EPA 440-9-73-004

AUTO-QUAL MODELLING SYSTEM

Supplement I

MODIFICATION FOR NON-POINT SOURCE LOADINGS

by

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I. INTRODUCTION

The purpose of this supplement is to document some changes and additions made to the "AUTØ-QUAL MØDELLING SYSTEM" [1]. Only the additions and changes to the original AUTØ-QUAL models will be discussed here, therefore, it is essential that the reader first read technical Report No. 54 [1] before reading this report.

The major additions to the original models are the inclusion of non-point sources and loads into the solution. These additions represent a new capability of the system, but do not change the original operating procedures in any way. Thus if one made the changes to the original source decks that are presented here, one could continue to use the models in exactly the same manner as before, even if the new options were not used.

No attempt is made here to present methods for catagorizing and quantifying non-point source flows and loads. Instead the method of inclusion of these data into the existing models is presented. The user may find that these changes to the models will make them a viable tool for use in the determination of non-point source loads.

The descriptions, operating instructions and sensitivity runs presented here should be viewed as supplemental to those presented in T.R. 54 and not definitive. Complete program listings are given here to give the reader a quick reference to the existing programs.

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[1] R. L. Crim, N. L. Lovelace, "AUTØ-QUAL Modelling System" Technical Report No. 54, Environmental Protection Agency, Region III, Annapolis Field Office, March 1973.

II. DESCRIPTION OF METHODS

The inclusion of non-point source flows and loads into the AUTØ-QUAL models primarily represents an input-output modification. There was no need to change either the structure of the programs or the computational methods used in them. Both models required the same changes, therefore, they will not be discussed separately at this point.

General:

The non-point source flows and loads are referenced to river miles and entered as a rate per mile of stream. These data are linearly interpolated to define values over the entire segment being modelled. This interpolation procedure is identical to the one described in T.R. 54. The non-point source data are considered as junction parameters and have a default value of zero.

Once values are established for each junction, they are multiplied by the channel length to obtain an equivalent point source flow or load. After the non-point source parameters have been reduced to effective point source data they are combined with the existing point sources and the solution proceeds exactly has presented in T.R. 54.

Non-Point Source Flows:

This parameter represents the net non-point source inflow (excluding rainfall) or non-point loss (excluding evaporation). It has the units of $(ft^3/sec)/mile$ and may assume either a positive or negative value. A positive value represents an inflow while a negative one is a loss. The variable defaults to zero.

The non-point source inflows and/or non-point losses are distinguished from the point source inflows and diversions during input and output operations. However, they are combined for internal computations.

Non-Point Source Quality Parameters:

This parameter(s) represents the non-point source contribution of whatever parameter(s) is being modelled. Both models have the capability to have non-point source inputs for all the quality parameters that they are designed to model (CBOD, NBOD, DO and conservatives). The non-point source values have the units of (lbs/day)/mile and default to zero if nothing is entered.

Once values have been established for each junction (linear interpolation), a mass loading rate (lbs/day) is computed for each junction by multiplying the non-point source value by the channel length. This mass loading rate is then combined with the non-point and point source inflows to give a inflow concentration. It is also combined with any point source inflow concentrations. If there are no inflows (point or non-point) at a junction then a fictitious one of 0.001 cfs is assigned for the purpose of assigning an inflow concentration to the non-point source loading. This fictitious inflow will not influence the resulting quality predictions, it did, however, greatly simplify the program modifications. Also this method enables the model to handle non-point flow losses while having non-point source mass loadings.

III. OPERATION AND RUNNING INSTRUCTION

Both models may be used in precisely the same manner as before, however, the user now has the option of entering non-point source flows and loads. Again, only the additions and modifications to the original operating instructions (T.R. 54) will be discussed here.

Entering Data:

The non-point parameters are entered as physical data in both models. Since entering physical data (SUBROUTINE NETDAT) is the same in both models, there is no need for distinction. Physical data is entered under the program control card "DATA". The following new data codes have been added for the non-point parameters:

Data Code	Definition
NØNPFLØW	-non-point source inflows (excluding rainfall) and/or non-point flow losses (excluding evaporation). (cfs/mile)
NØNPCBØD	-non-point source ultimate carbonaceous oxygen demand. (lbs CBOD/day)/mile
NØNPNBØD	-non-point source ultimate (lbs NBOD/day)/mile
NØNPDØ	-non-point source oxygen. (excluding reaeration and photosynthesis). This O_2 contribution is usually associated with runoff or rainfall. (lbs O_2/day)/mile
NØNP (4 letter name of conservative parameter)	-non-point source contributions of whatever conservative constituent is being modelled. (lbs/day)/mile

The card formats and method of entry for these new variables is the same as for other physical data (see T.R. 54).

Running Instructions:

The basic running instructions for both models remain unchanged. However, computational data entered under the control cards FLØW, CBØD, NBØD, DØ and the 4 letter conservative card are now strictly point source data. The non-point source parameters are entered under the "DATA" control card. Following are two general examples to demonstrate the use of the program control cards with the new options:

Example 1 (AUTØSS)

PROBLEM; Run TDS, CBØD and DØ under flow condition No. 1 with one set of non-point parameters. Then run CBØD, NBØD and DØ under flow condition No. 2 with a different set of non-point parameters. The control card set up for this problem would be;

DATA - enter physical data and first set of non-point parameters.

FLØW - enter point source inflows and diversions for flow condition 1.

TDS - enter point source TDS inflow concentrations and boundary conditions - compute solution.

CBØD - enter point source CBØD concentrations and boundary conditions - compute solution.

DØ - enter point source DØ concentrations and boundary conditions - compute solution.

DATA - enter new non-point parameters (there is no need to re-enter other physical data unless it is to be changed).

FLØW - enter point source inflows and diversions for flow condition no. 2.

CBØD - enter inflow CBØD - compute solution.

NBØD - enter inflow NBØD - compute solution.

DØ - enter inflow DØ - compute solution.

HALT.

Example 2 (AUTØQD)

PROBLEM: Run CBØD, NBØD and DØ for the period of 01/01/1972 through 02/01/1972. Assume there are three flow regimes during this period (01/01 - 01/10, 01/11 - 01/20, 01/21 - 02/01) and that the non-point parameters are constant for the period of 01/01 - 01/20 and change for the period 01/21 - 02/01. The control card set up for this problem would be;

DATA - enter physical data and non-point parameters for the period 01/01 - 01/20.

FLØW - enter point source inflows and diversions for 01/01/1972 - 01/10/1972.

DØ - enter point source CBØD, NBØD and DØ inflow concentrations and boundary conditions for 01/01/1972 through 01/10/1972.

FLØW - enter point source inflows and diversion for 01/11/1972-01/20/1972.

DØ - enter point source inflow concentrations for 01/11/1972-01/20/1972.

DATA - enter new non-point parameters for 01/21/1972 - 02/01/72.

FLØW - enter point source inflows and diversions for 01/21/1972-02/01/1972.

DØ - enter point source inflow concentrations for 01/21/1972-02/01/1972.

HALT.

IV. OUTPUT DESCRIPTIONS AND LISTINGS

AUTØSS

As already discussed, the input operations for AUTØSS and AUTØQD have not been significantly changed, except for the additional parameters. The program output has the same basic structure, however, some new data are printed:

Under the heading "Estuary/Stream Data" the non-point source input data and other physical data is printed.

Under the heading "Steady State Flow Conditions" the point source inflows and/or diversions, the non-point source inflows and/or non-point losses, and the channel flows are printed. The non-point losses, and the channel flows are printed. The non-point inflows or non-point losses printed here are the equivalent junction inflows or diversions (the non-point source value multiplied by the channel length).

Under the heading "Steady State (Constituent Name) Input Conditions" the point source inflow concentrations and equivalent non-point source loadings are printed. The non-point source loading is the total for the junction (non-point source value multiplied by the channel length).

The following new variables have been added to the program:

Variable	
CBDNP (J)	CBØD non-point source loading for junction J (lbs. CBØD/day)/mile
CØNNP (J)	Conservative constituent non-point source loading for function J (lbs/day)/mile

ØXYNP(J)	O_2 non-point source contribution (lbs O_2/day)/mile
QINP(J)	Non-point source inflow to junction J (cfs)
QIP(J)	Point source inflow to junction J (cfs)
QNP(J)	Non-point source inflow or non-point source loss at junction J (cfs/mile)
QØNP(J)	Non-point flow loss at junction J (cfs)
XNBNP(J)	NBØD non-point source loading for junction J (lbs NBØD/day)/mile

Program Listing:

Following is a complete listing of program AUTØSS. New or changed cards are marked by an arrow.

Main Program

```
C*****************************************************************
C*****************************************************************
C*********                                              ***********
C*********    PROGRAM AUTOSS - STEADY STATE WATER QUALITY    ***********
C*********                                              ***********
C*****************************************************************
C*****************************************************************
C*********                                              ***********
C*********    WRITTEN BY R.L. CRIM AND N.L. LOVELACE         ***********
C*********                                              ***********
C*********    ENVIRONMENTAL PROTECTION AGENCY, REGION III    ***********
C*********    ANNAPOLIS FIELD OFFICE                         ***********
C*********    TECHNICAL DEVELOPMENT SECTION                  ***********
C*********    ANNAPOLIS SCIENCE CENTER. ANNAPOLIS, MD. 21401 ***********
C*********    PHONE: 301-268-5038 OR 202-261-2410            ***********
C*********                                              ***********
C*****************************************************************
C*****************************************************************
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DATA LCBD/4HCBOD/,LNBD/4HNBOD/,LDO/4HDO  /,LHALT/4HHALT/,
     1     LFLOW/4HFLOW/,LDATA/4HDATA/
      NRD=1
      NWR=6
      NVT=0
      READ(NRD,10)(LALPHA(K),K=1,20)
   10 FORMAT(20A4)
      READ(NRD,20)RMDWN,RMUP,RMFR,NSECS
```

```
   20 FORMAT(3F10.0,I10)
      WRITE(NWR,30)
   30 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,13X,3HAAA,11X,3HUUU,9X,3H
     1UUU,5X,15(1HT),7X,11(1HO),9X,13(1HS),7X,13(1HS),/,1H ,12X,5HAAAAA,
     210X,3HUUU,9X,3HUUU,5X,15(1HT),6X,13(1HO),7X,14(1HS),6X,14(1HS),/,1
     3H ,11X,7(1HA),9X,3HUUU,9X,3HUUU,5X,15(1HT),5X,15(1HO),5X,2HSS,18X,
     42HSS,/,1H ,10X,3HAAA,3X,3HAAA,8X,3HUUU,9X,3HUUU,11X,3HTTT,11X,3HOO
     5O,9X,3HOOO,6X,13(1HS),7X,13(1HS),/,1H ,9X,3HAAA,5X,3HAAA,7X,3HUUU,
     69X,3HUUU,11X,3HTTT,11X,3HOOO,9X,3HOOO,8X,12(1HS),7X,13(1HS),/,1H ,
     78X,3HAAA,7X,3HAAA,6X,3HUUU,9X,3HUUU,11X,3HTTT,11X,3HOOO,9X,3HOOO,
     817X,3HSSS,17X,3HSSS,/,1H ,7X,15(1HA),5X,3HUUU,9X,3HUUU,11X,3HTTT,
     911X,3HOOO,9X,3HOOO,17X,3HSSS,17X,3HSSS)
      WRITE(NWR,40)
   40 FORMAT(1H ,7X,15(1HA),5X,15(1HU),11X,3HTTT,11X,15(1HO),5X,15(1HS),
     15X,15(1HS),/,1H ,7X,3HAAA,9X,3HAAA,6X,13(1HU),12X,3HTTT,12X,13(1HO
     2),6X,14(1HS),6X,14(1HS),/,1H ,7X,3HAAA,9X,3HAAA,7X,11(1HU),13X,3HT
     3TT,13X,11(1HO),7X,13(1HS),7X,13(1HS),/,1H ,130(1H*),/,1H ,130(1H*)
     4)
      WRITE(NWR,50)(LALPHA(K),K=1,20),RMDWN,RMUP,RMFR,NSECS
   50 FORMAT(1H0,20(1H*),5X,32HSTEADY STATE WATER QUALITY MODEL,/,1H ,20
     1(1H*),/,1H ,20(1H*),5X,14HRUN TITLE.....,20A4,/,1H ,20(1H*),/,1H ,
     220(1H*),/,1H ,20(1H*),5X,18HBASIC NETWORK DATA,/,1H ,20(1H*),5X,31
     3HRIVER MILE AT DOWNSTREAM END...,F10.2,/,1H ,20(1H*),5X,31HRIVER M
     4ILE AT UPSTREAM END.....,F10.2,/,1H ,20(1H*),5X,31HRIVER MILE OF F
     5ALL LINE.........,F10.2,/,1H ,20(1H*),5X,31HNUMBER OF SECTIONS.....
     6.........,I10 )
      CALL SETUP
 1000 READ(NRD,60)LTYPE
   60 FORMAT(A4)
   62 IF(LTYPE.NE.LDATA)GO TO 65
      CALL NETDAT
      GO TO 1000
   65 IF(LTYPE.NE.LCBD)GO TO 90
      LCONS=LTYPE
      DO 70 J=1,NJ
```

Main Program (Cont'd)

```
      C(J)=CBODI(J)
   70 CONTINUE
      CALL QUALIN
      CALL QALCMP
      CALL SOLVEX
      DO 80 J=1,NJ
      CBOD(J)=C(J)
   80 CONTINUE
      GO TO 1000
   90 IF(LTYPE.NE.LNBD) GO TO 120
      LCONS=LTYPE
      DO 100 J=1,NJ
      C(J)=XNODI(J)
  100 CONTINUE
      CALL QUALIN
      CALL QALCMP
      CALL SOLVEX
      DO 110 J=1,NJ
      XNOD(J)=C(J)
  110 CONTINUE
      GO TO 1000
  120 IF(LTYPE.NE.LDO) GO TO 140
      LCONS=LTYPE
      DO 130 J=1,NJ
      C(J)=OXY(J)
  130 CONTINUE
      CALL QUALIN
      CALL DOCMP
      CALL SOLVEX
      DO 135 J=1,NJ
      CBOD(J)=0.0
      XNOD(J)=0.0
  135 CONTINUE
      GO TO 1000
  140 IF(LTYPE.NE.LFLOW)GO TO 150
```

Main Program (Cont'd)

```
      CALL FLOWS
      GO TO 1000
  150 IF(LTYPE.EQ.LHALT)GO TO 2000
      LCONS=LTYPE
      DO 160 J=1,NJ
      C(J)=CS(J)
  160 CONTINUE
      CALL QUALIN
      CALL QALCMP
      CALL SOLVEX
      GO TO 1000
 2000 STOP
      END
```

Subroutine SETUP

```
      SUBROUTINE SETUP
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      NC=NSECS
      NJ=NSECS+1
      XMIL=(RMUP-RMDWN)/FLOAT(NC)
      XLEN=XMIL*5285.0
      RMJ(1)=RMDWN
      DO 10 J=2,NJ
      RMJ(J)=RMJ(J-1)+XMIL
   10 CONTINUE
      RMC(1)= RMDWN+(XMIL/2.0)
      DO 20 N=2,NC
      RMC(N)=RMC(N-1)+XMIL
   20 CONTINUE
      DO 30 J=1,NJ
      CBDNP(J)=0.0
      XNBNP(J)=0.0
      CONNP(J)=0.0
      QNP(J)=0.0
      OXYNP(J)=0.0
      QOUT(J)=0.0
      QIN(J)=0.0
      DVD(J) =0.0
      Q(J)=0.0
      A(J)=0.0
      Z(J)=0.0
      CIN(J)=0.0
```

Subroutine SETUP (Cont'd)

```
      C(J)=0.0
      REAIR(J)=0.0
      VOL(J)=0.0
      PHOTO(J)=0.0
      EVAP(J)=0.0
      AS(J)=0.0
      SEDMT(J)=0.0
      DOS(J)=0.0
      V(J)=0.0
      WIDTH(J)=0.0
      A1(J)=0.0
      A2(J)=0.0
      A3(J)=0.0
      TEMP(J)=20.0
      DK1(J)=0.0
      DK2(J)=0.0
      CBODI(J)=0.0
      CBOD(J)=0.0
      XNODI(J)=0.0
      XNOD(J)=0.0
      OXY(J)=0.0
      CS(J)=0.0
      NFS(J)=0
      DO 30 K=1,3
      ALPHA(J,K)=0.0
   30 CONTINUE
      RETURN
      END
```

Subroutine NETDAT

```
      SUBROUTINE NETDAT
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DATA LVAR1/4HJUNC/,LVAR2/4HCHAN/
      DATA LSTOP/4HSTOP/,LA1/4HA1  /,LA2/4HA2  /,LA3/4HA3  /,
     1    LWIDT/4HWIDT/,LVEL/4HVELO/,LTEMP/4HTEMP/,LVAP/4HEVAP/,
     2    LPHOTO/4HPHOT/ ,LSEDMT/4HSEDI/,LDISP/4HDISP/,LDK1/4HCDEC/,
     3    LDK2/4HNDEC/,LREAI/4HREAE/,LDOS/4HSATD/,LINIT/4HINIT/,
     4    LCBD/4HCBOD/,LNBD/4HNBOD/,LOXY/4HDO  /,LCSA/4HC-SA/,
     5    LCK2/ 4HC-RE/,LNON/4HNONP/,LFLO/4HFLOW/
      DATA VAPFAC/1.86224E07/,CVFAC/3.28075E00/
      DIMENSION X(250),Y(250)
      K2FL=0
      WRITE(NWR,10)
   10 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,35(1H*),61X,34(1H*),/,1H
     1,35(1H*),6X,49HE S T U A R Y / S T R E A M   I N P U T   D A T A,
     26X,34(1H*),/,1H ,35(1H*),61X,34(1H*),/,1H ,130(1H*),/,1H ,130(1H*)
     3)
 1000 READ(NRD,20)LABEL,LCST,NPTS
   20 FORMAT(2A4,2X,I5)
      IF(LABEL.EQ.LSTOP)GO TO 5000
      IF(NPTS.EQ.0) GO TO 45
      DO 40 J=1,NPTS
*     READ(NRD,30)I,X(J),Y(J)
   30 FORMAT(I5,5X,2F10.0)
   40 CONTINUE
   45 IF(LABEL.NE.LA1) GO TO 60
      CALL INTER(A1,NC,X,Y,NPTS,RMC)
```

* This change is indicated in the errata for T.R. 54

Subroutine NETDAT (Cont'd)

```
      WRITE(NWR,50)
   50 FORMAT(1H0,20(1H*),5X,32HA1 COEFFICIENT FOR FLOW EQUATION,5X,20(1H
     1*) )
      CALL OUTGO(LVAR2,NC,RMC,A1)
      GO TO 1000
   60 IF(LABEL.NE.LA2) GO TO 80
      CALL INTER(A2,NC,X,Y,NPTS,RMC)
      WRITE(NWR,70)
   70 FORMAT(1H0,20(1H*),5X,32HA2 COEFFICIENT FOR FLOW EQUATION,5X,20(1H
     1*) )
      CALL OUTGO(LVAR2,NC,RMC,A2)
      GO TO 1000
   80 IF(LABEL.NE.LA3) GO TO 100
      CALL INTER(A3,NC,X,Y,NPTS,RMC)
      WRITE(NWR,90)
   90 FORMAT(1H0,20(1H*),5X,79HA3 COEFFICIENT FOR FLOW EQUATION - RERESE
     1NTS DEPTH OF FLOW IF A1 AND/OR A2 ARE ,5X,20(1H*),/,1H ,20(1H*),5X
     2,27HNOT SPECIFIED (OR ARE ZERO),57X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,A3)
      GO TO 1000
  100 IF(LABEL.NE.LWIDT)GO TO 120
      CALL INTER(WIDTH,NC,X,Y,NPTS,RMC)
      WRITE(NWR,110)
  110 FORMAT(1H0,20(1H*),5X,19HCHANNEL WIDTHS (FT),5X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,WIDTH)
      AS(1)=WIDTH(1)*XLEN
      AS(NJ)=WIDTH(NC)*XLEN
      DO 112 J=2,NC
      AS(J)=XLEN*0.5*(WIDTH(J)+WIDTH(J-1))
  112 CONTINUE
      WRITE(NWR,114)
  114 FORMAT(1H0,20(1H*),5X,29HJUNCTION SURFACE AREAS (SQFT),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,AS)
      GO TO 1000
  120 IF(LABEL.NE.LVEL) GO TO 150
```

Subroutine NETDAT (Cont'd)

```
      NVT=1
      CALL INTER(V,NC,X,Y,NPTS,RMC)
      DO 130 N=1,NC
      IF(RMC(N).GT.RMFR) V(N)=0.0
  130 CONTINUE
      WRITE(NWR,140)
  140 FORMAT(1H0,20(1H*),5X,41HAVERAGE CHANNEL TIDAL VELOCITIES (FT/SEC)
     1,5X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,V)
      GO TO 1000
  150 IF(LABEL.NE.LTEMP) GO TO 170
      CALL INTER(TEMP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,160)
  160 FORMAT(1H0,20(1H*),5X,35HJUNCTION WATER TEMPERATURES (DEG-C),5X,20
     1(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,TEMP)
      GO TO 1000
  170 IF(LABEL.NE.LVAP) GO TO 200
      CALL INTER(EVAP,NJ,X,Y,NPTS,RMJ,EVAP)
      WRITE(NWR,180)
  180 FORMAT(1H0,20(1H*),5X,34HNET EVAPORATION - RAINFALL (IN/MO),5X,20(
     11H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,EVAP)
      DO 190 J=1,NJ
      EVAP(J)=EVAP(J)/VAPFAC
  190 CONTINUE
      GO TO 1000
  200 IF(LABEL.NE.LPHOTO) GO TO 230
      CALL INTER(PHOTO,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,210)
  210 FORMAT(1H0,20(1H*),5X,61HAVERAGE DAILY PHOTOSYNTHESIS-RESPIRATION
     1RATE (GM O2/SQM/DAY),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,PHOTO)
      DO 220 J=1,NJ
      PHOTO(J)=PHOTO(J)*CVFAC/86400.0
```

Subroutine NETDAT (Cont'd)

```
220 CONTINUE
    GO TO 1000
230 IF(LABEL.NE.LSEDMT) GO TO 260
    CALL INTER(SEDMT,NJ,X,Y,NPTS,RMJ)
    WRITE(NWR,240)
240 FORMAT(1H0,20(1H*),5X,42HOXYGEN UPTAKE OF SEDIMENTS (GM O2/SQM/DAY
   1),5X,20(1H*) )
    CALL OUTGO(LVAR1,NJ,RMJ,SEDMT)
    DO 250 J=1,NJ
    SEDMT(J)=SEDMT(J)*CVFAC/86400.0
250 CONTINUE
    GO TO 1000
260 IF(LABEL.NE.LDISP) GO TO 280
    CALL INTER(Z,NC,X,Y,NPTS,RMC)
    WRITE(NWR,270)
270 FORMAT(1H0,20(1H*),5X,34HDISPERSION COEFFICIENTS (SQFT/SEC),5X,20(
   11H*) )
    CALL OUTGO(LVAR2,NC,RMC,Z)
    GO TO 1000
280 IF(LABEL.NE.LDK1)GO TO 310
    CALL INTER(DK1,NJ,X,Y,NPTS,RMJ)
    DO 285 J=1,NJ
    DK1(J)=DK1(J)*1.047**(TEMP(J)-20.0)
285 CONTINUE
    WRITE(NWR,290)
290 FORMAT(1H0,20(1H*),5X,52HCBOD DECAY RATES CORRECTED TO STREAM TEMP
   1S - (1/DAY),5X,20(1H*))
    CALL OUTGO(LVAR1,NJ,RMJ,DK1)
    DO 300 J=1,NJ
    DK1(J)=DK1(J)/86400.0
300 CONTINUE
    GO TO 1000
310 IF(LABEL.NE.LDK2)GO TO 340
    CALL INTER(DK2,NJ,X,Y,NPTS,RMJ)
    DO 315 J=1,NJ
```

```
      DK2(J)=DK2(J)*1.015**(TEMP(J)-20.0)
  315 CONTINUE
      WRITE(NWR,320)
  320 FORMAT(1H0,20(1H*),5X,52HNBOD DECAY RATES CORRECTED TO STREAM TEMP
     1S - (1/DAY),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,DK2)
      DO 330 J=1,NJ
      DK2(J)=DK2(J)/86400.0
  330 CONTINUE
      GO TO 1000
  340 IF(LABEL.NE.LREAI) GO TO 370
      CALL INTER(REAIR,NJ,X,Y,NPTS,RMJ)
      DO 345 J=1,NJ
      REAIR(J)=REAIR(J)*1.024**(TEMP(J)-20.0)
  345 CONTINUE
      WRITE(NWR,350)
  350 FORMAT(1H0,20(1H*),5X,58HINPUT REAERATION RATES CORRECTED TO STREA
     1M TEMPS - (1/DAY),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,REAIR)
      DO 360 J=1,NJ
      REAIR(J)=REAIR(J)/86400.0
  360 CONTINUE
      GO TO 1000
  370 IF(LABEL.NE.LDOS) GO TO 390
      CALL INTER(DOS,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,380)
  380 FORMAT(1H0,20(1H*),5X,46HINPUTED OXYGEN SATURATION CONCENTRATIONS
     1(PPM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,DOS)
      GO TO 1000
  390 IF(LABEL.NE.LINIT) GO TO 470
      IF(LCST.NE.LCBD)GO TO 410
      CALL INTER(CBODI,NJ,X,Y,NPTS,RMJ)
  400 FORMAT(1H0,20(1H*),5X,33HINITIAL CBOD CONCENTRATIONS (PPM),5X,20(1
     1H*))
```

```
      WRITE(NWR,400)
      CALL OUTGO(LVAR1,NJ,RMJ,CBODI)
      GO TO 1000
  410 IF(LCST.NE.LNBD)GO TO 430
      CALL INTER(XNODI,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,420)
  420 FORMAT(1H0,20(1H*),5X,33HINITIAL NBOD CONCENTRATIONS (PPM),5X,20(1
     1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,XNODI)
      GO TO 1000
  430 IF(LCST.NE.LOXY) GO TO 450
      CALL INTER(OXY,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,440)
  440 FORMAT(1H0,20(1H*),5X,45HINITIAL DISSOLVED OXYGEN CONCENTRATIONS (
     1PPM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,OXY)
      GO TO 1000
  450 CALL INTER(CS,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,460)LCST
  460 FORMAT(1H0,20(1H*),5X,8HINITIAL ,A4,21H CONCENTRATIONS (PPM),5X,20
     1(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,CS)
      GO TO 1000
  470 IF(LABEL.NE.LCSA)GO TO 500
      DO 480 J=1,NJ
      DOS(J)=14.62-0.367*TEMP(J)+0.0045*(TEMP(J)**2.0)
  480 CONTINUE
      WRITE(NWR,490)
  490 FORMAT(1H0,20(1H*),5X,47HCOMPUTED OXYGEN SATURATION CONCENTRATIONS
     1 (PPM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,DOS)
      GO TO 1000
  500 IF(LABEL.NE.LCK2)GO TO 510
      K2FL=1
      GO TO 1000
  510 IF (LABEL.NE.LNON) GO TO 610
```

Subroutine NETDAT (Cont'd)

```
      IF(LCST.NE.LCBD)GO TO 530
      CALL INTER(CBDNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,520)
  520 FORMAT(1H0,20(1H*),5X,63HCBOD NONPOINT SOURCE CONTRIBUTION (LBS CB
     1OD/DAY/MILE OF STREAM),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CBDNP)
      GO TO 1000
  530 IF(LCST.NE.LNBD)GO TO 550
      CALL INTER(XNBNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,540)
  540 FORMAT(1H0,20(1H*),5X,63HNBOD NONPOINT SOURCE CONTRIBUTION (LBS NB
     1OD/DAY/MILE OF STREAM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,XNBNP)
      GO TO 1000
  550 IF(LCST.NE.LOXY)GO TO 570
      CALL INTER(OXYNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,560)
  560 FORMAT(1H0,20(1H*),5X,60HO2 NONPOINT SOURCE CONTRIBUTIONS (LBS O2/
     1DAY/MILE OF STREAM),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,OXYNP)
      GO TO 1000
  570 IF(LCST.NE.LFLO)GO TO 590
      CALL INTER(QNP,NJ,X,Y,NPTS,RMJ)
      WRITE (NWR,580)
  580 FORMAT(1H0,20(1H*),5X,41HNONPOINT SOURCE FLOW (CFS/MILE OF STREAM)
     1,5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,QNP)
      GO TO 1000
  590 CALL INTER(CONNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,600)LCST,LCST
  600 FORMAT(1H0,20(1H*),5X,A4,35H NONPOINT SOURCE CONTRIBUTION (LBS ,A4
     1,20H/DAY/MILE OF STREAM),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CONNP)
      GO TO 1000
  610 WRITE(NWR,620)LABEL
```

Subroutine NETDAT (Cont'd)

```
620 FORMAT(1H1,130(1H?),/,1H ,130(1H?),/,1H ,20(1H?),5X,10HDATA CODE ,
   1A4,36H DOES NOT EXIST - PROGRAM TERMINATES,/,1H ,130(1H?),/,1H ,
   2130(1H?))
    STOP
5000 RETURN
    END
```

Subroutine FLOWS

```
      SUBROUTINE FLOWS
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DIMENSION QINP(250),QONP(250)
      DATA LVAR1/4HJUNC/,LVAR2/4HCHAN/
      DATA LSTOP/4HSTOP/
      DO 10 J=1,NJ
      Q(J)=0.0
      QOUT(J)=0.0
      QIN(J)=0.0
      IF(QNP(J).LE.0.0)GO TO 5
      QINP(J)=QNP(J)*XMIL
      QONP(J)=0.0
      GO TO 10
    5 QONP(J)=-QNP(J)*XMIL
      QINP(J)=0.0
   10 CONTINUE
   20 READ(NRD,30)LABEL,DIST,QN,QAUT
   30 FORMAT(A4,6X,3F10.0)
      IF(LABEL.EQ.LSTOP)GO TO 40
      JUNC=JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
      QIN(JUNC)=QIN(JUNC)+QN
      QOUT(JUNC)=QOUT(JUNC)+QAUT
      GO TO 20
   40 Q(NC)=-QIN(NJ)-QINP(NJ)+EVAP(NJ)*AS(NJ)
      DO 50 N=2,NC
      NCHAN=NJ-N
      NCP=NCHAN+1
```

Subroutine FLOWS (Cont'd)

```
      Q(NCHAN)=Q(NCP)-QIN(NCP)-QINP(NCP)+QOUT(NCP)+QONP(NCP)+EVAP(NCP)*
     1AS(NCP)
   50 CONTINUE
      CALL FLOCMP
      SUMIN=0.0
      SUMOUT=0.0
      DO 70 J=1,NJ
      SUMIN=SUMIN+QIN(J)+QINP(J)
      SUMOUT=SUMOUT+QOUT(J)+QONP(J)
      IF(EVAP(J).LT.0.0)GO TO 60
      SUMOUT=SUMOUT+EVAP(J)*AS(J)
      GO TO 70
   60 SUMIN=SUMIN-EVAP(J)*AS(J)
   70 CONTINUE
      IF(SUMOUT.GT.SUMIN)GO TO 80
      QOUT(1)=QOUT(1)+SUMIN-SUMOUT
      GO TO 90
   80 QIN(1)=QIN(1)+SUMOUT-SUMIN
   90 WRITE(NWR,100)SUMIN,SUMOUT,QOUT(1)
  100 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),5X,28HSTEADY STAT
     1E FLOW CONDITIONS,47X,25(1H*),/,1H ,25(1H*),80X,25(1H*),/,1H ,25(1
     2H*),5X,15HTOTAL INFLOWS =,F10.1,4H CFS,46X,25(1H*),/,1H ,25(1H*),
     35X,18HTOTAL DIVERSIONS =,F10.1,4H CFS,43X,25(1H*),/,1H ,25(1H*),
     45X,32HOUTFLOW AT DOWNSTREAM JUNCTION =,F10.1,4H CFS,29X,25(1H*),/,
     51H ,130(1H*),/,1H ,130(1H*))
      WRITE(NWR,110)
  110 FORMAT(1H0,20(1H*),5X,26HPOINT SOURCE INFLOWS (CFS),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QIN)
      WRITE(NWR,120)
  120 FORMAT(1H0,20(1H*),5X,50HNONPOINT SOURCE INFLOWS (CFS) (EXCLUDING
     1RAINFALL),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QINP)
      WRITE(NWR,130)
  130 FORMAT(1H0,20(1H*),5X,22HPOINT DIVERSIONS (CFS),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QOUT)
```

Subroutine FLOWS (Cont'd)

```
      WRITE(NWR,140)
  140 FORMAT(1H0,20(1H*),5X,59HNONPOINT DIVERSIONS OR LOSSES (CFS) (EXCL
     1UDING EVAPORATION),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QONP)
      WRITE(NWR,150)
  150 FORMAT(1H0,20(1H*),5X,19HCHANNEL FLOWS (CFS),5X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,Q)
      DO 160 J=1,NJ
      QIN(J)=QIN(J)+QINP(J)
      QOUT(J)=QOUT(J)+QONP(J)
  160 CONTINUE
      RETURN
      END
```

Subroutine FLOCMP

```
      SUBROUTINE FLOCMP
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DATA LVAR1/4HJUNC/,LVAR2/4HCHAN/
      DIMENSION DEPTH(250),RN(250)
      DO 10 N=1,NC
      DEPTH(N)=A3(N)
      IF(A1(N).EQ.0.0.OR.Q(N).EQ.0.0)GO TO 5
      DEPTH(N)=DEPTH(N)+A1(N)*ABS(Q(N))**A2(N)
    5 A(N)=DEPTH(N)*WIDTH(N)
      IF(NVT.EQ.1.AND.RMC(N).LE.RMFR)GO TO 10
      IF(A(N).EQ.0.0)GO TO 8
      V(N)=ABS(Q(N))/A(N)
      GO TO 10
    8 WRITE(NWR,9)N
    9 FORMAT(1H1,130(1H?),/,1H ,20(1H?),21HZERO AREA IN CHANNEL ,I3,44H
     1DEPTH OR WIDTH IS ZERO - PROGRAM TERMINATES  )
      STOP
   10 CONTINUE
      VOL(1)=XLEN*A(1)
      VOL(NJ)=XLEN*A(NC)
      NL=NJ-1
      DO 20 J=2,NL
      VOL(J)=XLEN*0.5*(A(J-1)+A(J))
   20 CONTINUE
      WRITE(NWR,30)
   30 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),5X,38HDEPTH OR VE
     1LOCITY DEPENDENT VARIABLES,38X,25(1H*),/,1H ,130(1H*),/,1H ,130(1H
```

```
     3*))
      WRITE(NWR,40)
   40 FORMAT(1H0,20(1H*),5X,38HCROSSECTIONAL AREAS OF CHANNELS (SQFT),
     15X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,A)
      WRITE(NWR,50)
   50 FORMAT(1H0,20(1H*),5X,19HCHANNEL DEPTHS (FT),5X,20(1H*))
      CALL OUTGO(LVAR2,NC,RMC,DEPTH)
      WRITE(NWR,60)
   60 FORMAT(1H0,20(1H*),5X,27HCHANNEL VELOCITIES (FT/SEC),5X,20(1H*))
      CALL OUTGO(LVAR2,NC,RMC,V)
      WRITE(NWR,70)
   70 FORMAT(1H0,20(1H*),5X,23HJUNCTION VOLUMES (CUFT),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,VOL)
      IF(K2FL.NE.1) GO TO 140
      DO 80 N=1,NC
      RN(N)= (12.9*(V(N)**0.5))/(DEPTH(N)**1.5)
   80 CONTINUE
      REAIR(NJ)=RN(NC)
      REAIR(1)=RN(1)
      DO 90 J=2,NL
      REAIR(J)=0.5*(RN(J)+RN(J-1))
   90 CONTINUE
      DO 100  J=1,NJ
      XT=TEMP(J)-20.0
      XF=1.024**XT
      REAIR(J)=REAIR(J)*XF
  100 CONTINUE
      WRITE(NWR,120)
  120 FORMAT(1H0,20(1H*),5X,33HCOMPUTED REAERATION RATES (1/DAY),5X,20(1
     1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,REAIR)
      DO 130 J=1,NJ
      REAIR(J)=REAIR(J)/86400.0
  130 CONTINUE
  140 RETURN
      END
```

Subroutine QUALIN

```
      SUBROUTINE QUALIN
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DATA LSTOP/4HSTOP/,LFIXE/4HFIXE/
      DATA LVAR1/4HJUNC/,LVAR2/4HCHAN/
      DATA LNBD/4HNBOD/,LCBD/4HCBOD/,LDO/4HDO  /
      DIMENSION QIP(250)
      NOJFX=0
      DO 5 K=1,250
      NFS(K)=0
    5 CONTINUE
      DO 10 J=1,NJ
      CIN(J)=0.0
      QIN(J)=AMAX1(0.001,QIN(J))
      QIP(J)=0.0
   10 CONTINUE
 1000 READ(NRD,20)LABEL,DIST,QN,CN,CST
   20 FORMAT(A4,6X,4F10.0)
      IF(LABEL.EQ.LSTOP)GO TO 30
      JUNC=JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
      QIP(JUNC)=QIP(JUNC)+QN
      CIN(JUNC)=CN*QN+CIN(JUNC)
      IF(LABEL.NE.LFIXE) GO TO 1000
      NOJFX=NOJFX+1
      NFS(NOJFX)=JUNC
      C(JUNC)=CST
      GO TO 1000
   30 DO 50 J=1,NJ
```

```
      IF(QIN(J).EQ.0.0.AND.CIN(J).NE.0.0)  GO TO 60
      IF(QIP(J).EQ.0.0.AND.CIN(J).EQ.0.0)  GO TO 40
      CIN(J)=CIN(J)/QIP(J)
      GO TO 50
   40 CIN(J)=0.0
   50 CONTINUE
      GO TO 80
   60 WRITE(NWR,70)J,RMJ(J)
   70 FORMAT(1H1,130(1H?),/,1H ,130(1H?),/,1H0,10(1H?),5X,33HAN INFLOW W
     1AS READ IN AT JUNCTION ,I4,12H(RIVER MILE ,F7.2,54H) IN THE QUALIT
     2Y INPUT, BUT NOT IN THE HYDRAULIC INPUT,/,1H0,10(1H?),5X,18HPROGRA
     3M TERMINATES )
      STOP
   80 WRITE(NWR,90)LCONS
   90 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),80X,25(1H*),/,1H
     1,25(1H*),5X,13HSTEADY STATE ,A4,27H INPUT CONDITIONS            ,31X
     2,25(1H*),/,1H ,25(1H*),80X,25(1H*),/,1H ,130(1H*),/,1H ,130(1H*),/
     3,1H0 )
      WRITE(NWR,95)
   95 FORMAT(1H0,20(1H*),5X,40HPOINT SOURCE INFLOW CONCENTRATIONS (PPM),
     15X,20(1H*)  )
      CALL OUTGO(LVAR1,NJ,RMJ,CIN)
      WRITE(NWR,200)
  200 FORMAT(1H0,20(1H*),5X,31HNONPOINT SOURCE LOADS (LBS/DAY),5X,20(1H*
     1) )
      IF(LCONS.NE.LCBD)GO TO 230
      DO 210 J=1,NJ
      CBDNP(J)=CBDNP(J)*XMIL
  210 CONTINUE
      CALL OUTGO(LVAR1,NJ,RMJ,CBDNP)
      DO 220 J=1,NJ
      IF(CBDNP(J).LE.0.0)GO TO 215
      CIN(J)=(CBDNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
      CBDNP(J)=CBDNP(J)/XMIL
      GO TO 220
```

```
215 CIN(J)=CIN(J)*QIP(J)/QIN(J)
220 CONTINUE
    GO TO 320
230 IF(LCONS.NE.LNBD)GO TO 260
    DO 240 J=1,NJ
    XNBNP(J)=XNBNP(J)*XMIL
240 CONTINUE
    CALL OUTGO(LVAR1,NJ,RMJ,XNBNP)
    DO 250 J=1,NJ
    IF(XNBNP(J).LE.0.0) GO TO 245
    CIN(J)=(XNBNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
    XNBNP(J)=XNBNP(J)/XMIL
    GO TO 250
245 CIN(J)=CIN(J)*QIP(J)/QIN(J)
250 CONTINUE
    GO TO 320
260 IF(LCONS.NE.LDO)GO TO 290
    DO 270 J=1,NJ
    OXYNP(J)=OXYNP(J)*XMIL
270 CONTINUE
    CALL OUTGO(LVAR1,NJ,RMJ,OXYNP)
    DO 280 J=1,NJ
    IF(OXYNP(J).LE.0.0)GO TO 275
    CIN(J)=(OXYNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
    OXYNP(J)=OXYNP(J)/XMIL
    GO TO 280
275 CIN(J)=CIN(J)*QIP(J)/QIN(J)
280 CONTINUE
    GO TO 320
290 DO 300 J=1,NJ
    CONNP(J)=CONNP(J)*XMIL
300 CONTINUE
    CALL OUTGO(LVAR1,NJ,RMJ,CONNP)
    DO 310 J=1,NJ
    IF(CONNP(J).LE.0.0)GO TO 305
```

Subroutine QUALIN (Cont'd)

```
      CIN(J)=(CONNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
      CONNP(J)=CONNP(J)/XMIL
      GO TO 310
  305 CIN(J)=CIN(J)*QIP(J)/QIN(J)
  310 CONTINUE
  320 IF(NOJFX.EQ.0)GO TO 2000
      WRITE(NWR,100)
  100 FORMAT(1H0,25(1H*),5X,15HFIXED JUNCTIONS,/,1H0)
      DO 130 J=1,NOJFX
      K=NFS(J)
      WRITE(NWR,120)K,RMJ(K),C(K)
  120 FORMAT(1H ,25(1H.),5X, 9HJUNCTION ,I3,13H, RIVER MILE ,F7.2,14H, I
     1S FIXED AT ,1PE11.4,6H (PPM) )
  130 CONTINUE
 2000 RETURN
      END
```

Subroutine QALCMP

```
      SUBROUTINE QALCMP
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DATA LCBD/4HCBOD/,LNBD/4HNBOD/
      DIMENSION DECAY(250)
      IF(LCONS.NE.LCBD)GO TO 20
      DO 10 J=1,NJ
      DECAY(J)=DK1(J)
   10 CONTINUE
      GO TO 60
   20 IF(LCONS.NE.LNBD) GO TO 40
      DO 30 J=1,NJ
      DECAY(J)=DK2(J)
   30 CONTINUE
      GO TO 60
   40 DO 50 J=1,NJ
      DECAY(J)=0.0
   50 CONTINUE
   60 ALPHA(1,3)=QIN(1)*CIN(1)
      ALPHA(NJ,3)=QIN(NJ)*CIN(NJ)
      DVD(1)= -QOUT(1)-DECAY(1)*VOL(1)
      DVD(NJ)=-QOUT(NJ)-DECAY(NJ)*VOL(NJ)
      DO 1000 J=2,NC
      IF(NOJFX.EQ.0) GO TO 80
      DO 70 K=1,NOJFX
      IF(NFS(K).EQ.J) GO TO 1000
   70 CONTINUE
   80 DVD(J)=-QOUT(J)-DECAY(J)*VOL(J)
```

Subroutine QALCMP (Cont'd)

```
      ALPHA(J,3)=QIN(J)*CIN(J)
      JM1=J-1
      IF(Q(JM1).LT.0.0) GO TO 90
      ALPHA(J,1)=ABS(Q(JM1))+A(JM1)*Z(JM1)/XLEN
      DVD(J)=DVD(J)-A(JM1)*Z(JM1)/XLEN
      GO TO 100
   90 ALPHA(J,1)=Z(JM1)*A(JM1)/XLEN
      DVD(J)=DVD(J)-ABS(Q(JM1))-A(JM1)*Z(JM1)/XLEN
  100 IF(Q(J).GT.0.0) GO TO 110
      ALPHA(J,2)=ABS(Q(J))+A(J)*Z(J)/XLEN
      DVD(J)=DVD(J)-A(J)*Z(J)/XLEN
      GO TO 120
  110 ALPHA(J,2)=Z(J)*A(J)/XLEN
      DVD(J)=DVD(J)-ABS(Q(J))-A(J)*Z(J)/XLEN
  120 CONTINUE
 1000 CONTINUE
      IF(Q(NC).LT.0.0) GO TO 130
      ALPHA(NJ,1)=ABS(Q(NC))+A(NC)*Z(NC)/XLEN
      DVD(NJ)=DVD(NJ)-A(NC)*Z(NC)/XLEN
      GO TO 140
  130 ALPHA(NJ,1)=Z(NC)*A(NC)/XLEN
      DVD(NJ)=DVD(NJ)-ABS(Q(NC))-A(NC)*Z(NC)/XLEN
  140 IF(Q(1).GT.0.0) GO TO 150
      ALPHA(1,1)=ABS(Q(1))+A(1)*Z(1)/XLEN
      DVD(1)=DVD(1)-A(1)*Z(1)/XLEN
      GO TO 160
  150 ALPHA(1,1)=Z(1)*A(1)/XLEN
      DVD(1)=DVD(1)-ABS(Q(1))-A(1)*Z(1)/XLEN
  160 CALL DIVCK(NERR)
      IF(NERR.EQ.0)GO TO 2000
      WRITE(NWR,170)LCONS
  170 FORMAT(1H1,130(1H?),/,1H ,130(1H?),/,1H0,20(1H?),5X,16HZERO DIVISO
     1R IN ,A4,37H SOLUTION MATRIX - PROGRAM TERMINATES    )
      STOP
 2000 RETURN
      END
```

```
      SUBROUTINE DOCMP
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DVD(1)=-QOUT(1)-REAIR(1)*VOL(1)-EVAP(1)*AS(1)
      DVD(NJ)=-QOUT(NJ)-REAIR(NJ)*VOL(NJ)-EVAP(NJ)*AS(NJ)
      ALPHA(1,3)=QIN(1)*CIN(1)+PHOTO(1)-(DK1(1)*CBOD(1)+DK2(1)*XNOD(1))*
     1VOL(1)-SEDMT(1)*AS(1)+REAIR(1)*DOS(1)*VOL(1)
      ALPHA(NJ,3)=QIN(NJ)*CIN(NJ)+PHOTO(NJ)-(DK1(NJ)*CBOD(NJ)+DK2(NJ)*
     1XNOD(NJ))*VOL(NJ)-SEDMT(NJ)*AS(NJ)+REAIR(NJ)*DOS(NJ)*VOL(NJ)
      DO 1000 J=2,NC
      IF(NOJFX.EQ.0) GO TO 20
      DO 10 K=1,NOJFX
      IF(NFS(K).EQ.J) GO TO 1000
   10 CONTINUE
   20 DVD(J)=-QOUT(J)-REAIR(J)*VOL(J)-EVAP(J)*AS(J)
      ALPHA(J,3)=QIN(J)*CIN(J)+PHOTO(J)*AS(J)-(DK1(J)*CBOD(J)+DK2(J)*
     1XNOD(J))*VOL(J)-SEDMT(J)*AS(J)+REAIR(J)*DOS(J)*VOL(J)
      JM1=J-1
      IF(Q(JM1).LT.0.0) GO TO 30
      ALPHA(J,1)=ABS(Q(JM1))+A(JM1)*Z(JM1)/XLEN
      DVD(J)=DVD(J)-A(JM1)*Z(JM1)/XLEN
      GO TO 40
   30 ALPHA(J,1)=Z(JM1)*A(JM1)/XLEN
      DVD(J)=DVD(J)-ABS(Q(JM1))-A(JM1)*Z(JM1)/XLEN
   40 IF(Q(J).GT.0.0) GO TO 50
      ALPHA(J,2) =ABS(Q(J))+A(J)*Z(J)/XLEN
      DVD(J)=DVD(J)-A(J)*Z(J)/XLEN
      GO TO 60
*  50 ALPHA(J,2)=Z(J)*A(J)/XLEN
```

* This change is indicated in the errata for T.R. 54

Subroutine DOCMP (Cont'd)

```
      DVD(J)=DVD(J)-ABS(Q(J))-A(J)*Z(J)/XLEN
   60 CONTINUE
 1000 CONTINUE
      IF(Q(NC).LT.0.0) GO TO 70
      ALPHA(NJ,1)=ABS(Q(NC))+A(NC)*Z(NC)/XLEN
      DVD(NJ)=DVD(NJ)-A(NC)*Z(NC)/XLEN
      GO TO 80
   70 ALPHA(NJ,1)=Z(NC)*A(NC)/XLEN
      DVD(NJ) = DVD(NJ)-ABS(Q(NC))-A(NC)*Z(NC)/XLEN
   80 IF(Q(1).GT.0.0) GO TO 90
      ALPHA(1,1)=ABS(Q(1))+A(1)*Z(1)/XLEN
      DVD(1)=DVD(1)-A(1)*Z(1)/XLEN
      GO TO 100
   90 ALPHA(1,1)=Z(1)*A(1)/XLEN
      DVD(1)=DVD(1)-ABS(Q(1))-A(1)*Z(1)/XLEN
  100 CALL DIVCK (NERR)
      IF(NERR.EQ.0)GO TO 2000
      WRITE(NWR,110)LCONS
  110 FORMAT(1H1,130(1H?),/,1H ,130(1H?),/,1H0,20(1H?),5X,16HZERO DIVISO
     1R IN ,A4,37H SOLUTION MATRIX - PROGRAM TERMINATES     )
      STOP
 2000 RETURN
      END
```

Subroutine SOLVEX

```
      SUBROUTINE SOLVEX
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      RELAX=1.0
      MAXCYC=1000
      DELMAX=0.0001
      DO 1000  IT=1,MAXCYC
      BIG=0.0
      DO 30 J=2,NC
      IF(NOJFX.EQ.0) GO TO 20
      DO 10 K=1,NOJFX
      IF(J.EQ.NFS(K)) GO TO 30
   10 CONTINUE
   20 CNEW=0.0
      CNEW=CNEW-ALPHA(J,1)*C(J-1)/DVD(J)
      CNEW=CNEW-ALPHA(J,2)*C(J+1)/DVD(J)
      CNEW=CNEW-ALPHA(J,3)/DVD(J)
      DELC=CNEW-C(J)
      C(J)=C(J)+RELAX*DELC
      IF(ABS(DELC).LT.BIG) GO TO 30
      BIG= ABS(DELC)
      CHNG=DELC
      NBIG=J
   30 CONTINUE
      IF(NOJFX.EQ.0) GO TO 50
      DO 40 K=1,NOJFX
      IF(NJ.EQ.NFS(K)) GO TO 60
   40 CONTINUE
```

Subroutine SOLVEX (Cont'd)

```
   50 CNEW=-ALPHA(NJ,1)*C(NC)/DVD(NJ)
      CNEW= CNEW-ALPHA(NJ,3)/DVD(NJ)
      DELC= CNEW-C(NJ)
      C(NJ)=C(NJ)+RELAX*DELC
      IF(ABS(DELC).LT.BIG) GO TO 60
      BIG=ABS(DELC)
      CHNG=DELC
      NBIG=NJ
   60 IF(NOJFX.EQ.0) GO TO 80
      DO 70 K=1,NOJFX
      IF(1.EQ.NFS(K)) GO TO 90
   70 CONTINUE
   80 CNEW =-ALPHA(1,1)*C(2)/DVD(1)
      CNEW =CNEW-ALPHA(1,3)/DVD(1)
      DELC =CNEW-C(1)
      C(1)=C(1)+RELAX*DELC
      IF(ABS(DELC).LT.BIG) GO TO 100
      BIG = ABS(DELC)
      CHNG=DELC
      NBIG=1
   90 CONTINUE
  100 CONTINUE
      IF(BIG.LE.DELMAX)   GO TO 120
 1000 CONTINUE
      WRITE(NWR,110)MAXCYC,CHNG,NBIG
  110 FORMAT(1H ,18HNO CONVERGENCE IN ,I4,26H CYCLES.          HANGE IS,
     1E15.3,13H AT JUNC NO. ,I4,19H PROGRAM CONTINUI
      GO TO 140
  120 WRITE(NWR,130)IT
  130 FORMAT(1H ,15HCONVERGENCE IN ,I4,7H CYCLES    )
  140 CALL QALOUT
      RETURN
      END
```

Subroutine INTER

```
      SUBROUTINE INTER(REVAL,NMAT,X,Y,NPTS,RM)
      COMMON DT(250),DOUT(250),D(250),A1(250),A2(250),A3(250),
     1       HIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       DXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVO(250),NFS(250),RMC(250)
     6       ,CBOMP(250),XNBOD(250),CONCP(250),QMP(250),DXYNP(250)
      COMMON NC,NJ,XLEN,NOJEX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       IF,NWR,NVT
      DIMENSION REVAL(NMAT),X(NPTS),Y(NPTS),RM(NMAT)
      DO 21 I=1,NPTS
      TEST=X(I)
      JTMP=I
      DO 22 J=I,NPTS
      IF(X(J).GE.TEST) GO TO 22
      TEST=X(J)
      JTMP=J
   22 CONTINUE
      XTMP=X(I)
      YTMP=Y(I)
      X(I)=X(JTMP)
      Y(I)=Y(JTMP)
      X(JTMP)=XTMP
      Y(JTMP)=YTMP
   21 CONTINUE
      DO 10  J=1,NMAT
      XPT=RM(J)
      CALL TABU (X,Y,XPT,NPT,,YPT)
      REVAL(J)=YPT
   10 CONTINUE
      RETURN
      END
```

Subroutine TABU

```
      SUBROUTINE TABU(X.Y.XPT.NPTS.YPT)
      IF(NPTS.EQ.1) GO TO 10
      DIMENSION X(NPTS).Y(NPTS)
      NPM1=NPTS-1
      IF(XPT.LE.X(1)) GO TO 10
      IF(XPT.GE.X(NPTS)) GO TO 20
      DO 30 J=1.NPM1
      IF(XPT.GE.X(J).AND.XPT.LE.X(J+1)) GO TO 40
   30 CONTINUE
   40 S=(XPT-X(J))/(X(J+1)-X(J))
      YPT=Y(J)+(Y(J+1)-Y(J))*S
      GO TO 50
   20 YPT=Y(NPTS)
      GO TO 50
   10 YPT=Y(1)
   50 RETURN
      END
```

Subroutine OUTGO

```
      SUBROUTINE OUTGO(LVAR,NP,X,Y)
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DIMENSION X(250),Y(250)
      ILINE= NP/4
      IEXTA= NP-4*ILINE
      WRITE(NWR,10)LVAR,LVAR,LVAR,LVAR
   10 FORMAT(1H0,3X,A4,4X,5HRIVER,18X,A4,4X,5HRIVER,18X,A4,4X,5HRIVER,18
     1X,A4,4X,5HRIVER,/,1H ,4X,2HNO,5X,4HMILE,7X,5HVALUE,8X,2HNO,5X,4HMI
     2LE,7X,5HVALUE,8X,2HNO,5X,4HMILE,7X,5HVALUE,8X,2HNO,5X,4HMILE,7X,5H
     3VALUE )
      DO 30 I=1,ILINE
      I2=I+ILINE+IEXTA
      I3=I2+ILINE
      I4=I3+ILINE
      WRITE(NWR,20)I,X(I),Y(I),I2,X(I2),Y(I2),I3,X(I3),Y(I3),I4,X(I4),
     1             Y(I4)
   20 FORMAT(1H ,3X,I3,4X,F6.2,4X,1PE10.3,4X,I3,4X,0PF6.2,4X,1PE10.3,
     14X,I3,4X,0PF6.2,4X,1PE10.3,4X,I3,4X,0PF6.2,4X,1PE10.3)
   30 CONTINUE
      IF(IEXTA.EQ.0)GO TO 60
      IEND=ILINE+IEXTA
      IBEG=ILINE+1
      DO 50 I=IBEG,IEND
      WRITE(NWR,40)I,X(I),Y(I)
   40 FORMAT(1H ,3X,I3,4X,F6.2,4X,1PE10.3)
   50 CONTINUE
   60 RETURN
      END
```

Subroutine DIVCK

```
      SUBROUTINE DIVCK(NERR)
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRU,NWR,NVT
      NERR=0
      DO 10 J=1,NJ
      IF(NOJFX.EQ.0) GO TO 11
      DO 20 K=1,NOJFX
      IF(J.EQ.NFS(K)) GO TO 10
   20 CONTINUE
   11 IF(DVD(J).NE.0.0) GO TO 10
      WRITE(NWR,30)J
   30 FORMAT(1H ,20(1H?),5X,23HZERO DIVIDE AT JUNCTION,I5)
      NERR=NERR+1
   10 CONTINUE
      RETURN
      END
```

Function JKFND

```
FUNCTION JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
NSET=1+IFIX(((DIST-RMDWN)/XMIL)+0.5)
IF(DIST.LT.RMDWN) NSET=1
IF(DIST.GT.RMUP) NSET=NJ
JKFND=NSET
RETURN
END
```

Subroutine QALOUT

```
      SUBROUTINE QALOUT
      COMMON QIN(250),QOUT(250),Q(250),A1(250),A2(250),A3(250),
     1       WIDTH(250),AS(250),V(250),TEMP(250),EVAP(250),RMJ(250),
     2       PHOTO(250),SEDMT(250),Z(250),DK1(250),DK2(250),XNOD(250),
     3       REAIR(250),DOS(250),CBODI(250),CBOD(250),XNODI(250),
     4       OXY(250),CS(250),A(250),VOL(250),CIN(250),C(250),
     5       LALPHA(20),ALPHA(250,3),DVD(250),NFS(250),RMC(250)
     6       ,CBDNP(250),XNBNP(250),CONNP(250),QNP(250),OXYNP(250)
      COMMON NC,NJ,XLEN,NOJFX,RMUP,RMDWN,RMFR,NSECS,XMIL,LCONS,K2FL,
     1       NRD,NWR,NVT
      DATA LCBD/4HCBOD/,LNBD/4HNBOD/,LDO/4HDO   /
      DATA LVAR1/4HJUNC/,LVAR2/4HCHAN/
      WRITE(NWR,10)(LALPHA(K),K=1,20),LCONS,QOUT(1)
   10 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,20(1H*),5X,20A4,5X,20(1H*
     1),/,1H ,130(1H*),/,1H ,20(1H*),5X,13HSTEADY STATE ,A4,21H CONCENTR
     2ATIONS (PPM),47X,20(1H*),/,1H ,20(1H*),90X,20(1H*),/,1H ,20(1H*),
     35X,27HOUTFLOW AT DOWNSTREAM END =,F10.1,4H CFS,44X,20(1H*),/,1H ,
     4130(1H*),/,1H ,130(1H*))
      WRITE(NWR,20)
   20 FORMAT(1H0,50X,20HCONCENTRATIONS (PPM) )
      XCK=1.0E-10
      DO 25 J=1,NJ
      IF(C(J).LT.XCK)C(J)=0.0
   25 CONTINUE
      CALL OUTGO(LVAR1,NJ,RMJ,C)
      IF(LCONS.EQ.LCBD.OR.LCONS.EQ.LNBD.OR.LCONS.EQ.LDO)GO TO 30
      GO TO 40
   30 BOTTOM=0.0
      GO TO 60
   40 BOTTOM=1.0E25
      DO 50 J=1,NJ
      IF(C(J).LT.BOTTOM)BOTTOM=C(J)
   50 CONTINUE
      IF(BOTTOM.LT.0.0)BOTTOM=0.0
      IBOT=IFIX(BOTTOM)
```

Subroutine QALOUT (Cont'd)

```
      BOTTOM=FLOAT(IBOT)
   60 TOP=0.0
      DO 70 J=1,NJ
      IF(C(J).GT.TOP)TOP=C(J)
   70 CONTINUE
      ITOP=IFIX(TOP+1.0)
      TOP=FLOAT(ITOP)
      WRITE(NWR,80)LCONS
   80 FORMAT(1H1,12HX=RIVER MILE,85X,3HY= ,A4,21H CONCENTRATIONS (PPM),
     1/,1H0)
      CENT=0.0
      NSKIP=0
      CALL GRAPH(BOTTOM,TOP,NJ,RMJ,C,CENT,NSKIP,NWR)
      RETURN
      END
```

Subroutine GRAPH

```
      SUBROUTINE GRAPH(BOTTOM,TOP,NP,X,Y,CENT,NSKIP,NWR)
      DIMENSION X(NP),Y(NP),IPLT(100)
      DATA LCNT,LPLUS/1HI,1H+/
      DATA LRB,LRSTAR,LRPT,LRO/1H ,1H*,1H-,1H0/
      NDEX=NSKIP
      LINEZ=IABS(NSKIP)
      IF(NDEX.LT.1) NDEX=1
   40 WRITE(NWR,330) BOTTOM,TOP
  330 FORMAT(1H , 8X,1PE8.1,91X,E8.1)
      WRITE(NWR,310)
  310 FORMAT(1H ,4X,1HX,5X,101(1H.),5X,1HY )
      YS=(TOP-BOTTOM)/100.0
      NCENT=(CENT-BOTTOM)/YS
      DO 50 JFK=1,NP,NDEX
      DO 60 LY=1,100
      IPLT(LY)=LRB
   60 CONTINUE
      IF(NSKIP.GE.0) GO TO 3
      IF(NCENT.GT.0) IPLT(NCENT)=LCNT
      DO 5 LBJ=1,LINEZ
      WRITE(NWR,6)IPLT
    6 FORMAT(1H ,10X,1H.,100A1,1H.)
    5 CONTINUE
    3 NPOT=(Y(JFK)-BOTTOM)/YS
      IF(NPOT.GT.100) NPOT=100
      IF(NPOT.LT.1) NPOT=1
      IF(NCENT.GT.100) GO TO 550
      IF(NCENT.LE.0) GO TO 550
      IF(NPOT.LT.NCENT) GO TO 500
      LIMIT=NPOT-1
      IF(LIMIT.LT.1) GO TO 550
      DO 400 LL=NCENT,LIMIT
      IPLT(LL)=LPLUS
  400 CONTINUE
      IPLT(NCENT)=LCNT
```

Subroutine GRAPH (Cont'd)

```
      GO TO 550
  500 LIMIT=NPOT+1
      DO 501 LL=LIMIT,NCENT
      IPLT(LL)=LRPT
  501 CONTINUE
      IPLT(NCENT)= LCNT
  550 CONTINUE
    2 IPLT(NPOT)=LRSTAR
    4 WRITE(NWR,320) X(JFK),IPLT,Y(JFK)
  320 FORMAT(1H ,     1PE8.1,1X,1H.,100A1,1H.,    E8.1)
   50 CONTINUE
      WRITE(NWR,350)
  350 FORMAT(1H ,10X,101(1H.))
      RETURN
      END
```

AUTØQD:

The program output has the same basic format with the following additions:

Under the heading "Estuary/Stream Data" the non-point source input data and other physical data is printed.

Under the heading "Flow Conditions for the Period (Month-Day-Year) through (Month-Day-Year)" the point source inflows and/or diversions, the non-point source inflows and/or non-point losses and the channel flows are printed. The non-point values printed here are the equivalent junction inflows and/or diversions (non-point source value multiplied by channel length)"

Under the heading"Input Conditions for (Month-Day-Year) through (Month-Day-Year)" the point source inflow concentrations and the equivalent non-point source loadings are printed.
The non-point source loading is the total mass loading due to non-point sources for the junctions (non-point source value multiplied by channel length).

The same new variables have been added to program AUTØQD that were added to AUTØSS.

Program Listing

Following is a complete listing of Program AUTØQD. New or changed cards are marked by arrows.

```
C*******************************************************************
C*******************************************************************
C*********                                                **********
C*********    PROGRAM AUTOQD - QUASI-DYNAMIC WATER QUALITY ***********
C*********                                                ***********
C*******************************************************************
C*******************************************************************
C*********                                                ***********
C*********    WRITTEN BY R.L. CRIM AND N.L. LOVELACE       ***********
C*********                                                ***********
C*********    ENVIRONMENTAL PROTECTION AGENCY, REGION III  ***********
C*********    ANNAPOLIS FIELD OFFICE                       ***********
C*********    TECHNICAL DEVELOPMENT SECTION                ***********
C*********    ANNAPOLIS SCIENCE CENTER, ANNAPOLIS, MD. 21401 ***********
C*********    PHONE: 301-268-5038 OR 202-261-2410          ***********
C*********                                                ***********
C*******************************************************************
C*******************************************************************
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DATA LBD/4HCBOD/,LND/4HNBOD/,LO/4HDO  /,LSTO/4HSTOP/,
     1     LJU/4HJUNC/,LCH/4HCHAN/,LFX/4HFIXE/,LFLO/4HFLOW/,
     2     LDATA/4HDATA/,LHALT/4HHALT/
      LCBD=LBD
      LNBD=LND
      LDO=LO
      LSTOP=LSTO
```

AUTØQD:

The program output has the same basic format with the following additions:

Under the heading "Estuary/Stream Data" the non-point source input data and other physical data is printed.

Under the heading "Flow Conditions for the Period (Month-Day-Year) through (Month-Day-Year)" the point source inflows and/or diversions, the non-point source inflows and/or non-point losses and the channel flows are printed. The non-point values printed here are the equivalent junction inflows and/or diversions (non-point source value multiplied by channel length)"

Under the heading "Input Conditions for (Month-Day-Year) through (Month-Day-Year)" the point source inflow concentrations and the equivalent non-point source loadings are printed. The non-point source loading is the total mass loading due to non-point sources for the junctions (non-point source value multiplied by channel length).

The same new variables have been added to program AUTØQD that were added to AUTØSS.

Program Listing

Following is a complete listing of Program AUTØQD. New or changed cards are marked by arrows.

```
C***********************************************************************
C***********************************************************************
C*********                                                   ***********
C*********    PROGRAM AUTOQD - QUASI-DYNAMIC WATER QUALITY   ***********
C*********                                                   ***********
C***********************************************************************
C***********************************************************************
C*********                                                   ***********
C*********    WRITTEN BY R.L. CRIM AND N.L. LOVELACE         ***********
C*********                                                   ***********
C*********    ENVIRONMENTAL PROTECTION AGENCY, REGION III    ***********
C*********    ANNAPOLIS FIELD OFFICE                         ***********
C*********    TECHNICAL DEVELOPMENT SECTION                  ***********
C*********    ANNAPOLIS SCIENCE CENTER, ANNAPOLIS, MD. 21401 ***********
C*********    PHONE: 301-268-5038 OR 202-261-2410            ***********
C*********                                                   ***********
C***********************************************************************
C***********************************************************************
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DUS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),GNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DATA LBD/4HCBOD/,LND/4HNBOD/,LO/4HDO  /,LSTO/4HSTOP/,
     1     LJU/4HJUNC/,LCH/4HCHAN/,LFX/4HFIXE/,LFLO/4HFLOW/,
     2     LDATA/4HDATA/,LHALT/4HHALT/
      LCBD=LBD
      LNBD=LND
      LDO=LO
      LSTOP=LSTO
```

```
      LVAR1=LJU
      LVAR2=LCH
      LFIXE=LFX
      NRD=1
      NWR=6
      NVT=0
      READ(NRD,10)(LALPHA(K),K=1,20)
   10 FORMAT(20A4)
      READ(NRD,20)RMDWN,RMUP,RMFR,NSECS
   20 FORMAT(3F10.0,I10)
      WRITE(NWR,30)
   30 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,13X,3HAAA,11X,3HUUU,9X,3H
     1UUU,5X,15(1HT),7X,11(1HO),9X,11(1HQ),7X,13(1HD),/,1H ,12X,5HAAAAA,
     210X,3HUUU,9X,3HUUU,5X,15(1HT),6X,13(1HO),7X,13(1HQ),6X,14(1HD),/,1
     3H ,11X,7(1HA),9X,3HUUU,9X,3HUUU,5X,15(1HT),5X,15(1HO),5X,15(1HQ),5
     4X,15(1HD),/,1H ,10X,3HAAA,3X,3HAAA,8X,3HUUU,9X,3HUUU,11X,3HTTT,11X
     5,3HOOO,9X,3HOOO,
     6        5X,3HQQQ,9X,3HQQQ,5X,3HDDD,9X,3HDDD,/,1H ,9X,3HAAA,5X,3HAAA
     7,7X,3HUUU,9X,3HUUU,11X,3HTTT,11X,3HOOO,9X,3HOOO,5X,3HQQQ,9X,3HQQQ,
     85X,3HDDD,9X,3HDDD,/,1H ,8X,3HAAA,7X,3HAAA,6X,3HUUU,9X,3HUUU,11X,3H
     9TTT,11X,3HOOO,9X,3HOOO,5X,3HQQQ,5X,7HQQQ QQQ,5X,3HDDD,9X,3HDDD )
      WRITE(NWR,40)
   40 FORMAT(1H ,7X,15(1HA),5X,3HUUU,9X,3HUUU,11X,3HTTT,11X,3HOOO,9X,3HO
     1OO,5X,3HQQQ,6X,6HQQQQQQ,5X,3HDDD,9X,3HDDD,/,1H ,7X,15(1HA),5X,15(1
     2HU),11X,3HTTT,11X,15(1HO),5X,15(1HQ),5X,15(1HD),/,1H ,7X,3HAAA,9X,
     33HAAA,6X,13(1HU),12X,3HTTT,12X,13(1HO),7X,14(1HQ),5X,14(1HD),/,1H
     4,7X,3HAAA,9X,3HAAA,7X,11(1HU),13X,3HTTT,13X,11(1HO),9X,13(1HQ),5X,
     513(1HD),/,1H ,130(1H*),/,1H ,130(1H*) )
      WRITE(NWR,50)(LALPHA(K),K=1,20),RMDWN,RMUP,RMFR,NSECS
   50 FORMAT(1H0,20(1H*),5X,33HQUASI-DYNAMIC WATER QUALITY MODEL,/,1H ,2
     10(1H*),/,1H ,20(1H*),5X,14HRUN TITLE.....,20A4,/,1H ,20(1H*),/,1H
     2,20(1H*),/,1H ,20(1H*),5X,18HBASIC NETWORK DATA,/,1H ,20(1H*),5X,3
     31HRIVER MILE AT DOWNSTREAM END....,F10.2,/,1H ,20(1H*),5X,31HRIVER
     4MILE AT UPSTREAM END......,F10.2,/,1H ,20(1H*),5X,31HRIVER MILE OF
     5FALL LINE.........,F10.2,/,1H ,20(1H*),5X,31HNUMBER OF SECTIONS....
```

Main PROGRAM (Cont'd)

```
     6..........I10 )
      CALL SETUP
 1000 READ(NRD,10)LTYPE
      IF(LTYPE.EQ.LHALT)GO TO 2000
      IF(LTYPE.NE.LDATA)GO TO 60
      CALL NETDAT
      GO TO 1000
   60 IF(LTYPE.NE.LCBD)GO TO 80
      DO 70 J=1,NJ
      C(J)=CBOD(J)
   70 CONTINUE
      CALL VAULIN
      CALL VALCMP
      DO 75 J=1,NJ
      CBOD(J)=C(J)
   75 CONTINUE
      GO TO 1000
   80 IF(LTYPE.NE.LNBD)GO TO 100
      DO 90 J=1,NJ
      C(J)=XNOD(J)
   90 CONTINUE
      CALL VAULIN
      CALL VALCMP
      DO 95 J=1,NJ
      XNOD(J)=C(J)
   95 CONTINUE
      GO TO 1000
  100 IF(LTYPE.NE.LDO)GO TO 110
      CALL VDOIN
      CALL VDOCP
      GO TO 1000
  110 IF(LTYPE.NE.LFLO)GO TO 120
      CALL FLOWS
      GO TO 1000
  120 DO 130 J=1,NJ
```

Main PROGRAM (Cont'd)

```
      C(J)=CS(J)
  130 CONTINUE
      CALL VAULIN
      CALL VALCMP
      DO 135 J=1,NJ
      CS(J)=C(J)
  135 CONTINUE
      GO TO 1000
 2000 STOP
      END
```

Subroutine SETUP

```
      SUBROUTINE SETUP
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      NC=NSECS
      NJ=NSECS+1
      XMIL=(RMUP-RMDWN)/FLOAT(NC)
      XLEN=XMIL*5285.0
      RMJ(1)=RMDWN
      DO 10 J=2,NJ
      RMJ(J)=RMJ(J-1)+XMIL
   10 CONTINUE
      RMC(1)= RMDWN+(XMIL/2.0)
      DO 20 N=2,NC
      RMC(N)=RMC(N-1)+XMIL
   20 CONTINUE
      DO 30 J=1,NJ
      CBDNP(J)=0.0
      XNBNP(J)=0.0
      QNP(J)=0.0
      CONNP(J)=0.0
      OXYNP(J)=0.0
      QIN(J)=0.0
      QOUT(J)=0.0
      Q(J)=0.0
      A(J)=0.0
```

Subroutine SETUP (Cont'd)

```
      Z(J)=0.0
      XNDIN(J)=0.0
      CBDIN(J)=0.0
      OXIN(J)=0.0
      CIN(J)=0.0
      C(J)=0.0
      REAIR(J)=0.0
      VOL(J)=0.0
      PHOTO(J)=0.0
      EVAP(J)=0.0
      AS(J)=0.0
      SEDMT(J)=0.0
      DOS(J)=0.0
      V(J)=0.0
      WIDTH(J)=0.0
      A1(J)=0.0
      A2(J)=0.0
      A3(J)=0.0
      TEMP(J)=20.0
      DK1(J)=0.0
      DK2(J)=0.0
      CBOD(J)=0.0
      XNOD(J)=0.0
      OXY(J)=0.0
      CS(J)=0.0
      NFS(J)=0
      XMASS(J)=0.0
      XNMAS(J)=0.0
      XCMAS(J)=0.0
      XOMAS(J)=0.0
      DO 30 K=1.3
      MFS(J,K)=0
   30 CONTINUE
      RETURN
      END
```

Subroutine NEDAT

```
      SUBROUTINE NETDAT
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DATA LA1/4HA1   /,LA2/4HA2   /,LA3/4HA3   /,LWIDT/4HWIDT/,
     1    LVEL/4HVELO/,LTEMP/4HTEMP/,LVAP/4HEVAP/,LPHOTO/4HPHOT/,
     2    LSEDMT/4HSEDI/,LDISP/4HDISP/,LDK1/4HCDEC/,LDK2/4HNDEC/,
     3    LREAI/4HREAE/,LDOS/4HSATD/,LINIT/4HINIT/,LOXY/4HDO   /,
     4    LCSA/4HC-SA/,LCK2/4HC-RE/,LFLO/4HFLOW/,LNON/4HNONP/
      DATA VAPFAC/1.86224E07/,CVFAC/3.28075E00/
      DIMENSION X(250),Y(250)
      K2FL=0
      WRITE(NWR,10)
   10 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,35(1H*),61X,34(1H*),/,1H
     1,35(1H*),6X,49HE S T U A R Y / S T R E A M   I N P U T   D A T A,
     26X,34(1H*),/,1H ,35(1H*),61X,34(1H*),/,1H ,130(1H*),/,1H ,130(1H*)
     3)
 1000 READ(NRD,20)LABEL,LCST,NPTS
   20 FORMAT(2A4,2X,I5)
      IF(LABEL.EQ.LSTOP)GO TO 5000
      IF(NPTS.EQ.0) GO TO 45
      DO 40 J=1,NPTS
*     READ(NRD,30)I,X(J),Y(J)
   30 FORMAT(I5,5X,2F10.0)
   40 CONTINUE
   45 IF(LABEL.NE.LA1) GO TO 60
```

* This change is indicated in the errata for T.R. 54

Subroutine NEDAT (Cont'd)

```
      CALL  INTER(A1,NC,X,Y,NPTS,RMC)
      WRITE(NWR,50)
   50 FORMAT(1H0,20(1H*),5X,32HA1 COEFFICIENT FOR FLOW EQUATION,5X,20(1H
     1*) )
      CALL  OUTGO(LVAR2,NC,RMC,A1)
      GO TO 1000
   60 IF(LABEL.NE.LA2) GO TO 80
      CALL  INTER(A2,NC,X,Y,NPTS,RMC)
      WRITE(NWR,70)
   70 FORMAT(1H0,20(1H*),5X,32HA2 COEFFICIENT FOR FLOW EQUATION,5X,20(1H
     1*) )
      CALL  OUTGO(LVAR2,NC,RMC,A2)
      GO TO 1000
   80 IF(LABEL.NE.LA3) GO TO 100
      CALL  INTER(A3,NC,X,Y,NPTS,RMC)
      WRITE(NWR,90)
   90 FORMAT(1H0,20(1H*),5X,79HA3 COEFFICIENT FOR FLOW EQUATION - RERESE
     1NTS DEPTH OF FLOW IF A1 AND/OR A2 ARE ,5X,20(1H*),/,1H ,20(1H*),5X
     2,27HNOT SPECIFIED (OR ARE ZERO),57X,20(1H*) )
      CALL  OUTGO(LVAR2,NC,RMC,A3)
      GO TO 1000
  100 IF(LABEL.NE.LWIDT)GO TO 120
      CALL  INTER(WIDTH,NC,X,Y,NPTS,RMC)
      WRITF(NWR,110)
  110 FORMAT(1H0,20(1H*),5X,19HCHANNEL WIDTHS (FT),5X,20(1H*) )
      CALL  OUTGO(LVAR2,NC,RMC,WIDTH)
      AS(1)=WIDTH(1)*XLEN
      AS(NJ)=WIDTH(NJ)*XLEN
      DO 112 J=2,NC
      AS(J)=XLEN*0.5*(WIDTH(J)+WIDTH(J-1))
  112 CONTINUE
      WRITE(NWR,114)
  114 FORMAT(1H0,20(1H*),5X,29HJUNCTION SURFACE AREAS (SQFT),5X,20(1H*))
      CALL  OUTGO(LVAR1,NJ,RMJ,AS)
      GO TO 1000
  120 IF(LABEL.NE.LVEL) GO TO 150
```

Subroutine NETDAT (Cont'd)

```
      NVT=1
      CALL INTER(V,NC,X,Y,NPTS,RMC)
      DO 130 N=1,NC
      IF(RMC(N).GT.RMFR) V(N)=0.0
  130 CONTINUE
      WRITE(NWR,140)
  140 FORMAT(1H0,20(1H*),5X,41HAVERAGE CHANNEL TIDAL VELOCITIES (FT/SEC)
     1,5X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,V)
      GO TO 1000
  150 IF(LABEL.NE.LTEMP) GO TO 170
      CALL INTER(TEMP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,160)
  160 FORMAT(1H0,20(1H*),5X,35HJUNCTION WATER TEMPERATURES (DEG-C),5X,20
     1(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,TEMP)
      GO TO 1000
  170 IF(LABEL.NE.LVAP) GO TO 200
      CALL INTER(EVAP,NJ,X,Y,NPTS,RMJ,EVAP)
      WRITE(NWR,180)
  180 FORMAT(1H0,20(1H*),5X,34HNET EVAPORATION - RAINFALL (IN/MO),5X,20(
     11H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,EVAP)
      DO 190 J=1,NJ
      EVAP(J)=EVAP(J)/VAPFAC
  190 CONTINUE
      GO TO 1000
  200 IF(LABEL.NE.LPHOTO) GO TO 230
      CALL INTER(PHOTO,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,210)
  210 FORMAT(1H0,20(1H*),5X,61HAVERAGE DAILY PHOTOSYNTHESIS-RESPIRATION
     1RATE (GM O2/SQM/DAY),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,PHOTO)
      DO 220 J=1,NJ
      PHOTO(J)=PHOTO(J)*CVFAC/86400.0
```

```
220 CONTINUE
    GO TO 1000
230 IF(LABEL.NE.LSEDMT) GO TO 260
    CALL INTER(SEDMT,NJ,X,Y,NPTS,RMJ)
    WRITE(NWR,240)
240 FORMAT(1H0,20(1H*),5X,42HOXYGEN UPTAKE OF SEDIMENTS (GM O2/SQM/DAY
   1),5X,20(1H*) )
    CALL OUTGO(LVAR1,NJ,RMJ,SEDMT)
    DO 250 J=1,NJ
    SEDMT(J)=SEDMT(J)*CVFAC/86400.0
250 CONTINUE
    GO TO 1000
260 IF(LABEL.NE.LDISP) GO TO 280
    CALL INTER(Z,NC,X,Y,NPTS,RMC)
    WRITE(NWR,270)
270 FORMAT(1H0,20(1H*),5X,34HDISPERSION COEFFICIENTS (SQFT/SEC),5X,20(
   11H*) )
    CALL OUTGO(LVAR2,NC,RMC,Z)
    GO TO 1000
280 IF(LABEL.NE.LDK1)GO TO 310
    CALL INTER(DK1,NJ,X,Y,NPTS,RMJ)
    DO 285 J=1,NJ
    DK1(J)=DK1(J)*1.047**(TEMP(J)-20.0)
285 CONTINUE
    WRITE(NWR,290)
290 FORMAT(1H0,20(1H*),5X,52HCHOD DECAY RATES CORRECTED TO STREAM TEMP
   1S - (1/DAY),5X,20(1H*))
    CALL OUTGO(LVAR1,NJ,RMJ,DK1)
    DO 300 J=1,NJ
    DK1(J)=DK1(J)/86400.0
300 CONTINUE
    GO TO 1000
310 IF(LABEL.NE.LDK2)GO TO 340
    CALL INTER(DK2,NJ,X,Y,NPTS,RMJ)
    DO 315 J=1,NJ
```

Subroutine NETDAT (Cont'd)

```
      DK2(J)=DK2(J)*1.015**(TEMP(J)-20.0)
  315 CONTINUE
      WRITE(NWR,320)
  320 FORMAT(1H0,20(1H*),5X,52HNBOD DECAY RATES CORRECTED TO STREAM TEMP
     1S - (1/DAY),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,DK2)
      DO 330 J=1,NJ
      DK2(J)=DK2(J)/86400.0
  330 CONTINUE
      GO TO 1000
  340 IF(LABEL.NE.LREAI) GO TO 370
      CALL INTER(REAIR,NJ,X,Y,NPTS,RMJ)
      DO 345 J=1,NJ
      REAIR(J)=REAIR(J)*1.024**(TEMP(J)-20.0)
  345 CONTINUE
      WRITE(NWR,350)
  350 FORMAT(1H0,20(1H*),5X,58HINPUT REAERATION RATES CORRECTED TO STREA
     1M TEMPS - (1/DAY),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,REAIR)
      DO 360 J=1,NJ
      REAIR(J)=REAIR(J)/86400.0
  360 CONTINUE
      GO TO 1000
  370 IF(LABEL.NE.LDOS) GO TO 390
      CALL INTER(DOS,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,380)
  380 FORMAT(1H0,20(1H*),5X,46HINPUTED OXYGEN SATURATION CONCENTRATIONS
     1(PPM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,DOS)
      GO TO 1000
  390 IF(LABEL.NE.LINIT) GO TO 470
      IF(LCST.NE.LCBD)GO TO 410
      CALL INTER(CBOD,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,400)
  400 FORMAT(1H0,20(1H*),5X,33HINITIAL CBOD CONCENTRATIONS (PPM),5X,20(1
```

```
     1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,CBOD)
      GO TO 1000
  410 IF(LCST.NE.LNBD)GO TO 430
      CALL INTER(XNOD,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,420)
  420 FORMAT(1H0,20(1H*),5X,33HINITIAL NBOD CONCENTRATIONS (PPM),5X,20(1
     1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,XNOD)
      GO TO 1000
  430 IF(LCST.NE.LOXY) GO TO 450
      CALL INTER(OXY,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,440)
  440 FORMAT(1H0,20(1H*),5X,45HINITIAL DISSOLVED OXYGEN CONCENTRATIONS (
     1PPM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,OXY)
      GO TO 1000
  450 CALL INTER(CS,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,460)LCST
  460 FORMAT(1H0,20(1H*),5X,8HINITIAL ,A4,21H CONCENTRATIONS (PPM),5X,20
     1(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,CS)
      GO TO 1000
  470 IF(LABEL.NE.LCSA)GO TO 500
      DO 480 J=1,NJ
      DOS(J)=14.62-0.367*TEMP(J)+0.0045*(TEMP(J)**2.0)
  480 CONTINUE
      WRITE(NWR,490)
  490 FORMAT(1H0,20(1H*),5X,47HCOMPUTED OXYGEN SATURATION CONCENTRATIONS
     1 (PPM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,DOS)
      GO TO 1000
  500 IF(LABEL.NE.LCK2)GO TO 510
      K2FL=1
      GO TO 1000
```

```
  510 IF (LABEL.NE.LNON) GO TO 610
      IF(LCST.NE.LCBD)GO TO 530
      CALL INTER(CBDNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,520)
  520 FORMAT(1H0,20(1H*),5X,63HCBOD NONPOINT SOURCE CONTRIBUTION (LBS CB
     1OD/DAY/MILE OF STREAM),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CBDNP)
      GO TO 1000
  530 IF(LCST.NE.LNBD)GO TO 550
      CALL INTER(XNBNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,540)
  540 FORMAT(1H0,20(1H*),5X,63HNBOD NONPOINT SOURCE CONTRIBUTION (LBS NB
     1OD/DAY/MILE OF STREAM),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,XNBNP)
      GO TO 1000
  550 IF(LCST.NE.LOXY)GO TO 570
      CALL INTER(OXYNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,560)
  560 FORMAT(1H0,20(1H*),5X,60HO2 NONPOINT SOURCE CONTRIBUTIONS (LBS O2/
     1DAY/MILE OF STREAM),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,OXYNP)
      GO TO 1000
  570 IF(LCST.NE.LFLO)GO TO 590
      CALL INTER(QNP,NJ,X,Y,NPTS,RMJ)
      WRITE (NWR,580)
  580 FORMAT(1H0,20(1H*),5X,41HNONPOINT SOURCE FLOW (CFS/MILE OF STREAM)
     1,5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,QNP)
      GO TO 1000
  590 CALL INTER(CONNP,NJ,X,Y,NPTS,RMJ)
      WRITE(NWR,600)LCST,LCST
  600 FORMAT(1H0,20(1H*),5X,A4,35H NONPOINT SOURCE CONTRIBUTION (LBS ,A4
     1,20H/DAY/MILE OF STREAM),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CONNP)
      GO TO 1000
```

Subroutine NETDAT (Cont'd)

```
  610 WRITE(NWR,620)LABEL
  620 FORMAT(1H1,130(1H?),/,1H ,130(1H?),/,1H ,20(1H?),5X,10HDATA CODE ,
     1A4,36H DOES NOT EXIST - PROGRAM TERMINATES,/,1H ,130(1H?),/,1H ,
     2130(1H?))
      STOP
 5000 RETURN
      END
```

Subroutine FLOWS

```
      SUBROUTINE FLOWS
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION LMN(12),QINP(250),QONP(250)
      DATA LMN(1)/4HJAN./,LMN(2)/4HFEB./,LMN(3)/4HMAR./,LMN(4)/4HAPR./,
     1    LMN(5)/4HMAY /,LMN(6)/4HJUNE/,LMN(7)/4HJULY/,LMN(8)/4HAUG./,
     2    LMN(9)/4HSEP./,LMN(10)/4HOCT./,LMN(11)/4HNOV./,
     3    LMN(12)/4HDEC./
      DO 10 J=1,NJ
      QIN(J)=0.0
      QOUT(J)=0.0
      Q(J)=0.0
      IF(QNP(J).LE.0.0)GO TO 5
      QINP(J)=QNP(J)*XMIL
      QONP(J)=0.0
      GO TO 10
    5 QONP(J)=-QNP(J)*XMIL
      QINP(J)=0.0
   10 CONTINUE
      READ(NRD,15)IMOB,IDAYB,IYRB,IMOE,IDAYE,IYRE
   15 FORMAT(I2,1X,I2,1X,I4,5X,I2,1X,I2,1X,I4)
      IYB=IYRB-1900
      IYE=IYRE-1900
      CALL SERIAL(IDAYE,IMOE,IYE,NEND)
      CALL SERIAL(IDAYB,IMOB,IYB,NBEG)
```

Subroutine FLOWS

```
      NDAYS=NEND-NBEG+1
   20 READ(NRD,30)LABEL,DIST,QN,QAUT
   30 FORMAT(A4,6X,3F10.0)
      IF(LABEL.EQ.LSTOP)GO TO 40
      JUNC=JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
      QIN(JUNC)=QIN(JUNC)+QN
      QOUT(JUNC)=QOUT(JUNC)+QAUT
      GO TO 20
   40 Q(NC)=-QIN(NJ)-QINP(NJ)+EVAP(NJ)*AS(NJ)
      DO 50 N=2,NC
      NCHAN=NJ-N
      NCP=NCHAN+1
      Q(NCHAN)=Q(NCP)-QIN(NCP)-QINP(NCP)+QOUT(NCP)+QONP(NCP)+EVAP(NCP)*
     1AS(NCP)
   50 CONTINUE
      CALL FLOCMP
      SUMIN=0.0
      SUMOUT=0.0
      DO 70 J=1,NJ
      SUMIN=SUMIN+QIN(J)+QINP(J)
      SUMOUT=SUMOUT+QOUT(J)+QONP(J)
      IF(EVAP(J).LT.0.0)GO TO 60
      SUMOUT=SUMOUT+EVAP(J)*AS(J)
      GO TO 70
   60 SUMIN=SUMIN-EVAP(J)*AS(J)
   70 CONTINUE
      IF(SUMOUT.GT.SUMIN)GO TO 80
      QOUT(1)=QOUT(1)+SUMIN-SUMOUT
      GO TO 90
   80 QIN(1)=QIN(1)+SUMOUT-SUMIN
   90 WRITE(NWR,100)LMN(IMOB),IDAYB,IYRB,LMN(IMOE), IDAYE,IYRE,NDAYS,
     *                SUMIN,SUMOUT,QOUT(1)
  100 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),5X,21HFLOW CONDIT
     1IONS FOR  ,A4,1X,I2,2H, ,I4,1X,4HTHRU,1X,A4,1X,I2,2H, ,I4,22X,25(1
     2H*),/,1H ,25(1H*),80X,25(1H*),/,1H ,25(1H*),5X,32HNUMBER OF DAYS I
```

```
     3N THIS PERIOD = ,I4,39X,25(1H*),/,1H ,25(1H*),5X,16HTOTAL INFLOWS
     4= ,F10.2,4H CFS,45X,25(1H*),/,1H ,25(1H*),5X,19HTOTAL DIVERSIONS =
     5 ,F10.2,4H CFS,42X,25(1H*),/,1H ,25(1H*),5X,33HOUTFLOW AT DOWNSTRE
     6AM JUNCTION = ,F10.2,4H CFS,28X,25(1H*),/,1H ,130(1H*),/,1H ,130(1
     7H*))
      WRITE(NWR,110)
  110 FORMAT(1H0,20(1H*),5X,26HPOINT SOURCE INFLOWS (CFS),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QIN)
      WRITE(NWR,120)
  120 FORMAT(1H0,20(1H*),5X,50HNONPOINT SOURCE INFLOWS (CFS) (EXCLUDING
     1RAINFALL),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QINP)
      WRITE(NWR,130)
  130 FORMAT(1H0,20(1H*),5X,22HPOINT DIVERSIONS (CFS),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,QOUT)
      WRITE(NWR,140)
  140 FORMAT(1H0,20(1H*),5X,59HNONPOINT DIVERSIONS OR LOSSES (CFS) (EXCL
     1UDING EVAPORATION),5X,20(1H*)   )
      CALL OUTGO(LVAR1,NJ,RMJ,QONP)
      WRITE(NWR,150)
  150 FORMAT(1H0,20(1H*),5X,19HCHANNEL FLOWS (CFS),5X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,Q)
      DO 160 J=1,NJ
      QIN(J)=QIN(J)+QINP(J)
      QOUT(J)=QOUT(J)+QONP(J)
  160 CONTINUE
      RETURN
      END
```

Subroutine FLOCMP

```
      SUBROUTINE FLOCMP
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION LMN(12)
      DATA LMN(1)/4HJAN./,LMN(2)/4HFEB./,LMN(3)/4HMAR./,LMN(4)/4HAPR./,
     1    LMN(5)/4HMAY /,LMN(6)/4HJUNE/,LMN(7)/4HJULY/,LMN(8)/4HAUG./,
     2    LMN(9)/4HSEP./,LMN(10)/4HOCT./,LMN(11)/4HNOV./,
     3    LMN(12)/4HDEC./
      DIMENSION DEPTH(250),RN(250)
      DO 10 N=1,NC
      DEPTH(N)=A3(N)
      IF(A1(N).EQ.0.0.OR.Q(N).EQ.0.0)GO TO 5
      DEPTH(N)=DEPTH(N)+A1(N)*ABS(Q(N))**A2(N)
    5 A(N)=DEPTH(N)*WIDTH(N)
      IF(NVT.EQ.1.AND.RMC(N).LE.RMFR)GO TO 10
      IF(A(N).EQ.0.0)GO TO 8
      V(N)=ABS(Q(N))/A(N)
      GO TO 10
    8 WRITE(NWR,9)N
    9 FORMAT(1H1,130(1H?),/,1H ,20(1H?),21HZERO AREA IN CHANNEL ,I3,44H
     1DEPTH OR WIDTH IS ZERO - PROGRAM TERMINATES   )
      STOP
   10 CONTINUE
      VOL(1)=XLEN*A(1)
      VOL(NJ)=XLEN*A(NC)
```

Subroutine FLOCMP (Cont'd)

```
      NL=NJ-1
      DO 20 J=2,NL
      VOL(J)=XLEN*0.5*(A(J-1)+A(J))
   20 CONTINUE
      WRITE(NWR,30)LMN(IMOB),IDAYB,IYRB,LMN(IMOE),IDAYE,IYRE
   30 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),5X,38HDEPTH OR VE
     1LOCITY DEPENDENT VARIABLES,38X,25(1H*),/,1H ,25(1H*),5X,30HBASED O
     2N FLOWS FOR THE PERIOD ,A4,1X,I2,2H, ,I4,6H THRU ,A4,1X,I2,2H, ,I4
     3,13X,25(1H*),/,1H ,130(1H*),/,1H ,130(1H*))
      WRITE(NWR,40)
   40 FORMAT(1H0,20(1H*),5X,38HCROSSECTIONAL AREAS OF CHANNELS (SQFT),
     15X,20(1H*) )
      CALL OUTGO(LVAR2,NC,RMC,A)
      WRITE(NWR,50)
   50 FORMAT(1H0,20(1H*),5X,19HCHANNEL DEPTHS (FT),5X,20(1H*))
      CALL OUTGO(LVAR2,NC,RMC,DEPTH)
      WRITE(NWR,60)
   60 FORMAT(1H0,20(1H*),5X,27HCHANNEL VELOCITIES (FT/SEC),5X,20(1H*))
      CALL OUTGO(LVAR2,NC,RMC,V)
      WRITE(NWR,70)
   70 FORMAT(1H0,20(1H*),5X,23HJUNCTION VOLUMES (CUFT),5X,20(1H*))
      CALL OUTGO(LVAR1,NJ,RMJ,VOL)
      IF(K2FL.NE.1) GO TO 140
      DO 80 N=1,NC
      RN(N)= (12.9*(V(N)**0.5))/(DEPTH(N)**1.5)
   80 CONTINUE
      REAIR(NJ)=RN(NC)
      REAIR(1)=RN(1)
      DO 90 J=2,NL
      REAIR(J)=0.5*(RN(J)+RN(J-1))
   90 CONTINUE
      DO 100  J=1,NJ
      XT=TEMP(J)-20.0
      XF=1.024**XT
      REAIR(J)=REAIR(J)*XF
```

Subroutine FLOCMP (Cont'd)

```
100 CONTINUE
    WRITE(NWR,120)
120 FORMAT(1H0,20(1H*),5X,33HCOMPUTED REAERATION RATES (1/DAY),5X,20(1
   1H*))
    CALL OUTGO(LVAR1,NJ,RMJ,REAIR)
    DO 130 J=1,NJ
    REAIR(J)=REAIR(J)/86400.0
130 CONTINUE
140 VT=86400.0
    DO 150 N=1,NC
    VL=ABS(XLEN/V(N))
    IF(VL.LE.VT)VT=VL
150 CONTINUE
    DT=VT/3600.0
    IF(DT.GE.24.0)DT=24.0
    IF(DT.GE.12.0.AND.DT.LT.24.0)DT=12.0
    IF(DT.GE.8.0.AND.DT.LT.12.0)DT=8.0
    IF(DT.GE.6.0.AND.DT.LT.8.0)DT=6.0
    IF(DT.GE.4.0.AND.DT.LT.6.0)DT=4.0
    IF(DT.GE.3.0.AND.DT.LT.4.0)DT=3.0
    IF(DT.GE.2.0.AND.DT.LT.3.0)DT=2.0
    IF(DT.GE.1.5.AND.DT.LT.2.0)DT=1.5
    IF(DT.GE.1.0.AND.DT.LT.1.5)DT=1.0
    IF(DT.GE.0.75.AND.DT.LT.1.0)DT=0.75
    IF(DT.GE.0.50.AND.DT.LT.0.75)DT=0.50
    IF(DT.GE.0.25.AND.DT.LT.0.50)DT=0.25
    IF(DT.GE.0.125.AND.DT.LT.0.25)DT=0.125
    IF(DT.GE.0.0675.AND.DT.LT.0.125)DT=0.0675
    IF(DT.LT.0.0675)DT=0.0675
    DELTD=DT
    RETURN
    END
```

*This change is indicated in the errata for T.R. 54

Subroutine VAULIN

```
      SUBROUTINE VAULIN
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION QIP(250)
      DIMENSION LMN(12)
      DATA LMN(1)/4HJAN./,LMN(2)/4HFEB./,LMN(3)/4HMAR./,LMN(4)/4HAPR./,
     1    LMN(5)/4HMAY /,LMN(6)/4HJUNE/,LMN(7)/4HJULY/,LMN(8)/4HAUG./,
     2    LMN(9)/4HSEP./,LMN(10)/4HOCT./,LMN(11)/4HNOV./,
     3    LMN(12)/4HDEC./
      NOJFX=0
      DO 10 J=1,NJ
      NFS(J)=0
      CIN(J)=0.0
      QIN(J)=AMAX1(0.001,QIN(J))
      QIP(J)=0.0
   10 CONTINUE
      READ(NRD,20)IMOB,IDAYB,IYRB,IMOE,IDAYE,IYRE,NPRT,T
      IF(NPRT.EQ.0)NPRT=1
   20 FORMAT(I2,1X,I2,1X,I4,5X,I2,1X,I2,1X,I4,5X,I5,5X,F10.0)
      IF(T.NE.0.0)DELTD=T
      IF(DELTD.GT.24.0)DELTD=24.0
      NQCYC=(24.0/DELTD)+0.5
      DELT=DELTD*3600.0
      DELT2=DELT/2.0
      IYB=IYRB-1900
```

Subroutine VAULIN (Cont'd)

```
      IYE=IYRE-1900
      CALL SERIAL(IDAYE,IMOE,IYE,NEND)
      CALL SERIAL(IDAYB,IMOB,IYB,NBEG)
      NDAYS=NEND-NBEG+1
 1000 READ(NRD,30)LABEL,DIST,QN,CN,CST
   30 FORMAT(A4,6X,4F10.0)
      IF(LABEL.EQ.LSTOP)GO TO 40
      JUNC=JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
      CIN(JUNC)=CIN(JUNC)+QN*CN
      QIP(JUNC)=QIP(JUNC)+QN
      IF(LABEL.NE.LFIXE)GO TO 1000
      NOJFX=NOJFX+1
      NFS(NOJFX)=JUNC
      C(JUNC)=CST
      GO TO 1000
   40 DO 60 J=1,NJ
      XMASS(J)=C(J)*VOL(J)
      IF(QIN(J).EQ.0.0.AND.CIN(J).NE.0.0)GO TO 70
      IF(QIP(J).EQ.0.0.AND.CIN(J).EQ.0.0)GO TO 50
      CIN(J)=CIN(J)/QIP(J)
      GO TO 60
   50 CIN(J)=0.0
   60 CONTINUE
      GO TO 90
   70 WRITE(NWR,80)J,RMJ(J)
   80 FORMAT(1H1,130(1H?),/,1H ,130(1H?),/,1H0,10(1H?),5X,33HAN INFLOW W
     1AS READ IN AT JUNCTION ,I4,12H(RIVER MILE ,F7.2,34H) IN THE QUALIT
     2Y INPUT, BUT NOT IN THE HYDRAULIC INPUT,/,1H0,10(1H?),5X,18HPROGRA
     3M TERMINATES )
      STOP
   90 WRITE(NWR,100)LTYPE,LMN(IMOB),IDAYB,IYRB,LMN(IMOE),IDAYE,IYRE
  100 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),80X,25(1H*),/,1H
     1,25(1H*),5X,A4,26H INPUT CONDITIONS     FOR ,A4,1X,I2,2H, ,I4,6H T
     2HRU ,A4,1X,I2,2H, ,I4,13X,25(1H*),/,1H ,25(1H*),80X,25(1H*),/,1H ,
     3130(1H*),/,1H ,130(1H*))
```

Subroutine VAULIN (Cont'd)

```
      WRITE(NWR,105)
  105 FORMAT(1H0,20(1H*),5X,40HPOINT SOURCE INFLOW CONCENTRATIONS (PPM),
     15X,20(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CIN)
      WRITE(NWR,200)
  200 FORMAT(1H0,20(1H*),5X,31HNONPOINT SOURCE LOADS (LBS/DAY),5X,20(1H*
     1) )
      IF(LCONS.NE.LCBD)GO TO 230
      DO 210 J=1,NJ
      CBDNP(J)=CBDNP(J)*XMIL
  210 CONTINUE
      CALL OUTGO(LVAR1,NJ,RMJ,CBDNP)
      DO 220 J=1,NJ
      IF(CBDNP(J).LE.0.0)GO TO 215
      CIN(J)=(CBDNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
      CBDNP(J)=CBDNP(J)/XMIL
      GO TO 220
  215 CIN(J)=CIN(J)*QIP(J)/QIN(J)
  220 CONTINUE
      GO TO 320
  230 IF(LCONS.NE.LNBD)GO TO 290
      DO 240 J=1,NJ
      XNBNP(J)=XNBNP(J)*XMIL
  240 CONTINUE
      CALL OUTGO(LVAR1,NJ,RMJ,XNBNP)
      DO 250 J=1,NJ
      IF(XNBNP(J).LE.0.0) GO TO 245
      CIN(J)=(XNBNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
      XNBNP(J)=XNBNP(J)/XMIL
      GO TO 250
  245 CIN(J)=CIN(J)*QIP(J)/QIN(J)
  250 CONTINUE
      GO TO 320
  290 DO 300 J=1,NJ
      CONNP(J)=CONNP(J)*XMIL
  300 CONTINUE
```

Subroutine VAULIN (Cont'd)

```
      CALL OUTGO(LVAR1,NJ,RMJ,CONNP)
      DO 310 J=1,NJ
      IF(CONNP(J).LE.0.0)GO TO 305
      CIN(J)=(CONNP(J)/(5.3936*QIN(J)))+CIN(J)*QIP(J)/QIN(J)
      CONNP(J)=CONNP(J)/XMIL
      GO TO 310
  305 CIN(J)=CIN(J)*QIP(J)/QIN(J)
  310 CONTINUE
  320 IF(NOJFX.EQ.0)GO TO 2000
      WRITE(NWR,110)
  110 FORMAT(1H0,25(1H*),5X,15HFIXED JUNCTIONS )
      DO 130 J=1,NOJFX
      K=NFS(J)
      WRITE(NWR,120)K,RMJ(K),C(K)
  120 FORMAT(1H ,25(1H.),5X, 9HJUNCTION ,I3,13H, RIVER MILE ,F7.2,14H, I
     1S FIXED AT ,1PE11.4,6H (PPM) )
  130 CONTINUE
 2000 WRITE(NWR,135)(LALPHA(K),K=1,20)
  135 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),20A4,25(1H*))
      WRITE(NWR,140)LTYPE,LMN(IMOB),IDAYB,IYRB,LMN(IMOE),IDAYE,IYRE,
     *               NDAYS,DELTD
  140 FORMAT(                                     1H ,130(1H*),/,1H ,25(1H*),80
     1X,25(1H*),/,1H ,25(1H*),5X,A4,31H CONCENTRATIONS FOR THE PERIOD ,
     2A4,1X,I2,2H, ,I4,6H THRU ,A4,1X,I2,2H, ,I4, 8X,25(1H*),/,1H ,25(1H
     3*),5X,32HNUMBER OF DAYS IN THIS PERIOD = ,I4,39X,25(1H*),/,1H ,25(
     41H*),5X,21HTIME STEP IN HOURS = ,F6.3,48X,25(1H*),/,1H ,25(1H*),80
     5X,25(1H*),/,1H ,130(1H*),/,1H ,130(1H*),/,1H ,130(1H*))
      RETURN
      END
```

Subroutine VALCMP

```
      SUBROUTINE VALCMP
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1        CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2        PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3        WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4        DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5        XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6        RMJ(250),RMC(250),LALPHA(20)
     7        ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1        NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2        IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3        LFIXE,NRD,NWR,NVT
      DIMENSION LMN(12)
      DATA LMN(1)/4HJAN./,LMN(2)/4HFEB./,LMN(3)/4HMAR./,LMN(4)/4HAPR./,
     1     LMN(5)/4HMAY /,LMN(6)/4HJUNE/,LMN(7)/4HJULY/,LMN(8)/4HAUG./,
     2     LMN(9)/4HSEP./,LMN(10)/4HOCT./,LMN(11)/4HNOV./,
     3     LMN(12)/4HDEC./
      DIMENSION DS1(250),DS2(250),DECAY(250)
      INTEGER D,YA
      IF(LTYPE.NE.LCBD) GO TO 20
      DO 10 J=1,NJ
      DECAY(J)=DK1(J)
   10 CONTINUE
      GO TO 60
   20 IF(LTYPE.NE.LNBD)GO TO 40
      DO 30 J=1,NJ
      DECAY(J)=DK2(J)
   30 CONTINUE
      GO TO 60
   40 DO 50 J=1,NJ
      DECAY(J)=0.0
   50 CONTINUE
   60 KPRT=1
      DO 150 LBJ=1,NDAYS
      DO 130 LCYC=1,NQCYC
```

```
      CALL CDERIV(DECAY,DS1)
      DO 90 J=1,NJ
      IF(NOJFX.LE.0)GO TO 80
      DO 70 K=1,NOJFX
      IF(NFS(K).EQ.J)GO TO 90
   70 CONTINUE
   80 C(J)=(XMASS(J)+(DS1(J)*DELT2))/VOL(J)
      IF(C(J).LT.0.0)C(J)=0.0
   90 CONTINUE
      CALL CDERIV(DECAY,DS2)
      DO 120 J=1,NJ
      IF(NOJFX.LE.0)GO TO 110
      DO 100 K=1,NOJFX
      IF(NFS(K).EQ.J)GO TO 120
  100 CONTINUE
  110 SLPE=(DS1(J)+DS2(J))/2.0
      XMASS(J)=XMASS(J)+SLPE*DELT
      C(J)=XMASS(J)/VOL(J)
      IF(C(J).LT.0.0)C(J)=0.0
  120 CONTINUE
  130 CONTINUE
      IF(LBJ.NE.KPRT)GO TO 150
      JD=NBEG+LBJ-1
      KPRT=KPRT+NPRT
      CALL CALEN(JD,D,M,YA)
      YA=YA+1900
      WRITE(NWR,140)LTYPE,LMN(M),D,YA
  140 FORMAT(1H0,10(1H*),5X,A4,26H CONCENTRATIONS (PPM)  ON ,A4,1X,I2,2H
     1, ,I4)
      CALL OUTGO(LVAR1,NJ,RMJ,C)
  150 CONTINUE
      IF(LTYPE.NE.LCBD)GO TO 170
      DO 160 J=1,NJ
      CBOD(J)=C(J)
  160 CONTINUE
```

Subroutine VALCMP (Cont'd)

```
      GO TO 2000
  170 IF(LTYPE.NE.LNBD)GO TO 190
      DO 180 J=1,NJ
      XNOD(J)=C(J)
  180 CONTINUE
      GO TO 2000
  190 DO 200 J=1,NJ
      CS(J)=C(J)
  200 CONTINUE
 2000 RETURN
      END
```

Subroutine CDERIV

```
      SUBROUTINE CDERIV(DECAY,DXDT)
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION DXDT(250),DECAY(250)
      DO 10 J=1,NJ
      DXDT(J)=-DECAY(J)*VOL(J)*C(J)-C(J)*QOUT(J)+QIN(J)*CIN(J)
   10 CONTINUE
      DO 40 N=1,NC
      NL=N
      NH=N+1
      IF(Q(N).LE.0.0)GO TO 20
      CBAR=C(NL)
      GO TO 30
   20 CBAR=C(NH)
   30 DCDX=(C(NL)-C(NH))/XLEN
      FLOWQ=CBAR*Q(N)
      DIFFQ=Z(N)*A(N)*DCDX
      DXDT(NH)=DXDT(NH)+FLOWQ+DIFFQ
      DXDT(NL)=DXDT(NL)-FLOWQ-DIFFQ
   40 CONTINUE
      RETURN
      END
```

Subroutine VDOIN Con't

```
      DELT=DELTD*3600.0
      DELT2=DELT/2.0
      IYB=IYRB-1900
      IYE=IYRE-1900
      CALL  SERIAL(IDAYE,IMOE,IYE,NEND)
      CALL  SERIAL(IDAYB,IMOB,IYB,NBEG)
      NDAYS=NEND-NBEG+1
 1000 READ(NRD,30)LABEL,DIST,QN,CN,XN,ON,CNS,XNS,ONS
   30 FORMAT(A4,6X,2F10.0,6F7.0)
      IF(LABEL.EQ.LSTOP)GO TO 60
      JUNC=JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
      CBDIN(JUNC)=QN*CN+CBDIN(JUNC)
      XNDIN(JUNC)=QN*XN+XNDIN(JUNC)
      OXIN(JUNC)=QN*ON+OXIN(JUNC)
      QIP(JUNC)=QIP(JUNC)+QN
      IF(LABEL.NE.LFIXE)GO TO 1000
      NOJFX=NOJFX+1
      NFS(NOJFX)=JUNC
      IF(CNS.EQ.0.0)GO TO 40
      CBOD(JUNC)=CNS
      MFS(NOJFX,1)=1
   40 IF(XNS.EQ.0.0)GO TO 50
      XNOD(JUNC)=XNS
      MFS(NOJFX,2)=1
   50 IF(ONS.EQ.0.0)GO TO 1000
      OXY(JUNC)=ONS
      MFS(NOJFX,3)=1
      GO TO 1000
   60 DO 70 J=1,NJ
      XCMAS(J)=CBOD(J)*VOL(J)
      XNMAS(J)=XNOD(J)*VOL(J)
      XOMAS(J)=OXY(J)*VOL(J)
      IF(QIN(J).EQ.0.0)GO TO 65
      IF(QIP(J).EQ.0.0)GO TO 66
      CBDIN(J)=CBDIN(J)/QIP(J)
```

Subroutine VDOIN Con't

```
      XNDIN(J)=XNDIN(J)/QIP(J)
      OXIN(J)=OXIN(J)/QIP(J)
      GO TO 70
   65 IF(CBDIN(J).NE.0.0.OR.XNDIN(J).NE.0.0.OR.OXIN(J).NE.0.0) GO TO 80
      GO TO 70
   66 CBDIN(J)=0.0
      XNDIN(J)=0.0
      OXIN(J)=0.0
   70 CONTINUE
      GO TO 100
   80 WRITE(NWR,90)J,RMJ(J)
   90 FORMAT(1H1,130(1H?),/,1H ,10(1H?),5X,33HAN INFLOW WAS READ IN AT J
     1UNCTION ,I4,12H(RIVER MILE ,F7.2,54H) IN THE QUALITY INPUT, BUT NO
     2T IN THE HYDRAULIC INPUT,/,1H0,10(1H?),5X,18HPROGRAM TERMINATES )
      STOP
  100 WRITE(NWR,110)LCBD,LNBD,LDO,LMN(IMOB),IDAYB,IYRB,LMN(IMOE),IDAYE,
     *                IYRE
  110 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),80X,25(1H*),/,1H
     1,25(1H*),5X,A4,2H, ,A4,5H AND ,A4,17H INPUT COND. FOR ,A4,1X,I2,2H
     2, ,I4,6H THRU ,A4,1X,I2,2H, ,I4,7X,25(1H*),/,1H ,25(1H*),80X,25(1H
     3*),/,1H ,130(1H*),/,1H ,130(1H*))
      DO 300 J=1,NJ
      XNBNP(J)=XNBNP(J)*XMIL
      OXYNP(J)=OXYNP(J)*XMIL
  300 CONTINUE
      WRITE(NWR,310)LCBD
  310 FORMAT(1H0,25(1H*),5X,A4,41H POINT SOURCE INFLOW CONCENTRATIONS (P
     1PM),5X,25(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CBDIN)
      WRITE(NWR,320)LCBD
  320 FORMAT(1H0,25(1H*),5X,A4,32H NONPOINT SOURCE LOADS (LBS/DAY),5X,25
     1(1H*) )
      CALL OUTGO(LVAR1,NJ,RMJ,CBDNP)
      WRITE(NWR,310)LNBD
```

Subroutine VDOIn Con't

```
      CALL OUTGO(LVAR1,NJ,RMJ,XNDIN)
      WRITE(NWR,320)LNBD
      CALL OUTGO(LVAR1,NJ,RMJ,XNBNP)
      WRITE(NWR,310)LDO
      CALL OUTGO(LVAR1,NJ,RMJ,OXIN)
      WRITE(NWR,320)LO2
      CALL OUTGO(LVAR1,NJ,RMJ,OXYNP)
      DO 330 J=1,NJ
      CBDIN(J)=(CBDNP(J)/(5.3936*QIN(J)))+CBDIN(J)*QIP(J)/QIN(J)
      XNDIN(J)=(XNBNP(J)/(5.3936*QIN(J)))+XNDIN(J)*QIP(J)/QIN(J)
      OXIN(J)=(OXYNP(J)/(5.3936*QIN(J)))+OXIN(J)*QIP(J)/QIN(J)
      CBDNP(J)=CBDNP(J)/XMIL
      XNBNP(J)=XNBNP(J)/XMIL
      OXYNP(J)=OXYNP(J)/XMIL
  330 CONTINUE
      IF(NOJFX.EQ.0)GO TO 195
      WRITE(NWR,130)
  130 FORMAT(1H0,25(1H*),5X,15HFIXED JUNCTIONS )
      DO 190 J=1,NOJFX
      JK=NFS(J)
      IF(MFS(J,1).EQ.0)GO TO 150
      WRITE(NWR,140)JK,RMJ(JK),CBOD(JK)
  140 FORMAT(1H ,25(1H.),5X, 9HJUNCTION ,I3,13H, RIVER MILE ,F7.2,18H CB
     1OD IS FIXED AT ,1PE11.4,6H (PPM))
  150 IF(MFS(J,2).EQ.0)GO TO 170
      WRITE(NWR,160)JK,RMJ(JK),XNOD(JK)
  160 FORMAT(1H ,25(1H.),5X,9HJUNCTION ,I3,13H, RIVER MILE ,F7.2,18H NBO
     1D IS FIXED AT ,1PE11.4,6H (PPM))
  170 IF(MFS(J,3).EQ.0)GO TO 190
      WRITE(NWR,180)JK,RMJ(JK),OXY(JK)
  180 FORMAT(1H ,25(1H.),5X,9HJUNCTION ,I3,13H, RIVER MILE ,F7.2,16H DO
     1IS FIXED AT ,1PE11.4,6H (PPM))
  190 CONTINUE
  195 WRITE(NWR,194)(LALPHA(K),K=1,20)
  194 FORMAT(1H1,130(1H*),/,1H ,130(1H*),/,1H ,25(1H*),20A4,25(1H*))
```

Subroutine VDOIN Con'd

```
      WRITE(NWR,200)LCBD,LNBD,LDO,LMN(IMOB),IDAYB,IYRB,LMN(IMOE),IDAYE,
     *               IYRE,NDAYS,DELTD
  200 FORMAT(                                   1H ,130(1H*),/,1H ,25(1H*),80
     1X,25(1H*),/,1H ,25(1H*),5X,A4,2H, ,A4,5H AND ,A4,21H CONC FOR THE
     2PERIOD ,A4,1X,I2,2H, ,I4,6H THRU ,A4,1X,I2,2H, ,I4,3X,25(1H*),/,1H
     3 ,25(1H*),5X,32HNUMBER OF DAYS IN THIS PERIOD = ,I4,39X,25(1H*),/,
     41H ,25(1H*),5X,21HTIME STEP IN HOURS = ,F6.3,48X,25(1H*),/,1H ,25(
     51H*),80X,25(1H*),/,1H ,130(1H*),/,1H ,130(1H*),/,1H ,130(1H*) )
 2000 RETURN
      END
```

Subroutine VDOCP

```
      SUBROUTINE VDOCP
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNUIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION LMN(12)
      DATA LMN(1)/4HJAN./,LMN(2)/4HFEB./,LMN(3)/4HMAR./,LMN(4)/4HAPR./,
     1    LMN(5)/4HMAY /,LMN(6)/4HJUNE/,LMN(7)/4HJULY/,LMN(8)/4HAUG./,
     2    LMN(9)/4HSEP./,LMN(10)/4HOCT./,LMN(11)/4HNOV./,
     3    LMN(12)/4HDEC./
      DIMENSION DO1(250),DC1(250),DN1(250),DO2(250),DC2(250),DN2(250)
      INTEGER D,YA
      KPRT=1
      DO 150 LBJ=1,NDAYS
      DO 125 LCYC=1,NQCYC
      CALL ODERIV(DO1,DC1,DN1)
      DO 60 J=1,NJ
      IF(NOJFX.EQ.0) GO TO 50
      DO 40 L=1,NOJFX
      JK=NFS(L)
      IF(J.NE.JK)GO TO 40
      IF(MFS(L,1).EQ.1)GO TO 10
      CBOD(J)=(XCMAS(J)+(DC1(J)*DELT2))/VOL(J)
   10 IF(MFS(L,2).EQ.1)GO TO 20
      XNOD(J)=(XNMAS(J)+(DN1(J)*DELT2))/VOL(J)
   20 IF(MFS(L,3).EQ.1)GO TO 30
      OXY(J)=(XOMAS(J)+(DO1(J)*DELT2))/VOL(J)
```

Subroutine VDOCP (Cont'd)

```
SUBROUTINE VDOCP CON'T
   30 GO TO 55
   40 CONTINUE
   50 CBOD(J)=(XCMAS(J)+(DC1(J)*DELT2))/VOL(J)
      XNOD(J)=(XNMAS(J)+(DN1(J)*DELT2))/VOL(J)
      OXY(J)=(XOMAS(J)+(DO1(J)*DELT2))/VOL(J)
   55 IF(CBOD(J).LT.0.0)CBOD(J)=0.0
      IF(XNOD(J).LT.0.0)XNOD(J)=0.0
      IF(OXY(J).LT.0.0)OXY(J)=0.0
   60 CONTINUE
      CALL ODERIV(DO2,DC2,DN2)
      DO 120 J=1,NJ
      IF(NOJFX.EQ.0)GO TO 110
      DO 100 L=1,NOJFX
      JK=NFS(L)
      IF(J.NE.JK)GO TO 100
      IF(MFS(L,1).EQ.1)GO TO 70
      S=(DC1(J)+DC2(J))/2.0
      XCMAS(J)=XCMAS(J)+S*DELT
      CBOD(J)=XCMAS(J)/VOL(J)
   70 IF(MFS(L,2).EQ.1)GO TO 80
      S=(DN1(J)+DN2(J))/2.0
      XNMAS(J)=XNMAS(J)+S*DELT
      XNOD(J)=XNMAS(J)/VOL(J)
   80 IF(MFS(L,3).EQ.1)GO TO 90
      S=(DO1(J)+DO2(J))/2.0
      XOMAS(J)=XOMAS(J)+S*DELT
      OXY(J)=XOMAS(J)/VOL(J)
   90 GO TO 115
  100 CONTINUE
  110 S=(DC1(J)+DC2(J))/2.0
      XCMAS(J)=XCMAS(J)+S*DELT
      CBOD(J)=XCMAS(J)/VOL(J)
      S=(DN1(J)+DN2(J))/2.0
      XNMAS(J)=XNMAS(J)+S*DELT
      XNOD(J)=XNMAS(J)/VOL(J)
```

```
subroutine VDOCP CON'T
      S=(DO1(J)+DO2(J))/2.0
      XOMAS(J)=XOMAS(J)+S*DELT
      OXY(J)=XOMAS(J)/VOL(J)
  115 IF(CBOD(J).LT.0.0)CBOD(J)=0.0
      IF(XNOD(J).LT.0.0)XNOD(J)=0.0
      IF(OXY(J).LT.0.0)OXY(J)=0.0
  120 CONTINUE
  125 CONTINUE
      IF(LBJ.NE.KPRT)GO TO 150
      JD=NBEG+LBJ-1
      KPRT=KPRT+NPRT
      CALL CALEN(JD,D,M,YA)
      YA=YA+1900
      WRITE(NWR,130)LCBD,LNBD,LDO,LMN(M),D,YA
  130 FORMAT(1H0,10(1H*),5X,A4,2H, ,A4,5H AND ,A4,19H CONCENTRATIONS ON
     1,A4,1X,I2,2H, ,I4 )
      WRITE(NWR,140)LCBD
  140 FORMAT(1H0,10(1H.),5X,A4,21H CONCENTRATIONS (PPM) )
      CALL OUTGO(LVAR1,NJ,RMJ,CBOD)
      WRITE(NWR,140)LNBD
      CALL OUTGO(LVAR1,NJ,RMJ,XNOD)
      WRITE(NWR,140)LDO
      CALL OUTGO(LVAR1,NJ,RMJ,OXY)
  150 CONTINUE
      RETURN
      END
```

```
SUBROUTINE ODERIV
      SUBROUTINE ODERIV(DODT,DCDT,DNDT)
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION DODT(250),DCDT(250),DNDT(250)
      DO 10 J=1,NJ
      DKC=DK1(J)
      IF(OXY(J).LE.0.0)DKC=0.0
      DKN=DK2(J)
      CO=0.05*DOS(J)
      IF(OXY(J).LE.CO)DKN=0.0
      DCDT(J)=-DKC*VOL(J)*CBOD(J)-CBOD(J)*QOUT(J)+QIN(J)*CBDIN(J)
      DNDT(J)=-DKN*VOL(J)*XNOD(J)-XNOD(J)*QOUT(J)+QIN(J)*XNDIN(J)
      DODT(J)=OXIN(J)*QIN(J)-OXY(J)*QOUT(J)+REAIR(J)*VOL(J)*(DOS(J)-OXY(
     1J))-(DKN*XNOD(J)+DKC*CBOD(J))*VOL(J)+(PHOTO(J)-SEDMT(J)-EVAP(J)*OX
     2Y(J))*AS(J)
   10 CONTINUE
      DO 40 N=1,NC
      NL=N
      NH=N+1
      IF(Q(N).LE.0.0)GO TO 20
      OBAR=OXY(NL)
      CBAR=CBOD(NL)
      XBAR=XNOD(NL)
      GO TO 30
   20 OBAR=OXY(NH)
```

```
SUBROUTINE ODERIV CON'T
      CBAR=CBOD(NH)
      XBAR=XNOD(NH)
   30 DODX=(OXY(NL)-OXY(NH))/XLEN
      DCDX=(CBOD(NL)-CBOD(NH))/XLEN
      DNDX=(XNOD(NL)-XNOD(NH))/XLEN
      FLQO=OBAR*Q(N)
      FLQC=CBAR*Q(N)
      FLQN=XBAR*Q(N)
      DFQO=Z(N)*A(N)*DODX
      DFQC=Z(N)*A(N)*DCDX
      DFQN=Z(N)*A(N)*DNDX
      DODT(NH)=DODT(NH)+FLQO+DFQO
      DCDT(NH)=DCDT(NH)+FLQC+DFQC
      DNDT(NH)=DNDT(NH)+FLQN+DFQN
      DODT(NL)=DODT(NL)-FLQO-DFQO
      DCDT(NL)=DCDT(NL)-FLQC-DFQC
      DNDT(NL)=DNDT(NL)-FLQN-DFQN
   40 CONTINUE
      RETURN
      END
```

Function JKFND

```
      FUNCTION JKFND(NJ,XMIL,DIST,RMUP,RMDWN)
      NSET=1+IFIX(((DIST-RMDWN)/XMIL)+0.5)
      IF(DIST.LT.RMDWN) NSET=1
      IF(DIST.GT.RMUP) NSET=NJ
      JKFND=NSET
      RETURN
      END
      SUBROUTINE SERIAL(D,M,YA,K)
      INTEGER D,M,K,N,YA,XA
      IF(M.GT.2) GO TO 10
      N=M+9
      XA=YA-1
      GO TO 20
   10 N=M-3
      XA=YA
   20 K=(1461*XA)/4+(153*N+2)/5+D
      RETURN
      END
```

```
      SUBROUTINE TABU(X,Y,XPT,NPTS,YPT)
      DIMENSION X(NPTS),Y(NPTS)
      IF(NPTS.EQ.1) GO TO 10
      NPM1=NPTS-1
      IF(XPT.LE.X(1)) GO TO 10
      IF(XPT.GE.X(NPTS)) GO TO 20
      DO 30 J=1,NPM1
      IF(XPT.GE.X(J).AND.XPT.LE.X(J+1)) GO TO 40
   30 CONTINUE
   40 S=(XPT-X(J))/(X(J+1)-X(J))
      YPT=Y(J)+(Y(J+1)-Y(J))*S
      GO TO 50
   20 YPT=Y(NPTS)
      GO TO 50
   10 YPT=Y(1)
   50 RETURN
      END
```

Subroutine INTER

```
      SUBROUTINE INTER (REVAL,NMAT,X,Y,NPTS,RM)
      DIMENSION REVAL(NMAT),X(NPTS),Y(NPTS),RM(NMAT)
      DO 21 I=1,NPTS
      TEST=X(I)
      JTMP=I
      DO 22 J=I,NPTS
      IF(X(J).GE.TEST) GO TO 22
      TEST=X(J)
      JTMP=J
   22 CONTINUE
      XTMP=X(I)
      YTMP=Y(I)
       X(I)=X(JTMP)
      Y(I)=Y(JTMP)
      X(JTMP)=XTMP
      Y(JTMP)=YTMP
   21 CONTINUE
      DO 10  J=1,NMAT
      XPT=RM(J)
      CALL TABU (X,Y,XPT,NPTS,YPT)
      REVAL(J)=YPT
   10 CONTINUE
      RETURN
      END
```

Subroutine CALEN

```
      SUBROUTINE CALEN (K,D,M,YA)
      INTEGER K,D,M,YA
      YA=(4*K-1)/1461
      D= 4*K-1-1461*YA
      D=(D+4)/4
      M= (5*D-3)/153
      D= 5*D-3-153*M
      D=(D+5)/5
      IF(M.LT.10) GO TO 20
      M=M-9
      YA=YA+1
      GO TO 30
   20 M=M+3
   30 RETURN
      END
```

```
      SUBROUTINE OUTGO(LVAR,NP,X,Y)
      COMMON QIN(250),QOUT(250),Q(250),A(250),Z(250),XNDIN(250),
     1       CBDIN(250),OXIN(250),CIN(250),C(250),REAIR(250),VOL(250),
     2       PHOTO(250),EVAP(250),AS(250),SEDMT(250),DOS(250),V(250),
     3       WIDTH(250),A1(250),A2(250),A3(250),TEMP(250),DK1(250),
     4       DK2(250),CBOD(250),XNOD(250),OXY(250),CS(250),NFS(250),
     5       XMASS(250),XNMAS(250),XCMAS(250),XOMAS(250),MFS(250,3),
     6       RMJ(250),RMC(250),LALPHA(20)
     7       ,CBDNP(250),XNBNP(250),CONNP(250),OXYNP(250),QNP(250)
      COMMON NJ,NC,XLEN,NOJFX,RMUP,RMDWN,RMFR,DELT,DELT2,DELTD,NPRT,
     1       NQCYC,NSECS,XMIL,NBEG,NEND,IMOB,IDAYB,IYRB,IMOE,IDAYE,
     2       IYRE,NDAYS,K2FL,LTYPE,LCBD,LNBD,LDO,LSTOP,LVAR1,LVAR2,
     3       LFIXE,NRD,NWR,NVT
      DIMENSION X(250),Y(250)
C
C
      ILINE= NP/4
      IEXTA= NP-4*ILINE
      WRITE(NWR,10)LVAR,LVAR,LVAR,LVAR
   10 FORMAT(1H0,3X,A4,4X,5HRIVER,18X,A4,4X,5HRIVER,18X,A4,4X,5HRIVER,18
     1X,A4,4X,5HRIVER,/,1H ,4X,2HNO,5X,4HMILE,7X,5HVALUE,8X,2HNO,5X,4HMI
     2LE,7X,5HVALUE,8X,2HNO,5X,4HMILE,7X,5HVALUE,8X,2HNO,5X,4HMILE,7X,5H
     3VALUE )
      DO 30 I=1,ILINE
      I2=I+ILINE+IEXTA
      I3=I2+ILINE
      I4=I3+ILINE
      WRITE(NWR,20)I,X(I),Y(I),I2,X(I2),Y(I2),I3,X(I3),Y(I3),I4,X(I4),
     1            Y(I4)
   20 FORMAT(1H ,3X,I3,4X,F6.2,4X,1PE10.3,4X,I3,4X,0PF6.2,4X,1PE10.3,
     14X,I3,4X,0PF6.2,4X,1PE10.3,4X,I3,4X,0PF6.2,4X,1PE10.3)
   30 CONTINUE
      IF(IEXTA.EQ.0)GO TO 60
      IEND=ILINE+IEXTA
      IBEG=ILINE+1
```

```
      DO 50 I=IBEG,IEND
      WRITE(NWR,40)I,X(I),Y(I)
   40 FORMAT(1H ,3X,I3,4X,F6.2,4X,1PE10.3)
   50 CONTINUE
   60 RETURN
      END
```

V. EXAMPLE RUNS AND SENSITIVITY

The following figures illustrate the sensitivity of the AUTØ-QUAL models to variations in the non-point variables. Sensitivities to other variables are shown in T.R. 54. The sensitivity to various factors will depend on the physical and biochemical properties of a given system. Therefore, the user is urged to experiment with his own systems before drawing any definite conclusions about a variable.

AUTØSS was generally used for the sensitivity runs. The effects are the same in AUTØQD as in AUTØSS. Figures 9,10 and 11 shows the convergence of the AUTØQD solution to the AUTØSS solution over time.

A hypothetical estuary/stream (see figure 1) was used for the sensitivity runs. The following data values were assigned to the example estuary/stream;

Mile of Upstream end = 100.0

Mile of Downstream end = 0.0

Mile of fall line = 50.0

Number of Sections = 100

PHYSICAL DATA;

A_1;

Miles 0.0 through 48.0	$A_1 = 0.0$
@ Mile 50.0	$A_1 = 0.06$
@ Mile 100.0	$A_1 = 0.04$

A_2;

Miles 0.0 through 48.0	$A_2 = 0.0$
@ Mile 50.0	$A_2 = 0.6$
Miles 50.0 through 100.0	$A_2 = 0.6$

A_3;

@ Mile 0.0	$A_3 = 20.0$
@ Mile 50.0	$A_3 = 10.0$
Miles 50.1 through 100.0	$A_3 = 0.0$

WIDTHS;

@ Mile 0.0	Width = 5,000.0 ft.
@ Mile 50.0	Width = 500.0 ft.
Miles 50.0 through 100.0	Width = 500.0 ft.

DISPERSION COEFFICIENTS;

@ Mile 0.0	E= 5,000.0 ft^2/sec.
@ Mile 50.0	E = 100.0 ft^2/sec.
Miles 50.0 through 100.0	E = 100.0 ft^2/sec.

CBOD decay rate (@ 20°C);

Miles 0.0 through 100.0	CDECAY = 0.4 ^{1}/day

NBOD decay rate (@ 20°C);

Miles 0.0 through 100.0	NDECAY = 0.3 ^{1}/day

Non-point source CBOD;

Miles 0.0 through 100.0	NØNPCBØD = 200.0 (lbs/day)/mile

Reareation Rate (@ 20° C)

Miles 0.0 through 100.0	REAER = 0.4 ^{1}/day

Non-point source NBOD;

Miles 0.0 through 100.0 NØNPNBØD = 200.0 (lbs/day)/mile

Non-point source TDS;

Miles 0.0 through 100.0 NØNPTDS = 400.0 (lbs/day)/mile

Non-point source O_2;

Miles 0.0 through 100.0 NØNPDØ = 50.0 (lbs/day)/mile

Non-point source Flows;

Miles 0.0 through 100.0 NØNPFLØW = +1.0 cfs/mile

Computed Oxygen Saturation Concentrations.

All other physical data assumes its respective default value.

Where point values are specified the program will interpolate linearly between the points for intermediate values.

COMPUTATIØNAL DATA;

The following point source inflows and concentrations were specified.

Mile 100.0;	500.0 cfs
	5.0 ppm CBØD
	4.0 ppm NBØD
	20.0 ppm TDS
	9.0 ppm DØ
Mile 95.0;	50.0 cfs
	30.0 ppm CBØD
	40.0 ppm NBØD
	200.0 ppm TDS
	0.0 ppm DØ

Mile 25.0; 300.0 cfs

30.0 ppm CBØD

60.0 ppm NBØD

400.0 ppm TDS

0.0 ppm DØ

These data constitute the base condition upon which the sensitivity runs were made.

Following is the data deck used for running the base condition on AUTØSS;

```
     PØINT AND NØN-PØINT BASE CØNDITIØN ** AUTØSS
         0.0     100.0       50.0       100
DATA
A1            3
    1            48.0         0.0
    2            50.0         0.06
    3           100.0         0.04
A2            3
    1            48.0         0.0
    2            50.0         0.6
    3           100.0         0.6
A3            3
    1             0.0        20.0
    2            50.0        10.0
    3            50.1         0.0
WIDTH         2
    1             0.0      5000.0
    2            50.0       500.0
DISP          2
    1             0.0      5000.0
    2            50.0       100.0
```

```
CDECAY        1
    1            0.0       0.4
NDECAY        1
    1            0.0       0.3
REAER         1
    1            0.0       0.4
NØNPFLØW      1
    1            0.0       1.0
NØNPTDS       1
    1            0.0     400.0
NØNPCBØD      1
    1            0.0     200.0
NØNPNBØD      1
    1            0.0     200.0
NØNPDØ        1
    1            0.0      50.0
C-SATDØ
STØP
FLØW
               100.0     500.0
                95.0      50.0
                25.0     300.0
```

```
STØP
TDS
               100.0     500.0      20.0
                95.0      50.0     200.0
                25.0     300.0     400.0
STØP
CBØD
               100.0     500.0       5.0
                95.0      50.0      30.0
                25.0     300.0      30.0
STØP
NBØD
               100.0     500.0       4.0
                95.0      50.0      40.0
                25.0     300.0      60.0
STØP
DØ
               100.0     500.0       9.0
STØP
HALT
```

DESCRIPTION OF SENSITIVITY FIGURES;

Figure 1 -schematic of example. streams/estuary.

Figure 2 -base condition for sensitivity runs.

Figure 3 -base condition for sensitivity runs with all non-point parameters set to zero.

Figure 4 -base condition with varied non-point source inflows and non-point losses.

Figure 5 -base condition with varied non-point source CBØD loadings.

Figure 6 -base condition with varied non-point source NBØD loadings.

Figure 7 -base condition with varied non-point source 0_2 contributions.

Figure 8 -base condition with varied non-point source TDS loadings.

Figure 9 -AUTØSS and AUTØQD CBØD comparison. Ran with base condition input values. The AUTØQD CBØD starting concentrations were set at 3.4 ppm for the entire network.

Figure 10 -AUTØSS and AUTØQD NBØD comparison. Ran with base condition input values. NBØD starting concentrations were uniformly set at 3.5 ppm.

Figure 11 -AUTØSS and AUTØQD DØ comparison. Ran with base condition input values. DØ starting concentrations were uniformly set at 6.0 ppm.

FIGURE 1

EXAMPLE STREAM/ESTUARY

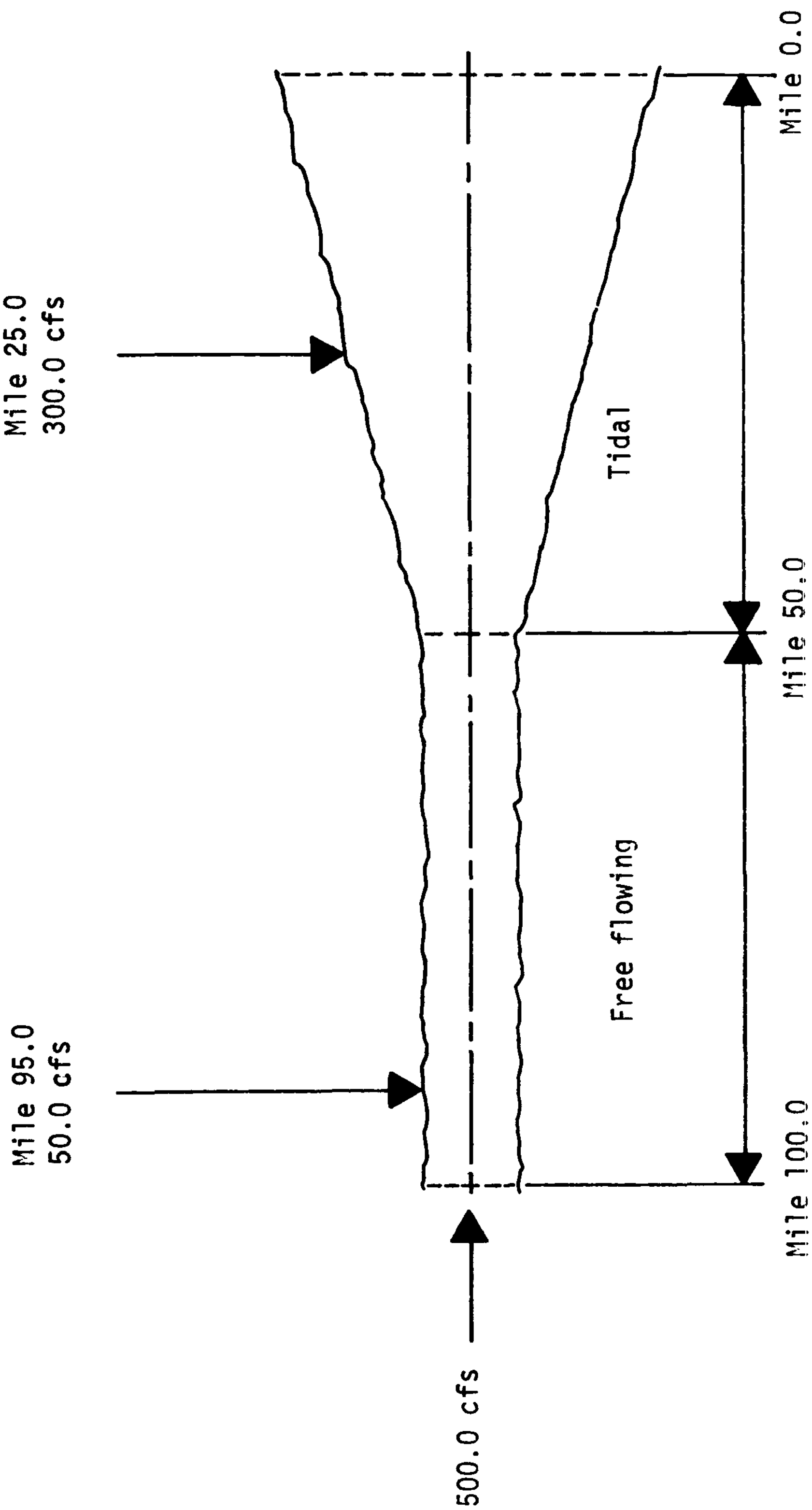


FIGURE 2

Example stream/estuary with point and non-point input parameters. Basic condition for sensitivity runs.

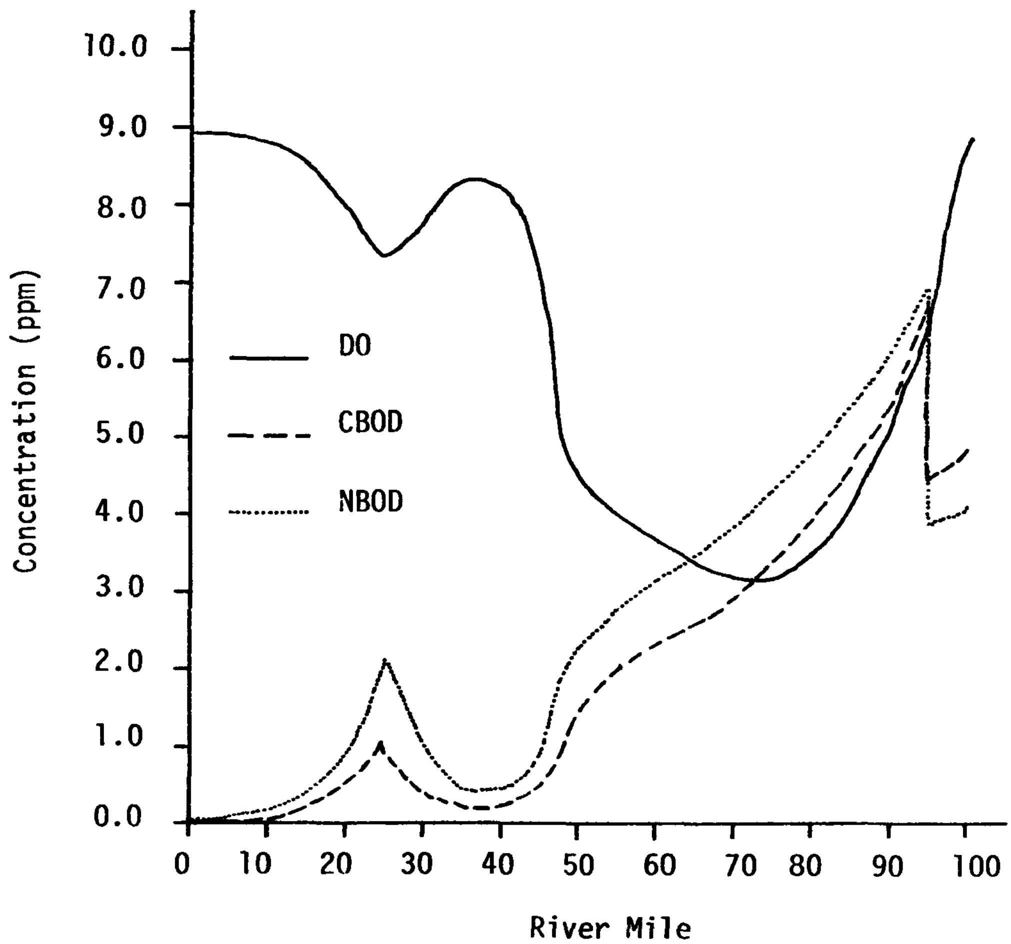


FIGURE 3

Example stream/estuary with only point source input parameters.

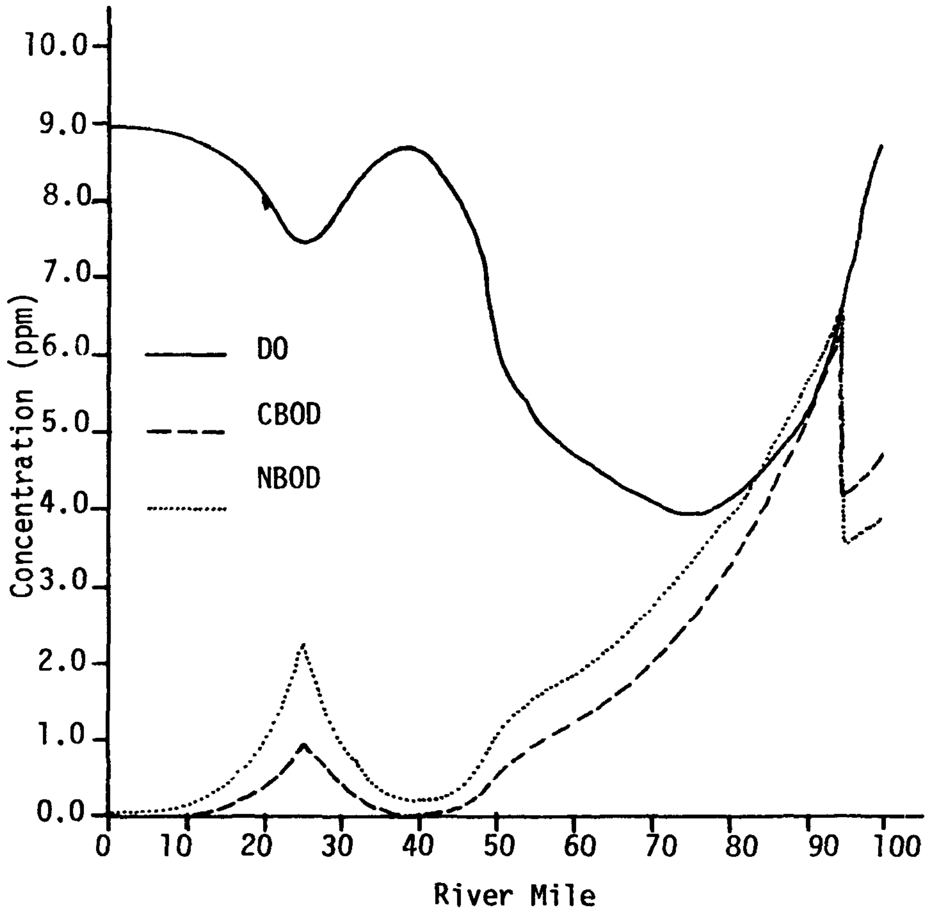
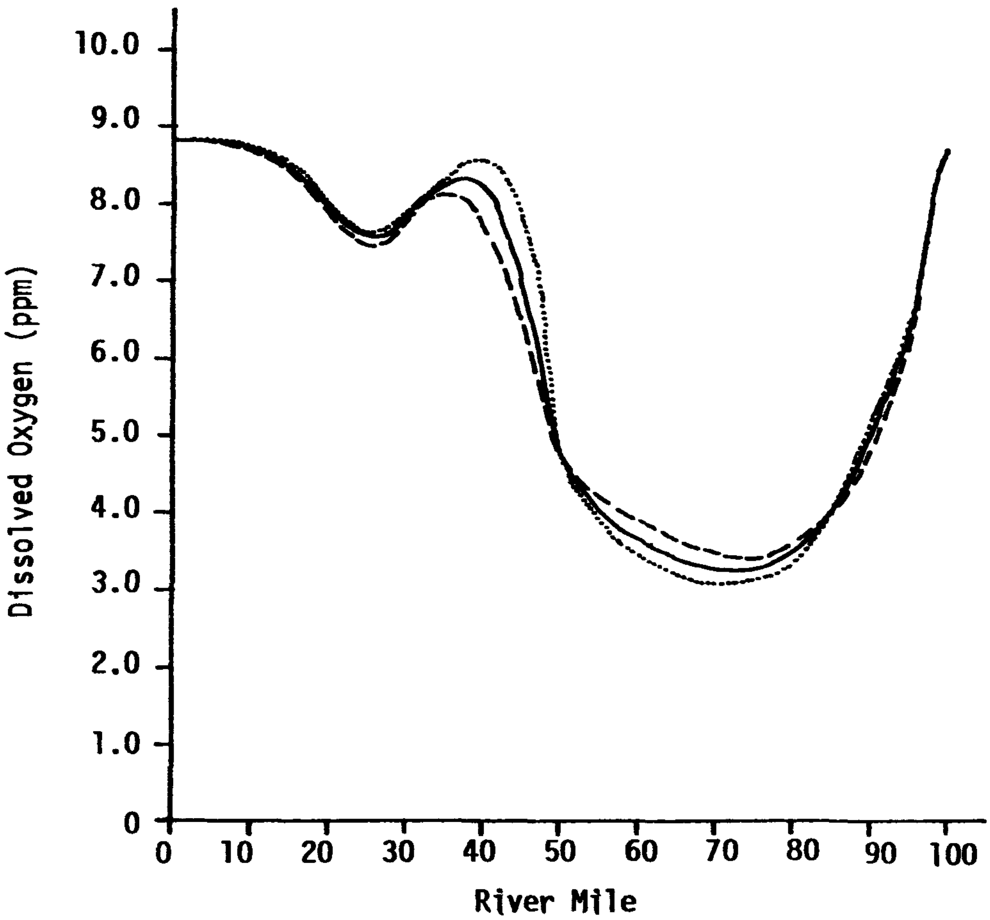


FIGURE 4

Sensitivity to non-point source inflows and non-point losses.



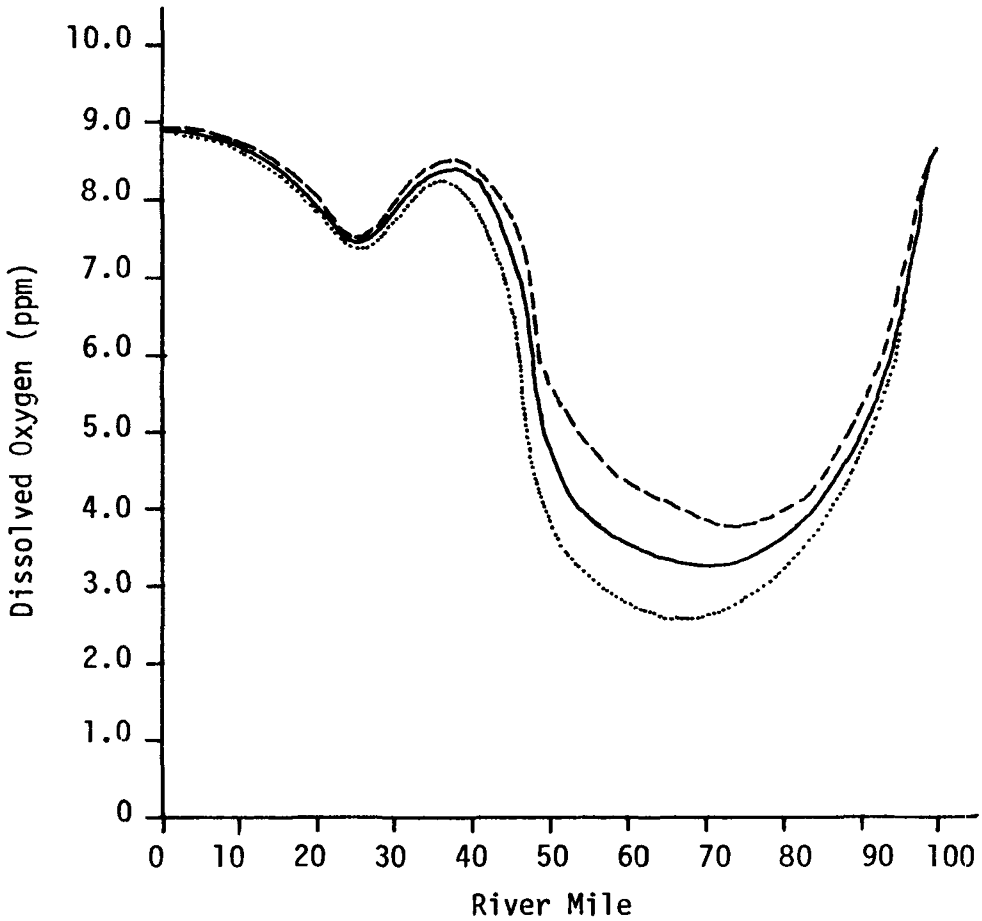
---- Non-point source inflows = +10.0 cfs/mile

—— Non-point source inflows = + 1.0 cfs/mile

······ Non-point losses = - 5.0 cfs/mile

FIGURE 5

Sensitivity to a non-point source
carbonaceous oxygen demand loading



Non-point source CBOD = 0.0 lbs/day/mile

Non-point source CBOD = 200.0 lbs/day/mile

Non-point source CBOD = 400.0 lba/day/mile

FIGURE 6

Sensitivity to a non-point source
nitrogenous oxygen demand loading

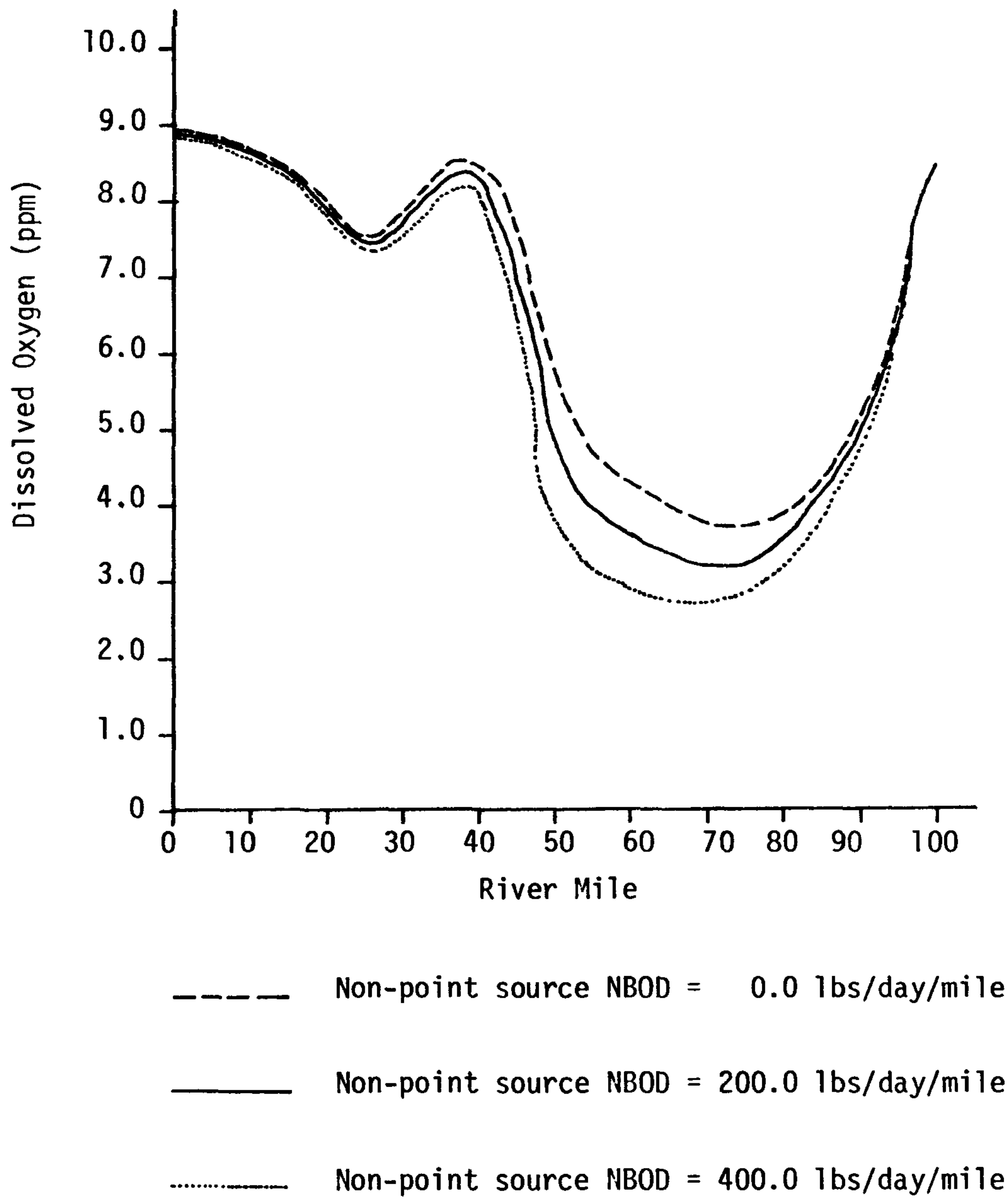
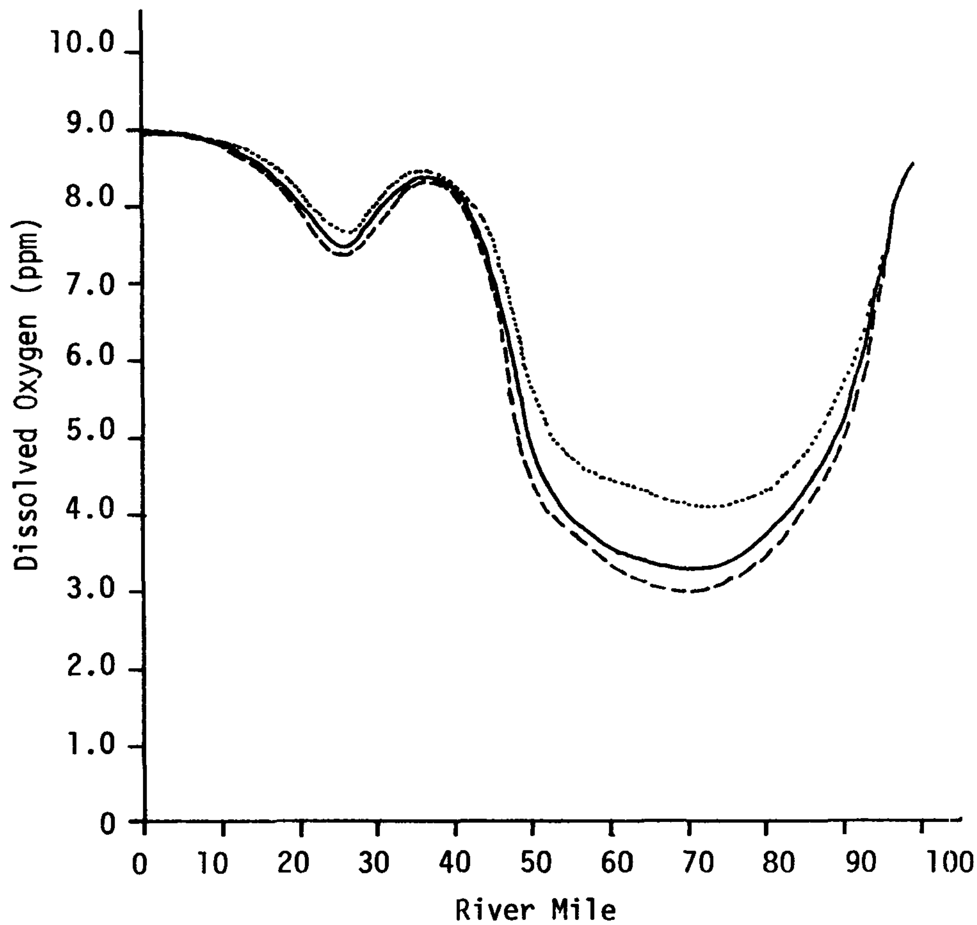


FIGURE 7

Sensitivity to a non-point source O_2 contribution



Non-point source O_2 = 0.0 lbs/day/mile

Non-point source O_2 = 50.0 lbs/day/mile

Non-point source O_2 = 200.0 lbs/day/mile

FIGURE 8

Sensitivity to a conservative parameter
non-point source loading

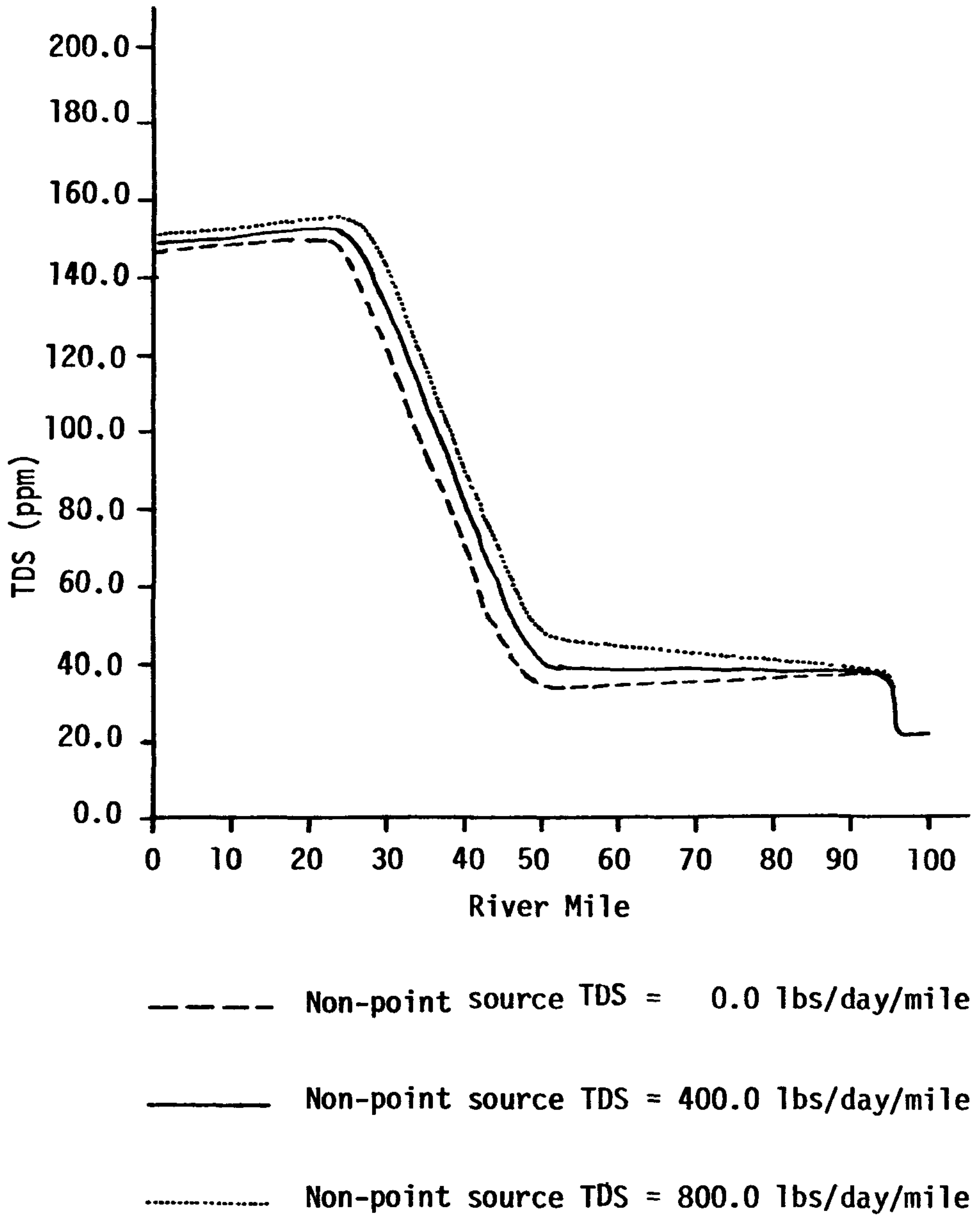


FIGURE 9

AUTØSS and AUTØQD Comparison
Carbonaceous Oxygen Demand
at selected miles

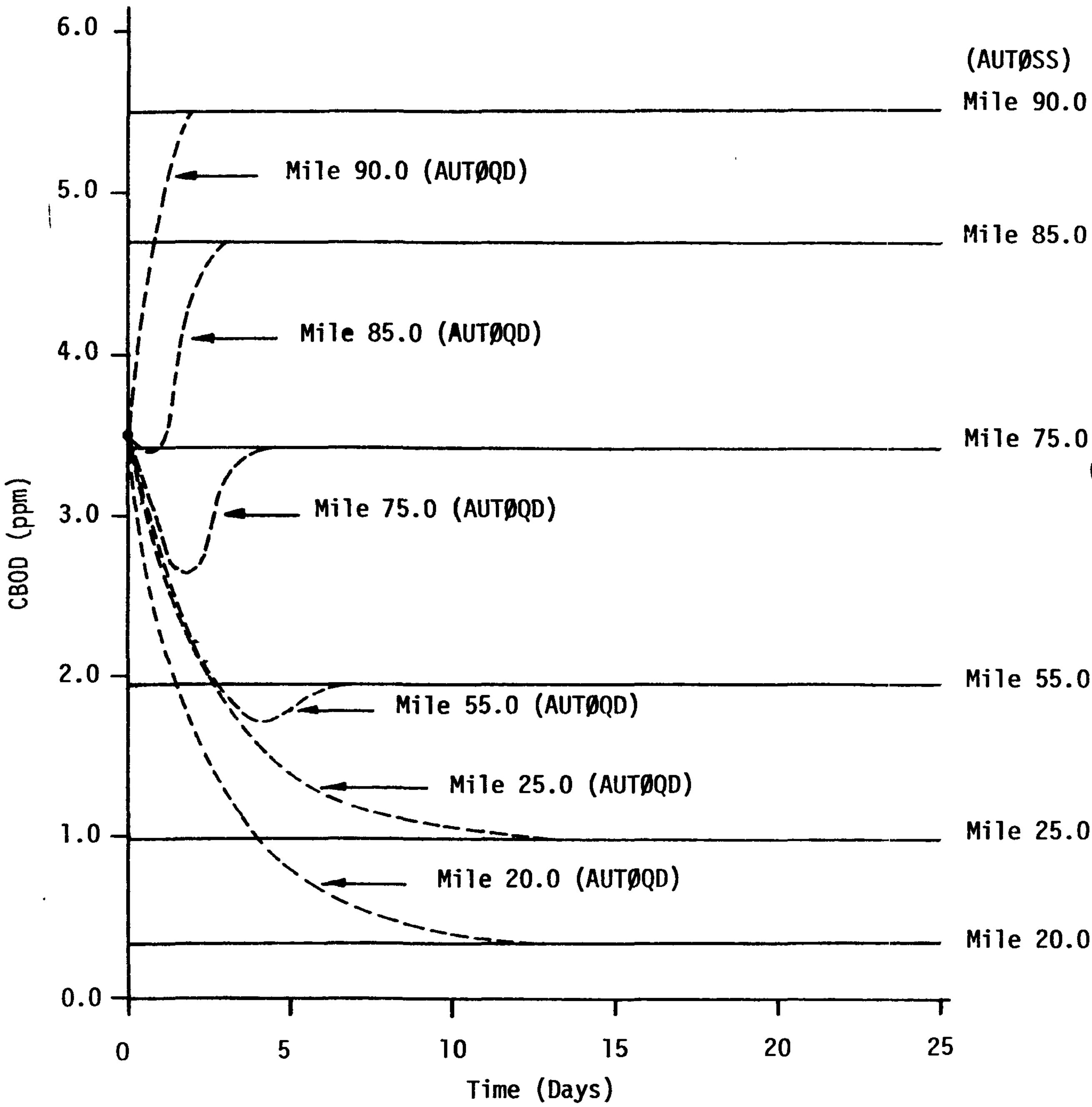


FIGURE 10

AUTØSS and AUTØQD Comparison
Nitrogenous Oxygen Demand
at selected miles

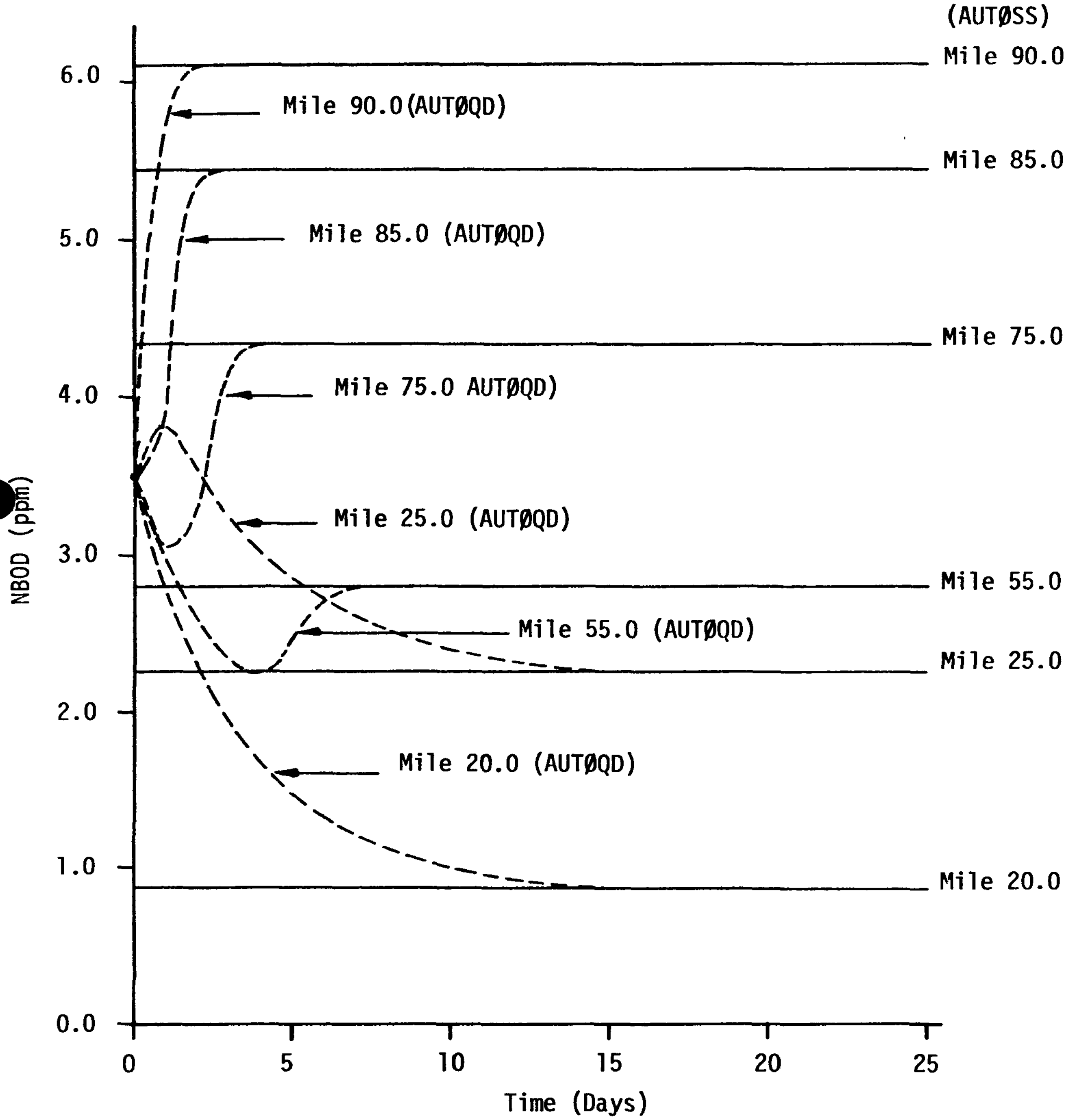


FIGURE 11

AUTØSS and AUTØQD Comparison
Dissolved Oxygen at selected miles