) *      MAIN1655
C *      SWTAB(I,J) = VALUE OF SW OF J-TH DATA POINT IN I-TH PROFILE FOR *      MAIN1660
C *      SOURCE OF WATER DISSOLVED CHEMICALS, (M/T/L) *      MAIN1665
C *      IF THE PROFILE IS TO BE APPLIED TO JUNCTION, THEN *      MAIN1670
C *      SWTAB(I,M) HAS THE UNIT OF (M/T/L**2) *      MAIN1675
C *      SW(I) = SOURCE OF WATER DISSOLVED CHEMICALS OF I-TH PROFILE AT THE *      MAIN1680
C *      GIVEN TIME, (M/T/L) OR (M/T/L**2) *      MAIN1685
C *      ISWTYP(M) = TYPE OF WATER DISSOLVED CHEMICAL SOURCE ASSIGNED TO *      MAIN1690
C *      N-TH COMPARTMENT *      MAIN1695
C *      *      MAIN1700
C *      TSPTAB(I,J,M) = TIME OF J-TH DATA POINT IN I-TH PROFILE OF M-TH *      MAIN1705
C *      PARTICULATE CHEMICAL SOURCE IN SP-T TABLE, (T) *      MAIN1710
C *      SPTAB(I,J,M) = VALUE OF SP OF J-TH DATA POINT IN I-TH PROFILE OF *      MAIN1715
C *      M-TH PARTICULATE CHEMICAL SOURCE IN SP-T TABLE, *      MAIN1720
C *      (M/T/L). IF THE PROFILE IS TO BE APPLIED TO *      MAIN1725
C *      JUNCTION THEN SP(I,J,M) WILL HAVE THE UNIT OF *      MAIN1730
C *      (M/T/L**2) *      MAIN1735
C *      SP(I,M) = SOURCE OF PARTICULATE CHEMICAL OF I-TH PROFILE, M-TH *      MAIN1740
C *      MATERIAL AT THE GIVEN TIME, (M/T/L) OR (M/T/L**2) *      MAIN1745
C *      ISPTYP(N,M) = SOURCE TYPE OF M-TH PARTICULATE CHEMICAL ASSIGNED TO *      MAIN1750
C *      N-TH COMPARTMENT *      MAIN1755
C *      *      MAIN1760
C *      *      MAIN1765
C *      TTATAB(I,J) = TIME OF J-TH DATA POINT IN I-TH AIR TEMPERATURE(TA)- *      MAIN1770
C *      TIME(T) PROFILE, (T) *      MAIN1775
C *      TATAB(I,J) = AIR TEMPERATURE OF J-TH DATA POINT IN I-TH TA-T *      MAIN1780
C *      PROFILE, (DEGREE C) *      MAIN1785
C *      TA(I) = VALUE OF AIR TEMPERATURE OF I-TH TA-T PROFILE AT THE GIVEN *      MAIN1790
C *      TIME, (DEGREE C) *      MAIN1795
C *      ITATYP(N) = TYPE OF AIR TEMPERATURE PROFILE ASSIGNED TO N-TH *      MAIN1800
C *      COMPARTMENT *      MAIN1805
C *      *      MAIN1810
C *      TSRTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH SOLAR RADIATION(SR)- *      MAIN1815
C *      TIME(T) PROFILE, (T) *      MAIN1820
C *      SRTAB(I,J) = SOLAR RADIATION OF J-TH DATA POINT IN I-TH SR-T *      MAIN1825
C *      PROFILE *      MAIN1830
C *      SR(I) = VALUE OF SOLAR RADIATION OF I-TH SR-T PROFILE AT THE GIVEN *      MAIN1835
C *      TIME *      MAIN1840
C *      ISRTYP(N) = TYPE OF SOLAR RADIATION PROFILE ASSIGNED TO N-TH *      MAIN1845
C *      COMPARTMENT *      MAIN1850
C *      *      MAIN1855
C *      TWSTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH WIND SPEED (WS)- *      MAIN1860
C *      TIME(T) PROFILE, (T) *      MAIN1865
C *      WSTAB(I,J) = WIND SPEED OF J-TH DATA POINT IN I-TH WS-T PROFILE, *      MAIN1870
C *      (L/T) *      MAIN1875
C *      WS(I) = VALUE OF WIND SPEED OF I-TH WS-T PROFILE AT THE GIVEN TIME *      MAIN1880
C *      IWSTYP(N) = TYPE OF WIND SPEED PROFILE ASSIGNED TO N-TH COMPART. *      MAIN1885
C *      *      MAIN1890
C *      *      MAIN1895
C *      TVPTAB(2,J) = TIME OF J-TH DATA POINT IN I-TH VAPOR PRESSURE(VP)- *      MAIN1900
C *      TIME(T) PROFILE, (T) *      MAIN1905
C *      VPTAB(I,J) = VAPOR PRESSURE OF J-TH DATA POINT IN I-TH VP-T *      MAIN1910
C *      PROFILE, (TOOR) *      MAIN1915
C *      VP(I) = VALUE OF VAPOR PRESSURE OF I-TH VP-T PROFILE AT THE GIVEN *      MAIN1920
C *      TIME, (TOOR) *      MAIN1925
C *      IVPTYP(N) = TYPE OF VAPOR PRESSURE PROFILE ASSIGNED TO N-TH *      MAIN1930
C *      COMPARTMENT

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Appendix C (continued)

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C * TTWTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH WATER TEMP. (TW)- * MAIN1935
C * TIME(T) PROFILE, (T) * MAIN1940
C * TWTAB(I,J) = WATER TEMP. OF J-TH DATA POINT IN I-TH TW-T PROFILE, * MAIN1945
C * (DEGREE C) * MAIN1950
C * TW(I) = VALUE OF WATER TEMP. OF I-TH TW-T PROFILE AT GIVEN TIME * MAIN1955
C * ITWTYP(N) = TYPE OF WATER TEMP. PROFILE ASSIGNED TO N-TH COMPART. * MAIN1960
C * * MAIN1965
C * * MAIN1970
C * TECTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH EXTINCTION COEF.(EC) * MAIN1975
C * -TIME (T) PROFILE, (T) * MAIN1980
C * ECTAB(I,J) = EXTINCTION COEF. OF J-TH DATA POINT IN I-TH EC-T, * MAIN1985
C * (/METER) * MAIN1990
C * EC(I) = VALUE OF EXTINCTION COEF. OF I-TH EC-T PROFILE AT THE * MAIN1995
C * GIVEN TIME, (/METER) * MAIN2000
C * IECTYP(N) = TYPE OF EXTINCTION COEF. PROFILE ASSIGNED TO N-TH * MAIN2005
C * PROFILE * MAIN2010
C * * MAIN2015
C * TPHTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH PH-TIME(T) PROFILE * MAIN2020
C * PHTAB(I,J) = PH VALUE OF J-TH DATA POINT IN I-TH PH-T PROFILE * MAIN2025
C * PH(I) = VALUE OF PH OF I-TH PH-T PROFILE AT THE GIVEN TIME * MAIN2030
C * IPHTYP(N) = TYPE OF PH PROFILE ASSIGNED TO N-TH COMPARTMENT * MAIN2035
C * * MAIN2040
C * TPOTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH POH (PO) - TIME (T) * MAIN2045
C * PROFILE * MAIN2050
C * POTAB(I,J) = POH VALUE OF J-TH DATA POINT IN I-TH PO-T PROFILE * MAIN2055
C * PO(I) = VALUE OF POH OF I-TH PO-T PROFILE AT THE GIVEN TIME * MAIN2060
C * IPOTYP(N) = TYPE OF POH PROFILE ASSIGNED TO N-TH COMPARTMENT * MAIN2065
C * * MAIN2070
C * TORTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH OXIDANT RADICAL(OR) * MAIN2075
C * - TIME(T) PROFILE, (T) * MAIN2080
C * ORTAB(I,J) = OXIDANT RADICAL VALUE OF J-TH DATA POINT IN I-TH * MAIN2085
C * OR-T PROFILE, (MOLE) * MAIN2090
C * OR(I) = VALUE OF OR OF I-TH OR-T PROFILE AT THE GIVEN TIME * MAIN2095
C * IORTYP(N) = TYPE OF OR PROFILE ASSIGNED TO N-TH COMPARTMENT * MAIN2100
C * TPDATAB(I,J) = TIME OF J-TH DATA POINT IN I-TH POPULATION DENSITY * MAIN2105
C * (PD)-TIME (T) PROFILE, (T) * MAIN2110
C * PDATAB(I,J) = POPULATION DENSITY VALUE OF J-TH DATA POINT IN I-TH * MAIN2115
C * PD-T PROFILE, (CELL/L**3) * MAIN2120
C * PD(I) = VALUE OF POPULATION DENSITY OF I-TH PD-T PROFILE AT THE * MAIN2125
C * GIVEN TIME, (CELLS/L**3) * MAIN2130
C * IPDTP(N) = TYPE OF POPULATION DENSITY PROFILE ASSIGNED TO N-TH * MAIN2135
C * COMPARTMENT * MAIN2140
C * * MAIN2145
C * TRTYP(I,J) = TIME OF J-TH DATA POINT IN I-TH BIO-TEMPERATURE(BT)- * MAIN2150
C * TIME(T) PROFILE, (T) * MAIN2155
C * BTAB(I,J) = BIO-TEMPERATURE VALUE OF J-TH DATA POINT IN I-TH * MAIN2160
C * BT-T PROFILE, (DEGREE C) * MAIN2165
C * BT(I) = VALUE OF BIO-TEMPERATURE OF I-TH BT-T PROFILE AT THE * MAIN2170
C * GIVEN TIME, (DEGREE C) * MAIN2175
C * IBTYP(N) = TYPE OF BIO-TEMPERATURE PROFILE ASSIGNED TO N-TH * MAIN2180
C * COMPARTMENT * MAIN2185
C * * MAIN2190
C * TPBTAB(I,J) = TIME OF J-TH DATA POINT IN I-TH PROPORTIONAL * MAIN2195
C * BACTERIAL(PB)-TIME(T) PROFILE, (T) * MAIN2200
C * PBATAB(I,J) = PROPORTIONAL BACTERIAL VALUE OF J-TH DATA POINT IN * MAIN2205
C * I-TH PB-T PROFILE, (DIMENSIONLESS IN DECIMAL POINT) * MAIN2210
C * PB(I) = VALUE OF PROPORTIONAL BACTERIAL OF I-TH PB-T PROFILE AT * MAIN2215
C * THE GIVEN TIME, (DIMENSIONLESS IN DECIMAL POINT) * MAIN2220
C * IPBTYP(N) = TYPE OF PROPORTIONAL BACTERIAL PROFILE ASSIGNED TO * MAIN2225
C * N-TH COMPARTMENT * MAIN2230
C * * MAIN2235
C * * MAIN2240
C * GSI(I,M) = GIVEN BOUNDARY SEDIMENT CONCENTRATION OF M-TH FRACTION * MAIN2245
C * SIZE IN I-TH PROFILE AT THE GIVEN TIME, (M/L**3) FOR * MAIN2250
C * DIRICHLET CONDITIONS OR (M/T) FOR NEUMANN AND CAUCHY * MAIN2255
C * CONDITIONS * MAIN2260
C * TGSITB(I,J,M) = TIME OF J-TH DATA POINT IN I-TH GIVEN BOUNDARY * MAIN2265
C * SEDIMENT(SI)-TIME(T) PROFILE FOR M-TH FRACTION, (T) * MAIN2270
C * GSITB(I,J,M) = GIVEN SI VALUE OF J-TH DATA POINT IN I-TH SI-T * MAIN2275
C * PROFILE FOR M-TH FRACTION, (M/L**3) * MAIN2280
C * * MAIN2285
C * GCW(I) = GIVEN BOUNDARY DISSOLVED CONCENTRATION IN I-TH PROFILE AT * MAIN2290
C * THE GIVEN TIME, (M/L**3) FOR DIRICHLET BOUNDARY CONDITIONS * MAIN2295
C * OF (M/T) FOR NEUMANN AND CAUCHY CONDITIONS * MAIN2300
C * TGCWTB(I,J) = TIME OF J-TH DATA POINT IN I-TH GIVEN BOUNDARY * MAIN2305
C * DISSOLVED CONCENTRATION(CW)-TIME(T) PROFILE, (T) * MAIN2310
C * GCWTB(I,J) = GIVEN CW VALUE OF J-TH DATA POINT IN I-TH CW-T * MAIN2315
C * PROFILE, (M/L**3) * MAIN2320
C * * MAIN2325
C * GCI(I,M) = GIVEN BOUNDARY PARTICULATE CONCENTRATION OF M-TH * MAIN2330
C * FRACTION SIZE IN I-TH PROFILE AT THE GIVEN TIME, (M/M) * MAIN2335
C * FOR DIRICHLET BOUNDARY CONDITIONS OR (M/T) FOR * MAIN2340
C * NEUMANN AND CAUCHY BOUNDARY CONDITIONS * MAIN2345
C * TGCITB(I,J,M) = TIME OF J-TH DATA POINT IN I-TH GIVEN BOUNDARY * MAIN2350
C * PARTICULATE CONCENTRATION(CI)-TIME(T) PROFILE FOR * MAIN2355
C * M-TH FRACTION SIZE, (T) * MAIN2360
C * GCITB(I,J,M) = GIVEN CI VALUE OF J-TH DATA POINT IN I-TH CI-T * MAIN2365
C * PROFILE FOR M-TH FRACTION, (M/M) * MAIN2370
C * * MAIN2375
C * * MAIN2380
C * CMATRIX(N,IB) = AN ARRAY TO STORE THE ASSEMBLED GLOBAL MATRIX * MAIN2385
C * * MAIN2390
C * ALLOAD(N) = AN ARRAYS TO STORE THE ASSEMBLED GLOBAL LOAD FUNCTION * MAIN2395
C * * MAIN2400
C *****

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Appendix C (continued)

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C      IMPLICIT REAL*8(A-H,O-Z)
C      REAL*4 TITLE(20)
C      REAL*8 MOLEW, KOPG, KAHG,KNHG,KBHG, KOXG, KBACWG,KBACSG
C      COMMON /CSIZE/ MAXNOD,MAXCON,MAXBND,MXEQS,MAXBWD
C      COMMON /CINTGR/ NODES,NCONS,NGBND,NTI,KVI,KSS
C      COMMON /EQUAS/ NEQS,IRAND,IHBP,HALFR,IMPL
C      COMMON /KPRT/ KPRED,KPRBS,KPRSI,KPRK,KPRCW,KPRBC,KPRCI,NREAD,NSTOR
C      COMMON /CREALR/ DELT,CHNG,EDDY,THETA
C      COMMON /PHOTO/ WLMG,WATETA,PIGETA,DOCEA
C      COMMON /FOTO/ CLOUDG,ELATG
C      COMMON /CSDCM/ MXSUB,MXSURP,MXSPY,NSURS,NSPY
C      COMMON /CSOS/ MXSPR,MXSDP,NSPR,NSDP
C      COMMON /CTA/ MXTAPP,MXTADP,NTAPP,NTADP
C      COMMON /CSR/ MXSRPR,MXSRDP,NSRPR,NSRDP
C      COMMON /CWS/ MXWSPR,MXWSDP,NWSPP,NWSDP
C      COMMON /CVP/ MXVPPP,MXVPDP,NVPPR,NVDPD
C      COMMON /CTW/ MXTWPR,MXTWDP,NTWPR,NTWDP
C      COMMON /CEC/ MXECPR,MXECDP,NECPR,NECDP
C      COMMON /CPH/ MXPHPR,MXPHPD,NPHPR,NPHDP
C      COMMON /CPO/ MXPQPR,MXPQDP,NPQPR,NPQDP
C      COMMON /COR/ MXOPPR,MXORDP,NORPR,NORDP
C      COMMON /CPD/ MXPDP,MPDDP,NPDPR,NPDDP
C      COMMON /CBT/ MXBTPR,MXBTD,NTBPR,NTBTP
C      COMMON /CPB/ MXPBPR,MXPBDP,NPBPR,NPBDP
C      COMMON /CBV/ MXBVP,MBVDP,NBVP,MBVDP
C      DIMENSION DCN(100),SEDCN(100,3),PCN(100,3)
C      DIMENSION DCNP(100),SEDCNP(100,3),PCNP(100,3)
C      DIMENSION BEDSC(100,3),BEDSDP(100,3)
C      DIMENSION BDCHM(100,3),BDCHMP(100,3),CNBED(100,3),CNBEDP(100,3)
C      DIMENSION ERSN(100,3),DPOSN(100,3),QS(100,3)
C      DIMENSION DX(100),CN(100),NODTYP(100)
C      DIMENSION Q(100),A(100),B(100),P(100),H(100)
C      DIMENSION QP(100),AP(100),BP(100),PP(100),HP(100)
C      DIMENSION NOD1(99),NOD2(99),KSIGN(99),D1IC(99),D2IC(99),ICNTYP(99)
C      DIMENSION KGBND(10),IGRTYP(10)
C      DIMENSION ABSOPK(3),FOILKD(3),ABSOPB(3)
C      DIMENSION WSK(3),ERODTY(3),TAUCD(3),TAUCR(3),DIAMS(3)
C      DIMENSION RATKV(100,4),RATKH(100,4),RATKO(100,4),RATKP(100,4)
C      DIMENSION RATKB(100,4),RATEK(100,4)
C      DIMENSION MOLEW(1,4),HENPY(1,4)
C      DIMENSION KOPG(1,4),RFLAG(1,4),QUANTG(1,4),ABSG(1,39)
C      DIMENSION WLMG(39),WATETA(39),PIGETA(39),DOCEA(39)
C      DIMENSION KAHG(1,4),KNHG(1,4),KBHG(1,4)
C      DIMENSION EAHG(1,4),ENHG(1,4),EBHG(1,4)
C      DIMENSION KOXG(1,4),EOXG(1,4)
C      DIMENSION KBACWG(1,4),KBACSG(1,4),QTRAWG(1,4),QTBASG(1,4)
C      DIMENSION TSSTAB(2,24,3),SSTAB(2,24,3),SS(2,3),ISSTYP(100,3)
C      DIMENSION TSWTAB(2,24),SWTAB(2,24),SW(2),ISWTYP(100)
C      DIMENSION TSPTAB(2,24,3),SPTAB(2,24,3),SP(2,3),ISPTYP(100,3)
C      DIMENSION TTATAB(2,24),TATAB(2,24),TA(2),ITATYP(100)
C      DIMENSION TSRTAB(2,24),SRTAB(2,24),SR(2),ISRTYP(100)
C      DIMENSION TWSTAB(2,24),WSTAB(2,24),WS(2),IWSYP(100)
C      DIMENSION TVPTAB(2,24),VPTAB(2,24),VP(2),IVPTYP(100)
C      DIMENSION TTWTAB(2,24),TWTAB(2,24),TW(2),ITWTYP(100)
C      DIMENSION TECTAB(2,24),FCTAB(2,24),EC(2),IECTYP(100)
C      DIMENSION TPHTAB(2,24),PHTAB(2,24),PH(2),IPHYP(100)
C      DIMENSION TPOTAB(2,24),POTAB(2,24),PO(2),IPOTYP(100)
C      DIMENSION TORTAB(2,24),OPTAB(2,24),OR(2),IORTYP(100)
C      DIMENSION TPDTAB(2,24),PDTAB(2,24),PD(2),IPDTYP(100)
C      DIMENSION BTTAB(2,24),BTAB(2,24),BT(2),IBTTYP(100)
C      DIMENSION TPSTAB(2,24),PSTAB(2,24),PR(2),IPSTYP(100)
C      DIMENSION GSI(4,3),TGSITB(4,16,3),GSITB(4,16,3)
C      DIMENSION GCW(4),TGCWTB(4,16),GCWTB(4,16)
C      DIMENSION GCI(4,3),TGCITB(4,16,3),GCITB(4,16,3)
C      DIMENSION CMATRX(100,13),ALOAD(100)
C      ----- READ AND WRITE TITLE
C      READ 10, TITLE
C      PRINT 1000, TITLE
C      ----- COMPUTE AND WRITE TOTAL REAL AND INTEGER ARRAY SIZES

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Appendix C (continued)

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      NRSIZE=12*MAXNOD*MXSUB + 14*MAXNOD + 2*MAXCON + 8*MXSUB +
1      6*MAXNOD*MXSUBP + 5*MXSPY*MXSUBP + MXSPY*39 +
2      12*MXSPY*MXSUBP + 2*(MXSPR*MXSUB*(1+2*MXSDP)) +
3      MXSPR*(1+2*MXSDP) + MXTAPR*(2*MXTADP+1) +
4      MXSRPR*(2*MXSRDP+1) + MXWSPR*(2*MXWSDP+1) +
5      MXVPPR*(2*MXVPDP+1) + MXTWPR*(2*MXTWDP+1) +
6      MXECPR*(2*MXECDP+1) + MXPHPR*(2*MXPHDP+1) +
7      MXPOPR*(2*MXPODP+1) + MXORPR*(2*MXORDP+1) +
8      MXPDPR*(2*MXPDOP+1) + MXBTPR*(2*MXBTDP+1) +
9      MXBPBR*(2*MXBPDP+1) + 2*(MXBVPR*MXSUB*(1+2*MXBVDOP)) +
A      MXBVPR*(1+2*MXBVDOP) + MXEQS*MXBWD + MAXNOD
C
C      NISIZE=MAXNOD+4*MAXCON+2*MXBND+2*MAXNOD*MXSUB+MAXNOD+12*MAXNOD
C
C      PRINT 2000, NRSIZE, NISIZE
C
C
C      ----- INITIATE ARRAYS DEFINED OVER COMPARTMENTS
C
      DO 190 N=1, MAXNOD
        DCN(N)=0.0
        DCNP(N)=0.0
        DX(N)=0.0
        CN(N)=0.0
        Q(N)=0.0
        A(N)=0.0
        B(N)=0.0
        P(N)=0.0
        H(N)=0.0
        QP(N)=0.0
        AP(N)=0.0
        BP(N)=0.0
        PP(N)=0.0
        HP(N)=0.0
        NDOTYP(N)=0
C
C      ISWTYP(N)=0
C
C      ITATYP(N)=0
C      ISPTYP(N)=0
C      IWSTYP(N)=0
C      IVPTYP(N)=0
C      ITWTYP(N)=0
C      IECTYP(N)=0
C
C      IPHTYP(N)=0
C      IPOTYP(N)=0
C
C      IORTYP(N)=0
C
C      IPDTYP(N)=0
C      IBTTYP(N)=0
C      IPBTYP(N)=0
C
C      DO 110 M=1, MXSUB
        SEDCN(N,M)=0.0
        PCN(N,M)=0.0
        SEDCNP(N,M)=0.0
        PCNP(N,M)=0.0
        BEDSD(N,M)=0.0
        BEDSDP(N,M)=0.0
        BDCHM(N,M)=0.0
        BDCHMP(N,M)=0.0
        CNBED(N,M)=0.0
        CNBEDP(N,M)=0.0
        EPSN(N,M)=0.0
        OPOSN(N,M)=0.0
        QS(N,M)=0.0
C
C      ISSTYP(N,M)=0
C      ISPTYP(N,M)=0
C
C      110 CONTINUE
C
C      DO 120 M=1, MXSUBP
        RATKV(N,M)=0.0
        RATKH(N,M)=0.0
        RATKO(N,M)=0.0
        RATKP(N,M)=0.0
        RATEK(N,M)=0.0
C
C      120 CONTINUE
C
C      190 CONTINUE
C
C
C      ----- INITIATE ARRAYS DEFINED OVER CONNECTORS
C
      DO 250 K=1, MAXCON
        D11C(K)=0.0
        D21C(K)=0.0
        NOD1(K)=0
        NOD2(K)=0
        KSIGN(K)=0
        ICNTYP(K)=0
C
C      250 CONTINUE
C
C      DO 290 K=1, MXBND
        KGBND(K)=0
        IGBTYP(K)=0
C
C      290 CONTINUE

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Appendix C (continued)

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C
CC ----- INITIATE ARRAYS FOR MATERIAL PROPERTIES
C
  DO 390 M=1,MXSUB
    ABSOPK(M)=0.0
    EQILKO(M)=0.0
    ABSOPB(M)=0.0
    WSK(M)=0.0
    ERODTY(M)=0.0
    TAUCD(M)=0.0
    TAUCR(M)=0.0
    CIAMS(M)=0.0
  390 CONTINUE
C
CC ----- INITIATE ARRAYS FOR SPECIES PROPERTIES THROUGH EACH MATERIALS
C
  DO 490 I=1,MXSPY
    DO 410 M=1,MXSUBP
      MOLEW(I,M)=0.0
      HENRY(I,M)=0.0
    C
      KDPG(I,M)=0.0
      RFLAG(I,M)=0.0
      QUANTG(I,M)=0.0
    C
      KAHG(I,M)=0.0
      KNHG(I,M)=0.0
      KBHG(I,M)=0.0
      EAHG(I,M)=0.0
      ENHG(I,M)=0.0
      EBHG(I,M)=0.0
    C
      KQXG(I,M)=0.0
      EQXG(I,M)=0.0
    C
      KBACWG(I,M)=0.0
      KBACSG(I,M)=0.0
      QTBAWG(I,M)=0.0
      QTBASG(I,M)=0.0
    410 CONTINUE
    DO 420 J=1.39
      ABSG(I,J)=0.0
    420 CONTINUE
    490 CONTINUE
C
CC ----- INITIATE ARRAYS FOR SOURCES
C
  DO 550 M=1,MXSUB
    DO 530 I=1,MXSPR
      DO 520 J=1,MXSDP
        TSSTAB(I,I,M)=0.0
        SSTAB(I,J,M)=0.0
        TSPTAB(I,J,M)=0.0
        SPTAB(I,J,M)=0.0
      520 CONTINUE
      SS(I,M)=0.0
      SP(I,M)=0.0
    530 CONTINUE
    550 CONTINUE
C
  DO 590 I=1,MXSPR
    DO 580 J=1,MXSDP
      TSWTAB(I,J)=0.0
      SWTAB(I,J)=0.0
    580 CONTINUE
    SW(I)=0.0
  590 CONTINUE
C
CC ----- INITIATE ARRAYS FOR ENVIRONMENTAL CONDITIONS
C
  DO 610 I=1,MXTAPR
    DO 605 J=1,MXTADP
      TTATAB(I,J)=0.0
      TATAB(I,J)=0.0
    605 CONTINUE
    TA(I)=0.0
  610 CONTINUE
C
  DO 620 I=1,MXSRPP
    DO 615 J=1,MXSRDP
      TSRTAB(I,J)=0.0
      SRTAB(I,J)=0.0
    615 CONTINUE
    SR(I)=0.0
  620 CONTINUE
C
  DO 630 I=1,MXWSPR
    DO 625 J=1,MXWSDP
      TWSTAB(I,J)=0.0
      WSTAB(I,J)=0.0
    625 CONTINUE

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Appendix C (continued)

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      WS(I)=0.0
C 630 CONTINUE
      DO 640 I=1,MXVPPR
      DO 635 J=1,MXVPDP
      TVPTAB(I,J)=0.0
      VPTAB(I,J)=0.0
C 635 CONTINUE
      VP(I)=0.0
C 640 CONTINUE
      DO 650 I=1,MXTWPR
      DO 645 J=1,MXTWDP
      TTWTAB(I,J)=0.0
      TWTAB(I,J)=0.0
C 645 CONTINUE
      TW(I)=0.0
C 650 CONTINUE
      DO 660 I=1,MXECPR
      DO 655 J=1,MXECDP
      TECTAB(I,J)=0.0
      ECTAB(I,J)=0.0
C 655 CONTINUE
      EC(I)=0.0
C 660 CONTINUE
C
C
C 700 CONTINUE
      DO 710 I=1,MXPHPR
      DO 705 J=1,MXPHPDP
      TPHTAB(I,J)=0.0
      PHTAB(I,J)=0.0
C 705 CONTINUE
      PH(I)=0.0
C 710 CONTINUE
C
C 720 CONTINUE
      DO 720 I=1,MXPQPP
      DO 715 J=1,MXPQDP
      TPQTAB(I,J)=0.0
      PQTAB(I,J)=0.0
C 715 CONTINUE
      PQ(I)=0.0
C 720 CONTINUE
C
C 730 CONTINUE
      DO 730 I=1,MXORPR
      DO 725 J=1,MXORDP
      TORTAB(I,J)=0.0
      ORTAB(I,J)=0.0
C 725 CONTINUE
      OR(I)=0.0
C 730 CONTINUE
C
C 740 CONTINUE
      DO 740 I=1,MXPDP
      DO 735 J=1,MXPDDP
      TPDTAB(I,J)=0.0
      PDTAB(I,J)=0.0
C 735 CONTINUE
      PD(I)=0.0
C 740 CONTINUE
C
C 750 CONTINUE
      DO 750 I=1,MXBTPR
      DO 745 J=1,MXBTD
      BTBTAB(I,J)=0.0
      BTTAB(I,J)=0.0
C 745 CONTINUE
      BT(I)=0.0
C 750 CONTINUE
C
C
C 760 CONTINUE
      DO 760 I=1,MXPBPP
      DO 755 J=1,MXPBDDP
      TPBTAB(I,J)=0.0
      PBTAB(I,J)=0.0
C 755 CONTINUE
      PB(I)=0.0
C 760 CONTINUE
C
C
C
C ----- INITIATE ARRAYS FOR BOUNDARY CONDITIONS
C
      DO 850 M=1,MXSUR
      DO 830 I=1,MXBVPR
      DO 820 J=1,MXBVDP
      TGSITB(I,J,M)=0.0
      GSITB(I,J,M)=0.0
      TGCITB(I,J,M)=0.0
      GCITB(I,J,M)=0.0
C 820 CONTINUE
      GSI(I,M)=0.0
      GCI(I,M)=0.0
C 830 CONTINUE
      GSI(I,M)=0.0
C 850 CONTINUE
C
C 880 CONTINUE
      DO 890 I=1,MXBVPR
      DO 880 J=1,MXBVDP
      TGCWTB(I,J)=0.0
      GCWTB(I,J)=0.0
C 880 CONTINUE
      GCW(I)=0.0

```

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MAIN3885
MAIN3890
MAIN3895
MAIN3900
MAIN3905
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MAIN3985
MAIN3990
MAIN3995
MAIN4000
MAIN4005
MAIN4010
MAIN4015
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MAIN4100
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MAIN4110
MAIN4115
MAIN4120
MAIN4125
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MAIN4185
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MAIN4200
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MAIN4210
MAIN4215
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MAIN4280
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MAIN4290
MAIN4295
MAIN4300
MAIN4305
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MAIN4345
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MAIN4360
MAIN4365
MAIN4370
MAIN4375

```

Appendix C (continued)

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      890 CONTINUE
C
      DO 920 N=1,MXEQS
        ALOAD(N)=0.0
        DO 910 I=1,MXBWD
          910 CMATRX(N,I)=0.0
        920 CONTINUE
C
C----- CALL DATAIO TO READ AND WRITE THE INPUT DATA
C
      CALL DATAIO(SEDCN,DCN,PCN,BEDSD,BDCHM,CNBED,DX,NODTYP,CN,
1 NOD1,NOD2,KSIGN,D1IC,D2IC,ICNTYP,KGBND,IGBTYP,
2 ABSOPK,EQILKD,ABSOPR,WSK,EROOTY,TAUCD,TAUCR,DIAMS,
3 MOLEW,HENRY,KDPG,RFLAG,ABSG,QUANTG,
4 KAHG,KNHG,KBHG,EAHG,ENHG,ERHG,KOXG,EOXG,
5 KBACWG,KBACSG,QTBWAG,QTBASG)
C
C----- CALL SOURCE, ENVIRONMENT, AND BOUNDARY CONDITIONS DATA
C
      CALL SENBCD(TSSTAB,SSTAB,ISSTYP,TSWTAB,SWTAB,ISWTYP,TSPTAB,
> SPTAB,ISPTYP,TTATAB,TATAB,ITATYP,T3RTAB,SRTAB,ISRTYP,TWSTAB,
> WSTAB,IWSTYP,TVPTAB,VPTAB,IVPTYP,TTWTAB,TWTAB,ITWTYP,
> TECTAB,ECTAB,IECTYP,TPHTAB,PHTAB,IPHTYP,TPOTAB,POTAB,IPOTYP,
> TPBTAB,PBTAB,IPBTYP,TPDTAB,PDTAB,IPDTYP,TBTTAB,BTTAB,IBTTYP,
> TPBTAB,PBTAB,IPBTYP,TGSI TB,GSITB,TGCW TB,GCWTR,TGCITB,GCITB)
C
C----- CALL CHNTRN TO PERFORM TRANSIENT COMPUTATION
C
      CALL CHNTRN(SEDCN,DCN,PCN,BEDSD,BDCHM,CNBED,
1 SEDCN,DCNP,PCNP,BEDSDP,BDCHMP,CNBEDP,ERSN,DPOSN,QS,Q,A,B,P,H,
2 QP,AP,BP,PP,HP,CN,DX,NODTYP,NOD1,NOD2,KSIGN,D1IC,D2IC,ICNTYP,
3 ABSOPK,EQILKD,ABSOPR,WSK,EROOTY,TAUCD,TAUCR,DIAMS,
4 MOLEW,HENRY,QUANTG,KDPG,RFLAG,ABSG,
5 KAHG,KNHG,KBHG,EAHG,ENHG,ERHG,KOXG,EOXG,KBACWG,KBACSG,QTBWAG,
6 QTBASG,RATKV,RATKP,RATKH,RATKO,RATKB,RATEK,CMATRX,ALOAD,
7 TSSTAB,SSTAB,SS,ISSTYP,TSWTAB,SWTAB,SW,ISWTYP,TSPTAB,SPTAB,SP,
8 ISPTYP,TTATAB,TATAB,TA,ITATYP,TSRTAB,SRTAB,SR,ISRTYP,
9 TWSTAB,WSTAB,WS,IWSTYP,TTWTAB,TWTAB,TW,ITWTYP,TVPTAB,VPTAB,VP,
A IVPTYP,TECTAB,ECTAB,EC,IECTYP,TPHTAB,PHTAB,PH,IPHTYP,
B TPOTAB,POTAB,PO,IPOTYP,TPRTAB,ORTAB,OR,IORTYP,
C TBTTAB,BTTAB,BT,IBTTYP,TPDTAB,PDTAB,PD,IPDTYP,
D TPBTAB,PBTAB,PB,IPBTYP,KGBND,GSITB,TGSI TB,GSITB,
E GCW,TGCW TB,GCWTR,GCITB,TGCITB)
C
C
      10 FORMAT(20A4)
      1000 FORMAT(1H1///5X,82(' ')/5X,'*',80X,'*/5X,'*',20A4,'*/5X,
1 ' ',80X,'*/5X,82(' ')/)
      2000 FORMAT(1H0/5X,9H NPSIZE =,110/5X,9H NISIZE =,110/)
      STOP
      END

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MAIN4380
MAIN4385
MAIN4390
MAIN4395
MAIN4400
MAIN4405
MAIN4410
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MAIN4445
MAIN4450
MAIN4455
MAIN4460
MAIN4465
MAIN4470
MAIN4475
MAIN4480
MAIN4485
MAIN4490
MAIN4495
MAIN4500
MAIN4505
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MAIN4560
MAIN4565
MAIN4570
MAIN4575
MAIN4580
MAIN4585
MAIN4590
MAIN4595
MAIN4600
MAIN4605
MAIN4610
MAIN4615
MAIN4620
MAIN4625
MAIN4630
MAIN4635
MAIN4640
MAIN4645
MAIN4650

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Appendix C (continued)

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BLOCK DATA
IMPLICIT REAL*8 (A-H,O-Z)

COMMON /CSIZE/ MAXNOD,MAXCON,MAXBND,MXEQS,MAXBWD
COMMON /CSDCH/ MXSUB,MXSUBP,MXSPY,NSUBS,NSPY
COMMON /CSOS/ MXSPR,MXSDP,NSPR,NSDP
COMMON /CTA/ MXTAPR,MXTADP,NTAPR,NTADP
COMMON /CSR/ MXSRPR,MXSRDP,NSRPR,NSRDP
COMMON /CWS/ MXWSPR,MXWSDP,NWSPR,NWSDP
COMMON /CVP/ MXVPPR,MXVPDP,NVPPR,NVDPD
COMMON /CTW/ MXTWPR,MXTWDP,NTWPR,NTWDP
COMMON /CEC/ MXECPR,MXECDP,NECPR,NECDP
COMMON /CPH/ MXPHPR,MXPHDP,NPHPR,NPHDP
COMMON /CPD/ MXPDP,MPDP,NPDP,NPDP
COMMON /COR/ MXORPR,MXORDP,NORPR,NORDP
COMMON /CPD/ MXPDP,MPDP,NPDP,NPDP
COMMON /CBT/ MXBT,MBT,NBT,NBT
COMMON /CPB/ MXPBP,MPBP,NBP,NBP
COMMON /CBV/ MXBVP,MBVP,NBVP,NBVP
COMMON /PHOTO/ WLAMG,WATETA,PIGETA,DOCETA

DIMENSION WLAMG(39),WATETA(39),PIGETA(39),DOCETA(39)

DATA MAXNOD,MAXCON,MAXBND,MXEQS,MAXBWD/100,99,10,100,13/
DATA MXSUB,MXSUBP,MXSPY/3,4,1/
DATA MXSPR,MXSDP/2,24/
DATA MXTAPR,MXTADP,MXSRPR,MXSRDP,MXWSPR,MXWSDP/2,24,2,24,2,24/
DATA MXVPPR,MXVPDP,MXTWPR,MXTWDP,MXECPR,MXECDP/2,24,2,24,2,24/
DATA MXPHPR,MXPHDP,MXPDP,MPDP,MXORPR,MXORDP/2,24,2,24,2,24/
DATA MXPDP,MPDP,NPDP,NPDP,MXPBP,MPBP,NBP,NBP/2,24,2,24,2,24/
DATA MXBVP,MBVP,NBVP,NBVP/4,16/

DATA WLAMG/0.9810E+11, 0.3380E+12, 0.1110E+13, 0.2990E+13,
1 0.5400E+13, 0.8840E+13, 0.1380E+14, 0.1850E+14, 0.2330E+14,
2 0.2810E+14, 0.5210E+14, 0.1810E+15, 0.2210E+15, 0.2260E+15,
3 0.2410E+15, 0.248E+15, 0.2940E+15, 0.3660E+15, 0.5260E+15,
4 0.6920E+15, 0.7120E+15, 0.6880E+15, 0.8410E+15, 0.9170E+15,
5 0.9270E+15, 0.9590E+15, 0.9830E+15, 0.9300E+15, 0.9490E+15,
6 0.1000E+16, 0.1050E+16, 0.1060E+16, 0.1070E+16, 0.1080E+16,
7 0.1090E+16, 0.1080E+16, 0.1070E+16, 0.1030E+16, 0.9880E+15/

DATA WATETA/.198,.186,.175,.166,.157,.150,.142,.136,.129,
1 .122,.116,.103,.087,.059,.051,.044,.040,.031,.027,.025,.024,
2 .022,.022,.023,.023,.023,.022,.025,.032,.050,.063,.082,.131,
3 .244,.336,.485,.630,2.53,2.00/

DATA PIGETA/13*0.,
1 .66,.66,.61,.55,.51,.49,.47,.45,.42,.39,.37,.34,.31,.29,.26.,
2 23,.17,.12,.9,.7,.6,.9,.16,.4,.2,.0/

DATA DOCETA/6.3,6.12,5.94,5.76,5.57,5.39,5.22,5.06,4.90,
1 4.74,4.56,4.17,3.64,3.15,2.74,2.34,2.00,1.64,1.39,1.19,
2 1.02,.870,.753,.654,.573,.504,.444,.396,.357,.282,.228,.188,
3 .159,6*0./

END

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BLOC 005
BLOC 010
BLOC 015
BLOC 020
BLOC 025
BLOC 030
BLOC 035
BLOC 040
BLOC 045
BLOC 050
BLOC 055
BLOC 060
BLOC 065
BLOC 070
BLOC 075
BLOC 080
BLOC 085
BLOC 090
BLOC 095
BLOC 100
BLOC 105
BLOC 110
BLOC 115
BLOC 120
BLOC 125
BLOC 130
BLOC 135
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BLOC 145
BLOC 150
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BLOC 165
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BLOC 215
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BLOC 225
BLOC 230
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BLOC 240
BLOC 245
BLOC 250
BLOC 255
BLOC 260
BLOC 265
BLOC 270
BLOC 275
BLOC 280

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Appendix C (continued)

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SUBROUTINE CATAIO(SEDON,DCN,PCN,BEDSD,BDCHM,CNBED,DX,NODTYP,CN,
1 NOD1,NOD2,KSIGN,D1IC,D2IC,ICNTYP,KGBND,IGBTYP,
2 ABSOPK,EQILKD,ABSOPB,WSK,EROOTY,TAUCD,TAUCR,DIAMS,
3 MOLEW,HENRY,          KDPG,RFLAG,ABSG,QUANTG,
4 KAHG,KNHG,KBHG,EAHG,ENHG,EBHG,KOXG,EOXG,
5 KBACWG,KBACSG,QTBAWG,QTBASG)
C
C IMPLICIT REAL*8 (A-H,O-Z)
C REAL*8 MOLEW, KDPG, KAHG,KNHG,KBHG, KOXG, KBACWG,KBACSG
C
C COMMON /CSIZE/ MAXNOD,MAXCON,MXBND,MXEQS,MXBWD
C COMMON /CINTGR/ NODES,NCONS,NGBND,NTI,KVI,KSS
C COMMON /CSDCM/ MXSUB,MXSUBP,MXSPY,NSUBS,NSPY
C COMMON /EQUAS/ NEQS,IRAND,IHBP,IHALFB,IMPL
C COMMON /CREALR/ DELT,CHNG,EDDY,THETA
C COMMON /KPRIT/ KPRED,KPRBS,KPRSI,KPRK,KPRCW,KPRBC,KPRCI,NREAD,NSTOR
C
C COMMON /FOTO/ CLOUDG,ELATG
C
C DIMENSION SEDON(MAXNOD,MXSUB),DCN(MAXNOD),PCN(MAXNOD,MXSUB)
C DIMENSION BEDSD(MAXNOD,MXSUB)
C DIMENSION BDCHM(MAXNOD,MXSUB),CNBED(MAXNOD,MXSUB)
C
C DIMENSION DX(MAXNOD),NODTYP(MAXNOD),CN(MAXNOD)
C DIMENSION NOD1(MAXCON),NOD2(MAXCON),ICNTYP(MAXCON)
C DIMENSION KSIGN(MAXCON),D1IC(MAXCON),D2IC(MAXCON)
C
C DIMENSION KGBND(MXBND),IGBTYP(MXBND)
C
C DIMENSION ABSOPK(MXSUB),EQILKD(MXSUB),ABSOPB(MXSUB)
C DIMENSION WSK(MXSUB),EROOTY(MXSUB),TAUCD(MXSUB),TAUCR(MXSUB)
C DIMENSION DIAMS(MXSUB)
C
C DIMENSION MOLEW(MXSPY,MXSUBP),HENRY(MXSPY,MXSUBP)
C
C DIMENSION KDPG(MXSPY,MXSUBP),RFLAG(MXSPY,MXSUBP)
C DIMENSION QUANTG(MXSPY,MXSUBP),ABSG(MXSPY,39)
C
C DIMENSION KAHG(MXSPY,MXSUBP),KNHG(MXSPY,MXSUBP),KBHG(MXSPY,MXSUBP)
C DIMENSION EAHG(MXSPY,MXSUBP),ENHG(MXSPY,MXSUBP),EBHG(MXSPY,MXSUBP)
C
C DIMENSION KOXG(MXSPY,MXSUBP),EOXG(MXSPY,MXSUBP)
C
C DIMENSION KBACWG(MXSPY,MXSUBP),KBACSG(MXSPY,MXSUBP)
C DIMENSION QTBAWG(MXSPY,MXSUBP),QTBASG(MXSPY,MXSUBP)
C
C ----- READ AND WRITE INTEGER PARAMETERS
C
C READ 10, NODES,NCONS,NGBND,NTI,KVI,KSS,NEQS,IMPL,NSUBS,NSPY
C
C PRINT 1100, NODES,NCONS,NGBND,NTI,KVI,KSS,NEQS,IMPL,NSUBS,NSPY
C
C ----- READ AND WRITE OUTPUT CONTROL
C
C READ 10, KPRED,KPRBS,KPRSI,KPRK,KPRCW,KPRBC,KPRCI,NREAD,NSTOR
C PRINT 1200, KPRED,KPRBS,KPRSI,KPRK,KPRCW,KPRBC,KPRCI,NREAD,NSTOR
C
C ----- READ AND WRITE REAL PARAMETERS
C
C READ(5,20) DELT,CHNG,EDDY,THETA
C PRINT 1300, DELT,CHNG,EDDY,THETA
C
C ----- READ NODE INFORMATION VIA LOGICAL UNIT 1
C
C IF(KVI.LE.0) GO TO 100
C
C REWIND 1
C READ(1) NODES,NCONS,(NODTYP(N),N=1,NODES),(DX(N),N=1,NODES),
1 (CN(N),N=1,NODES)
C GO TO 180
C
C ----- READ NODE INFORMATION VIA CARDS
C
C 100 NODESS=0
C 110 READ 25, NI,NSEQ,NTYPNI,NAD,CNNI,DXNI,DXAD
C IF(NI.EQ.0) GO TO 130
C NJ=NI+NSEQ
C DO 120 N=NI,NJ
C I=NI+(N-NI)*NAD
C NODTYP(I)=NTYPNI
C CN(I)=CNNI
C DX(I)=DXNI+DXAD*DFLOAT(N-NI)
C NODESS=NODESS+1
C 120 CONTINUE
C GO TO 110
C 130 IF(NODESS.EQ.NODES) GO TO 140
C PRINT 2100
C STOP
C 140 IF(NODES.LE.MAXNOD) GO TO 150
C PRINT 2200
C STOP
C 150 CONTINUE
C
C ----- WRITE NODE INFORMATION
C
C 180 DO 190 N=1,NODES,3
C NMIN=N
C NMAX=MIN0(N+2,NODES)

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DATA 005
 DATA 010
 DATA 015
 DATA 020
 DATA 025
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 DATA 070
 DATA 075
 DATA 080
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 DATA 090
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 DATA 455
 DATA 460
 DATA 465
 DATA 470
 DATA 475
 DATA 480
 DATA 485
 DATA 490
 DATA 495

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Appendix C (continued)

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      IF(MOD(N-1,50).EQ.0) WRITE(6,3010)
      WRITE(6,3020) (I,NODTYP(I),DX(I),CN(I),I=NMIN,NMAX)
190  CONTINUE
C ----- READ CONNECTOR INFORMATION VIA LOGICAL UNIT 1
C
      IF(KVI.LE.0) GO TO 200
      READ(1) (NOD1(K),NOD2(K),ICNTYP(K),KSIGN(K),D1IC(K),D2IC(K),K=1,
1  NCONS)
      GO TO 260
C ----- READ CONNECTOR INFORMATION VIA CARD INPUTS
C
200  NCONSS=0
210  READ 35, KI,NO1,NO2,KTP,NSEQ,ND1,ND2,KSGN,D1K,D2K
      35  FORMAT(8I5,2D10.2)
      IF(KI.EQ.0) GO TO 230
      KJ=KI+NSEQ
      DO 220 K=KI,KJ
      ICNTYP(K)=KTP
      NOD1(K)=NO1+(K-KI)*ND1
      NOD2(K)=NO2+(K-KI)*ND2
      D1IC(K)=D1K
      D2IC(K)=D2K
      KSIGN(K)=KSGN
      NCONSS=NCONSS+1
220  CONTINUE
      GO TO 210
230  IF(NCONSS.EQ.NCONS) GO TO 240
      PRINT 2300
      STOP
240  IF(NCONS.LE.MAXCON) GO TO 250
      PRINT 2400
      STOP
250  CONTINUE
C ----- READ BOUNDARY CONNECTORS
C
C ***** IT SHOULD BE NOTED THAT IN NUMBERING BOUNDARY CONNECTORS, ONE
C ***** SHOULD NUMBER THE JUNCTION CONNECTORS LAST, BECAUSE
C ***** MXBVPR IS LESS THAN OR EQUAL TO MXBND AND THE FIRST BOUNDARY
C ***** LINK IS CORRESPONDING THE FIRST BOUNDARY PROFILE AND SO ON.
C ***** KGBND(1) MUST EQUAL TO (NOCIN+1), KGBND(2) EQUAL TO (NOCIN+2),
C ***** .... AND KGBND(NGBND) EQUAL TO (NOCIN+NGBND), WHERE NOCIN =
C ***** NCONS - NGBND.
260  READ(5,10) (KGBND(I),IGBTYP(I),I=1,NGBND)
C ----- CHECK IF KGBND(1), KGBND(2), .... KGBND(NGBND) ARE READ IN
C ----- ACCORDING TO THE ABOVE ARRANGEMENT.
C
      NOCIN=NCONS-NGBND
      DO 265 I=1,NGBND
      KGBNDI=KGBND(I)
      J=I+NOCIN
      IF(J.EQ.KGBNDI) GO TO 265
      WRITE(6,3045)
      STOP
265  CONTINUE
C ----- CHANGE THE DESIGNATION OF NODE AND CONNECTOR TYPES FOR
C ----- BOUNDARY NODES AND CONNECTORS FROM THOSE FOR CHNHYD TO
C ----- THOSE FOR CINTRN
C
      IF(KVI.LE.0) GO TO 280
      DO 270 I=1,NGBND
      K=KGBND(I)
      ICNTYP(K)=IGBTYP(I)
      N2=NOD2(K)
      NODTYP(N2)=IGBTYP(I)
270  CONTINUE
C ----- COMPUTE AND WRITE THE MATRIX SIZE
C
280  IHALFB=0
      DO 285 K=1,NCONS
      KTMP=ICNTYP(K)
      IF(KTMP.GE.1 .AND. KTMP.LE.3) GO TO 285
      MAXDIF=IABS(NOD1(K)-NOD2(K))
      IHALFB=MAX0(IHALFB,MAXDIF)
285  CONTINUE
      IHBP=IHALFB+1
      IBAND=2*IHALFB+1
      WRITE(6,3050) IHALFB,IHBP,IBAND,NEQS
C ----- WRITE CONNECTOR INFORMATION
C
      DO 290 K=1,NCONS,2
      KMIN=K
      KMAX=MIN0(K+1,NCONS)
      IF(MOD(K-1,50).EQ.0) WRITE(6,3030)
      WRITE(6,3040) (I,NOD1(I),NOD2(I),ICNTYP(I),KSIGN(I),D1IC(I),
      >  D2IC(I), I=KMIN,KMAX)
290  CONTINUE

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DATA 500
DATA 505
DATA 510
DATA 515
DATA 520
DATA 525
DATA 530
DATA 535
DATA 540
DATA 545
DATA 550
DATA 555
DATA 560
DATA 565
DATA 570
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DATA 580
DATA 585
DATA 590
DATA 595
DATA 600
DATA 605
DATA 610
DATA 615
DATA 620
DATA 625
DATA 630
DATA 635
DATA 640
DATA 645
DATA 650
DATA 655
DATA 660
DATA 665
DATA 670
DATA 675
DATA 680
DATA 685
DATA 690
DATA 695
DATA 700
DATA 705
DATA 710
DATA 715
DATA 720
DATA 725
DATA 730
DATA 735
DATA 740
DATA 745
DATA 750
DATA 755
DATA 760
DATA 765
DATA 770
DATA 775
DATA 780
DATA 785
DATA 790
DATA 795
DATA 800
DATA 805
DATA 810
DATA 815
DATA 820
DATA 825
DATA 830
DATA 835
DATA 840
DATA 845
DATA 850
DATA 855
DATA 860
DATA 865
DATA 870
DATA 875
DATA 880
DATA 885
DATA 890
DATA 895
DATA 900
DATA 905
DATA 910
DATA 915
DATA 920
DATA 925
DATA 930
DATA 935
DATA 940
DATA 945
DATA 950
DATA 955
DATA 960
DATA 965
DATA 970
DATA 975
DATA 980
DATA 985
DATA 990

Appendix C (continued)

```

C ----- WRITE BOUNDARY CONNECTORS
C
C      WRITE(6,4100) (KGBND(I),IGBTYP(I),I=1,NGRND)
CC
CC ----- READ AND WRITE SEDIMENT CHEMICAL INTERACTION PARAMETERS
C
C      WRITE(6,3100)
C      READ(5,20) (ABSOPK(J),J=1,NSUBS)
C      READ(5,20) (EQ ILKD(J),J=1,NSUBS)
C      READ(5,20) (ABSOPB(J),J=1,NSUBS)
CC
C ----- READ AND WRITE SEDIMENT EROSION AND DEPOSITION PARAMETERS
C
C      READ(5,20) (WSK(J),J=1,NSUBS)
C      READ(5,20) (TAUCD(J),J=1,NSUBS)
C      READ(5,20) (TAUCR(J),J=1,NSUBS)
C      READ(5,20) (DIAMS(J),J=1,NSUBS)
C
C      WRITE(6,3110) (ABSOPK(J),J=1,NSUBS)
C      WRITE(6,3120) (EQ ILKD(J),J=1,NSUBS)
C      WRITE(6,3125) (ABSOPB(J),J=1,NSUBS)
C      WRITE(6,3130) (WSK(J),J=1,NSUBS)
C      WRITE(6,3140) (TAUCD(J),J=1,NSUBS)
C      WRITE(6,3150) (TAUCR(J),J=1,NSUBS)
C      WRITE(6,3160) (DIAMS(J),J=1,NSUBS)
CC
C ----- READ AND WRITE PARAMETERS FOR THE COMPUTATION OF
C ----- RATE CONSTANTS FOR VOLATILIZATION, PHOTOLYSIS,
C ----- HYDROLYSIS, OXIDATION, AND BIOLYSIS
C
C      NSUBSP=NSUBS+1
C      READ(5,20) ((MOLEW(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((HENRY(I,J),J=1,NSUBSP),I=1,NSPY)
C
C      READ(5,20) CLOUDG,ELATG
C      READ(5,20) ((KDPG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((RFLAG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((QUANTG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((ABSG(I,J),J=1,39),I=1,NSPY)
C
C      READ(5,20) ((KAHG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((KNHG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((KBHG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((EAHG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((ENHG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((EBHG(I,J),J=1,NSUBSP),I=1,NSPY)
C
C      READ(5,20) ((KOXG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((EOXG(I,J),J=1,NSUBSP),I=1,NSPY)
C
C      READ(5,20) ((KBACWG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((KBACSG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((OTBAWG(I,J),J=1,NSUBSP),I=1,NSPY)
C      READ(5,20) ((OTBASG(I,J),J=1,NSUBSP),I=1,NSPY)
C
C      DO 300 I=1,NSPY
C      WRITE(6,3600) I
C      WRITE(6,3610) (MOLEW(I,J),J=1,NSUBSP)
C      WRITE(6,3620) (HENRY(I,J),J=1,NSUBSP)
C      WRITE(6,3630) CLOUDG,ELATG
C      WRITE(6,3640) (KDPG(I,J),J=1,NSUBSP)
C      WRITE(6,3650) (RFLAG(I,J),J=1,NSUBSP)
C      WRITE(6,3660) (QUANTG(I,J),J=1,NSUBSP)
C      WRITE(6,3670) (KAHG(I,J),J=1,NSUBSP)
C      WRITE(6,3680) (KNHG(I,J),J=1,NSUBSP)
C      WRITE(6,3690) (KBHG(I,J),J=1,NSUBSP)
C      WRITE(6,3700) (EAHG(I,J),J=1,NSUBSP)
C      WRITE(6,3710) (ENHG(I,J),J=1,NSUBSP)
C      WRITE(6,3720) (EBHG(I,J),J=1,NSUBSP)
C      WRITE(6,3730) (KOXG(I,J),J=1,NSUBSP)
C      WRITE(6,3740) (EOXG(I,J),J=1,NSUBSP)
C      WRITE(6,3750) (KBACWG(I,J),J=1,NSUBSP)
C      WRITE(6,3760) (KBACSG(I,J),J=1,NSUBSP)
C      WRITE(6,3770) (OTBAWG(I,J),J=1,NSUBSP)
C      WRITE(6,3780) (OTBASG(I,J),J=1,NSUBSP)
C      WRITE(6,3800)
C 300 CONTINUE
CC
CC ----- READ INITIAL CONDITIONS FOR SEDCN, DCN, PCN, BEDM, AND CNBED
C
C ----- READ INITIAL SEDIMENT CONCENTRATION
C
C      DO 350 J=1,NSUBS
C      CALL READR(SEDEN(1,J),NODES,MAXNOD)
C 350 CONTINUE
C
C ----- READ INITIAL DISSOLVED CONCENTRATION
C
C      CALL READR(DCN,NODES,MAXNOD)
C
C ----- READ INITIAL PARTICULATE CONCENTRATION
C
C      DO 550 J=1,NSUBS
C      CALL READR(PCN(1,J),NODES,MAXNOD)
C 550 CONTINUE

```

DATA 995
 DATA1000
 DATA1005
 DATA1010
 DATA1015
 DATA1020
 DATA1025
 DATA1030
 DATA1035
 DATA1040
 DATA1045
 DATA1050
 DATA1055
 DATA1060
 DATA1065
 DATA1070
 DATA1075
 DATA1080
 DATA1085
 DATA1090
 DATA1095
 DATA1100
 DATA1105
 DATA1110
 DATA1115
 DATA1120
 DATA1125
 DATA1130
 DATA1135
 DATA1140
 DATA1145
 DATA1150
 DATA1155
 DATA1160
 DATA1165
 DATA1170
 DATA1175
 DATA1180
 DATA1185
 DATA1190
 DATA1195
 DATA1200
 DATA1205
 DATA1210
 DATA1215
 DATA1220
 DATA1225
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 DATA1235
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 DATA1245
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 DATA1260
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 DATA1290
 DATA1295
 DATA1300
 DATA1305
 DATA1310
 DATA1315
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 DATA1400
 DATA1405
 DATA1410
 DATA1415
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 DATA1425
 DATA1430
 DATA1435
 DATA1440
 DATA1445
 DATA1450
 DATA1455
 DATA1460
 DATA1465
 DATA1470
 DATA1475
 DATA1480
 DATA1485

```

C ----- READ INITIAL BED SEDIMENT
C
C DO 650 J=1,NSUBS
C CALL READR(BEDSD(1,J),NODES,MAXNOD)
C 650 CONTINUE
C
C ----- READ INITIAL BED CHEMICALS
C
C DO 690 J=1,NSUBS
C CALL READR(BOCHM(1,J),NODES,MAXNOD)
C 690 CONTINUE
C
C ----- COMPUTE INITIAL BED CONCENTRATION
C
C DO 750 J=1,NSUBS
C DO 740 N=1,NODES
C BEDMNJ=BEDSD(N,J)
C IF(BEDMNJ.EQ.0.0) GO TO 730
C CNBED(N,J)=BOCHM(N,J)/BEDSD(N,J)
C GO TO 740
C 730 CNBED(N,J)=0.0
C 740 CONTINUE
C 750 CONTINUE
C
C
C 10 FORMAT(16I5)
C 20 FORMAT(8F10.0)
C 25 FORMAT(4I5,3D10.2)
C 30 FORMAT(3I5,5X,2F10.0)
C 1100 FORMAT(1H0/5X,
C 1 'NO. OF NODES .....',15/5X,
C 2 'NO. OF CONNECTORS .....',15/5X,
C 3 'NO. OF GIVEN BOUNDARY CONDITION CONNECTORS .....',15/5X,
C 4 'NO. OF TIME STEPS .....',15/5X,
C 5 'HYDRODYNAMIC VARIABLES INPUT CONTROL .....',15/5X,
C 6 'STEADY STATE SOLUTION CONTROL .....',15/5X,
C 7 'NO. OF EQUATIONS TO BE SOLVED .....',15/5X,
C 8 'IMPLICIT SCHEME CONTROL .....',15/5X,
C 9 'NO. OF SIZE FRACTION .....',15/5X,
C A 'NO. OF CHEMICAL SPECIES .....',15/5X,
C 1200 FORMAT(1H0,4X,
C 1 'EROSIN AND DEPOSITION RATE PRINT CONTROL.....',15/5X,
C 2 'BED SEDIMENT PRINT CONTROL .....',15/5X,
C 3 'SEDIMENT CONCENTRATION PRINT CONTROL .....',15/5X,
C 4 'RATE CONSTANT PRINT CONTROL .....',15/5X,
C 5 'DISSOLVED CONCENTRATION PRINT CONTROL .....',15/5X,
C 6 'BED CHEMICAL AMOUNT AND CONCENTRATION PRINT CONTROL.....',15/5X,
C 7 'PARTICULATE CONCENTRATION PRINT CONTROL .....',15/5X,
C 8 'EVERY NREAD TIME STEPS READ HYDRODYNAMIC PARAMETERS.....',15/5X,
C 9 'EVERY NSTOR TIME STEPS STORE RESULTS ON UNIT 2 .....',15/5X,
C 1300 FORMAT(1H0/5X,
C 1 'TIME STEP SIZE, T .....',E12.4/5X,
C 2 'PERCENTAGE OF TIME STEP CHANGE .....',E12.4/5X,
C 3 'EDDY DIFFUSIVITY, .....',E12.4/5X,
C 4 'TIME INTEGRATION PARAMETER .....',E12.4/5X,
C 2100 FORMAT(1H1/1H, '*** ERROR OCCURS IN READING NODE: STOP ***')
C 2200 FORMAT(1H1/1H, '*** NODES .GT. MAXNOD IN READING NODE, STOP ***')
C 2300 FORMAT(1H1/1H, '*** ERROR OCCURS IN READING LINKS: STOP ***')
C 2400 FORMAT(1H1/1H, '*** NCONS .GT. MAXCON IN READING LINK: STOP ***')
C 3010 FORMAT(1H1//5X, '*** NODE INFORMATION ****'//2X,
C 1 3(4X, 'N', 'NTYP', 6X, 'DX', 8X, 'CN', 2X)/2X,
C 2 3(4X, 'I', 'I1', 6X, 'I2', 8X, 'I3', 2X)/2X,
C 3020 FORMAT(1H, 1X, 3(2I5, 2E10.2))
C 3030 FORMAT(1H1//5X, '*** CONNECTOR INFORMATION ****'//1X,
C 1 2(4X, 'I', 'I1', 'NOD1', 1X, 'NOD2', 2X, 'TYP', 1X, 'SIGN', 6X, 'D1IC', 6X,
C 2 'D2IC', 1X, 2(4X, 'I', 'I1', 1X, 'I2', 1X, 'I3', 1X, 'I4', 1X, 'I5', 1X, 'I6', 1X, 'I7', 1X, 'I8', 1X, 'I9', 1X, 'I10', 1X, 'I11', 1X, 'I12', 1X, 'I13', 1X, 'I14', 1X, 'I15', 1X, 'I16', 1X, 'I17', 1X, 'I18', 1X, 'I19', 1X, 'I20', 1X, 'I21', 1X, 'I22', 1X, 'I23', 1X, 'I24', 1X, 'I25', 1X, 'I26', 1X, 'I27', 1X, 'I28', 1X, 'I29', 1X, 'I30', 1X, 'I31', 1X, 'I32', 1X, 'I33', 1X, 'I34', 1X, 'I35', 1X, 'I36', 1X, 'I37', 1X, 'I38', 1X, 'I39', 1X, 'I40', 1X, 'I41', 1X, 'I42', 1X, 'I43', 1X, 'I44', 1X, 'I45', 1X, 'I46', 1X, 'I47', 1X, 'I48', 1X, 'I49', 1X, 'I50', 1X, 'I51', 1X, 'I52', 1X, 'I53', 1X, 'I54', 1X, 'I55', 1X, 'I56', 1X, 'I57', 1X, 'I58', 1X, 'I59', 1X, 'I60', 1X, 'I61', 1X, 'I62', 1X, 'I63', 1X, 'I64', 1X, 'I65', 1X, 'I66', 1X, 'I67', 1X, 'I68', 1X, 'I69', 1X, 'I70', 1X, 'I71', 1X, 'I72', 1X, 'I73', 1X, 'I74', 1X, 'I75', 1X, 'I76', 1X, 'I77', 1X, 'I78', 1X, 'I79', 1X, 'I80', 1X, 'I81', 1X, 'I82', 1X, 'I83', 1X, 'I84', 1X, 'I85', 1X, 'I86', 1X, 'I87', 1X, 'I88', 1X, 'I89', 1X, 'I90', 1X, 'I91', 1X, 'I92', 1X, 'I93', 1X, 'I94', 1X, 'I95', 1X, 'I96', 1X, 'I97', 1X, 'I98', 1X, 'I99', 1X, 'I100', 1X, 'I101', 1X, 'I102', 1X, 'I103', 1X, 'I104', 1X, 'I105', 1X, 'I106', 1X, 'I107', 1X, 'I108', 1X, 'I109', 1X, 'I110', 1X, 'I111', 1X, 'I112', 1X, 'I113', 1X, 'I114', 1X, 'I115', 1X, 'I116', 1X, 'I117', 1X, 'I118', 1X, 'I119', 1X, 'I120', 1X, 'I121', 1X, 'I122', 1X, 'I123', 1X, 'I124', 1X, 'I125', 1X, 'I126', 1X, 'I127', 1X, 'I128', 1X, 'I129', 1X, 'I130', 1X, 'I131', 1X, 'I132', 1X, 'I133', 1X, 'I134', 1X, 'I135', 1X, 'I136', 1X, 'I137', 1X, 'I138', 1X, 'I139', 1X, 'I140', 1X, 'I141', 1X, 'I142', 1X, 'I143', 1X, 'I144', 1X, 'I145', 1X, 'I146', 1X, 'I147', 1X, 'I148', 1X, 'I149', 1X, 'I150', 1X, 'I151', 1X, 'I152', 1X, 'I153', 1X, 'I154', 1X, 'I155', 1X, 'I156', 1X, 'I157', 1X, 'I158', 1X, 'I159', 1X, 'I160', 1X, 'I161', 1X, 'I162', 1X, 'I163', 1X, 'I164', 1X, 'I165', 1X, 'I166', 1X, 'I167', 1X, 'I168', 1X, 'I169', 1X, 'I170', 1X, 'I171', 1X, 'I172', 1X, 'I173', 1X, 'I174', 1X, 'I175', 1X, 'I176', 1X, 'I177', 1X, 'I178', 1X, 'I179', 1X, 'I180', 1X, 'I181', 1X, 'I182', 1X, 'I183', 1X, 'I184', 1X, 'I185', 1X, 'I186', 1X, 'I187', 1X, 'I188', 1X, 'I189', 1X, 'I190', 1X, 'I191', 1X, 'I192', 1X, 'I193', 1X, 'I194', 1X, 'I195', 1X, 'I196', 1X, 'I197', 1X, 'I198', 1X, 'I199', 1X, 'I200', 1X, 'I201', 1X, 'I202', 1X, 'I203', 1X, 'I204', 1X, 'I205', 1X, 'I206', 1X, 'I207', 1X, 'I208', 1X, 'I209', 1X, 'I210', 1X, 'I211', 1X, 'I212', 1X, 'I213', 1X, 'I214', 1X, 'I215', 1X, 'I216', 1X, 'I217', 1X, 'I218', 1X, 'I219', 1X, 'I220', 1X, 'I221', 1X, 'I222', 1X, 'I223', 1X, 'I224', 1X, 'I225', 1X, 'I226', 1X, 'I227', 1X, 'I228', 1X, 'I229', 1X, 'I230', 1X, 'I231', 1X, 'I232', 1X, 'I233', 1X, 'I234', 1X, 'I235', 1X, 'I236', 1X, 'I237', 1X, 'I238', 1X, 'I239', 1X, 'I240', 1X, 'I241', 1X, 'I242', 1X, 'I243', 1X, 'I244', 1X, 'I245', 1X, 'I246', 1X, 'I247', 1X, 'I248', 1X, 'I249', 1X, 'I250', 1X, 'I251', 1X, 'I252', 1X, 'I253', 1X, 'I254', 1X, 'I255', 1X, 'I256', 1X, 'I257', 1X, 'I258', 1X, 'I259', 1X, 'I260', 1X, 'I261', 1X, 'I262', 1X, 'I263', 1X, 'I264', 1X, 'I265', 1X, 'I266', 1X, 'I267', 1X, 'I268', 1X, 'I269', 1X, 'I270', 1X, 'I271', 1X, 'I272', 1X, 'I273', 1X, 'I274', 1X, 'I275', 1X, 'I276', 1X, 'I277', 1X, 'I278', 1X, 'I279', 1X, 'I280', 1X, 'I281', 1X, 'I282', 1X, 'I283', 1X, 'I284', 1X, 'I285', 1X, 'I286', 1X, 'I287', 1X, 'I288', 1X, 'I289', 1X, 'I290', 1X, 'I291', 1X, 'I292', 1X, 'I293', 1X, 'I294', 1X, 'I295', 1X, 'I296', 1X, 'I297', 1X, 'I298', 1X, 'I299', 1X, 'I300', 1
```

Appendix C (continued)

```

3710 FORMAT(1H,16X,'ENHG(I,J)',7E13.5)
3720 FORMAT(1H,16X,'EBHG(I,J)',7E13.5)
3730 FORMAT(1H0,16X,'KDXG(I,J)',7E13.5/)
3740 FORMAT(1H,15X,'EOXG(I,J)',7E13.5/)
3750 FORMAT(1H0,14X,'KBACWG(I,J)',7E13.5/)
3760 FORMAT(1H,14X,'KBACSG(I,J)',7E13.5/)
3770 FORMAT(1H,14X,'QTBWG(I,J)',7E13.5/)
3780 FORMAT(1H,14X,'QTBASG(I,J)',7E13.5/)
3800 FORMAT(1H0,14X,
1 ' MOLEW(I,J) = MOLECULAR WEIGHT'/15X,
2 ' HENRY(I,J) = HENRY CONSTANT'//15X,
3 ' KDPG(I,J) = NEAR SURFACE PHOTOLYTIC RATE CONSTANT'/15X,
4 ' RFIATG(I,J) = REFERENCE LATITUDE FOR DIRECT PHOTOLYSIS'/15X,
5 ' QUANTG(I,J) = REACTION QUANTUM YIELD IN PHOTOLYSIS'//15X,
6 ' KAHG(I,J) = SECOND ORDER RATE CONST. FOR ACID HYDROLYSIS'/15X,
7 ' KNHG(I,J) = FIRST ORDER RATE CONST. FOR NEUTRAL HYDRO.'/15X,
8 ' KBHG(I,J) = SECOND ORDER RATE CONST. FOR BASE HYDROLYSIS'/15X,
9 ' EAHG(I,J) = ARRHENIUS ACTIVATING ENERGY '/15X,
A ' ENHG(I,J) = ARRHENIUS ACTIVATING ENERGY '/15X,
B ' ERHG(I,J) = ARRHENIUS ACTIVATING ENERGY '//15X,
C ' KOXG(I,J) = SECOND ORDER RATE CONST. OF OXIDATION'/15X,
D ' EOXG(I,J) = ARRHENIUS ACTIVATING ENERGY FOR OXIDATION'/15X,
E ' KBACWG(I,J) = SECOND ORDER RATE CONST. FOR BIOLYSIS BY WATER-BOR
FNE BACTERIAL'/15X,'KBACSG(I,J) = SECOND ORDER RATE CONST. FOR BIOL
YSIS BY SEDI-BIOMASS BORNE BACTERIAL'/15X,'QTBWG(I,J) = Q-10 VALU
HE FOR KBACWG'/15X,'QTBASG(I,J) = Q-10 VALUE FOR KBACSG'/)
DATA1985
DATA1990
DATA1995
DATA2000
DATA2005
DATA2010
DATA2015
DATA2020
DATA2025
DATA2030
DATA2035
DATA2040
DATA2045
DATA2050
DATA2055
DATA2060
DATA2065
DATA2070
DATA2075
DATA2080
DATA2085
DATA2090
DATA2095
DATA2100
DATA2105
DATA2110
DATA2115
DATA2120
DATA2125
DATA2130
DATA2135
C
4100 FORMAT(1H0,5X,'LIST OF BOUNDARY CONNECTORS AND THEIR TYPES')
1 5(5X,21S,5X))
RETURN
END

```

Appendix C (continued)

```

      SURROUTINE SENBCD(TSSTAB,SSTAB,ISSTYP,TSWTAB,SWTAB,ISWTYP,TSPTAB,
> SPTAB,ISPTYP,TTATAB,TATAB,ITATYP,TSRTAB,SRTAB,ISRTYP,TWSTAB,
> WSTAB,IWSTYP,TVPTAB,VPTAB,IVPTYP,TTWTAB,TWTAB,ITWTYP,
> TECTAB,ECTAB,IECTYP,TPHTAB,PHTAB,IPHTYP,TPOTAB,POTAB,IPOTYP,
> TORTAB,ORTAB,IORTYP,TPDTAB,PDTAB,IPDTYP,TBTAB,BTTAB,IBTTYP,
> TPBTAB,PBTAB,IPBTYP,TGSITB,GSITB,TGCWTB,GCWTB,TGCITB,GCITB)
      IMPLICIT REAL*8(A-H,O-Z)

      COMMON /CSIZE/ MAXNOD,MAXCON,MAXBND,MXEQS,MAXBND
      COMMON /CINTGR/ NODES,NCONS,NGRND,NTI,KVI,KSS
      COMMON /CSDCM/ MXSUB,MXSUBP,MXSPY,NSURS,NSPY
      COMMON /CSOS/ MXSPR,MXSDP,NSPR,NSDP
      COMMON /CTA/ MXTAPP,MXTADP,NTAPP,NTADP
      COMMON /CSR/ MXSRPR,MXSRDP,NSRPR,NSRDP
      COMMON /CWS/ MXWSPR,MXWSDP,NWSPR,NWSDP
      COMMON /CVP/ MXVPPR,MXVPDP,NVPPR,NVDPD
      COMMON /CTW/ MXTWPR,MXTWDP,NTWPR,NTWDP
      COMMON /CEC/ MXECPR,MXECDP,NECPR,NECDP
      COMMON /CPH/ MXPHPR,MXPHDP,NPHPR,NPHDP
      COMMON /CPO/ MXPOPR,MXPDP,NPOP,NPODP
      COMMON /COR/ MXORPR,MXORDP,NORPR,NORDP
      COMMON /CPD/ MXPDPR,MXPDDP,NPDPR,NPDOP
      COMMON /CBT/ MXTBPR,MXTBDP,NBTPR,NBDOP
      COMMON /CPB/ MXPBPR,MXPBDP,NPBPR,NPBOP
      COMMON /CBV/ MXBVPR,MXBVDP,NBVPR,NBVDP

      DIMENSION TSSTAB(MXSPR,MXSDP,MXSUB),SSTAB(MXSPR,MXSDP,MXSUB)
      DIMENSION ISSTYP(MAXNOD,MXSUB)
      DIMENSION TSWTAB(MXSPR,MXSDP),SWTAB(MXSPR,MXSDP),ISWTYP(MAXNOD)
      DIMENSION TSPTAB(MXSPR,MXSDP,MXSUB),SPTAB(MXSPR,MXSDP,MXSUB)
      DIMENSION ISPTYP(MAXNOD,MXSUB)

      DIMENSION TTATAB(MXTAPP,MXTADP),TATAB(MXTAPP,MXTADP)
      DIMENSION ITATYP(MAXNOD)
      DIMENSION TSRTAB(MXSRPR,MXSRDP),SRTAB(MXSRPR,MXSRDP)
      DIMENSION ISRTYP(MAXNOD)
      DIMENSION TWSTAB(MXWSPR,MXWSDP),WSTAB(MXWSPR,MXWSDP)
      DIMENSION IWSTYP(MAXNOD)
      DIMENSION TVPTAB(MXVPPR,MXVPDP),VPTAB(MXVPPR,MXVPDP)
      DIMENSION IVPTYP(MAXNOD)
      DIMENSION TTWTAB(MXTWPR,MXTWDP),TWTAB(MXTWPR,MXTWDP)
      DIMENSION ITWTYP(MAXNOD)
      DIMENSION TECTAB(MXECPR,MXECDP),ECTAB(MXECPR,MXECDP)
      DIMENSION IECTYP(MAXNOD)
      DIMENSION TPHTAB(MXPHPR,MXPHDP),PHTAB(MXPHPR,MXPHDP)
      DIMENSION IPHTYP(MAXNOD)
      DIMENSION TPOTAB(MXPOPR,MXPDP),POTAB(MXPOPR,MXPDP)
      DIMENSION IPOTYP(MAXNOD)
      DIMENSION TORTAB(MXORPR,MXORDP),ORTAB(MXORPR,MXORDP)
      DIMENSION IORTYP(MAXNOD)
      DIMENSION TPDTAB(MXPDPR,MXPDDP),PDTAB(MXPDPR,MXPDDP)
      DIMENSION IPDTYP(MAXNOD)
      DIMENSION TBTAB(MXTBPR,MXTBDP),BTTAB(MXTBPR,MXTBDP)
      DIMENSION IBTTYP(MAXNOD)
      DIMENSION TPBTAB(MXPBPR,MXPBDP),PBTAB(MXPBPR,MXPBDP)
      DIMENSION IPBTYP(MAXNOD)

      DIMENSION TGSITB(MXBVPR,MXBVDP,MXSUB),GSITB(MXBVPR,MXBVDP,MXSUB)
      DIMENSION TGCWTB(MXBVPR,MXBVDP),GCWTB(MXBVPR,MXBVDP)
      DIMENSION TGCITB(MXBVPR,MXBVDP,MXSUB),GCITB(MXBVPR,MXBVDP,MXSUB)

      READ 10, NSPR,NSDP,NTAPP,NTADP,NSRPR,NSRDP,NWSPR,NWSDP,
> NVPPR,NVDPD,NTWPR,NTWDP,NECPR,NECDP,NPHPR,NPHDP,NPOP,NPODP,
> NORPR,NORDP,NPDPR,NPDOP,NBTPR,NBDOP,NPBPR,NPBOP,NBVPR,NBVDP

      PRINT 1100, NSPR,NSDP,NTAPP,NTADP,NSRPR,NSRDP,NWSPR,NWSDP,
> NVPPR,NVDPD,NTWPR,NTWDP,NECPR,NECDP
      PRINT 1200, NPHPR,NPHDP,NPOP,NPODP,NORPR,NORDP,NPDPR,NPDOP,
      1 NBTPR,NBDOP,NPBPR,NPBOP,NBVPR,NBVDP

      ----- READ SOURCES OF SEDIMENT SS

      PRINT 2000
      DO 120 M=1,NSUBS
      PRINT 2100, M
      DO 110 I=1,NSPR
      PRINT 2200, I
      READ 20, (TSSTAB(I,J,M),SSTAB(I,J,M),J=1,NSDP)
      PRINT 2300, (TSSTAB(I,J,M),SSTAB(I,J,M),J=1,NSDP)
      110 CONTINUE

      CALL READN(ISSTYP(I,M),MAXNOD,NODES)
      PRINT 2400
      PRINT 2500, (ISSTYP(I,M),I=1,NODES)
      120 CONTINUE

      ----- READ SOURCES OF WATER DISSOLVED CHEMICALS

      PRINT 2000
      PRINT 3100
      DO 130 I=1,NSPR
      PRINT 2200, I
      READ 20, (TSWTAB(I,J),SWTAB(I,J),J=1,NSDP)
      PRINT 2300, (TSWTAB(I,J),SWTAB(I,J),J=1,NSDP)
      130 CONTINUE
      CALL READN(ISWTYP,MAXNOD,NODES)

```

Appendix C (continued)

```

      PRINT 3400
      PRINT 2500, (ISWTYP(I),I=1,NODES)
C ----- READ SOURCES OF PARTICULATE CHEMICALS
C
      PRINT 2000
      DO 160 M=1,NSUBS
      PRINT 4100, M
      DC 150 I=1,NSPR
      READ 20, (TSPTAB(I,J,M),SPTAB(I,J,M),J=1,NSDP)
      PRINT 2200, I
      PRINT 2300, (TSPTAB(I,J,M),SPTAB(I,J,M),J=1,NSDP)
150 CONTINUE
      CALL READN(ISPTYP(I,M),MAXNOD,NODES)
      PRINT 4400
      PRINT 2500, (ISPTYP(I,M),I=1,NODES)
160 CONTINUE
C ----- READ AIR TEMPERATURE TA
C
      PRINT 2000
      PRINT 5110
      DO 210 I=1,NTAPR
      PRINT 2200, I
      READ 20, (TTATAB(I,J),TATAB(I,J),J=1,NTADP)
      PRINT 2300, (TTATAB(I,J),TATAB(I,J),J=1,NTADP)
210 CONTINUE
      CALL READN(ITATYP,MAXNOD,NODES)
      PRINT 5410
      PRINT 2500, (ITATYP(N),N=1,NODES)
C ----- READ SOLAR RADIATION SR
C
      PRINT 5120
      DO 220 I=1,NSRPR
      READ 20, (TSRTAB(I,J),SRTAB(I,J),J=1,NSRDP)
      PRINT 2200, I
      PRINT 2300, (TSRTAB(I,J),SRTAB(I,J),J=1,NSRDP)
220 CONTINUE
      CALL READN(ISRTYP,MAXNOD,NODES)
      PRINT 5420
      PRINT 2500, (ISRTYP(N),N=1,NODES)
C ----- READ WIND SPEED WS
C
      PRINT 5130
      DO 230 I=1,NWSPR
      READ 20, (TWSTAB(I,J),WSTAB(I,J),J=1,NWSDP)
      PRINT 2200, I
      PRINT 2300, (TWSTAB(I,J),WSTAB(I,J),J=1,NWSDP)
230 CONTINUE
      CALL READN(IWSTYP,MAXNOD,NODES)
      PRINT 5430
      PRINT 2500, (IWSTYP(N),N=1,NODES)
C ----- READ VAPOR PRESSURE VP
C
      PRINT 5140
      DO 240 I=1,NVPPR
      READ 20, (TVPTAB(I,J),VPTAB(I,J),J=1,NVPPDP)
      PRINT 2200, I
      PRINT 2300, (TVPTAB(I,J),VPTAB(I,J),J=1,NVPPDP)
240 CONTINUE
      CALL READN(IVPTYP,MAXNOD,NODES)
      PRINT 5440
      PRINT 2500, (IVPTYP(N),N=1,NODES)
C ----- READ WATER TEMPERATURE TW
C
      PRINT 2000
      PRINT 5150
      DO 310 I=1,NTWPR
      READ 20, (TTWTAB(I,J),TWTAB(I,J),J=1,NTWDP)
      PRINT 2200, I
      PRINT 2300, (TTWTAB(I,J),TWTAB(I,J),J=1,NTWDP)
310 CONTINUE
      CALL READN(ITWTYP,MAXNOD,NODES)
      PRINT 5450
      PRINT 2500, (ITWTYP(N),N=1,NODES)
C ----- READ EXTINCTION COEFFICIENT OF LIGHT EC
C
      PRINT 5160
      DO 320 I=1,NECPR
      READ 20, (TECTAB(I,J),ECTAB(I,J),J=1,NECDP)
      PRINT 2200, I
      PRINT 2300, (TECTAB(I,J),ECTAB(I,J),J=1,NECDP)
320 CONTINUE
      CALL READN(IECTYP,MAXNOD,NODES)
      PRINT 5460
      PRINT 2500, (IECTYP(N),N=1,NODES)
C ----- READ PH
C
      PRINT 2000
      PRINT 6110
      DO 410 I=1,NPHPR
      READ 20, (TPHTAB(I,J),PHTAB(I,J),J=1,NPHDP)

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SEN8 495
SEN8 500
SEN8 505
SEN8 510
SEN8 515
SEN8 520
SEN8 525
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SEN8 555
SEN8 560
SEN8 565
SEN8 570
SEN8 575
SEN8 580
SEN8 585
SEN8 590
SEN8 595
SEN8 600
SEN8 605
SEN8 610
SEN8 615
SEN8 620
SEN8 625
SEN8 630
SEN8 635
SEN8 640
SEN8 645
SEN8 650
SEN8 655
SEN8 660
SEN8 665
SEN8 670
SEN8 675
SEN8 680
SEN8 685
SEN8 690
SEN8 695
SEN8 700
SEN8 705
SEN8 710
SEN8 715
SEN8 720
SEN8 725
SEN8 730
SEN8 735
SEN8 740
SEN8 745
SEN8 750
SEN8 755
SEN8 760
SEN8 765
SEN8 770
SEN8 775
SEN8 780
SEN8 785
SEN8 790
SEN8 795
SEN8 800
SEN8 805
SEN8 810
SEN8 815
SEN8 820
SEN8 825
SEN8 830
SEN8 835
SEN8 840
SEN8 845
SEN8 850
SEN8 855
SEN8 860
SEN8 865
SEN8 870
SEN8 875
SEN8 880
SEN8 885
SEN8 890
SEN8 895
SEN8 900
SEN8 905
SEN8 910
SEN8 915
SEN8 920
SEN8 925
SEN8 930
SEN8 935
SEN8 940
SEN8 945
SEN8 950
SEN8 955
SEN8 960
SEN8 965
SEN8 970
SEN8 975
SEN8 980
SEN8 985

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Appendix C (continued)

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      PRINT 2200, I
      PRINT 2300, (TPHTAB(I,J),PHTAB(I,J),J=1,NPHDP)
410  CONTINUE
      CALL READN(IPHTYP,MAXNOD,NODES)
      PRINT 6410
      PRINT 2500, (IPHTYP(N),N=1,NODES)
C
C ----- READ POH
C
      PRINT 6120
      DO 420 I=1,NPOPR
      READ 20, (TPOTAB(I,J),POTAB(I,J),J=1,NPODP)
      PRINT 2200, I
      PRINT 2300, (TPOTAB(I,J),POTAB(I,J),J=1,NPODP)
420  CONTINUE
      CALL READN(IPOTYP,MAXNOD,NODES)
      PRINT 6420
      PRINT 2500, (IPOTYP(N),N=1,NODES)
C
C ----- READ OXIDATION RADICALS
C
      PRINT 6130
      DO 430 I=1,NORPP
      READ 20, (TOPTAB(I,J),ORTAB(I,J),J=1,NORDP)
      PRINT 2200, I
      PRINT 2300, (TOPTAB(I,J),ORTAB(I,J),J=1,NORDP)
430  CONTINUE
      CALL READN(IORTYP,MAXNOD,NODES)
      PRINT 6430
      PRINT 2500, (IORTYP(N),N=1,NODES)
C
C ----- READ POPULATION DENSITY OF BACTERIALS PD
C
      PRINT 2000
      PRINT 6140
      DO 510 I=1,NPDPR
      READ 20, (TPDTAB(I,J),PDTAB(I,J),J=1,NPDDP)
      PRINT 2200, I
      PRINT 2300, (TPDTAB(I,J),PDTAB(I,J),J=1,NPDDP)
510  CONTINUE
      CALL READN(IPDTYP,MAXNOD,NODES)
      PRINT 6440
      PRINT 2500, (IPDTYP(N),N=1,NODES)
C
C ----- READ BIO TEMPERATURE BT
C
      PRINT 6150
      DO 520 I=1,NBTPR
      READ 20, (TBTTAB(I,J),BTAB(I,J),J=1,NBTDP)
      PRINT 2200, I
      PRINT 2300, (TBTTAB(I,J),BTAB(I,J),J=1,NBTDP)
520  CONTINUE
      CALL READN(IBTTYP,MAXNOD,NODES)
      PRINT 6450
      PRINT 2500, (IBTTYP(N),N=1,NODES)
C
C ----- READ PROPORTIONAL BACTERIALS TO DEGRADE PB
C
      PRINT 6160
      DO 530 I=1,NPBPR
      READ 20, (TPBTAB(I,J),PBTAB(I,J),J=1,NPBDP)
      PRINT 2200, I
      PRINT 2300, (TPBTAB(I,J),PBTAB(I,J),J=1,NPBDP)
530  CONTINUE
      CALL READN(IPBTYP,MAXNOD,NODES)
      PRINT 6460
      PRINT 2500, (IPBTYP(N),N=1,NODES)
C
C ----- READ GIVEN SEDIMENT CONDITIONS GSI
C
      PRINT 2000
      DO 620 M=1,NSUBS
      PRINT 7100, M
      DO 610 I=1,NBVPR
      READ 20, (TGSITB(I,J,M),GSITB(I,J,M),J=1,NBVDP)
      PRINT 2200, I
      PRINT 2300, (TGSITB(I,J,M),GSITB(I,J,M),J=1,NBVDP)
610  CONTINUE
620  CONTINUE
C
C ----- READ GIVEN WATER-DISSOLVED-CHEMICAL CONDITIONS CW
C
      PRINT 2000
      PRINT 8100
      DO 630 I=1,NBVPR
      READ 20, (TGCWTB(I,J),GCWTB(I,J),J=1,NBVDP)
      PRINT 2200, I
      PRINT 2300, (TGCWTB(I,J),GCWTB(I,J),J=1,NBVDP)
630  CONTINUE
C
C ----- READ GIVEN PARTICULATE-CHEMICAL CI
C
      PRINT 2000
      DO 660 M=1,NSURS
      PRINT 9100, M
      DO 650 I=1,NBVPR
      READ 20, (TGCITB(I,J,M),GCITB(I,J,M),J=1,NBVDP)
      PRINT 2200, I
      PRINT 2300, (TGCITB(I,J,M),GCITB(I,J,M),J=1,NBVDP)

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SEN8 990
SEN8 995
SEN81000
SEN81005
SEN81010
SEN81015
SEN81020
SEN81025
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SEN81075
SEN81080
SEN81085
SEN81090
SEN81095
SEN81100
SEN81105
SEN81110
SEN81115
SEN81120
SEN81125
SEN81130
SEN81135
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SEN81145
SEN81150
SEN81155
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SEN81170
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SEN81185
SEN81190
SEN81195
SEN81200
SEN81205
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SEN81480

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Appendix C (continued)

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650 CONTINUE
660 CONTINUE
C
  10 FORMAT(16I5)
  20 FORMAT(8D10.3)
C
  1100 FORMAT(1H1/5X,'**** TRANSIENT SOURCE, ENVIRONMENTAL PARAMETERS AND
1  BOUNDARY CONDITIONS ****'///5X,
2  'NO. OF SOURCE PROFILES .....',15/5X,
3  'NO. OF SOURCE DATA POINT FOR EACH PROFILE.....',15//5X,
4  'NO. OF AIR TEMPERATURE PROFILE CH PROFILE.....',15/5X,
5  'NO. OF AIR TEMPERATURE DATA POINT FOR EACH PROFIL E',15/5X,
6  'NO. OF SOLAR RADIATION PROFILES .....',15/5X,
7  'NO. OF SOLAR RADIATION DATA POINTS FOR EACH PROFILE',15/5X,
8  'NO. OF WIND SPEED PROFILES .....',15/5X,
9  'NO. OF WIND SPEED DATA POINTS FOR EACH PROFILE ....',15/5X,
A  'NO. OF VAPOR PRESSURE PROFILES .....',15/5X,
B  'NO. OF VAPOR PRESSURE DATA POINTS FOR EACH PROFILE',15/5X,
C  'NO. OF WATER TEMPERATURE PROFILES .....',15/5X,
D  'NO. OF WATER TEMPERATURE DATA POINTS FOR EACH PROF.',15/5X,
E  'NO. OF EXTINCTION COEFFICIENT PROFILES .....',15/5X,
F  'NO. OF EXTINCTION CCEFF. DATA POINTS FOR EACH PROF.',15/)
1200 FORMAT(1H0/5X,
1  'NO. OF PH PROFILES .....',15/5X,
2  'NO. OF PH DATA POINTS FOR EACH PH PROFILE .....',15/5X,
3  'NO. OF POH PROFILE S .....',15/5X,
4  'NO. OF POH DATA POINTS FOR EACH POH PROFILE .....',15/5X,
5  'NO. OF OXIDATION RADICAL PROFILES .....',15/5X,
6  'NO. OF OXIDATION RADICAL DATA POINTS FOR EACH PROF.',15/5X,
7  'NO. OF BACTERIAL POPULATION DENSITY PROFILES .....',15/5X,
8  'NO. OF PD DATA POINTS FOR EACH PROFILE .....',15/5X,
9  'NO. OF BIO-TEMPERATURE PROFILES .....',15/5X,
A  'NO. OF BIO-TEMPERATURE DATA POINTS FOR EACH PROF.',15/5X,
B  'NO. OF PROPORTIONAL BACTERIAL FOR DEGRADATION PROF.',15/5X,
C  'NO. OF PB DATA POINTS FOR EACH PROFILE .....',15//5X,
D  'NO. OF BOUNDARY VALUE PROFILES .....',15/5X,
E  'NO. OF BOUNDARY VALU DATA POINTS FOR EACH PROF. ....',15/)
2000 FORMAT(1H1)
2100 FORMAT(1H0///1H,'**** SOURCES OF SEDIMENT FOR FRACTION SIZE',12,
> ' ****')
2200 FORMAT(1H0,10X,'PROFILE NO.',12/ 14X,5X,'TIME',6X,'VALUE',5X,
1  'TIME',6X,'VALUE',5X,'TIME',6X,'VALUE',5X,'TIME',6X,'VALUE',5X,
2  'TIME',6X,'VALUE')
2300 FORMAT((15X,10D10.3))
2400 FORMAT(1H0/10X,'LIST OF PPROFILE TYPE OF SOURCE SEDIMENT ASSIGNED
> TO EACH COMPARTMENT')
2500 FORMAT((15X,50I2))
3100 FORMAT(1H0///1H,'**** SOURCES OF DISSOLVED CHEMICALS ****')
3400 FORMAT(1H0,10X,'LIST OF PROFILE TYPE OF DISSOLVED CHEMICALS ASSIGN
> ED TO EACH COMPARTMENT')
4100 FORMAT(1H0///1H,'**** SOURCES OF PARTICULATE CHEMICALS FOR FRACTI
> ON SIZE NO.',12,' ****')
4400 FORMAT(1H0,10X,'LIST OF PROFILE TYPE OF PARTICULATE CHEMICALS ASSI
> GNE TO EACH COMPARTMENT')
5110 FORMAT(1H0///1H,'*** AIR TEMPERATURE ***')
5410 FORMAT(1H0,10X,'LIST OF AIR TEMPERATURE TYPE ASSIGNED TO EACH N')
5120 FORMAT(1H0///1H,'*** SOLAR RADIATION ***')
5420 FORMAT(1H0,10X,'LIST OF SOLAR RADIATION TYPE ASSIGNED TO EACH N')
5130 FORMAT(1H0///1H,'*** WIND SPEED ***')
5430 FORMAT(1H0,10X,'LIST OF WIND SPEED TYPE ASSIGNED TO EACH N')
5140 FORMAT(1H0///1H,'*** VAPOR PRESSURE ***')
5440 FORMAT(1H0,10X,'LIST OF VAPOR PRESSURE TYPE ASSIGNED TO EACH N')
5150 FORMAT(1H0///1H,'*** WATER TEMPERATURE ***')
5450 FORMAT(1H0,10X,'LIST OF WATER TEMP. TYPE ASSIGNED TO EACH N')
5160 FORMAT(1H0///1H,'*** EXTINCTION COEFFICIENT ***')
5460 FORMAT(1H0,10X,'LIST OF EXTINCTION COEFF. TYPE ASSIGNED TO EACH N')
6110 FORMAT(1H0///1H,'*** PH VALUE ***')
6410 FORMAT(1H0,10X,'LIST OF PH TYPE ASSIGNED TO EACH N')
6120 FORMAT(1H0///1H,'*** POH VALUE ***')
6420 FORMAT(1H0,10X,'LIST OF POH TYPE ASSIGNED TO EACH N')
6130 FORMAT(1H0///1H,'*** OXIDATION RADICAL (OR) ***')
6430 FORMAT(1H0,10X,'LIST OF OXIDATION TYPE ASSIGNED TO EACH N')
6140 FORMAT(1H0///1H,'*** POPULATION DENSITY (PD) ***')
6440 FORMAT(1H0,10X,'LIST OF PD TYPE ASSIGNED TO EACH N')
6150 FORMAT(1H0///1H,'*** BIO-TEMPERATURE (BT) ***')
6450 FORMAT(1H0,10X,'LIST OF BT TYPE ASSIGNED TO EACH N')
6160 FORMAT(1H0///1H,'*** PROPORTIONAL BACTERIAL TO DEGRADE ***')
6460 FORMAT(1H0,10X,'LIST OF PB TYPE ASSIGNED TO EACH N')
7100 FORMAT(1H0///1H,'**** BOUNDARY VALUES OF SEDIMENT FOR FRACTION SI
> ZE NO.',13,' ****')
8100 FORMAT(1H0///1H,'**** BOUNDARY VALUE OF DISSOLVED CHEMICAL ****')
9100 FORMAT(1H0///1H,'**** BOUNDARY VALUE OF PARTICULAR CHEMICAL FOR
> FRACTION SIZE NO.',12,' ****')
C
  RETURN
  END

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SENB1485
 SENB1490
 SENB1495
 SENB1500
 SENB1505
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 SENB1880
 SENB1885
 SENB1890
 SENB1895
 SENB1900
 SENB1905
 SENB1910

Appendix C (continued)

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SUBROUTINE TSENB(TSSTAB,SSTAB,SS,TSWTAB,SWTAB,SW,TSPTAB,SPTAB,SP,
> TTATAB,TATAB,TA,TSRTAB,SRTAB,SR,TWSTAB,WSTAB,WS,
> TWTAB,TWTAB,TW,TVPTAB,VPTAB,VP,TECTAB,ECTAB,EC,
> TPHTAB,PHTAB,PH,TPOTAB,POTAB,PO,TORTAB,ORTAB,OR,
> TBTTAB,BTTAB,BT,TPDTAB,PDTAB,PD,TPBTAB,PBTAB,PB,
> GSI,TGSITB,GSITB,GCW,TGCWTB,GCWTB,GCI,TGCITB,GCITB,TIME)
C
C      IMPLICIT REAL*8(A-H,O-Z)
C
COMMON /CSIZE/ MAXNOD,MAXCON,MXBND,MXEQS,MXBWD
COMMON /CSDCM/ MXSUR,MXSUBP,MXSPY,NSUBS,NSPY
COMMON /CSOS/ MXSPR,MXSDP,NSPR,NSDP
COMMON /CTA/ MXTAPR,MXTADP,NTAPR,NTADP
COMMON /CSR/ MXSRPR,MXSRDP,NSRPR,NSRDP
COMMON /CWS/ MXWSPR,MXWSDP,NWSPR,NWSDP
COMMON /CVP/ MXVPPR,MXVPDP,NVPPR,NVPDP
COMMON /CTW/ MXTWPR,MXTWDP,NTWPR,NTWDP
COMMON /CEC/ MXECPR,MXECDP,NECPR,NECDP
COMMON /CPH/ MXPHPR,MXPHPD,NPHPR,NPHDP
COMMON /CPO/ MXPOPR,MXPORD,NPOP,NPODP
COMMON /COR/ MXORPR,MXORDP,NORPR,NORDP
COMMON /CPD/ MXPDPR,MXPDDP,NPDP,NPDDP
COMMON /CBT/ MXBTPR,MXBTD,NTBTPR,NBTD
COMMON /CPB/ MXPBPR,MXPBDP,NPBPR,NPBDDP
COMMON /CBV/ MXBVPR,MXBVDP,NBVP,NBDDP
C
C      DIMENSION TSSTAB(MXSPR,MXSDP,MXSUR),SSTAB(MXSPR,MXSDP,MXSUB)
C      DIMENSION SS(MXSPR,MXSUR)
C      DIMENSION TSWTAB(MXSPR,MXSDP),SWTAB(MXSPR,MXSDP),SW(MXSPR)
C      DIMENSION TSPTAB(MXSPR,MXSDP,MXSUR),SPTAB(MXSPR,MXSDP,MXSUR)
C      DIMENSION SP(MXSPR,MXSUR)
C
C      DIMENSION TTATAB(MXTAPR,MXTADP),TATAB(MXTAPR,MXTADP),TA(MXTAPR)
C      DIMENSION TSRTAB(MXSRPR,MXSRDP),SRTAB(MXSRPR,MXSRDP),SR(MXSRPR)
C      DIMENSION TWSTAB(MXWSPR,MXWSDP),WSTAB(MXWSPR,MXWSDP),WS(MXWSPR)
C      DIMENSION TVPTAB(MXVPPR,MXVPDP),VPTAB(MXVPPR,MXVPDP),VP(MXVPPR)
C      DIMENSION TWTAB(MXTWPR,MXTWDP),TWTAB(MXTWPR,MXTWDP),TW(MXTWPR)
C      DIMENSION TECTAB(MXECPR,MXECDP),ECTAB(MXECPR,MXECDP),EC(MXECPR)
C      DIMENSION TPHTAB(MXPHPR,MXPHPD),PHTAB(MXPHPR,MXPHPD),PH(MXPHPR)
C      DIMENSION TPOTAB(MXPOPR,MXPORD),POTAB(MXPOPR,MXPORD),PO(MXPOPR)
C      DIMENSION TORTAB(MXORPR,MXORDP),ORTAB(MXORPR,MXORDP),OR(MXORPR)
C      DIMENSION TPDTAB(MXPDPR,MXPDDP),PDTAB(MXPDPR,MXPDDP),PD(MXPDPR)
C      DIMENSION TBTTAB(MXBTPR,MXBTD),BTTAB(MXBTPR,MXBTD),BT(MXBTPR)
C      DIMENSION TPBTAB(MXPBPR,MXPBDP),PBTAB(MXPBPR,MXPBDP),PB(MXPBPR)
C
C      DIMENSION TGSITB(MXBVPR,MXBVDP,MXSUR),GSITB(MXBVPR,MXBVDP,MXSUR)
C      DIMENSION TGCWTB(MXBVPR,MXBVDP),GCWTB(MXBVPR,MXBVDP)
C      DIMENSION TGCITB(MXBVPR,MXBVDP,MXSUR),GCITB(MXBVPR,MXBVDP,MXSUR)
C      DIMENSION GSI(MXBVPR,MXSUR),GCW(MXBVPR),GCI(MXBVPR,MXSUR)
C
C      ----- INTERPOLATION FOR SS
C
C      DO 190 M=1,NSUBS
C      DO 160 I=1,NSPR
C      DO 140 J=2,NSDP
C      IF(TSSTAB(I,J-1,M).LE.TIME .AND. TIME.LE.TSSTAB(I,J,M)) GO TO 120
C      GO TO 140
C      120 SS(I,M)=SSTAB(I,J-1,M)+(TIME-TSSTAB(I,J-1,M))*(SSTAB(I,J,M)-
C      > SSTAB(I,J-1,M))/(TSSTAB(I,J,M)-TSSTAB(I,J-1,M))
C      GO TO 160
C      140 CONTINUE
C      SS(I,M)=0.0
C      160 CONTINUE
C      190 CONTINUE
C
C      ----- INTERPOLATION FOR SW
C      CALL INTERP(SW,TSWTAB,SWTAB,TIME,MXSPR,MXSDP,NSPR,NBDDP)
C
C      ----- INTERPOLATION FOR SP
C      DO 290 M=1,NSUBS
C      DO 260 I=1,NSPR
C      DO 240 J=2,NSDP
C      IF(TSPTAB(I,J-1,M).LE.TIME .AND. TIME.LE.TSPTAB(I,J,M)) GO TO 220
C      GO TO 240
C      220 SP(I,M)=SPTAB(I,J-1,M)+(TIME-TSPTAB(I,J-1,M))*(SPTAB(I,J,M)-
C      > SPTAB(I,J-1,M))/(TSPTAB(I,J,M)-TSPTAB(I,J-1,M))
C      GO TO 260
C      240 CONTINUE
C      SP(I,M)=0.0
C      260 CONTINUE
C      290 CONTINUE
C
C      ----- INTERPOLATION FOR TA
C      CALL INTERP(TA,TTATAB,TATAB,TIME,MXTAPR,MXTADP,NTAPR,NTADP)
C
C      ----- INTERPOLATION FOR SR
C      CALL INTERP(SR,TSRTAB,SRTAB,TIME,MXSRPR,MXSRDP,NSRPR,NSRDP)
C
C      ----- INTERPOLATION FOR WS
C      CALL INTERP(WS,TWSTAB,WSTAB,TIME,MXWSPR,MXWSDP,NWSPR,NWSDP)
C
C      ----- INTERPOLATION FOR VP
C      CALL INTERP(VP,TVPTAB,VPTAB,TIME,MXVPPR,MXVPDP,NVPPR,NVPDP)
C
C      ----- INTERPOLATION FOR TW

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Appendix C (continued)

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C      CALL INTERP(TW,TTWTAB,TWTAB,TIME,MXTWPR,MXTWDP,NTWPR,NTWDP)
C      ----- INTERPOLATION FOR EC
C      CALL INTERP(EC,TECTAB,ECTAB,TIME,MXECPR,MXECDP,NECPR,NECDP)
C      ----- INTERPOLATION FOR PH
C      CALL INTERP(PH,TPHTAB,PHTAB,TIME,MXPHPR,MXPHDP,NPHPR,NPHDP)
C      ----- INTERPOLATION FOR POH
C      CALL INTERP(PO,TPOTAB,POTAB,TIME,MXPOPR,MXPODP,NPOPR,NPODP)
C      ----- INTERPOLATION FOR OR
C      CALL INTERP(OR,TORTAB,ORTAB,TIME,MXORPR,MXORDP,NORPR,NORDP)
C      ----- INTERPOLATION FOR PD
C      CALL INTERP(PD,TPDTAB,PDTAB,TIME,MXPDP,XPDP,NPDP,NPDP)
C      ----- INTERPOLATION FOR BT
C      CALL INTERP(BT,TBTAB,BTAB,TIME,MXBTPR,MXBTP,NBTPR,NBTP)
C      ----- INTERPOLATION FOR PB
C      CALL INTERP(PB,TPBTAB,PBTAB,TIME,MXPBPR,MXPBDP,NPBPR,NPBDP)
C      ----- INTERPOLATION FOR SI
C      DO 390 M=1,NSUBS
C      DO 340 I=1,NBVPR
C      DO 340 J=2,NBVDP
C      IF(TGSITB(I,J-1,M).LE.TIME .AND. TIME.LE.TGSITB(I,J,M)) GO TO 320
C      GO TO 340
C      320 GSI(I,M)=GSI(I,J-1,M)+(TIME-TGSITB(I,J-1,M))*(GSI(I,J,M)-
C      > GSI(I,J-1,M))/(TGSITB(I,J,M)-TGSITB(I,J-1,M))
C      GO TO 340
C      340 CONTINUE
C      GSI(I,M)=0.0
C      360 CONTINUE
C      390 CONTINUE
C      ----- INTERPOLATION FOR CW
C      CALL INTERP(GCW,TGCWTB,GCWTB,TIME,MXBVPR,MXBVDP,NBVPR,NBVDP)
C      ----- INTERPOLATION FOR CI
C      DO 490 M=1,NSUBS
C      DO 460 I=1,NBVPR
C      DO 440 J=2,NBVDP
C      IF(TGCITB(I,J-1,M).LE.TIME .AND. TIME.LE.TGCITB(I,J,M)) GO TO 420
C      GO TO 440
C      420 GCI(I,M)=GCI(I,J-1,M)+(TIME-TGCITB(I,J-1,M))*(GCI(I,J,M)-
C      > GCI(I,J-1,M))/(TGCITB(I,J,M)-TGCITB(I,J-1,M))
C      GO TO 440
C      440 CONTINUE
C      GCI(I,M)=0.0
C      460 CONTINUE
C      490 CONTINUE
C      RETURN
C      END

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TSEN 835

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Appendix C (continued)

	SUBROUTINE CHNTRN(SEDCH,DCN,PCN,BEDSD,BDCHM,CNBED,	CHNT 005
1	SEDCH,DCN,PCN,BEDSD,BDCHM,CNBED,ERSN,DPOSN,QS,Q,A,B,P,H,	CHNT 010
2	OP,AP,BP,PP,HP,CN,DX,NODTYP,NOD1,NOD2,KSIGN,D1IC,D2IC,ICNTYP,	CHNT 015
3	ABSOPK,EQILKD,ABSOPB,WSK,ERODTY,TAUCD,TAUCR,DIAMS,	CHNT 020
4	MOLEW,HENRY,QUANTG,KDPG,RFLAG,ABSG,	CHNT 025
5	KAHG,KNHG,KBHG,EAHG,ENHG,EBHG,KOXG,EOXG,KBACWG,KBACSG,OTBAWG,	CHNT 030
6	OTBASG,RATKV,RATKP,RATKH,PATKO,RATKB,RAK,CMATRX,ALOAD,	CHNT 035
7	TSSTAB,SSTAB,SS,ISSTYP,TSWTAB,SWTAB,SW,ISWTYP,TSPTAB,SPTAB,SP,	CHNT 040
8	ISPTYP,TTATAB,TATAB,TA,ITATYP,TSRTAB,SRTAB,SR,ISRTYP,	CHNT 045
9	TWSTAB,WSTAB,WS,IWSTYP,TWTAB,TWTAB,TW,IWTYP,TVPTAB,VPTAB,VP,	CHNT 050
A	IVPTYP,TECTAB,ECTAB,EC,IECTYP,TPHTAB,PHTAB,PH,IPHTYP,	CHNT 055
B	TPOTAB,POTAB,PO,IPOTYP,TPOTAB,ORTAB,OR,IORTYP,	CHNT 060
C	TBTAB,BTAB,BT,IBTYP,TPOTAB,POTAB,PO,IPOTYP,	CHNT 065
D	TPBTAB,PBTAB,PB,IPBTYP,KGBND,GS1,TGSI TB,GSITB,	CHNT 070
E	GCW,TGCWTB,GCWTB,GCI,TGCITB,GCI TB)	CHNT 075
C	IMPLICIT REAL*8 (A-H,O-Z)	CHNT 080
	REAL*8 MOLEW,KDPG,KAHG,KNHG,KBHG,KOXG,KBACWG,KBACSG	CHNT 085
C		CHNT 090
	COMMON /CSIZE/ MAXNOD,MAXCON,MAXBND,MXEQS,MAXBWD	CHNT 095
	COMMON /CINTGR/ NODES,NCONS,NGBND,NTI,KVI,KSS	CHNT 100
	COMMON /EQUAS/ NEQS,IRAND,IHBP,IALFB,IMPL	CHNT 105
	COMMON /CREALP/ DELT,CHNG,EDDY,THETA	CHNT 110
	COMMON /KPR/ KPRD,KPRBS,KPRSI,KPRK,KPRCW,KPRBC,KPRCI,NREAD,NSTOR	CHNT 115
C		CHNT 120
	COMMON /FOTO/ CLOUDG,ELATG	CHNT 125
C		CHNT 130
	COMMON /CSDCM/ MXSUB,MXSUBP,MXSPY,NSUBS,NSPY	CHNT 135
	COMMON /CSOS/ MXSPR,MXSDP,NSPR,NSDP	CHNT 140
C		CHNT 145
	COMMON /CTA/ MXTAPP,MXTADP,NTAPP,NTADP	CHNT 150
	COMMON /CSR/ MXSRPR,MXSRDP,NSRPR,NSRDP	CHNT 155
	COMMON /CWS/ MXWSPR,MXWSDP,NWSPR,NWSDP	CHNT 160
	COMMON /CVP/ MXVPPR,MXVPDP,NVPPR,NVPDP	CHNT 165
	COMMON /CTW/ MXTWPR,MXTWDP,NTWPR,NTWDP	CHNT 170
	COMMON /CEC/ MXECPR,MXECDP,NECPR,NECDP	CHNT 175
	COMMON /CPH/ MXPHPR,MXPHDP,NPHPR,NPHDP	CHNT 180
	COMMON /CPD/ MXPDPR,MXPDDP,NPDPR,NPDDP	CHNT 185
	COMMON /COP/ MXOPPR,MXORDP,NORPR,NORDP	CHNT 190
	COMMON /CPD/ MXPDPR,MXPDDP,NPDPR,NPDDP	CHNT 195
	COMMON /CPT/ MXPDP,MPDPP,NPDPR,NPDPP	CHNT 200
	COMMON /CPB/ MXPBPR,MXPBDP,NPBPR,NPBDP	CHNT 205
	COMMON /CBV/ MXBVP,MBVDP,NBVPR,NBVDP	CHNT 210
C		CHNT 215
	----- UNKNOWNNS TO BE FOUND	CHNT 220
C		CHNT 225
	DIMENSION SEDCH(MAXNOD,MXSUB),DCN(MAXNOD),PCN(MAXNOD,MXSUB)	CHNT 230
	DIMENSION BEDSD(MAXNOD,MXSUB),CNBND(MAXNOD,MXSUB)	CHNT 235
	DIMENSION BDCHM(MAXNOD,MXSUB),CNBND(MAXNOD,MXSUB)	CHNT 240
	DIMENSION SEDCH(MAXNOD,MXSUB),DCN(MAXNOD),PCN(MAXNOD,MXSUB)	CHNT 245
	DIMENSION BEDSD(MAXNOD,MXSUB)	CHNT 250
	DIMENSION BDCHM(MAXNOD,MXSUB),CNBND(MAXNOD,MXSUB)	CHNT 255
C		CHNT 260
	----- SECONDARY UNKNOWNNS TO BE FOUND	CHNT 265
C		CHNT 270
	DIMENSION ERSN(MAXNOD,MXSUB),DPOSN(MAXNOD,MXSUB)	CHNT 275
	DIMENSION QS(MAXNOD,MXSUB)	CHNT 280
C		CHNT 285
	----- HYDRODYNAMIC FLOWS	CHNT 290
C		CHNT 295
	DIMENSION Q(MAXNOD),A(MAXNOD),B(MAXNOD),P(MAXNOD),H(MAXNOD)	CHNT 300
	DIMENSION QP(MAXNOD),AP(MAXNOD),BP(MAXNOD),PP(MAXNOD),HP(MAXNOD)	CHNT 305
	DIMENSION CN(MAXNOD)	CHNT 310
C		CHNT 315
	----- GEOMETRY	CHNT 320
C		CHNT 325
	DIMENSION OX(MAXNOD),NODTYP(MAXNOD)	CHNT 330
	DIMENSION NOD1(MAXCON),NOD2(MAXCON),ICNTYP(MAXCON)	CHNT 335
	DIMENSION D1IC(MAXCON),D2IC(MAXCON),KSGN(MAXCON)	CHNT 340
C		CHNT 345
	DIMENSION KGBND(MAXBND)	CHNT 350
C		CHNT 355
	----- RATE CONSTANTS	CHNT 360
C		CHNT 365
	DIMENSION RATKV(MAXNOD,MXSUBP),RATKH(MAXNOD,MXSUBP)	CHNT 370
	DIMENSION RATKO(MAXNOD,MXSUBP),RATKP(MAXNOD,MXSUBP)	CHNT 375
	DIMENSION RATKB(MAXNOD,MXSUBP),RATEK(MAXNOD,MXSUBP)	CHNT 380
C		CHNT 385
	----- SOIL-CHEMICAL INTERACTION PARAMETERS	CHNT 390
C		CHNT 395
	DIMENSION ABSOPK(MXSUB),EQILKD(MXSUB),ABSOPB(MXSUB)	CHNT 400
C		CHNT 405
	----- PARAMETERS FOR COMPUTING SEDIMENT DEPOSITION AND EROSION	CHNT 410
C		CHNT 415
	DIMENSION WSK(MXSUB),ERODTY(MXSUB),TAUCD(MXSUB),TAUCR(MXSUB)	CHNT 420
	DIMENSION DIAMS(MXSUB)	CHNT 425
C		CHNT 430
	DIMENSION MOLEW(MXSPY,MXSUBP),HENRY(MXSPY,MXSUBP)	CHNT 435
C		CHNT 440
	DIMENSION KCPG(MXSPY,MXSUBP),RFLAG(MXSPY,MXSUBP)	CHNT 445
	DIMENSION QUANTG(MXSPY,MXSUBP),ABSG(MXSPY,39)	CHNT 450
C		CHNT 455
	DIMENSION KAHG(MXSPY,MXSUBP),KNHG(MXSPY,MXSUBP),KBHG(MXSPY,MXSUBP)	CHNT 460
	DIMENSION EAHG(MXSPY,MXSUBP),ENHG(MXSPY,MXSUBP),EBHG(MXSPY,MXSUBP)	CHNT 465
C		CHNT 470
	DIMENSION KOXG(MXSPY,MXSUBP),EOXG(MXSPY,MXSUBP)	CHNT 475
C		CHNT 480
	DIMENSION KBACWG(MXSPY,MXSUBP),KBACSG(MXSPY,MXSUBP)	CHNT 485
	DIMENSION OTBAWG(MXSPY,MXSUBP),OTBASG(MXSPY,MXSUBP)	CHNT 490
C		CHNT 495

Appendix C (continued)

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C ----- SOURCE INPUT
C
  DIMENSION TSSTAB(MXSPR,MXSDP,MXSUB),SSTAB(MXSPR,MXSDP,MXSUB)
  DIMENSION SS(MXSPR,MXSUB),ISSTYP(MAXNOD,MXSUB)
  DIMENSION TSWTAB(MXSPR,MXSDP),SWTAB(MXSPR,MXSDP)
  DIMENSION SW(MXSPR),ISWTYP(MAXNOD)
  DIMENSION TSPTAB(MXSPR,MXSDP,MXSUB),SPTAB(MXSPR,MXSDP,MXSUB)
  DIMENSION SP(MXSPR,MXSUB),ISPTYP(MAXNOD,MXSUB)
C ----- ADDITIONAL ENVIRONMENTAL PARAMETERS FOR COMPUTING RATE K'S
C
  DIMENSION TTATAB(MXTAPR,MXTADP),TATAB(MXTAPR,MXTADP)
  DIMENSION TA(MXTAPR),ITATYP(MAXNOD)
  DIMENSION TSRTAB(MXSRPR,MXSRDP),SRTAB(MXSRPR,MXSRDP)
  DIMENSION SR(MXSRPR),ISRTYP(MAXNOD)
  DIMENSION TWSTAB(MXWSPR,MXWSDP),WSTAB(MXWSPR,MXWSDP)
  DIMENSION WS(MXWSPR),IWSTYP(MAXNOD)
  DIMENSION TVPTAB(MXVPPR,MXVPDP),VPTAB(MXVPPR,MXVPDP)
  DIMENSION VP(MXVPPR),IVPTYP(MAXNOD)
  DIMENSION TTWTAB(MXTWPR,MXTWDP),TWTAB(MXTWPR,MXTWDP)
  DIMENSION TW(MXTWPR),ITWTYP(MAXNOD)
  DIMENSION TECTAB(MXECPR,MXECDP),ECTAB(MXECPR,MXECDP)
  DIMENSION EC(MXECPR),IECTYP(MAXNOD)
  DIMENSION TPHTAB(MXPHPR,MXPHDP),PHTAB(MXPHPR,MXPHDP)
  DIMENSION PH(MXPHPR),IPHTYP(MAXNOD)
  DIMENSION TPOTAB(MXPDP,MPDP),POTAB(MXPDP,MPDP)
  DIMENSION PP(MXPDP),IPOTYP(MAXNOD)
  DIMENSION TORTAB(MXORPR,MXORDP),ORTAB(MXORPR,MXORDP)
  DIMENSION OR(MXORPR),IOPTYP(MAXNOD)
  DIMENSION TPOTAB(MXPDP,MPDP),PDAB(MXPDP,MPDP)
  DIMENSION PD(MXPDP),IPDTYP(MAXNOD)
  DIMENSION TBTTAB(MXBT,MPBD),BTAB(MXBT,MPBD)
  DIMENSION BT(MXBT),IBTTYP(MAXNOD)
  DIMENSION TPBTAB(MXPBP,MPBD),PBAB(MXPBP,MPBD)
  DIMENSION PB(MXPBP),IPBTYP(MAXNOD)
C ----- BOUNDARY CONDITIONS
C
  DIMENSION TGSITB(MXBVPR,MXBVDP,MXSUB),GSITB(MXBVPR,MXBVDP,MXSUB)
  DIMENSION TGCTB(MXBVPR,MXBVDP),GCTB(MXBVPR,MXBVDP)
  DIMENSION TGCITB(MXBVPR,MXBVDP,MXSUB),GCITB(MXBVPR,MXBVDP,MXSUB)
  DIMENSION GSI(MXBVPR,MXSUB),GCW(MXBVPR),GCI(MXBVPR,MXSUB)
C
  DIMENSION CMATRIX(MXEOS,MXROW),ALOAD(MAXNOD)
C
  NSUBSP=NSUBS+1
C ----- START TRANSIENT LOOP COMPUTATION
C
  TIME=0.0
  NTIP=NTI+1
C
  IF(KVI.EQ.1) READ(1) TIM, (A(N),N=1,NODES), (H(N),N=1,NODES),
  1 (B(N),N=1,NODES), (P(N),N=1,NODES), (Q(N),N=1,NODES)
C
  IF(KVI.LE.0) GO TO 110
  GO TO 150
C
  110 READ 20, (A(N),N=1,NODES)
  READ 20, (H(N),N=1,NODES)
  READ 20, (B(N),N=1,NODES)
  READ 20, (P(N),N=1,NODES)
  READ 20, (Q(N),N=1,NODES)
  20 FORMAT(8D10.2)
C
  ----- STORE GEOMETRY ON UNIT 2 FOR PLOTTING IF REQUIRED
C
  150 IF(NSTOP.EQ.0) GO TO 160
  REWIND 2
  WRITE(2) NODES,NCONS,(NODTYP(N),N=1,NODES), (DX(N),N=1,NODES),
  > (CN(N),N=1,NODES)
  WRITE(2) (NOD1(K),NOD2(K),ICNTYP(K),KSIGN(K),D1IC(K),D2IC(K),K=1,
  > NCONS)
  IF(KVI.LE.1) WRITE(2) TIME, (A(N),N=1,NODES), (H(N),N=1,NODES),
  > (B(N),N=1,NODES), (P(N),N=1,NODES), (Q(N),N=1,NODES)
C
  160 CONTINUE
C ----- START TRANSIENT SIMULATION, SHOULD SET KSS = 0
C
  KSS=0
  DO 990 IT=1,NTIP1
C
  IF(KVI.NE.2) GO TO 300
C
  IPEAD=MND(IT-1,NREAD)
C
  IF(IPEAD.EQ.0 .AND. KVI.EQ.2) READ(1) TIM, (A(N),N=1,NODES),
  1 (H(N),N=1,NODES), (B(N),N=1,NODES), (P(N),N=1,NODES),
  2 (Q(N),N=1,NODES)
C
  300 CONTINUE
C
  CALL TSENB(TSSTAB,SS,TSRTAB,SR,TSWTAB,SW,TSPTAB,SPTAB,SP,
  > TTATAB,TATAB,TA,TSRTAB,SRTAB,SR,TWTAB,WSTAB,WS,
  > TTWTAB,TWTAB,TW,TVPTAB,VPTAB,VP,TECTAB,ECTAB,EC,
  > TPHTAB,PHTAB,PH,TPOTAB,POTAB,PD,TORTAB,ORTAB,OB,
  > TBTTAB,BTTAB,BT,TPOTAB,POTAB,PD,TPBTAB,PBTAB,PB,

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Appendix C (continued)

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> GSI,TGSITB,GSITB, GCW,TGCWTB,GCWTB, GCI,TGCITB,GCITB, TIME)
C
C IF(IT.EQ.1) GO TO 400
C
C ----- FOR IT .GT.2 START HERE
C
C ----- CALL ERODEP TO COMPUTE EROSION AND DEPOSITION RATES
C
C CALL ERODEP(ERSN,DPOSN,QS, Q,A,B,P,H,OP,AP,BP,PP,HP, DX,CN,
1 NODTYP, TW,ITWTYP, SEDCN,SEDCNP, WSK,EROOTY,TAUCD,TAUCR,DIAMS,
2 MAXNOD,MXSUB,MXTWPR, NODES,NSURS)
C
C ----- CALL SEDTRAN TO COMPUTE SEDIMENT CONCENTRATION
C
C DO 360 M=1,NSUBS
C CALL SEDTRN(SEDCNP,BEDSD,BEDSDP,ERSN,DPOSN,QS,
1 Q,A,B,P,H,OP,AP,BP,PP,HP, DX,NODTYP, NOD1,NOD2,KSIGN,D1IC,D2IC,
2 ICNTYP, SS,ISSTYP, KGBND,GSI, MXSPR,MXBVPR, CMATRX,ALOAD, M)
C DO 350 N=1,NODES
C 350 SEDCN(N,M)=ALOAD(N)
C 360 CONTINUE
C
C ----- CALL SUBROUTINE CHEMK TO COMPUTE ALL CHEMICAL RATE CONSTANTS
C
C CALL CHEMK(RATKV,RATKH,RATKO,RATKP,RATKB,RATEK,SEDCN,
1 Q,A,B,P,H,OP,AP,BP,PP,HP, MOLEW,HENRY, KDPG,RFLAG,QUANTG,ABSG,
2 KAHG,KNHG,KBHG,EAHG,ENHG,EBHG, KDXG,EOXG,
3 KBACWG,KBACSG,QTBAWG,QTBASG, NODTYP,NODES,
4 TA,ITATYP,SR,ISRTYP,WS,IWSTYP,TW,ITWTYP,VO,IVPTYP,EC,IECTYP,
5 PH,IPHTYP,PO,IPOTYP,OR,IORTYP,BT,IBTTYP,PD,IPOTYP,PB,IPBTYP,
6 MXTAPR,MXSRPR,MXWSPR,MXTWPR,MXVPR,MXECPR, MXPHPR,MXPORPR,MXORPR,
7 MXPDRR,MXBTPR,MXPBR)
C
C ----- CALL DISCON TO COMPUTE DISSOLVED CONCENTRATION DISTRIBUTION
C
C CALL DISCON(DCN,DCNP, Q,A,B,H,P,OP,AP,BP,HP,PP,
1 SEDCN,SEDCNP,PCN,PCNP,BEDSD,BEDSDP,BDCHM,BDCHMP,CNBED,CNBEDP,
2 DX,NODTYP, KSIGN,NOD1,NOD2,D1IC,D2IC,ICNTYP, RATEK,NSUBSP,
3 EQILKO,ABSOPK,ABSOPB, SW,ISWTYP,MXSPR, KGBND,GCW,MXBVPR, CMATRX)
C
C ----- CALL PARCON TO COMPUTE PARTICULATE CONCENTRATION DISTRIBUTION
C
C DO 390 M=1,NSUBS
C CALL PARCON(PCNP,BEDSD,BEDSDP,BDCHM,BDCHMP,CNBED,CNBEDP,
1 DCN,DCNP, SEDCN,SEDCNP,ERSN,DPOSN, Q,A,B,H,P,OP,AP,BP,HP,PP,
2 DX,NODTYP, KSIGN,NOD1,NOD2,D1IC,D2IC,ICNTYP, RATEK,
3 EQILKO(M),ABSOPK(M),ABSOPB(M), SP,ISPTYP,MXSPR, KGBND,GCI,MXBVPR,
4 CMATRX,ALOAD,M)
C DO 380 N=1,NODES
C 380 PCN(N,M)=ALOAD(N)
C 390 CONTINUE
C
C ----- WRITE THE RESULTS
C
C 400 CONTINUE
C
C ----- LINE-PRINT EROSION AND DEPOSITION RATES IF REQUIRED
C
C IF(KPREC.EQ.0) GO TO 410
C IF(MOD(IT-1,KPREC).NE.0 .AND. IT.GT.5) GO TO 410
C DO 405 M=1,NSUBS
C WRITE(6,3100) M, TIME
C WRITE(6,3110)
C CALL OUTPUT(ERSN(1,M),NODES,MAXNOD)
C WRITE(6,3120)
C CALL OUTPUT(DPOSN(1,M),NODES,MAXNOD)
C 405 CONTINUE
C 410 CONTINUE
C
C ----- LINE-PRINT BED SEDIMENT IF REQUIRED
C
C IF(KPRBS.EQ.0) GO TO 420
C IF(MOD(IT-1,KPRBS).NE.0 .AND. IT.GT.5) GO TO 420
C DO 415 M=1,NSUBS
C WRITE(6,4100) M,TIME
C CALL OUTPUT(BEDSD(1,M),NODES,MAXNOD)
C 415 CONTINUE
C 420 CONTINUE
C
C ----- LINE PRINT SEDIMENT CONCENTRATION IF REQUIRED
C
C IF(KORSI.EQ.0) GO TO 430
C IF(MOD(IT-1,KORSI).NE.0 .AND. IT.GT.5) GO TO 430
C
C DO 425 M=1,NSUBS
C WRITE(6,4200) M,TIME
C CALL OUTPUT(SEDCN(1,M),NODES,MAXNOD)
C 425 CONTINUE
C 430 CONTINUE
C
C ----- LINE-PRINT RATE CONSTANTS IF REQUIRED
C
C IF(KPRK.EQ.0) GO TO 440
C IF(MOD(IT-1,KPRK).NE.0 .AND. IT.GT.5) GO TO 440
C DO 435 M=1,NSUBSP
C WRITE(6,5100) M,TIME
C CALL OUTPUT(RATEK(1,M),NODES,MAXNOD)
C 435 CONTINUE

```

Appendix C (continued)

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C 440 CONTINUE
C ----- LINE-PRINT DISSOLVED CONCENTRATION IF REQUIRED
C
      IF(KPRCW.EQ.0) GO TO 450
      IF(MOD(IT-1,KPRCW).NE.0 .AND. IT.GT.5) GO TO 450
      WRITE(6,6100) TIME
      CALL OUTPUT(DCN,NODES,MAXNOD)
C 450 CONTINUE
C ----- LINE-PRINT BED CHEMICAL AMOUNT AND BED CHEMICAL CONCENTRATION
C
      IF(KPRBC.EQ.0) GO TO 460
      IF(MOD(IT-1,KPRBC).NE.0 .AND. IT.GT.5) GO TO 460
      DO 455 M=1,NSUBS
      WRITE(6,7100) M,TIME
      WRITE(6,7110)
      CALL OUTPUT(BDCHM(1,M),NODES,MAXNOD)
      WRITE(6,7120)
      CALL OUTPUT(CNBED(1,M),NODES,MAXNOD)
C 455 CONTINUE
C 460 CONTINUE
C ----- LINE-PRINT PARTICULATE CONCENTRATION IF REQUIRED
C
      IF(KPRCI.EQ.0) GO TO 470
      IF(MOD(IT-1,KPRCI).NE.0 .AND. IT.GT.5) GO TO 470
      DO 465 M=1,NSUBS
      WRITE(6,7200) M,TIME
      CALL OUTPUT(PCN(1,M),NODES,MAXNOD)
C 465 CONTINUE
C 470 CONTINUE
C ----- PUT SEDCN,DCN,PCN,BEDSD,BDCHM,CNBED INTO
C ----- SEDCNP,DCNP,PCNP,BEDSDP,BDCHMP,CNBEDP, RESPECTIVELY
C
      DO 510 N=1,NODES
      DCNP(N)=DCN(N)
      DO 510 M=1,NSUBS
      SEDCNP(N,M)=SEDCN(N,M)
      PCNP(N,M)=PCN(N,M)
      BEDSDP(N,M)=BEDSD(N,M)
      BDCHMP(N,M)=BDCHM(N,M)
      CNBEDP(N,M)=CNBED(N,M)
C 510 CONTINUE
C
      DO 520 N=1,NODES
      QP(N)=Q(N)
      AP(N)=A(N)
      HP(N)=H(N)
      BP(N)=B(N)
      PP(N)=P(N)
C 520 DCNP(N)=DCN(N)
C ----- STORE HYDRODYNAMIC VARIABLES AND ALL CONCENTRATIONS ON UNIT 2
C ----- FOR PLOTTING IF REQUIRED
C
      IF(NSTOR.FQ.0) GO TO 650
      IF(MOD(IT-1,NSTOR).NE.0) GO TO 650
      IF(KVI.EQ.2) WRITE(2) TIME,(A(N),N=1,NODES),(H(N),N=1,NODES),
      > (B(N),N=1,NODES),(P(N),N=1,NODES),(Q(N),N=1,NODES)
C
      DO 610 M=1,NSUBS
      WRITE(2) (SEDCN(N,M),N=1,NODES)
C 610 CONTINUE
C
      WRITE(2) (DCN(N),N=1,NODES)
C
      DO 620 M=1,NSUBS
      WRITE(2) (PCN(N,M),N=1,NODES)
C 620 CONTINUE
C
      650 CONTINUE
C ----- PREPARE FOR THE NEXT TIME STEP COMPUTATIONS
C
      TIME=TIME+DELT
      DELT=DELT*(1.0+CHNG)
C
      990 CONTINUE
C
      3100 FORMAT(1H1,5X,'*** EROSION AND DEPOSITION RATE OF SIZE',I2,' AT
      > TIME',E12.4,' ***')
      3110 FORMAT(1H0/5X,'--- EROSION ---')
      3120 FORMAT(1H0/5X,'--- DEPOSITION RATE ---')
      4100 FORMAT(1H1//5X,'*** BED SEDIMENT OF SIZE',I2,' AT TIME',E12.4,' *
      > ***//')
      4200 FORMAT(1H1//5X,'*** SEDIMENT CONCENTRATION OF SIZE',I2,' AT TIME
      > ',E12.4,' ***//')
      5100 FORMAT(1H1//5X,'*** RATE CONSTANT THROUGH FRACTION SIZE',I2,' AT T
      > IME',E12.4,' ***//')
      6100 FORMAT(1H1//5X,'*** DISSOLVED CONCENTRATION AT TIME',E12.4,' ***
      > //')
      7100 FORMAT(1H1/5X,'*** BED CHEMICAL AMOUNT AND CONCENTRATION IN SIZE
      > NO.',I2,' AT TIME',E12.4,' ***')
      7110 FORMAT(1H0/10X,'--- AMOUNT ---')
      7120 FORMAT(1H0/10X,'--- CONCENTRATION ---')
      7200 FORMAT(1H1//5X,'*** PARTICULATE CONCENTRATION IN SIZE',I2,' AT
      > 1 TIME',E12.4,' ***//')
C
      RETURN
      END

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 CHNT1495
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 CHNT1975
 CHNT1980
 CHNT1985
 CHNT1990
 CHNT1995
 CHNT2000
 CHNT2005

Appendix C (continued)

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SUBROUTINE ERODEP(ERSN,DPSN,OS, O,A,B,P,H,OP,AP,BP,PP,HP,DX,CN,
1 NODTYP, TW,ITWTYP, SEDCN,SEDCNP, WSK,ERODTY,TAUCD,TAUCR,DIAMS,
2 MAXNOD,MXSUB,MXTWPR, NODES,NSUBS)
C
C   IMPLICIT REAL*8 (A-H,O-Z)
C
C   DIMENSION ERSN(MAXNOD,MXSUB), DPSN(MAXNOD,MXSUB)
C   DIMENSION OS(MAXNOD,MXSUB)
C
C   DIMENSION O(MAXNOD),A(MAXNOD),B(MAXNOD),P(MAXNOD),H(MAXNOD)
C   DIMENSION OP(MAXNOD),AP(MAXNOD),BP(MAXNOD),PP(MAXNOD),HP(MAXNOD)
C   DIMENSION DX(MAXNOD),CN(MAXNOD),NODTYP(MAXNOD)
C
C   DIMENSION TW(MXTWPR),ITWTYP(MAXNOD)
C
C   DIMENSION SEDCN(MAXNOD,MXSUB), SEDCNP(MAXNOD,MXSUB)
C
C   DIMENSION WSK(MXSUB), ERODTY(MXSUB), TAUCD(MXSUB), TAUCR(MXSUB)
C   DIMENSION DIAMS(MXSUB)
C
C   DIMENSION DATAA(6),DATAYA(5), DATAK(4),DATAYK(4)
C
C   DATA DATAA/0.125,0.5,0.68,0.72,1.3,3.1/
C   DATA DATAYA/200.0,29.0,31.0,49.0,49.0,700.0/
C   DATA DATAK/0.20,0.25,0.34,2.0/
C   DATA DATAYK/1.0,1.0,1.5,0.24/
C
C   ----- DATAK AND DATAYK TO STORE FIG. 2.109(B) OF ASCE M&R NO. 54
C
C   DO 290 N=1,NODES
C     NTP=NODTYP(N)
C     IF(NTP.NE.0) GO TO 290
C     RNODE=A(N)/P(N)
C     UNODE=CN(N)/A(N)
C     IF(NTP.NE.0) UNODE=O(N)/((P(N)-B(N))/4.0D0)
C     CNN=CN(N)
C     CHEZ=1.0/CNN*RNODE**0.1666667
C     TAUB=1000.0*9.8*UNODE*UNODE/(CHEZ*CHEZ)
C     USTAR=TAUB/1000.0
C     USTAR=DSORT(USTAR)
C
C   DO 190 J=1,NSUBS
C     OS(N,J)=0.0
C
C   ----- J = 1 = FOR CLAY
C   ----- J = 2 = FOR SILT
C   ----- J = 3 = FOR SAND
C
C     GO TO ((110,110,130),J)
C
C   110 CONTINUE
C     DPSNI=WSK(J)*(1.0-TAUB/TAUCD(J))*SEDCN(N,J)
C     DPSN(N,J)=DPSNI
C     IF(DPSNI.LT.0.0) DPSN(N,J)=0.0
C     ERSNI=ERODTY(J)*(TAUB/TAUCR(J)-1.0)
C     ERSN(N,J)=ERSNI
C     IF(ERSNI.LT.0.0) ERSN(N,J)=0.0
C     GO TO 190
C
C   130 CONTINUE
C     SLOPE=(UNODE*CNN/RNODE**0.6666667)**2
C
C   ----- CONVERT VARIABLES FROM SI UNITS TO ENGLISH UNITS
C     ITW=ITWTYP(N)
C     WTEMP=TW(ITW)*9.0/5.0+32.0
C     USTAR=USTAR*3.28084
C     UNODE=UNODE*3.28084
C     RNODE=RNODE*3.28084
C     DIAMS=DIAMS(J)*3.28084
C     WSKI=WSK(J)*3.28084
C
C   ----- COMPUTE EXPERIMENTAL GSSL I
C     RNU=0.1198+0.00048*WTEMP
C     CZ=260.67-0.667*WTEMP
C     ZI=WSKI*UNODE/(CZ*RNODE*SLOPE)
C     I=1.1*(0.051+0.0009*WTEMP)
C     XA=1.0/(10.0*USTAR)
C     XK=XA
C     CALL INTP11(XA,YA,DATAA,DATAYA,1,1,1,6,IER)
C     CALL INTP11(XK,YK,DATAK,DATAYK,1,1,1,4,IER)
C     UNODE2=UNODE*UNODE
C     YAYK=YAYK
C     IF(YAYK.LT.16.0) YAYK=16.0
C     DENOM1=(IT*YAYK/UNODE2)**1.6666667
C     DENOM2=(DIAMS/0.00058)**1.6666667
C     GSSL I=0.6/(DENOM1*DENOM2)
C
C   ----- COMPUTE CL I
C     AMI=43.2*(1.0+RNU)*UNODE*RNODE**0.758*ZI-RNU
C     R01124=RNODE/11.24
C     R025=RNODE/2.5
C     EXP1=1.0+RNU-0.758*Z I

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Appendix C (continued)

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EXP2=1.0*PNNU-0.756*Z I
EXP3=1.0*RNNU-Z I
EXP4=1.0*RNNU-1.5*Z I
EXP5=0.244*Z I
EXP6=0.5*Z I
CLICOE=AMI*(R01124**EXP1-(2.0*DIAMSI)**EXP2)/EXP2
CLI=GSSLI/CLICOE
C
C ----- COMPUTE GSSLI, GSSMI, GSSUI, AND GSBI
C AMI=AMI*CLI
C GSSLI=GSSLI*CLI
C GSSMI=AMI*(R01124**EXP5)*(R025**EXP3-R01124**EXP3)/EXP3
C GSSUI=AMI*(R01124**EXP5)*(R025**EXP6)*(RNODE**EXP4-R025**EXP4)/
1 EXP4
C GSBI=AMI*(2.0*DIAMSI)**EXP1
C
C ----- TO CHECK IF CLI IS TOO BIG
C C2DSI=CLI*((2.0*DIAMSI/RNODE)**(-0.736*Z I))
C IF(C2DSI.LE.100.0) GO TO 150
C RATIO=100.0/C2DSI
C GSSLI=GSSLI*RATIO
C GSSMI=GSSMI*RATIO
C GSSUI=GSSUI*RATIO
C GSBI=GSBI*RATIO
150 GSI=GSSLI+GSSMI+GSSUI+GSBI
C
C ----- CONVERT GSI FROM TONS/DAY/FT TO KG/SEC/M
C CONVSN=2000.0*0.4536*3.28084/(24.0*3600.0)
C
C ----- SEDIMENT TRANSPORT RATE PER UNIT WIDTH
C GSI=GSI*CONVSN
C
C ----- TOTAL SEDIMENT TRANSPORT RATE CAPACITY
C BN=B(N)
C IF(NTYP.NE.0) BN=DSORT(BN)/4.000
C GSI=GSI*BN
C
C ----- ACTUAL SEDIMENT TRANSPORT RATE
C GSIA=SEDCNP(N,J)*QP(N)
C BEDA=DX(N)*P(N)
C IF(GSIA.GT.GSI) GO TO 170
C ERSN(N,J)=(GSI-GSIA)/BEDA
C OS(N,J)=GSI/BEDA
C DPOSN(N,J)=0.0
C GO TO 170
C
170 ERSN(N,J)=0.0
C DPOSN(N,J)=(GSIA-GSI)/BEDA
C OS(N,J)=GSIA/BEDA
C
190 CONTINUE
290 CONTINUE
RETURN
END

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EROD 500
EROD 505
EROD 510
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EROD 790
EROD 795
EROD 800
EROD 805
EROD 810
EROD 815
EROD 820

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Appendix C (continued)

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SUBROUTINE SEDTRN(SED CNP,BEDSD,BEDSDP,ERSN,DPOSN,QS,
1 Q,A,B,P,H,OP,AP,BP,PP,HP,DX,NODTYP,NOD1,NOD2,KSIGN,D1IC,D2IC,
2 ICNTYP,SS,ISSTYP,KGBND,GS1,MXSPR,MXEVPR,CMATRX,ALOAD,M)
C
C      IMPLICIT REAL*8 (A-H,O-Z)
C
C      COMMON /CSIZE/ MAXNOD,MAXCON,MXBND,MXEQS,MXBWD
C      COMMON /CINTGR/ NODES,NCONS,NGBND,NTI,KVI,KSS
C      COMMON /EQUAS/ NEQS,IBAND,IHBP,HALFB,IMPL
C      COMMON /CREALR/ DELT,CHNG,EDDY,THETA
C      COMMON /CSDCM/ MXSUB,MXSUBP,MXSPY,NSUBS,NSPY
C
C      DIMENSION SEDCNP(MAXNOD,MXSUB)
C      DIMENSION BEDSD(MAXNOD,MXSUB),BEDSDP(MAXNOD,MXSUB)
C      DIMENSION ERSN(MAXNOD,MXSUB),DPOSN(MAXNOD,MXSUB)
C      DIMENSION QS(MAXNOD,MXSUB)
C
C      DIMENSION Q(MAXNOD),A(MAXNOD),B(MAXNOD),P(MAXNOD),H(MAXNOD)
C      DIMENSION QP(MAXNOD),AP(MAXNOD),BP(MAXNOD),PP(MAXNOD),HP(MAXNOD)
C
C      DIMENSION DX(MAXNOD),NODTYP(MAXNOD)
C      DIMENSION NOD1(MAXCON),NOD2(MAXCON),ICNTYP(MAXCON)
C      DIMENSION D1IC(MAXCON),D2IC(MAXCON),KSIGN(MAXCON)
C
C      DIMENSION SS(MXSPR,MXSUB),ISSTYP(MAXNOD,MXSUB)
C      DIMENSION KGBND(MAXNOD),GS1(MXBVPR,MXSUB)
C      DIMENSION CMATRX(MXEQS,MXBWD),ALOAD(MAXNOD)
C      DIMENSION CSM(2,2)
C
C      NCINS=NCONS-NGBND
C
C      ----- INITIATE THE GLOBAL MATRIX AND LOAD FUNCTION
C
C      DO 100 N=1,NODES
C        ALOAD(N)=0.0
C        BEDSD(N,M)=0.0
C        DO 100 IB=1,IBAND
C          CMATRX(N,IB)=0.0
C      100 CONTINUE
C
C      ----- COMPUTE THE CONTRIBUTION FROM ALL LINKS
C
C      THETAM=1.000-THETA
C      DO 290 K=1,NCONS
C        KTYP=ICNTYP(K)
C        KSIGNK=KSIGN(K)
C        N1=NOD1(K)
C        N2=NOD2(K)
C        D1=D1IC(K)
C        D2=D2IC(K)
C        DIST=D1+D2
C        IF(KTYP.EQ.4) DIST=2.000*D1
C        QN1=(Q(N1)+QP(N1))*0.500
C        QN2=(Q(N2)+QP(N2))*0.500
C        QIC=(D1*QN2+D2*QN1)/DIST*DFLOAT(KSIGNK)
C        IF(KTYP.EQ.4) QIC=QN1*DFLOAT(KSIGNK)
C        AKN1=EDDY*DABS(QN1)
C        AKN2=EDDY*DABS(QN2)
C        AKIC=DIST*AKN1*AKN2/(D1*AKN1+D2*AKN2)
C
C        SEDCN1=SEDCNP(N1,M)
C        SEDCN2=SEDCNP(N2,M)
C
C        GAMA=1.000
C        IF(QIC.LT.0.0) GAMA=-1.000
C
C        IF(KTYP.NE.0) GO TO 230
C
C      ----- CONTRIBUTION BY INTERIOR LINKS
C
C        CSM(1,1)=QIC*(THETA*D2/DIST+0.500*THETAM*(1.000+GAMA))+AKIC/DIST
C        CSM(1,1)=QIC*0.500*(1.000+GAMA)+AKIC/DIST
C        CSM(1,2)=QIC*(THETA*D1/DIST+0.500*THETAM*(1.000-GAMA))-AKIC/DIST
C        CSM(1,2)=QIC*0.500*(1.000-GAMA)-AKIC/DIST
C
C      220 CSM(2,1)=-CSM(1,1)
C        CSM(2,2)=-CSM(1,2)
C
C        CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
C        IB=N2-N1+IHBP
C        CMATRX(N1,IB)=CMATRX(N1,IB)+THETA*CSM(1,2)
C        ALOAD(N1)=ALOAD(N1)-THETAM*(CSM(1,1)*SEDCN1+CSM(1,2)*SEDCN2)
C        CMATRX(N2,IHBP)=CMATRX(N2,IHBP)+THETA*CSM(2,2)
C        IB=N1-N2+IHBP
C        CMATRX(N2,IB)=CMATRX(N2,IB)+THETA*CSM(2,1)
C        ALOAD(N2)=ALOAD(N2)-THETAM*(CSM(2,1)*SEDCN1+CSM(2,2)*SEDCN2)
C        GO TO 290
C
C      ----- ADD THE CONTRIBUTION BY BOUNDARY LINKS
C
C      230 I=K-NCINS
C
C        GO TO (240,250,260,270), KTYP
C
C      ----- CONNECTOR TO NODES WITH DIRICHLET CONDITIONS
C
C      240 SEDCN2=GS1(I,M)

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SEDT 005
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 SEDT 410
 SEDT 415
 SEDT 420
 SEDT 425
 SEDT 430
 SEDT 435
 SEDT 440
 SEDT 445
 SEDT 450
 SEDT 455
 SEDT 460
 SEDT 465
 SEDT 470
 SEDT 475
 SEDT 480
 SEDT 485
 SEDT 490
 SEDT 495

Appendix C (continued.)

```

CSM(1,1)=QIC*(THETA*D2/DIST+0.5D0*THETAM*(1.0D0+GAMA))+AKIC/DIST
CSM(1,1)=QIC*0.5D0*(1.0D0+GAMA)+AKIC/DIST
CSM(1,2)=QIC*(THETA*D1/DIST+0.5D0*THETAM*(1.0D0+GAMA))-AKIC/DIST
CSM(1,2)=QIC*0.5D0*(1.0D0+GAMA)-AKIC/DIST
CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
ALOAD(N1)=ALOAD(N1)-THETAM*CSM(1,1)*SEDCN1-CSM(1,2)*SEDCN2
GO TO 290
----- LINKS TO NODES WITH NFUMANN CONDITIONS.
250 DISFLX=GSI(I,M)
CSM(1,1)=QIC*(THETA*D2/DIST+0.5D0*THETAM*(1.0D0+GAMA))
CSM(1,1)=QIC*0.5D0*(1.0D0+GAMA)
CSM(1,2)=QIC*(THETA*D1/DIST+0.5D0*THETAM*(1.0D0+GAMA))
CSM(1,2)=QIC*0.5D0*(1.0D0+GAMA)
CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
ALOAD(N1)=ALOAD(N1)-THETAM*CSM(1,1)*SEDCN1-CSM(1,2)*SEDCN2-DISFLX
***** NOTE: ALOAD(N1)= (... - DISFLX) SINCE GSI = - N.KA.GRAD(C)
GO TO 290
----- CONNECTOR TO NODES OF CUACHY CONDITIONS
260 ALOAD(N1)=ALOAD(N1)-GSI(I,M)
***** NOTE: ALOAD= (... - GSI) BECAUSE GSI= -N.KA(GRAD(C)) + N.QC
GO TO 290
----- CONNECTOR TO JUNCTION
270 AKIC=AKN1
CSM(1,1)=QIC*0.5D0*(1.0D0+GAMA)+AKIC/DIST
CSM(1,2)=QIC*0.5D0*(1.0D0+GAMA)-AKIC/DIST
GO TO 220
290 CONTINUE
----- COMPUTE THE CONTRIBUTION FROM INTERIOR AND JUNCTION COMPARTS.
DELT1=1.0D0/DELT
IF(KSS.EQ.1) DELT1=0.0
DO 390 N=1,NODES
NTYP=NODTYP(N)
IF(NTYP.EQ.1 .OR. NTYP.EQ.2 .OR. NTYP.EQ.3) GO TO 390
ISS=ISSTYP(N,M)
XAREAN=A(N)
XAREAP=AP(N)
DXN=CX(N)
SEDNOD=SEDCNP(N,M)
----- INTERIOR NODE
IF(NTYP.EQ.4) GO TO 310
VOLDTN=DXN*XAREAN*DELT1
VOLDTP=DXN*XAREAP*DELT1
BD=1.0D0
GO TO 320
----- JUNCTIONS
310 VOLDTN=XAREAN*DELT1
VOLDTP=XAREAP*DELT1
DXN=1.0D0
BD=B(N)
320 CONTINUE
----- WHEN EROSION IS OCCURRING, ONE COMPUTE BED SEDIMENT FIRST,
----- THEN SOLVE FOR SUSPENDED SEDIMENT CONCENTRATION.
DEPOSN=DPOSN(N,M)
IF(DEPOSN.GT.0.0) GO TO 340
BEDMNM=BEDSD(N,M)-ERSN(N,M)*DELT
BEDSD(N,M)=BEDMNM
IF(BEDMNM.LT.0.0) BEDSD(N,M)=0.0
DELTBM=BEDSD(N,M)-BEDSDP(N,M)
CMATRX(N,IHBP)=CMATRX(N,IHBP)+VOLDTN
ALOAD(N)=ALOAD(N)+VOLDTP*SEDNOD+DXN*(SS(ISS,M)*BD-DELTBM*B(N))
GO TO 390
----- WHEN DEPOSITION IS OCCURRING, ONE SOLVE FOR SUSPENDED SEDIMENT
----- CONCENTRATION FIRST, THEN COMPUTE THE AMOUNT OF BED SEDIMENT
340 DPOSN=(DPOSN(N,M)-QS(N,M))/SEDNOD
CMATRX(N,IHBP)=CMATRX(N,IHBP)+VOLDTN+DXN*(N)*DPOSN
ALOAD(N)=ALOAD(N)+VOLDTP*SEDNOD+DXN*(N)*QS(N,M)
BEDSD(N,M)=BEDSDP(N,M)+DELT*DPOSN(N,M)
390 CONTINUE
----- COMPUTE SEDIMENT CONCENTRATION AT INTERIOR AND JUNCTION NODES
----- BY CALLING SOLVE
CALL SOLVE(1,CMATRX,ALOAD,NEQS,IHALFB,MXEQS,MXBWD)
CALL SOLVE(2,CMATRX,ALOAD,NEQS,IHALFB,MXEQS,MXBWD)

```

Appendix C (continued)

```

C ----- COMPUTE SEDIMENTATION CONCENTRATION AT ALL BOUNDARY NODES
C
C      DO 490 I=1,NGBND
C
C          K=KGBND(I)
C          KTYP=ICNTYP(K)
C          KSIGNK=KSGN(K)
C          N1=NOD1(K)
C          N2=NOD2(K)
C          D1=D1IC(K)
C          D2=D2IC(K)
C          DIST=D1+D2
C          QN1=(Q(N1)+QP(N1))*0.5D0
C          QN2=(Q(N2)+QP(N2))*0.5D0
C          QIC=(D1*QN2+D2*QN1)/DIST*DFLOAT(KSIGNK)
C          AKN1=EDDY*DABS(QN1)
C          AKN2=EDDY*DABS(QN2)
C          AKIC=DIST*AKN1*AKN2/(D1*AKN1+D2*AKN2)
C
C ----- BRANCHING TO DIFFERENT BOUNDARIES
C
C          GO TO (410,420,430,440), KTYP
C
C ----- CONNECTOR TO NODES WITH DIRICHLET CONDITIONS
C
C      410 ALOAD(N2)=GSI(I,M)
C          GO TO 490
C
C ----- CONNECTOR TO NODES WITH NEUMANN CONDITIONS
C
C      420 ALOAD(N2)=ALOAD(N1)-GSI(I,M)*DIST/AKIC
C          GO TO 490
C
C ----- CONNECTOR TO NODES WITH CAHCHY CONDITIONS
C
C      430 ALOAD(N2)=(AKIC*ALOAD(N1)/DIST + GSI(I,M))/(AKIC/DIST-QIC)
C          GO TO 490
C
C ----- CONNECTOR TO JUNCTION
C
C      440 CONTINUE
C
C      490 CONTINUE
C
C          RETURN
C          END

```

```

SED1 990
SED1 995
SED11000
SED11005
SED11010
SED11015
SED11020
SED11025
SED11030
SED11035
SED11040
SED11045
SED11050
SED11055
SED11060
SED11065
SED11070
SED11075
SED11080
SED11085
SED11090
SED11095
SED11100
SED11105
SED11110
SED11115
SED11120
SED11125
SED11130
SED11135
SED11140
SED11145
SED11150
SED11155
SED11160
SED11165
SED11170
SED11175
SED11180
SED11185
SED11190
SED11195
SED11200
SED11205
SED11210
SED11215

```

Appendix C (continued)

```

SURFROUTINE CHEMAK(RATKV,RATKH,RATKW,RATKP,RATKB,SEDCN,  

1 O,A,B,P,H,QP,AP,BP,PP,HP,MOLEW,HENRY,KDPG,RFLAG,QUANTG,ABSG,  

2 KAHG,KNHG,KBHG,EAHG,ENHG,EBHG,KOXG,EOXG,  

3 KBACWG,KBACSG,OTBAWG,OTBASG,NODTYP,NODES,  

> TA,ITATYP,SR,ISRTYP,WS,IWSTYP,TW,ITWTYP,VP,IVPTYP,EC,IECTYP,  

> PH,IPHTYP,PO,IPOTYP,OR,IORTYP,BT,IBTTYP,PD,IPDTYP,PB,IPBTYP,  

> MXTAPR,MXSRRPR,MXWSPR,MXTWPR,MXVPPR,MXECPR,MXPHPR,MXPOPR,MXORPR,  

> MXPDPR,MXBTPR,MXPBPR)  

C  

IMPLICIT REAL*8 (A-H,O-Z)  

REAL*8 MOLEW, KOPG, KAHG, KNHG, KBHG, KOXG, KBACWG, KBACSG  

COMMON /CSIZE/ MAXNOD,MAXCON,MXBND,MXEQS,MXBWD  

COMMON /CSDCM/ MXSUB,MXSURP,MXSPY,NSUBS,NSPY  

COMMON /PHOTO/ WLANG,WATETA,PIGETA,DOCETA  

COMMON /FOTO/ CLOUDG,ELATG  

C  

DIMENSION RATKV(MAXNOD,MXSUBP),RATKH(MAXNOD,MXSUBP)  

DIMENSION RATKO(MAXNOD,MXSUBP),RATKP(MAXNOD,MXSUBP)  

DIMENSION RATKB(MAXNOD,MXSUBP),PATEK(MAXNOD,MXSUBP)  

C  

DIMENSION SEDCN(MAXNOD,MXSURP)  

C  

DIMENSION Q(MAXNOD),A(MAXNOD),B(MAXNOD),P(MAXNOD),H(MAXNOD)  

DIMENSION QP(MAXNOD),AP(MAXNOD),BP(MAXNOD),PP(MAXNOD),HP(MAXNUU)  

DIMENSION NODTYP(MAXNOD)  

C  

DIMENSION MOLEW(MXSPY,MXSUBP),HENRY(MXSPY,MXSURP)  

C  

DIMENSION KOPG(MXSPY,MXSURP),RFLAG(MXSPY,MXSURP)  

DIMENSION QUANTG(MXSPY,MXSURP),ABSG(MXSPY,39)  

DIMENSION WLANG(39),WATETA(39),PIGETA(39),DOCETA(39)  

C  

DIMENSION KAHG(MXSPY,MXSUBP),KNHG(MXSPY,MXSUBP),KBHG(MXSPY,MXSUBP)  

DIMENSION EAHG(MXSPY,MXSUBP),ENHG(MXSPY,MXSUBP),EBHG(MXSPY,MXSUBP)  

C  

DIMENSION KOXG(MXSPY,MXSUBP),EOXG(MXSPY,MXSUBP)  

C  

DIMENSION KBACWG(MXSPY,MXSUBP),KBACSG(MXSPY,MXSURP)  

DIMENSION OTBAWG(MXSPY,MXSUBP),OTBASG(MXSPY,MXSUBP)  

C  

DIMENSION TA(MXTAPR),ITATYP(MAXNOD)  

DIMENSION SR(MXSRRPR),ISRTYP(MAXNOD)  

DIMENSION WS(MXWSPR),IWSTYP(MAXNOD)  

DIMENSION VP(MXVPPR),IVPTYP(MAXNOD)  

DIMENSION TW(MXTWPR),ITWTYP(MAXNOD)  

DIMENSION EC(MXECPR),IECTYP(MAXNOD)  

DIMENSION PH(MXPHPR),IPHTYP(MAXNOD)  

DIMENSION PO(MXPDPR),IPOTYP(MAXNOD)  

DIMENSION OR(MXORPR),IORTYP(MAXNOD)  

DIMENSION PD(MXPDRP),IPDTYP(MAXNOD)  

DIMENSION BT(MXBTPR),IBTTYP(MAXNOD)  

DIMENSION PB(MXPBPR),IPBTYP(MAXNOD)  

C  

XTES=.874  

NSUBSP=NSUBS+1  

C  

DO 490 N=1,NODES  

NTYP=NODTYP(N)  

IF(NTYP.GE.1.AND.NTYP.LE.3) GO TO 490  

ITA=ITATYP(N)  

ISR=ISRTYP(N)  

IWS=IWSTYP(N)  

IVP=IVPTYP(N)  

ITW=ITWTYP(N)  

IEC=IECTYP(N)  

IPH=IPHTYP(N)  

IPO=IPOTYP(N)  

IOR=IORTYP(N)  

IPD=IPDTYP(N)  

IBT=IBTTYP(N)  

IPB=IPBTYP(N)  

C  

TKEL=TW(ITW)+273.15  

ACBAQL=QQ(IPO)*PB(IPB)  

C  

RNODE=A(N)/P(N)  

UNODE=Q(N)/A(N)  

UWIND=WS(IWS)  

C  

----- VOLATILIZATION  

DO 100 I=1,NSUBSP  

100 RATKV(N,I)=0.0  

C  

DO 120 K=1,NSPY  

DO 110 I=1,NSUBSP  

C  

----- I = 1 = CLAY ABSORBED PHASE  

----- I = 2 = SILT ABSORBED PHASE  

----- I = 3 = SAND ABSORBED PHASE  

----- I = 4 = DISOLVED PHASE  

C  

WEIGHT=MOLEW(K,I)  

HENRYN=HENRY(K,I)  

C  

AKGAS=0.003160*(UWIND*UNODE)*DSQRT(18.0/WEIGHT)  

IF(UWIND.GE.1.9) AKLIQD=(6.530E-5)*((UNODE**0.969)/(RNODE**0.673))  

1*DSQRT(32.0/WEIGHT)  

IF(UWIND.LT.1.9) AKLIQD=(6.530E-5)*((UNODE**0.969)/(RNODE**0.673))  

1*(DSQRT(32.0/WEIGHT))*(DEXP(0.526*(UWIND-1)))
```

Appendix C (continued)

```

C      AKL=HENRYN*AKGAS*AKLIOD/(HENRYN*AKGAS+AKLIOD)
      RATKV(N,I)=RATKV(N,I) + AKL/RNODE
110  CONTINUE
120  CONTINUE
C
C
C
C----- PHOTOLYSIS, HYDROLYSIS, OXIDATION, AND BIOLYSIS
C
      HPLUS=10.0**(-PH(IPH))
      HYDRX=10.0**(-PO(IPO))
C
      DO 140 I=1,NSUBSP
      RATKP(N,I)=0.0
      RATKH(N,I)=0.0
      RATKO(N,I)=0.0
140  RATKB(N,I)=0.0
C
      XXX=EC(IEC)*RNODE*1.19
      IF(XXX.GT.XTES) BOTLIT=0.0
      IF(XXX.LT.XTES) BOTLIT=DEXP(-XXX)
      BOTLIT=(1.0-BOTLIT)/XXX
C
      ACPACL=PD(IPD)*PB(IPR)
C
      DO 290 K=1,NSPY
      DO 190 I=1,NSUBSP
C----- PHOTOLYSIS
C
C----- PHOTO1
C
      IF(KDPG(K,I).EQ.0.0) GO TO 160
      FACTOR=(191696.65+87054.63*DCOS(0.0349*ELATG))/(191696.65+
      1 87054.63*DCOS(0.0349*RFLAG(K,I)))
      PATKPN=KDPG(K,I)*BOTLIT*(1.0-0.056*CLOUDG)*FACTOR
      GO TO 170
C----- PHOTO2 WILL IMPLEMENTED LATER
160  CONTINUE
170  RATKP(N,I)=RATKP(N,I)+RATKPN*QUANTG(K,I)
C
C----- HYDROLYSIS
C
      AKAHL=KAHG(K,I)
      IF(EAHG(K,I).NE.0.0) AKAHL=10.0**((KAHG(K,I)-((1000.0*EAHG(K,I))/
      1 (4.58*TKEL))))
      AKNHL=KNHG(K,I)
      IF(ENHG(K,I).NE.0.0) AKNHL=10.0**((KNHG(K,I)-((1000.0*ENHG(K,I))/
      1 (4.58*TKEL))))
      AKBHL=KEHG(K,I)
      IF(EBHG(K,I).NE.0.0) AKBHL=10.0**((KBHG(K,I)-((1000.0*EBHG(K,I))/
      1 (4.58*TKEL))))
      RATKH(N,I)=RATKH(N,I)+(AKAHL*HPLUS+AKNHL+AKBHL*HYDRX)
C
C----- OXIDATION
      AKOXL=KOXG(K,I)
      IF(EOXG(K,I).NE.0.0) AKOXL=10.0**((KOXG(K,I)-((1000.0*EOXG(K,I))/
      1 (4.58*TKEL))))
      RATKO(N,I)=RATKO(N,I) + AKOXL*OR(IOR)
C
C----- BIOLYSIS
C
      BACWL=KBACWG(K,I)
      BACSL=KBACSG(K,I)
      IF(QTBWG(K,I).NE.0.0) BACWL=KBACWG(K,I)*QTBWG(K,I)**((
      1 BT(IPT) -20.0)/10.0)
      IF(QTBASG(K,I).NE.0.0) BACSL=KBACSG(K,I)*QTBASG(K,I)**((
      1 BT(IPT) -20.0)/10.0)
      RATKB(N,I)=RATKB(N,I)+(BACWL+BACSL)*ACPACL
C
190  CONTINUE
290  CONTINUE
C----- TOTAL RATE CONSTANT
C
      DO 390 I=1,NSUBSP
390  RATEK(N,I)=RATKV(N,I)+RATKP(N,I)+RATKH(N,I)+RATKO(N,I)+RATKB(N,I)
C
490  CONTINUE
      RETURN
      END

```

CHMK 530
 CHMK 535
 CHMK 540
 CHMK 545
 CHMK 550
 CHMK 555
 CHMK 560
 CHMK 565
 CHMK 570
 CHMK 575
 CHMK 580
 CHMK 585
 CHMK 590
 CHMK 595
 CHMK 600
 CHMK 605
 CHMK 610
 CHMK 615
 CHMK 620
 CHMK 625
 CHMK 630
 CHMK 635
 CHMK 640
 CHMK 645
 CHMK 650
 CHMK 655
 CHMK 660
 CHMK 665
 CHMK 670
 CHMK 675
 CHMK 680
 CHMK 685
 CHMK 690
 CHMK 695
 CHMK 700
 CHMK 705
 CHMK 710
 CHMK 715
 CHMK 720
 CHMK 725
 CHMK 730
 CHMK 735
 CHMK 740
 CHMK 745
 CHMK 750
 CHMK 755
 CHMK 760
 CHMK 765
 CHMK 770
 CHMK 775
 CHMK 780
 CHMK 785
 CHMK 790
 CHMK 795
 CHMK 800
 CHMK 805
 CHMK 810
 CHMK 815
 CHMK 820
 CHMK 825
 CHMK 830
 CHMK 835
 CHMK 840
 CHMK 845
 CHMK 850
 CHMK 855
 CHMK 860
 CHMK 865
 CHMK 870
 CHMK 875
 CHMK 880
 CHMK 885
 CHMK 890
 CHMK 895
 CHMK 900
 CHMK 905
 CHMK 910
 CHMK 915
 CHMK 920
 CHMK 925
 CHMK 930
 CHMK 935
 CHMK 940
 CHMK 945
 CHMK 950
 CHMK 955
 CHMK 960
 CHMK 965
 CHMK 970
 CHMK 975

Appendix C (continued)

```

SUBROUTINE DISCON(DCN,DCNP, Q,A,B,H,P,QP,AP,BP,HP,PP,
1 SEDCN,SEDCNP,PCN,PCNP,BEDSD,BEDSDP,BDCHM,BDCHMP,CNBED,CNBEDP,
2 DX,NODTYP, KSIGN,NOD1,NOD2,D1IC,D2IC,ICNTYP, RATEK,NSUBSP,
3 EQILKD,ABSOPK,ABSOPB, SW,ISWTYP,MXSPR, KGBND,GCW,MXBVPR, CMATRX)
C
C      IMPLICIT REAL*8 (A-H,O-Z)
C
C      COMMON /CSIZE/ MAXNOD,MAXCON,MXBND,MXEQS,MXBWD
C      COMMON /CINTGR/ NODES,NCONS,NGBND,NTI,KVI,KSS
C      COMMON /EQUAS/ NEQS,IBAND,IHBP,HALFB,IHPL
C      COMMON /CREALR/ DELT,CHNG,EDDY,THETA
C      COMMON /CSOCM/ MXSUB,MXSUBP,MXSPY,NSUBS,NSPY
C
C      DIMENSION DCN(MAXNOD),DCNP(MAXNOD)
C      DIMENSION Q(MAXNOD),A(MAXNOD),B(MAXNOD),H(MAXNOD),P(MAXNOD)
C      DIMENSION QP(MAXNOD),AP(MAXNOD),BP(MAXNOD),HP(MAXNOD),PP(MAXNOD)
C      DIMENSION SEDCN(MAXNOD,MXSUB),SEDCNP(MAXNOD,MXSUB)
C      DIMENSION PCN(MAXNOD,MXSUB),PCNP(MAXNOD,MXSUB)
C      DIMENSION BEDSD(MAXNOD,MXSUB),BEDSDP(MAXNOD,MXSUB)
C      DIMENSION BDCHM(MAXNOD,MXSUB),BDCHMP(MAXNOD,MXSUB)
C      DIMENSION CNBED(MAXNOD,MXSUB),CNBEDP(MAXNOD,MXSUB)
C
C      DIMENSION DX(MAXNOD),NODTYP(MAXNOD)
C      DIMENSION NOD1(MAXCON),NOD2(MAXCON),ICNTYP(MAXCON)
C      DIMENSION D1IC(MAXCON),D2IC(MAXCON),KSIGN(MAXCON)
C
C      DIMENSION RATEK(MAXNOD,MXSUBP)
C      DIMENSION EQILKD(MXSUB), ABSOPK(MXSUB), ABSOPB(MXSUB)
C
C      DIMENSION SW(MXSPR),ISWTYP(MAXNOD)
C      DIMENSION KGBND(MXND),GCW(MXBVPR)
C
C      DIMENSION CMATRX(MXEQS,MXBWD)
C      DIMENSION CSM(2,2)
C
C      NCINS=NCONS-NGBND
C
C      ----- INITIATE DCN(N)
C
C      DO 100 N=1,NODES
C      DCN(N)=0.0
C      DO 100 IB=1,IBAND
C      CMATRX(N,IB)=0.0
C 100 CONTINUE
C
C      ----- COMPUTE THE CONTRIBUTION FROM ALL LINKS
C
C      THETAM=1.000-THETA
C      DO 290 K=1,NCONS
C      KTYP=ICNTYP(K)
C      KSIGNK=KSIGN(K)
C      N1=NOD1(K)
C      N2=NOD2(K)
C      D1=D1IC(K)
C      D2=D2IC(K)
C      DIST=D1+D2
C      IF(KTYP.EQ.4) DIST=2.000*D1
C      QN1=(Q(N1)+QP(N1))*0.500
C      QN2=(Q(N2)+QP(N2))*0.500
C      QIC=(D1*QN2+D2*QN1)/DIST*DFLOAT(KSIGNK)
C      IF(KTYP.EQ.4) QIC=QN1*DFLOAT(KSIGNK)
C      AKN1=EDDY*DABS(QN1)
C      AKN2=EDDY*DABS(QN2)
C      AKIC=DIST*AKN1*AKN2/(D1*AKN1+D2*AKN2)
C
C      DCN1=DCNP(N1)
C      DCN2=DCNP(N2)
C
C      GAMA=1.000
C      IF(QIC.LT.0.0) GAMA=-1.000
C
C      IF(KTYP.NE.0) GO TO 230
C
C      ----- CONTRIBUTION BY INTERIOR LINKS
C
C      CSM(1,1)=QIC*(THETA*D2/DIST+0.500*THETAM*(1.000+GAMA))+AKIC/DIST
C      CSM(1,1)=QIC*0.500*(1.000+GAMA)+AKIC/DIST
C      CSM(1,2)=QIC*(THETA*D1/DIST+0.500*THETAM*(1.000-GAMA))-AKIC/DIST
C      CSM(1,2)=QIC*0.500*(1.000-GAMA)-AKIC/DIST
C 220 CSM(2,1)=-CSM(1,1)
C      CSM(2,2)=-CSM(1,2)
C
C      CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
C      IB=N2-N1+IHBP
C      CMATRX(N1,IB)=CMATRX(N1,IB)+THETA*CSM(1,2)
C      DCN(N1)=DCN(N1)-THETAM*(CSM(1,1)*DCN1+CSM(1,2)*DCN2)
C      CMATRX(N2,IHBP)=CMATRX(N2,IHBP)+THETA*CSM(2,2)
C      IB=N1-N2+IHBP
C      CMATRX(N2,IB)=CMATRX(N2,IB)+THETA*CSM(2,1)
C      DCN(N2)=DCN(N2)-THETAM*(CSM(2,1)*DCN1+CSM(2,2)*DCN2)
C      GO TO 290
C
C
C
C      ----- ADD THE CONTRIBUTION BY BOUNDARY LINKS

```

DISC 005
DISC 010
DISC 015
DISC 020
DISC 025
DISC 030
DISC 035
DISC 040
DISC 045
DISC 050
DISC 055
DISC 060
DISC 065
DISC 070
DISC 075
DISC 080
DISC 085
DISC 090
DISC 095
DISC 100
DISC 105
DISC 110
DISC 115
DISC 120
DISC 125
DISC 130
DISC 135
DISC 140
DISC 145
DISC 150
DISC 155
DISC 160
DISC 165
DISC 170
DISC 175
DISC 180
DISC 185
DISC 190
DISC 195
DISC 200
DISC 205
DISC 210
DISC 215
DISC 220
DISC 225
DISC 230
DISC 235
DISC 240
DISC 245
DISC 250
DISC 255
DISC 260
DISC 265
DISC 270
DISC 275
DISC 280
DISC 285
DISC 290
DISC 295
DISC 300
DISC 305
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DISC 485
DISC 490
DISC 495

Appendix C (continued)

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230 I=K-NCINS
      GO TO (240,250,260,270), KTYP
C ----- LINKS TO NODES WITH DIRICHLET CONDITIONS
240 DCN2=GCW(I)
      CSM(1,1)=QIC*(THETA*D2/DIST+0.5D0*THETAM*(1.0D0+GAMA))+AKIC/DIST
      CSM(1,1)=QIC*0.5D0*(1.0D0+GAMA) + AKIC/DIST
      CSM(1,2)=QIC*(THETA*D1/DIST+0.5D0*THETAM*(1.0D0-GAMA))-AKIC/DIST
      CSM(1,2)=QIC*0.5D0*(1.0D0-GAMA) - AKIC/DIST
      CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
      DCN(N1)=DCN(N1)-THETAM*CSM(1,1)*DCN1-CSM(1,2)*DCN2
      GO TO 290
C ----- LINKS TO NODES WITH DISPERSIVE FLUX CONDITIONS
250 DISFLX=GCW(I)
      CSM(1,1)=QIC*(THETA*D2/DIST+0.5D0*THETAM*(1.0D0+GAMA))
      CSM(1,1)=QIC*0.5D0*(1.0D0+GAMA)
      CSM(1,2)=QIC*(THETA*D1/DIST+0.5D0*THETAM*(1.0D0-GAMA))
      CSM(1,2)=QIC*0.5D0*(1.0D0-GAMA)
      CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
      DCN(N1)=DCN(N1)-THETAM*CSM(1,1)*DCN1-CSM(1,2)*DCN2-DISFLX
C ***** NOTE: DCN(N1)= (... - DISFLX) SINCE GCW = - N.KA.(GRAD(C))
      GO TO 290
C ----- LINKS TO NODES WITH CAUCHY CONDITIONS
260 DCN(N1)=DCN(N1)-GCW(I)
C ***** NOTE: DCN(N1)= (... -GCW(I)) SINCE GCW = - N.KA.(GRAD(C))+N.QC
      GO TO 290
C ----- LINKS TO JUNCTION
270 AKIC=AKN1
      CSM(1,1)=QIC*0.5D0*(1.0D0+GAMA) + AKIC/DIST
      CSM(1,2)=QIC*0.5D0*(1.0D0-GAMA) - AKIC/DIST
      GO TO 220
290 CONTINUE
C ----- CONTRIBUTION FROM INTERIOR COMPARTMENTS AND JUNCTIONS
      DELTI=1.0D0/DELT
      IF(KSS.EQ.1) DELTI=0.0
      DO 390 N=1,NODES
      NTYP=NODTYP(N)
      ISWTY=ISWTYP(N)
      IF(NTYP.EQ.1 .OR. NTYP.EQ.2 .OR. NTYP.EQ.3) GOT O 390
      XAREAN=A(N)
      XAREAP=AP(N)
      DXN=DX(N)
      BNODE=B(N)
      RATEKN=RATEK(N,NSUBSD)
      DCNPN=DCNP(N)
C ----- INTERIOR NODES
      IF(NTYP.EQ.4) GO TO 320
      VOLDTN=DXN*XAREAN*DELTI
      VOLDTP=DXN*XAREAP*DELT
      BD=1.0
      GO TO 325
320 VOLDTN=XAREAN*DELT
      VOLDTP=XAREAP*DELT
      DXN=1.0D0
      BD=BNODE
C
325 CONTINUE
      SEDCOE=0.0
      BEDCOE=0.0
      SEDINT=0.0
      BEDINT=0.0
      DO 330 M=1,NSUBS
      SEDCN1=SEDCN(N,M)
      PCNPI=PCNP(N,M)
      BEDMI=BEDSD(N,M)
      CRFDP1=CRFDDP(N,M)
C
      SEDCOE=SEDCOE+ABSOPK(M)*SEDCN1*XAREAN*EQILKD(M)*DXN
      SEDINT=SEDINT+ABSOPK(M)*SEDCN1*XAREAN*PCNPI*DXN
      BEDCOE=BEDCOE + BNODE*BEDMI*ABSOPB(M)*EQILKD(M)*DXN
      BEDINT=BEDINT + BNODE*BEDMI*ABSOPB(M)*CRFDP1*DXN
330 CONTINUE
      CMATRX(N,IHBP)=CMATRX(N,IHBP)+VOLDTN+RATEKN*XAREAN*DXN+
      > BEDCOE*SEDCOE
      DCN(N)=DCN(N)+VOLDTP*DCNPN+DXN*BD*SW(ISWTY) +
      > BEDINT*SEDINT
390 CONTINUE
      CALL SOLVE(1,CMATRX,DCN,NEQS,IHALFB,MXEQS,MXBWD)
      CALL SOLVE(2,CMATRX,DCN,NEQS,IHALFB,MXEQS,MXBWD)
C ----- COMPUTE DISSOLVED CONCENTRATION AT ALL BOUNDARY NODES

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 DISC 950
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 DISC 965
 DISC 970
 DISC 975
 DISC 980
 DISC 985
 DISC 990

Appendix C (continued)

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C      DO 490 I=1,NGBND
C      K=KGBND(I)
C      KTYP=ICNTYP(K)
C      KSIGNK=KSIGN(K)
C      N1=NOD1(K)
C      N2=NOD2(K)
C      D1=D1IC(K)
C      D2=D2IC(K)
C      DIST=D1+D2
C      QN1=(Q(N1)+QP(N1))*0.5D0
C      QN2=(Q(N2)+QP(N2))*0.5D0
C      QIC=(D1*QN2+D2*QN1)/DIST*DFLOAT(KSIGNK)
C      AKN1=EDDY*DABS(QN1)
C      AKN2=EDDY*DABS(QN2)
C      AKIC=DIST*AKN1*AKN2/(D1*AKN1+D2*AKN2)
C      ----- BRANCHING TO DIFFERENT BOUNDARIES
C      GO TO (410,420,430,440), KTYP
C      ----- LINKS TO NODES WITH DIRICHLET CONDITIONS
C      410 DCN(N2)=GCW(I)
C      GO TO 490
C      ----- LINKS TO NODES WITH NEUMANN CONDITIONS
C      420 DCN(N2)=DCN(N1)-GCW(I)*DIST/AKIC
C      GO TO 490
C      ----- LINKS TO NODES WITH CAUCHY CONDITIONS
C      430 DCN(N2)=(AKIC*DCN(N1)/DIST+GCW(I))/(AKIC/DIST-QIC)
C      GO TO 490
C      ----- LINKS TO JUNCTIONS
C      440 CONTINUE
C      490 CONTINUE
C      RETURN
C      END

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DISC 995
DISC1000
DISC1005
DISC1010
DISC1015
DISC1020
DISC1025
DISC1030
DISC1035
DISC1040
DISC1045
DISC1050
DISC1055
DISC1060
DISC1065
DISC1070
DISC1075
DISC1080
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DISC1090
DISC1095
DISC1100
DISC1105
DISC1110
DISC1115
DISC1120
DISC1125
DISC1130
DISC1135
DISC1140
DISC1145
DISC1150
DISC1155
DISC1160
DISC1165
DISC1170
DISC1175
DISC1180
DISC1185
DISC1190
DISC1195
DISC1200
DISC1205
DISC1210
DISC1215

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Appendix C (continued)

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SUBROUTINE PARCON(PCNP,BEDSN,BEDSDP,BDCHM,BDCHMP,CNBED,CNBEDP,
1 DCN,DCNP,SEDCN,SEDCNP,ERSN,DPOSN, O,A,B,H,P,OP,AP,BP,HP,PP,
2 DX,NODTYP, KSIGN,NOD1,NOD2,D1IC,D2IC,ICNTYP, RATEK,
3 EQILKD,ABSOPK,ABSOPB, SP,ISPTYP,MXSPR, KGBND,GCI,MXBVPR,
4 CMATRX,ALOAD,M)
C
C      IMPLICIT REAL*8 (A-H,C-Z)
C
C      COMMON /CSIZE/ MAXNOD,MAXCON,MXBND,MXEOS,MXBWD
C      COMMON /CINTGR/ NODES,NCONS,NGBND,NTI,KVI,KSS
C      COMMON /EQUAS/ NEQS,IBAND,IHBP,IHALFB,IMPL
C      COMMON /CREALR/ DELT,CHNG,EDDY,THETA
C      COMMON /CSDCM/ MXSUR,MXSURP,MXSPY,NSUBS,NSPY
C
C      DIMENSION PCNP(MAXNOD,MXSUB)
C      DIMENSION BECD(MAXNOD,MXSUR),BEDSDP(MAXNOD,MXSUB)
C      DIMENSION BDCHM(MAXNOD,MXSUR),BDCHMP(MAXNOD,MXSUB)
C      DIMENSION CNBED(MAXNOD,MXSUB),CNBEDP(MAXNOD,MXSUB)
C      DIMENSION DCN(MAXNOD),DCNP(MAXNOD)
C
C      DIMENSION SEDCN(MAXNOD,MXSUB),SEDCNP(MAXNOD,MXSUB)
C      DIMENSION ERSN(MAXNOD,MXSUR),DPOSN(MAXNOD,MXSUB)
C
C      DIMENSION Q(MAXNOD),A(MAXNOD),B(MAXNOD),H(MAXNOD),P(MAXNOD)
C      DIMENSION OP(MAXNOD),AP(MAXNOD),BP(MAXNOD),HP(MAXNOD),PP(MAXNOD)
C
C      DIMENSION DX(MAXNOD),NODTYP(MAXNOD)
C      DIMENSION NOD1(MAXCON),NOD2(MAXCON),ICNTYP(MAXCON)
C      DIMENSION D1IC(MAXCON),D2IC(MAXCON),KSIGN(MAXCON)
C
C      DIMENSION SP(MXSPR,MXSUB),ISPTYP(MAXNOD,MXSUB)
C      DIMENSION KGBND(MXBND),GCI(MXBVPR,MXSUB)
C
C      DIMENSION RATEK(MAXNOD,MXSUBP)
C      DIMENSION CMATRX(MXEOS,MXBWD),ALOAD(MAXNOD)
C      DIMENSION CSM(2,2)
C
C      NCINS=NCONS-NGBND
C
C      ----- INITIATE GLOBAL MATRIX AND GLOBAL LOAD FUNCTION
C
C      DO 100 N=1,NODES
C        ALOAD(N)=0.0
C        BDCHM(N,M)=0.0
C100 CONTINUE
C
C      DO 110 IB=1,IBAND
C        DO 110 N=1,NODES
C110 CMATRX(N,IB)=0.0
C
C      ----- COMPUTE THE CONTRIBUTION FROM ALL LINKS
C
C      THETAM=1.000-THETA
C      DO 290 K=1,NCONS
C        KTYP=ICNTYP(K)
C        KSIGN=KSIGN(K)
C        N1=NOD1(K)
C        N2=NOD2(K)
C        D1=D1IC(K)
C        D2=D2IC(K)
C        DIST=D1+D2
C        IF(KTYP.EQ.4) DIST=2.000*D1
C        QN1=(Q(N1)+OP(N1))*0.500
C        QN2=(Q(N2)+OP(N2))*0.500
C        QIC=(D1*QN2+D2*QN1)/DIST*DFLOAT(KSIGN)
C        IF(KTYP.EQ.4) QIC=QN1*DFLOAT(KSIGN)
C        AKN1=EDDY*DABS(QN1)
C        AKN2=EDDY*DABS(QN2)
C        AKIC=DIST*AKN1*AKN2/(D1*AKN1+D2*AKN2)
C        PCN1=PCNP(N1,M)
C        PCN2=PCNP(N2,M)
C        SEDN1=SEDCN(N1,M)
C        SEDN2=SEDCN(N2,M)
C        SEDIC=(D1*SEDN2+D2*SEDN1)/DIST
C
C        GAMA=1.000
C        IF(QIC.LT.0.0) GAMA=-1.000
C
C        IF(KTYP.NE.0) GO TO 230
C
C      ----- CONTRIBUTION BY INTERIOR LINKS
C
C        CSM(1,1)=QIC*(THETA*SEDIC*D2/DIST+0.500*THETAM*SEDN1*(1.00+GAMA))+
C        > AKIC*SEDN1/DIST
C        CSM(1,1)=(QIC*0.500*(1.000+GAMA)+AKIC/DIST)*SEDN1
C        CSM(1,2)=QIC*(THETA*SEDIC*D1/DIST+0.500*THETAM*SEDN2*(1.00-GAMA))-
C        > AKIC*SEDN2/DIST
C        CSM(1,2)=(QIC*0.500*(1.000-GAMA)-AKIC/DIST)*SEDN2
C
C220 CSM(2,1)=-CSM(1,1)
C      CSM(2,2)=-CSM(1,2)
C
C      CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
C      IB=N2-N1+IHBP
C      CMATRX(N1,IB)=CMATRX(N1,IB)+THETA*CSM(1,2)
C      ALOAD(N1)=ALOAD(N1)-THETAM*(CSM(1,1)*PCN1+CSM(1,2)*PCN2)
C      CMATRX(N2,IHBP)=CMATRX(N2,IHBP)+THETA*CSM(2,2)
C      IB=N1-N2+IHBP

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Appendix C (continued)

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CMATRX(N2,IB)=CMATRX(N2,IB)+THETA*CSM(2,1)
ALOAD(N2)=ALOAD(N2)-THETAM*(CSM(2,1)*PCN1+CSM(2,2)*PCN2)
GO TO 290

C
C
C ----- ADD THE CONTRIBUION BY BOUNDARY LINKS
C
C 230 I=K-NCINS
C
C      GO TO (240,250,260,270), KTYP
C
C ----- LINKS TO NODES WITH DIRICHLET CONDITIONS
C
C 240 PCN2=GCI(1,M)
C      CSM(1,1)=QIC*(THETA*SEDIC*D2/DIST+0.5D0*THETAM*SEDN1*(1.0D0+GAMA))+
C      > AKIC*SEDN1/DIST
C      CSM(1,1)=(QIC*0.5D0*(1.0D0+GAMA)+AKIC/DIST)*SEDN1
C      CSM(1,2)=QIC*(THETA*SEDIC*D1/DIST+0.5D0*THETAM*SEDN2*(1.0D0-GAMA))-
C      > AKIC*SEDN2/DIST
C      CSM(1,2)=(QIC*0.5D0*(1.0D0-GAMA)-AKIC/DIST)*SEDN2
C      CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
C      ALOAD(N1)=ALOAD(N1)-THETAM*CSM(1,1)*PCN1-CSM(1,2)*PCN2
C      GO TO 290
C
C ----- LINKS TO NODES WITH DISPERSIVE FLUX CONDITIONS
C
C 250 DISFLX=GCI(1,M)
C      CSM(1,1)=QIC*(THETA*SEDIC*D2/DIST+0.5D0*THETAM*SEDN1*(1.0D0+GAMA))
C      CSM(1,1)=(QIC*0.5D0*(1.0D0+GAMA)+AKIC/DIST)*SEDN1
C      CSM(1,2)=QIC*(THETA*SEDIC*D1/DIST+0.5D0*THETAM*SEDN2*(1.0D0-GAMA))
C      CSM(1,2)=(QIC*0.5D0*(1.0D0-GAMA)+AKIC/DIST)*SEDN2
C      CMATRX(N1,IHBP)=CMATRX(N1,IHBP)+THETA*CSM(1,1)
C      ALOAD(N1)=ALOAD(N1)-THETAM*CSM(1,1)*PCN1-CSM(1,2)*PCN2-DISFLX
C ***** NOTE: ALOAD(N1)= (... - DISFLX) SINCE GCI = - N.KA(GRAD(C))
C      GO TO 290
C
C ----- LINKS TO NODES WITH CAUCHY CONDITIONS
C
C 260 ALOAD(N1)=ALOAD(N1) - GCI(1,M)
C ***** NOTE: ALOAD= (... - GCI) BECAUSE GCI= -N.KA(GRAD(C)) + N.QC
C      GO TO 290
C
C ----- LINKS TO JUNCTION
C
C 270 AKIC=AKN1
C      CSM(1,2)=(QIC*0.5D0*(1.0D0-GAMA)-AKIC/DIST)*SEDN2
C      CSM(1,1)=(QIC*0.5D0*(1.0D0+GAMA)+AKIC/DIST)*SEDN1
C      CSM(1,2)=QIC*0.5D0*(1.0D0-GAMA)*SEDN2
C      GO TO 220
C
C 290 CONTINUE
C
C ----- CONTRIBUTION FROM INTERIOR COMPARTMENTS AND JUNCTIONS
C
C      DELTI=1.0D0/DELT
C      IF(K55.EQ.1) DELTI=0.0
C      DO 390 N=1,NODES
C      NTYPE=NDOTYP(N)
C      ISP=ISPTYP(N,M)
C      IF(NTYP.EQ.1) OR, NTYPE.EQ.2) OR, NTYPE.EQ.3) GO TO 390
C      XAREAN=A(N)
C      XAREAP=AP(N)
C      DXN=DX(N)
C      BNODE=B(N)
C      DCNN=DCN(N)
C
C      RATEKN=RATEK(N,M)
C      SEDCN1=SEDCN(N,M)
C      PCNPI=PCNP(N,M)
C      BEDMI=BEDSD(N,M)
C      CBEDPI=CNBEDP(N,M)
C      DPOSNI=DPOSN(N,M)
C      ERSNI=ERSN(N,M)
C
C ----- COMPUTE CHEMICAL CONCENTRATION AND CHEMICAL AMOUNT PER UNIT
C      BED AREA IN BED SEDIMENT
C
C      BEDLD=BEDMI*CBEDPI*DELT+DPOSNI*PCNPI+ABSOPB*BEDMI*EQILKO*DCNN
C      BEDMTX=BEDMI*DELT*(ERSNI+BEDMI*(RATEKN+ABSOPB))
C      IF(BEDMTX.EQ.0.0) GO TO 305
C      CNBED(N,M)=BEDLD/BEDMTX
C      GO TO 310
C 305 CONTINUE
C ----- INSERT COMPUTATION FOR THE CASE WHEN BEDMTX IS 0.0
C 310 CONTINUE
C      BDCNM(N,M)=CNBED(N,M)*BEDMI
C
C
C ----- INTERIOR NODES
C
C      IF(NTYP.EQ.4) GO TO 320
C      VOLDTN=XAREAN*DXN*DELT
C      VOLDTP=XAREAP*DXN*DELT
C      BD=1.0D0
C      GO TO 325
C
C ----- JUNCTIONS

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 PARC 980
 PARC 985

Appendix C (continued)

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C 320 VOLDTN=XAREAN*DEL TI
      VOLDTP=XAREAP*DEL TI
      DXN=1.000
      BD=BNODE
C
C 325 CONTINUE
C
      SEDCOE=XAREAN*SEDCN1*ABSOPK*DXN
      SEDINT=SEDCOE*EQILKD*DCNN
      BEDCOE=DPOSNI*BNODE*DXN
      BEDINT=ERSNI*BNODE*CNBED(N,M)*DXN
C
      CMATRX(N,IHBP)=CMATRX(N,IHBP)+VOLDTN*SEDCOE+BEDCOE
      > RATEKN=XAREAN*SEDCN1*DXN
      ALCAD(N)=ALOAD(N)+VOLDTP*PCNP1+SEDINT+BEDINT+SP(ISP,M)*DXN*BD
C
C 390 CONTINUE
C
      CALL SOLVE(1,CMATRX,ALOAD,NEQS,IHALFB,MXEQS,MXBWD)
      CALL SOLVE(2,CMATRX,ALOAD,NEQS,IHALFB,MXEQS,MXBWD)
C
C ----- COMPUTATE PARTICULATE CONCENTRATION AT ALL BOUNDARY NODES
C
      DO 490 I=1,NGRND
C
      K=KGRND(I)
      KTYP=ICNTYP(K)
      KSIGNK=KSIGN(K)
      N1=NOD1(K)
      N2=NOD2(K)
      D1=D1IC(K)
      D2=D2IC(K)
      DIST=D1+D2
      QN1=(Q(N1)+OP(N1))*0.5D0
      QN2=(Q(N2)+OP(N2))*0.5D0
      OIC=(D1*QN2+D2*QN1)/DIST*DFLOAT(KSIGNK)
      AKN1=EDDY*DABS(QN1)
      AKN2=EDDY*DABS(QN2)
      AKIC=DIST*AKN1*AKN2/(D1*AKN1+D2*AKN2)
C
C ----- BRANCHING TO DIFFERENT BOUNDARIES
C
      GO TO (410,420,430,440), KTYP
C
C ----- LINKS TO NODES WITH DIRICHLET CONDITIONS
C
      410 ALOAD(N2)=GCI(I,M)
          GO TO 490
C
C ----- LINKS TO NODES WITH NEUMANN CONDITIONS
C
      420 SEDCN2=SEDCN(N2,M)
          IF(SEDCN2.EQ.0.0) GO TO 425
          ALOAD(N2)=(ALOAD(N1)*SEDCN(N1,M) - GCI(I,M)*DIST/AKIC)/SEDCN2
          GO TO 490
      425 ALOAD(N2)=0.0
          GO TO 490
C
C ----- LINKS TO NODES WITH CAUCHY CONDITIONS
C
      430 SEDCN1=SEDCN(N1,M)
          SEDCN2=SEDCN(N2,M)
          IF(SEDCN2.EQ.0.0) GO TO 435
          SEDIC=(D1*SEDCN2+D2*SEDCN1)/DIST
          ALOAD(N2)=((AKIC*ALOAD(N1)*SEDCN1/DIST + GCI(I,M))/
          1 (AKIC/DIST-OIC*SEDCN1))/SEDCN2
          GO TO 490
      435 ALOAD(N2)=0.0
          GO TO 490
C
C ----- LINKS TO JUNCTIONS
C
      440 CONTINUE
C
      490 CONTINUE
C
      RETURN
      END

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PARC 990
 PARC 995
 PARC1000
 PARC1005
 PARC1010
 PARC1015
 PARC1020
 PARC1025
 PARC1030
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Appendix C (continued)

```

C      SUBROUTINE SOLVE(KKK,C,R,NNP,IHALFB,MAXNP,MAXBW)
C      FUNCTION OF SUBROUTINE--TO SOLVE THE MATRIX EQUATION CX = R,
C      RETURNING THE SOLUTION X IN R. IT IS ASSUMED THAT THE ARRAY C(NP,IB)
C      CONTAINS THE FULL BAND OF AN ASYMMETRIC MATRIX.
C
C      IMPLICIT REAL*8(A-H,O-Z)
C      DIMENSION C(MAXNP,MAXBW),R(MAXNP)
C      IHBP=IHALFB+1
C
C      IF KKK = 1, THEN TRIANGULARIZE THE BAND MATRIX C(NP,IB). BUT
C      IF KKK = 2, THEN SIMPLY SOLVE WITH THE RIGHT-HAND SIDE R(NP)
C
C      IF (KKK.EQ.2) GO TO 50
C      TRIANGULARIZE MATRIX C(NP,IB)
C
C      NU=NNP-IHALFB
C      DO 20 NI=1,NU
C        PIVOTI=1./C(NI,IHBP)
C        NJ=NI+1
C        IB=IHBP
C        NK=NI+IHALFB
C        DO 10 NL=NJ,NK
C          IB=IB-1
C          A=-C(NL,IB)*PIVOTI
C          C(NL,IB)=A
C          JB=IB+1
C          KB=IB+IHALFB
C          LB=IHBP-IB
C          DO 10 MB=JB,KB
C            NB=LB+MB
C            C(NL,MB)=C(NL,MB)+A*C(NI,NB)
C10      CONTINUE
C20      NR=NU+1
C      NU=NNP-1
C      NK=NNP
C      IF (NR.GT.NU) RETURN
C      DO 40 NI=NR,NU
C        PIVOTI=1./C(NI,IHBP)
C        NJ=NI+1
C        IB=IHBP
C        DO 30 NL=NJ,NK
C          IB=IB-1
C          A=-C(NL,IB)*PIVOTI
C          C(NL,IB)=A
C          JB=IB+1
C          KB=IB+IHALFB
C          LB=IHBP-IB
C          DO 30 MB=JB,KB
C            NR=LB+MB
C            C(NL,MB)=C(NL,MB)+A*C(NI,NB)
C30      CONTINUE
C40      RETURN
C
C      MODIFY LOAD VECTOR R(NP)
C
C      50 NU=NNP+1
C      IBAND=2*IHALFB+1
C      DO 70 NI=2,IHBP
C        IB=IHBP-NI+1
C        NJ=1
C        SUM=0.0
C        DO 60 JB=IB,IHALFB
C          SUM=SUM+C(NI,JB)*R(NJ)
C60      NJ=NJ+1
C70      R(NI)=R(NI)+SUM
C      IB=1
C      NL=IHBP+1
C      DO 80 NI=NL,NNP
C        NJ=NI-IHBP+1
C        SUM=0.0
C        DO 80 JB=IB,IHALFB
C          SUM=SUM+C(NI,JB)*R(NJ)
C80      NJ=NJ+1
C90      R(NI)=R(NI)+SUM
C
C      BACK SOLVE

```

SOLV 005
 SOLV 010
 SOLV 015
 SOLV 020
 SOLV 025
 SOLV 030
 SOLV 035
 SOLV 040
 SOLV 045
 SOLV 050
 SOLV 055
 SOLV 060
 SOLV 065
 SOLV 070
 SOLV 075
 SOLV 080
 SOLV 085
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 SOLV 095
 SOLV 100
 SOLV 105
 SOLV 110
 SOLV 115
 SOLV 120
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 SOLV 360
 SOLV 365
 SOLV 370
 SOLV 375
 SOLV 380
 SOLV 385
 SOLV 390
 SOLV 395
 SOLV 400
 SOLV 405
 SOLV 410
 SOLV 415

Appendix C (continued)

```

R(NNP)=R(NNP)/C(NNP,IHBP)
DO 110 IB=2,IHBP
  NI=NU-IB
  NJ=NI
  MB=IHALFB+IB
  SUM=0.0
  DO 100 JB=NL,MB
    NJ=NJ+1
    SUM=SUM+C(NI,JB)*R(NJ)
110  R(NI)=(R(NI)-SUM)/C(NI,IHBP)
  MB=IBAND
  DO 130 IB=NL,NNP
    NI=NU-IB
    NJ=NI
    SUM=0.0
    DO 120 JB=NL,MB
      NJ=NJ+1
      SUM=SUM+C(NI,JB)*R(NJ)
120  R(NI)=(R(NI)-SUM)/C(NI,IHBP)
130  RETURN
      END

```

```

SOLV 420
SOLV 425
SOLV 430
SOLV 435
SOLV 440
SOLV 445
SOLV 450
SOLV 455
SOLV 460
SOLV 465
SOLV 470
SOLV 475
SOLV 480
SOLV 485
SOLV 490
SOLV 495
SOLV 500
SOLV 505
SOLV 510
SOLV 515
SOLV 520

```

Appendix C (continued)

```

SUBROUTINE OUTPUT(F,NODES,MAXNOD)
IMPLICIT REAL*8 (A-H,O-Z)
DIMENSION F(MAXNOD)
C
WRITE(6,1000)
LINE=0
DO 100 I=1,NODES,5
IMIN=I
IMAX=MIN0(I+4,NODES)
WRITE(6,1100) (J,F(J),J=IMIN,IMAX)
LINE=LINE+1
IF(MOD(LINE,50).EQ.0) WRITE(6,1200)
100 CONTINUE
C
1000 FORMAT(1H0//5(4X,'I',6X,'F',8X)/5(4X,'-',6X,'-',8X))
1100 FORMAT(1H,5(14,1X,F12.4,3X))
1200 FORMAT(1H1//,4X,'CONTINUED'//5(4X,'I',6X,'F',8X)/5(4X,'-',6X,'-',8X))
1 8X))
RETURN
END

```

OUTP 005
OUTP 010
OUTP 015
OUTP 020
OUTP 025
OUTP 030
OUTP 035
OUTP 040
OUTP 045
OUTP 050
OUTP 055
OUTP 060
OUTP 065
OUTP 070
OUTP 075
OUTP 080
OUTP 085
OUTP 090
OUTP 095
OUTP 100

```

SUBROUTINE READR(F,NODES,MAXNOD)
IMPLICIT REAL*8(A-H,O-Z)
DIMENSION F(MAXNOD)
NODESS=0
410 READ(5,30) NI,NSEQ,NIAD,FNI,FAD
IF(NI.EQ.0) GO TO 430
NJ=NI+NSEQ
DO 420 N=NI,NJ
I=NI+(N-NI)*NIAD
F(I)=FNI+FAD*DFLOAT(N-NI)
NODESS=NODESS+1
420 CONTINUE
GO TO 410
C
430 IF(NODESS.EQ.NODES) GO TO 440
WRITE(6,5210)
STOP
C
440 IF(NODESS.LE.MAXNOD) GO TO 500
WRITE(6,5220)
STOP
C
500 CONTINUE
C
30 FORMAT(3I5,5X,2F10.0)
5210 FORMAT(1H1,46H *** ERRORS OCCUR IN EXECUTING READR: STOP ***)
5220 FORMAT(1H1,46H *** NODES .GT. MAXNOD IN EXECUTING READR: STOP)
C
RETURN
END

```

READR 005
READR 010
READR 015
READR 020
READR 025
READR 030
READR 035
READR 040
READR 045
READR 050
READR 055
READR 060
READR 065
READR 070
READR 075
READR 080
READR 085
READR 090
READR 095
READR 100
READR 105
READR 110
READR 115
READR 120
READR 125
READR 130
READR 135
READR 140
READR 145
READR 150

Appendix C (continued)

```

SUBROUTINE READN(INDTYP,MAXNOD,NODES)
IMPLICIT REAL*8(A-H,O-Z)
DIMENSION INDTYP(MAXNOD)
C
  NODESS=0
110 READ 30,NI,NSEQ,NAD,NITYP
30  FORMAT(4I5)
   IF(NI.EQ.0) GO TO 130
   NJ=NI+NSEQ
   DO 120 N=NI,NJ
     I=NI+(N-NI)*NAD
     INDTYP(I)=NITYP
     NODESS=NODESS+1
120  CONTINUE
   GO TO 110
130 IF(NODESS.EQ.NODES) GO TO 140
   PRINT 1100
1100 FORMAT(1H1/1H , '*** ERROR OCCURS IN EXECUTING SUBROUTINE READN BEC
1  AUSE OF NODES .NE. NODES: STOP ***')
   STOP
140 IF(NODESS.LE.MAXNOD) GO TO 150
   PRINT 1200
1200 FORMAT(1H1/1H , '*** NCDES .GT. MAXNOD IN EXECUTING SUBROUTINE READ
1  N: STOP ***')
   STOP
150 CONTINUE
C
  RETURN
END

```

```

REDN 005
REDN 010
REDN 015
REDN 020
REDN 025
REDN 030
REDN 035
REDN 040
REDN 045
REDN 050
REDN 055
REDN 060
REDN 065
REDN 070
REDN 075
REDN 080
REDN 085
REDN 090
REDN 095
REDN 100
REDN 105
REDN 110
REDN 115
REDN 120
REDN 125
REDN 130
REDN 135
REDN 140
REDN 145

```

```

SUBROUTINE INTERP(FALL,TRF,RF,TIME,MXPR,MXDP,NPR,NDP)
IMPLICIT REAL*8(A-H,O-Z)
DIMENSION FALL(MXPR),TRF(MXPR,MXDP),RF(MXPR,MXDP)
C
  DO 160 I=1,NPR
    DO 140 J=2,NDP
      IF((TRF(I,J-1).LE.TIME .AND. TIME.LE.TRF(I,J)) GO TO 120
      GO TO 140
120  FALL(I)=RF(I,J-1)+(TIME-TRF(I,J-1))*(RF(I,J)-RF(I,J-1))/
    > (TRF(I,J)-TRF(I,J-1))
      GO TO 160
140  CONTINUE
      FALL(I)=0.0
160  CONTINUE
C
  RETURN
END

```

```

INTE 005
INTE 010
INTE 015
INTE 020
INTE 025
INTE 030
INTE 035
INTE 040
INTE 045
INTE 050
INTE 055
INTE 060
INTE 065
INTE 070
INTE 075
INTE 080
INTE 085

```

```

SUBROUTINE INTP11(XX,YY,X,Y,ISX,ISY,IN,IE,IER)
IMPLICIT REAL*8 (A-H,O-Z)
C
  DIMENSION X(1),Y(1)
C
  ----- CHECK THE ORDER
C
  IER=0
  ISLINE=0
  DO 150 I=IN,IE
    IF(XX-X(I)) 110,120,150
110  IX=I-1
    IF(I.NE.IN) GO TO 200
    IX=IN
    IER=-1
    GO TO 200
120  IX=I
    ISLINE=1
    GO TO 200
150  CONTINUE
    IX=IE-1
    IER=-1
200  CONTINUE
C
  ----- END OF CHECKING ORDER
C
  IF(ISLINE.NE.1) GO TO 300
  YY=Y(IX)
  RETURN
C
  ----- INTERPRETATION LINEARLY OR LOGLINEARLY
C
300  CONTINUE
  XS=X(IX)
  YS=Y(IX)
  X2=X(IX+1)
  Y2=Y(IX+1)
  U1=XS
  U2=X2
  UU=XX

```

```

INTP 005
INTP 010
INTP 015
INTP 020
INTP 025
INTP 030
INTP 035
INTP 040
INTP 045
INTP 050
INTP 055
INTP 060
INTP 065
INTP 070
INTP 075
INTP 080
INTP 085
INTP 090
INTP 095
INTP 100
INTP 105
INTP 110
INTP 115
INTP 120
INTP 125
INTP 130
INTP 135
INTP 140
INTP 145
INTP 150
INTP 155
INTP 160
INTP 165
INTP 170
INTP 175
INTP 180
INTP 185
INTP 190
INTP 195
INTP 200
INTP 205

```

Appendix C (continued)

```
V1=Y5
V2=Y2
IF(ISX.NE.1) GO TO 600
IF(U1.GT.0.0 .AND. U2.GT.0.0 .AND. UU.GT.0.0) GO TO 500
400 IER=1
GO TO 800
500 U1= DLOG(U1)
U2= DLOG(U2)
UU = DLOG(UU)
600 IF(ISY.NE.1) GO TO 700
IF(V1.LE.0.0 .OR. V2.LE.0.0) GO TO 400
V1= DLOG(V1)
V2= DLOG(V2)
700 YY=(UU-U1)*(V2-V1)/(U2-U1) + V1
IF(ISY.EQ.1) YY=DEXP(YY)
IER=0
800 CONTINUE
C
C ----- END OF INTERPRETATION
C
C RETURN
END
```

```
INTP 210
INTP 215
INTP 220
INTP 225
INTP 230
INTP 235
INTP 240
INTP 245
INTP 250
INTP 255
INTP 260
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INTP 315
```

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