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CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)550GPMaStratFinal6.0
 FILE NAME:         P:\...50GPMFinalRiver\JD289(2)550GPMaStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:58:43 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1099.33  QA    =    203.38  ICHREG= 1
 HA    =      6.94  HD    =      4.86
 Tidal Simulation at TIME =     -2.550 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.073 (m/s)/h
 UA    =      0.185 F     =      0.026 USTAR =0.1049E-01
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1017.9011
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAH0= 1017.9011  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      2.87  ES    =0.3349E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.01
 D0    =      0.135 A0    =      0.014 H0    =      4.86  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      4.409 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1820E+02  GP0   =0.1753E+00
 C0    =0.9900E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.2795E+00  J0    =0.1112E-01  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.12  LM    =      3.65  Lm    =      2.86  Lb    =      1.76
                                       Lmp   =  99999.00  Lbp   =  99999.00
 Tidal:             Tu    =   0.3033 h Lu    =     24.026 Lmin  =      0.400

NON-DIMENSIONAL PARAMETERS
 FR0   =     28.63  R     =     23.83

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV3   1
 1  Applicable layer depth HS =     4.86  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.9900E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
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 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.01 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.86     1.0 0.990E-01   0.07    4.409   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION


 Zone of flow establishment:            THETAE=    -87.01  SIGMAE=     70.57
  LE    =      0.59  XE    =      0.01  YE    =      0.03  ZE    =      4.27

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.86     1.0 0.990E-01   0.07    4.409   .00000E+00
      0.01     0.03    4.27     1.0 0.990E-01   0.07    4.409   .33086E-02
      0.01     0.04    4.15     1.0 0.967E-01   0.08    4.409   .25378E-01
      0.01     0.04    4.01     1.2 0.815E-01   0.10    4.246   .55970E-01
      0.02     0.05    3.87     1.4 0.704E-01   0.11    3.649   .91846E-01
      0.03     0.05    3.75     1.6 0.630E-01   0.13    3.250   .12687E+00
      0.04     0.06    3.61     1.8 0.560E-01   0.14    2.874   .17281E+00
      0.06     0.07    3.48     2.0 0.504E-01   0.16    2.568   .22434E+00
      0.07     0.07    3.36     2.1 0.463E-01   0.17    2.346   .27307E+00
      0.09     0.08    3.22     2.3 0.423E-01   0.19    2.125   .33538E+00
      0.12     0.09    3.08     2.5 0.389E-01   0.21    1.934   .40376E+00
      0.14     0.09    2.96     2.7 0.363E-01   0.22    1.790   .46737E+00
      0.17     0.10    2.83     2.9 0.336E-01   0.24    1.641   .54762E+00
      0.19     0.11    2.71     3.1 0.316E-01   0.26    1.525   .62179E+00
      0.23     0.12    2.58     3.4 0.295E-01   0.27    1.404   .71485E+00
      0.27     0.12    2.44     3.6 0.275E-01   0.29    1.293   .81528E+00
      0.30     0.13    2.33     3.8 0.260E-01   0.31    1.207   .90751E+00
      0.35     0.14    2.20     4.1 0.244E-01   0.33    1.113   .10227E+01
      0.40     0.14    2.06     4.3 0.230E-01   0.35    1.027   .11463E+01
      0.45     0.15    1.95     4.5 0.218E-01   0.37    0.958   .12595E+01
      0.50     0.16    1.83     4.8 0.206E-01   0.39    0.884   .14004E+01
      0.56     0.16    1.70     5.1 0.194E-01   0.41    0.814   .15514E+01
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      0.62     0.17    1.60     5.4 0.185E-01   0.43    0.758   .16892E+01
      0.69     0.18    1.48     5.7 0.175E-01   0.46    0.697   .18604E+01
      0.76     0.18    1.36     6.0 0.165E-01   0.48    0.640   .20435E+01
      0.83     0.19    1.26     6.3 0.158E-01   0.50    0.595   .22103E+01
      0.91     0.20    1.15     6.6 0.150E-01   0.53    0.545   .24169E+01
      1.00     0.20    1.04     7.0 0.142E-01   0.55    0.498   .26374E+01
      1.08     0.21    0.95     7.3 0.135E-01   0.57    0.459   .28381E+01
      1.17     0.22    0.84     7.7 0.128E-01   0.60    0.417   .30869E+01
      1.27     0.22    0.75     8.2 0.121E-01   0.63    0.378   .33522E+01
      1.36     0.23    0.66     8.5 0.116E-01   0.65    0.346   .35932E+01
 Cumulative travel time =           3.5932 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      1.36     0.23    0.66     8.5 0.116E-01   0.65 .35932E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.71     0.21    4.86     8.5 0.116E-01   0.00     0.00    4.86    4.86
.35932E+01
      0.91     0.21    4.86     8.5 0.116E-01   0.99     0.50    4.86    3.86
.35932E+01
      1.10     0.22    4.86     8.5 0.116E-01   1.18     0.71    4.86    3.68
.35932E+01
      1.30     0.23    4.86     8.5 0.116E-01   1.29     0.86    4.86    3.56
.35932E+01
      1.49     0.23    4.86     8.8 0.113E-01   1.38     1.00    4.86    3.47
.43020E+01
      1.69     0.24    4.86     9.9 0.101E-01   1.45     1.12    4.86    3.41
.53583E+01
      1.88     0.24    4.86    11.4 0.872E-02   1.50     1.22    4.86    3.36
.64146E+01
      2.08     0.25    4.86    12.7 0.779E-02   1.53     1.32    4.86    3.32
.74709E+01
      2.27     0.26    4.86    13.7 0.725E-02   1.56     1.41    4.86    3.30
.85273E+01
      2.47     0.26    4.86    14.2 0.699E-02   1.57     1.50    4.86    3.28
.95836E+01
      2.67     0.27    4.86    14.5 0.683E-02   1.58     1.58    4.86    3.28
.10640E+02
 Cumulative travel time =          10.6399 sec

END OF MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.67    -1.01    4.86    14.5 0.683E-02   1.74     2.86    4.86    3.11
.10640E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     52.15    -1.01    4.86    23.3 0.425E-02   0.48    16.87    4.86    4.37
.27804E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    101.64    -1.01    4.86    28.7 0.345E-02   0.40    25.25    4.86    4.45
.54545E+03
    151.12    -1.01    4.86    35.9 0.276E-02   0.40    31.97    4.86    4.45
.81285E+03
    200.61    -1.01    4.86    45.4 0.218E-02   0.44    37.86    4.86    4.42
.10803E+04
    250.09    -1.01    4.86    57.6 0.172E-02   0.49    43.26    4.86    4.37
.13477E+04
    299.57    -1.01    4.86    72.7 0.136E-02   0.56    48.35    4.86    4.30
.16151E+04
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    349.06    -1.01    4.86    90.8 0.109E-02   0.64    53.22    4.86    4.22
.18825E+04
    398.54    -1.01    4.86   112.2 0.883E-03   0.73    57.92    4.86    4.12
.21499E+04
    448.03    -1.01    4.86   136.9 0.723E-03   0.84    62.49    4.86    4.02
.24173E+04
    497.51    -1.01    4.86   165.1 0.600E-03   0.95    66.95    4.86    3.91
.26847E+04
    547.00    -1.01    4.86   197.0 0.502E-03   1.07    71.31    4.86    3.78
.29521E+04
    596.48    -1.01    4.86   232.8 0.425E-03   1.20    75.59    4.86    3.65
.32195E+04
    645.97    -1.01    4.86   272.5 0.363E-03   1.34    79.79    4.86    3.51
.34869E+04
    695.45    -1.01    4.86   316.3 0.313E-03   1.49    83.92    4.86    3.37
.37543E+04
    744.94    -1.01    4.86   364.3 0.272E-03   1.64    88.00    4.86    3.21
.40217E+04
    787.95    -1.01    4.86   409.9 0.242E-03   1.79    91.48    4.86    3.07
 Cumulative travel time =        4254.0996 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)550GPMaStratFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD289(2)550GPMaStra
tFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:58:43
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 203.38 m^3/s
  Average depth                   HA     = 6.94 m
  Depth at discharge              HD     = 4.86 m
  Darcy-Weisbach friction factor  F      = 0.0257
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = -2.55 hours
  Instantaneous ambient velocity  UA     = 0.185 m/s
  Maximum tidal velocity          UaMAX  = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.0725 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1012 kg/m^3
  Bottom density                  RHOAB  = 1022 kg/m^3
  Stratification height           HINT   = 2.87 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 1.01 m
  Port diameter                   D0     = 0.1353 m
  Port cross-sectional area       A0     = 0.0144 m^2
  Discharge velocity              U0     = 4.41 m/s
  Discharge flowrate              Q0     = 0.063399 m^3/s
  Discharge port height           H0     = 4.86 m
  Vertical discharge angle        THETA  = -87.18 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 18.1992 kg/m^3
  Buoyant acceleration            GP0    = 0.1753 m/s^2
  Discharge concentration         C0     = 0.099 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.12 m         Lm  = 2.86 m         Lb  = 1.76 m
  LM  = 3.65 m         Lm' = 99999 m         Lb' = 99999 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.3033 hours     Lu  = 24.03 m         Lmin= 0.40 m
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NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 28.63
  Velocity ratio                  R      = 23.83
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MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV3 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.  The ambient density stratification at the
  discharge site is relatively weak and unimportant so the discharge flow
  penetrates to the surface and/or breaks down the existing stratification
  through vigorous mixing.
  Applicable layer depth = water depth = 4.86 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.01 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0068 mg/l
  Dilution at edge of NFR              s = 14.5
  NFR Location:                        x = 2.67 m
    (centerline coordinates)           y = 0.27 m
                                       z = 4.86 m
  NFR plume dimensions:  half-width (bh) = 1.58 m
                          thickness (bv) = 1.58 m
Cumulative travel time:       10.6399 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified ambient density stratification is weak relative to the
  discharge conditions and is dynamically unimportant. The discharge will
  behave as if the ambient were unstratified.
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PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 2.67 m downstream.
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UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 787.95 m
                                        y = -1.01 m
                                        z = 4.86 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 17.068966
The CMC was encountered at the following plume position:
  Plume location:                       x = 8.54 m
    (centerline coordinates)            y = -1.01 m
                                        z = 4.86 m
  Plume dimension:       half-width (bh) = 5.51 m
                          thickness (bv) = 1.07 m

 Computed distance from port opening to CMC location = 8.60 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.12 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.60 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.86 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.60 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 4.41 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.003603  mg/l
  Corresponding dilution                s = 27.5
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -1.01 m
                                        z = 4.86 m
  Plume dimensions:      half-width (bh) = 23.70 m
                          thickness (bv) = 0.41 m
Cumulative travel time:       490.3532 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
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  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 26.5
  Plume location:                      x = 83.21 m
    (centerline coordinates)           y = -1.01 m
                                       z = 4.86 m
  Plume dimensions:      half-width (bh) = 22.40 m
                          thickness (bv) = 0.42 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
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CORMIX1 PREDICTION FILE:
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1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)550GPMbStratFinal6.0
 FILE NAME:         P:\...50GPMFinalRiver\JD289(2)550GPMbStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:00:55 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1035.95  QA    =     90.13  ICHREG= 1
 HA    =      6.54  HD    =      4.58
 Tidal Simulation at TIME =     -1.300 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.067 (m/s)/h
 UA    =      0.087 F     =      0.026 USTAR =0.4983E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1017.6293
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAH0= 1022.0000  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      2.58  ES    =0.3726E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.98
 D0    =      0.096 A0    =      0.007 H0    =      4.58  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.220 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.2230E+02  GP0   =0.2140E+00
 C0    =0.8700E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.1985E+00  J0    =0.8135E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.09  LM    =      3.30  Lm    =      5.12  Lb    =     12.35
                                       Lmp   =      1.52  Lbp   =      1.03
 Tidal:             Tu    =   0.3023 h Lu    =     22.020 Lmin  =      0.284

NON-DIMENSIONAL PARAMETERS
 FR0   =     36.37  R     =     60.01

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.00  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8700E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.98 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.870E-01   0.05    5.220   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -88.52  SIGMAE=     74.54
  LE    =      0.46  XE    =      0.00  YE    =      0.01  ZE    =      4.12

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.870E-01   0.05    5.220   .00000E+00
      0.00     0.01    4.12     1.0 0.870E-01   0.05    5.220   .25990E-02
      0.00     0.01    4.01     1.1 0.806E-01   0.06    5.220   .20409E-01
      0.00     0.02    3.88     1.3 0.657E-01   0.08    4.629   .46005E-01
      0.01     0.02    3.75     1.6 0.555E-01   0.09    3.895   .76821E-01
      0.01     0.02    3.64     1.8 0.490E-01   0.10    3.426   .10742E+00
      0.02     0.03    3.51     2.0 0.431E-01   0.12    3.000   .14803E+00
      0.02     0.03    3.40     2.2 0.390E-01   0.13    2.708   .18711E+00
      0.03     0.03    3.27     2.5 0.352E-01   0.14    2.429   .23771E+00
      0.04     0.04    3.15     2.7 0.321E-01   0.16    2.199   .29379E+00
      0.04     0.04    3.04     2.9 0.298E-01   0.17    2.031   .34627E+00
      0.06     0.04    2.91     3.2 0.275E-01   0.19    1.863   .41274E+00
      0.07     0.05    2.78     3.4 0.256E-01   0.20    1.717   .48493E+00
      0.08     0.05    2.67     3.6 0.241E-01   0.21    1.607   .55146E+00
      0.09     0.05    2.54     3.8 0.226E-01   0.23    1.493   .63459E+00
      0.11     0.06    2.41     4.1 0.213E-01   0.24    1.392   .72381E+00
      0.12     0.06    2.30     4.3 0.203E-01   0.26    1.313   .80524E+00
      0.14     0.06    2.18     4.5 0.192E-01   0.27    1.230   .90616E+00
      0.16     0.07    2.05     4.8 0.183E-01   0.29    1.154   .10136E+01
      0.17     0.07    1.94     5.0 0.175E-01   0.30    1.095   .11111E+01
      0.20     0.07    1.81     5.2 0.167E-01   0.32    1.030   .12313E+01
```

```
      0.22     0.08    1.69     5.4 0.160E-01   0.33    0.971   .13587E+01
      0.24     0.08    1.58     5.6 0.154E-01   0.35    0.923   .14739E+01
      0.27     0.08    1.45     5.9 0.148E-01   0.36    0.871   .16153E+01
      0.30     0.09    1.33     6.1 0.143E-01   0.38    0.822   .17649E+01
      0.32     0.09    1.22     6.3 0.138E-01   0.39    0.782   .18997E+01
      0.35     0.09    1.09     6.5 0.133E-01   0.41    0.738   .20652E+01
      0.39     0.10    0.97     6.8 0.129E-01   0.43    0.697   .22400E+01
      0.42     0.10    0.86     6.9 0.125E-01   0.44    0.663   .23974E+01
      0.46     0.10    0.74     7.2 0.121E-01   0.46    0.625   .25907E+01
      0.50     0.11    0.62     7.4 0.118E-01   0.48    0.588   .27947E+01
      0.53     0.11    0.51     7.6 0.115E-01   0.50    0.558   .29788E+01
 Cumulative travel time =           2.9788 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -70.07 deg
  Horizontal angle of layer/boundary impingement  =       5.53 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                =       3.95 m
        X-position of upstream stagnation point =      -3.41 m
        Thickness in intrusion region            =       0.41 m
        Half-width at downstream end             =       6.90 m
        Thickness at downstream end              =       0.41 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.53     0.11    0.51     7.6 0.115E-01   0.50 .29788E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -3.41     0.11    0.00  9995.1 0.000E+00   0.00     0.00    0.00    0.00
.42646E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -3.27     0.11    0.00    32.0 0.272E-02   0.10     0.98    0.10    0.00
.29788E+01
     -2.54     0.11    0.00    13.3 0.655E-02   0.23     2.37    0.23    0.00
.29788E+01
```

```
     -1.82     0.11    0.00    10.0 0.866E-02   0.31     3.21    0.31    0.00
.29788E+01
     -1.09     0.11    0.00     8.6 0.101E-01   0.36     3.87    0.36    0.00
.29788E+01
     -0.37     0.11    0.00     7.9 0.110E-01   0.39     4.43    0.39    0.00
.29788E+01
      0.36     0.11    0.00     7.6 0.114E-01   0.41     4.93    0.41    0.00
.29788E+01
      1.08     0.11    0.00     7.8 0.111E-01   0.41     5.38    0.41    0.00
.74112E+01
      1.81     0.11    0.00     9.5 0.916E-02   0.41     5.80    0.41    0.00
.16220E+02
      2.54     0.11    0.00    11.4 0.766E-02   0.41     6.19    0.41    0.00
.25029E+02
      3.26     0.11    0.00    12.4 0.700E-02   0.41     6.56    0.41    0.00
.33838E+02
      3.99     0.11    0.00    12.9 0.675E-02   0.41     6.90    0.41    0.00
.42646E+02
 Cumulative travel time =          42.6465 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      3.99    -0.98    0.00    12.9 0.675E-02   0.70     8.00    0.70    0.00
.42646E+02
     22.46    -0.98    0.00    16.6 0.523E-02   0.36    20.19    0.36    0.00
.25486E+03
     40.93    -0.98    0.00    19.3 0.452E-02   0.29    29.20    0.29    0.00
.46706E+03
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     59.40    -0.98    0.00    22.2 0.391E-02   0.27    36.88    0.27    0.00
.67927E+03
     77.87    -0.98    0.00    25.9 0.336E-02   0.26    43.77    0.26    0.00
.89148E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     96.34    -0.98    0.00    30.3 0.287E-02   0.27    50.10    0.27    0.00
.11037E+04
    114.81    -0.98    0.00    35.8 0.243E-02   0.28    56.03    0.28    0.00
.13159E+04
    133.28    -0.98    0.00    42.2 0.206E-02   0.30    61.65    0.30    0.00
.15281E+04
    151.75    -0.98    0.00    49.7 0.175E-02   0.33    67.02    0.33    0.00
.17403E+04
    170.22    -0.98    0.00    58.4 0.149E-02   0.36    72.18    0.36    0.00
.19525E+04
    188.69    -0.98    0.00    68.3 0.127E-02   0.40    77.18    0.40    0.00
.21647E+04
    207.16    -0.98    0.00    79.4 0.110E-02   0.43    82.02    0.43    0.00
.23769E+04
    225.63    -0.98    0.00    91.7 0.948E-03   0.48    86.73    0.48    0.00
.25892E+04
    235.30    -0.98    0.00    98.9 0.884E-03   0.50    89.14    0.50    0.00
 Cumulative travel time =        2700.3323 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)550GPMbStratFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD289(2)550GPMbStra
tFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--16:00:55
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 90.13 m^3/s
  Average depth                   HA      = 6.54 m
  Depth at discharge              HD      = 4.58 m
  Darcy-Weisbach friction factor  F       = 0.0262
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 8.5 m/s
TIDAL SIMULATION at time          Tsim    = -1.3 hours
  Instantaneous ambient velocity  UA      = 0.087 m/s
  Maximum tidal velocity          UaMAX   = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.0669 (m/s)/hour
  Period of reversal              T       = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS   = 1012 kg/m^3
  Bottom density                  RHOAB   = 1022 kg/m^3
  Stratification height           HINT    = 2.58 m (pycnocline level)
  Density below pycnocline        RHOAP   = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.98 m
  Port diameter                   D0      = 0.0963 m
  Port cross-sectional area       A0      = 0.0073 m^2
  Discharge velocity              U0      = 5.22 m/s
  Discharge flowrate              Q0      = 0.038021 m^3/s
  Discharge port height           H0      = 4.58 m
  Vertical discharge angle        THETA   = -88.57 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 22.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.214 m/s^2
  Discharge concentration         C0      = 0.087 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.09 m         Lm  = 5.12 m         Lb  = 12.35 m
  LM  = 3.30 m         Lm' = 1.52 m         Lb' = 1.03 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.3023 hours     Lu  = 22.02 m         Lmin= 0.28 m
-----------------------------------------------------------------------------
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NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 36.37
  Velocity ratio                  R      = 60.01
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.00 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.98 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0067 mg/l
  Dilution at edge of NFR              s = 12.9
  NFR Location:                        x = 3.99 m
    (centerline coordinates)           y = 0.11 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 6.90 m
                          thickness (bv) = 0.41 m
Cumulative travel time:       42.6465 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

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  discharge buoyancy.
  Intrusion length                        =  3.95 m
  Intrusion stagnation point              =  -3.41 m
  Intrusion thickness                     =  0.41 m
  Intrusion half width at impingement     =  6.90 m
  Intrusion half thickness at impingement =  0.41 m
-------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 3.99 m downstream.
  Plume contacts second bank at 558.08 m downstream.
-------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                       x = 235.30 m
                                       y = -0.98 m
                                       z = 0 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 15
The CMC was encountered at the following plume position:
  Plume location:                      x = -0.25 m
    (centerline coordinates)           y = 0.11 m
                                       z = 0.19 m
  Plume dimension:       half-width (bh) = 2.75 m
                          thickness (bv) = 0.06 m

 Computed distance from port opening to CMC location = 4.40 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.09 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 0.27 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.58 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 4.40 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.56 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.22 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002994  mg/l
  Corresponding dilution               s = 29.1
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.98 m
```

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                                        z = 0 m
  Plume dimensions:      half-width (bh) = 48.45 m
                          thickness (bv) = 0.27 m
Cumulative travel time:       1047.4453 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 23.3
  Plume location:                       x = -2.28 m
    (centerline coordinates)            y = 0.11 m
                                        z = 0.06 m
  Plume dimensions:      half-width (bh) = 1.56 m
                          thickness (bv) = 0.09 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)550GPMcStrat2Final6.0
 FILE NAME:         P:\...50GPMFinalRiver\JD289(2)550GPMcStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:02:18 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1035.95  QA    =     72.52  ICHREG= 1
 HA    =      6.54  HD    =      4.58
 Tidal Simulation at TIME =      0.700 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.100 (m/s)/h
 UA    =      0.070 F     =      0.026 USTAR =0.4009E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1017.6293
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAH0= 1017.6293  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      2.58  ES    =0.3726E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.03
 D0    =      0.124 A0    =      0.012 H0    =      4.58  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.223 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1793E+02  GP0   =0.1728E+00
 C0    =0.1570E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.3312E+00  J0    =0.1095E-01  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.11  LM    =      4.17  Lm    =      8.22  Lb    =     31.93
                                       Lmp   =  99999.00  Lbp   =  99999.00
 Tidal:             Tu    =   0.2519 h Lu    =     22.844 Lmin  =      0.367

NON-DIMENSIONAL PARAMETERS
 FR0   =     35.64  R     =     74.62

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV5   1
 1  Applicable layer depth HS =     4.58  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1570E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.03 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.58     1.0 0.157E+00   0.06    5.223   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

 INITIAL LOCAL VERTICAL INSTABILITY REGION:
   Bulk dilution (S =  33.74) occurs in a limited region (horizontal extent
   =    12.51 m) surrounding the discharge location.

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    4.58     1.0 0.157E+00   0.06 .00000E+00

** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   due to mixing in this control volume.
 The actual extent of the TOXIC DILUTION ZONE will be smaller than control
   volume outflow values predicted below.

  Control volume outflow:
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.00     0.00    4.58     1.0 0.157E+00  11.44     0.00    0.00    0.00
.00000E+00

END OF MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
BEGIN MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       3.18 m
        X-position of upstream stagnation point =      -3.18 m
        Thickness in intrusion region           =       2.39 m
        Half-width at downstream end            =     123.28 m
        Thickness at downstream end             =       0.15 m
```

```
  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    2.29    33.6 0.467E-02   0.06 .00000E+00

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -3.18     0.00    4.58  9954.6 0.000E+00   0.00     0.00    4.58    4.58
.88057E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -1.88     0.00    4.58    43.4 0.361E-02   1.85    17.43    4.58    2.73
.00000E+00
      4.47     0.00    4.58    33.7 0.465E-02   2.34    42.35    4.58    2.23
.63893E+02
     10.82     0.00    4.58    34.4 0.457E-02   2.13    57.30    4.58    2.45
.15463E+03
     17.18     0.00    4.58    35.5 0.443E-02   1.79    69.08    4.58    2.78
.24538E+03
     23.53     0.00    4.58    36.7 0.427E-02   1.40    79.13    4.58    3.17
.33612E+03
     29.88     0.00    4.58    37.9 0.414E-02   1.03    88.04    4.58    3.55
.42686E+03
     36.23     0.00    4.58    38.9 0.404E-02   0.72    96.13    4.58    3.86
.51760E+03
     42.58     0.00    4.58    39.5 0.397E-02   0.49   103.58    4.58    4.09
.60835E+03
     48.94     0.00    4.58    39.9 0.394E-02   0.33   110.54    4.58    4.24
.69909E+03
     55.29     0.00    4.58    40.0 0.392E-02   0.24   117.08    4.58    4.33
.78983E+03
     61.64     0.00    4.58    40.2 0.391E-02   0.15   123.28    4.58    4.42
.88057E+03
 Cumulative travel time =         880.5720 sec

END OF MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY
-------------------------------------------------------------------------------
---------------
** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
```

```
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     61.64    -1.03    4.58    40.2 0.391E-02   0.31   124.31    4.58    4.27
.88057E+03
     69.19    -1.03    4.58    43.4 0.362E-02   0.33   125.26    4.58    4.24
.98840E+03
     76.75    -1.03    4.58    46.7 0.336E-02   0.35   126.23    4.58    4.22
.10962E+04
     84.30    -1.03    4.58    50.0 0.314E-02   0.38   127.22    4.58    4.20
.12041E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     88.20    -1.03    4.58    51.7 0.304E-02   0.39   127.75    4.58    4.18
 Cumulative travel time =        1259.6685 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting time due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)550GPMcStrat2Final6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD289(2)550GPMcStra
tFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--16:02:18
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 72.52 m^3/s
  Average depth                   HA     = 6.54 m
  Depth at discharge              HD     = 4.58 m
  Darcy-Weisbach friction factor  F      = 0.0262
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 0.7 hours
  Instantaneous ambient velocity  UA     = 0.07 m/s
  Maximum tidal velocity          UaMAX  = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.1 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1012 kg/m^3
  Bottom density                  RHOAB  = 1022 kg/m^3
  Stratification height           HINT   = 2.58 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 1.03 m
  Port diameter                   D0     = 0.1243 m
  Port cross-sectional area       A0     = 0.0121 m^2
  Discharge velocity              U0     = 5.22 m/s
  Discharge flowrate              Q0     = 0.063399 m^3/s
  Discharge port height           H0     = 4.58 m
  Vertical discharge angle        THETA  = -87.62 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 17.9274 kg/m^3
  Buoyant acceleration            GP0    = 0.1728 m/s^2
  Discharge concentration         C0     = 0.157 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.11 m         Lm  = 8.22 m         Lb  = 31.93 m
  LM  = 4.17 m         Lm' = 99999 m         Lb' = 99999 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2519 hours     Lu  = 22.84 m         Lmin= 0.37 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 35.64
  Velocity ratio                  R      = 74.62
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.  The ambient density stratification at the
  discharge site is relatively weak and unimportant so the discharge flow
  penetrates to the surface and/or breaks down the existing stratification
  through vigorous mixing.
  Applicable layer depth = water depth = 4.58 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.03 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0039 mg/l
  Dilution at edge of NFR              s = 40.2
  NFR Location:                        x = 61.64 m
    (centerline coordinates)           y = 0 m
                                       z = 4.58 m
  NFR plume dimensions:  half-width (bh) = 123.28 m
                          thickness (bv) = 0.15 m
Cumulative travel time:       880.5718 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified ambient density stratification is weak relative to the
  discharge conditions and is dynamically unimportant. The discharge will
  behave as if the ambient were unstratified.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

```
  discharge buoyancy.
  Intrusion length                        =  3.18 m
  Intrusion stagnation point              =  -3.18 m
  Intrusion thickness                     =  2.39 m
  Intrusion half width at impingement     =  123.28 m
  Intrusion half thickness at impingement =  0.15 m
-------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m
  downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 61.64 m downstream.
  Plume contacts second bank at 288.28 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                       x = 88.20 m
                                       y = -1.03 m
                                       z = 4.58 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 27.068966
The CMC was encountered within a control volume describing a portion
  of the discharge plume.
Therefore, the following plume conditions are a conservative estimate (with
  lower concentrations or with larger dimensions) for the region at whose
  boundary the CMC is met:
  Local boundary concentration           = 0.004662  mg/l
Corresponding dilution                   = 33.6751
  Plume location:                      x = 0 m
    (centerline coordinates)           y = 0 m
                                       z = 2.29 m
  Plume dimension:       half-width (bh) = 11.44 m
                          thickness (bv) = 0 m

 Computed distance from port opening to CMC location = 2.29 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.11 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 0 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.58 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 2.29 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++
```

```
 The diffuser discharge velocity is equal to 5.22 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002957  mg/l
  Corresponding dilution               s = 53.1
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.03 m
                                       z = 4.58 m
  Plume dimensions:      half-width (bh) = 128.18 m
                          thickness (bv) = 0.40 m
Cumulative travel time:       1305.9138 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 42.1
  Plume location:                      x = -1.88 m
    (centerline coordinates)           y = 0 m
                                       z = 4.58 m
  Plume dimensions:      half-width (bh) = 17.51 m
                          thickness (bv) = 1.85 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333333
3
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3:   Buoyant Surface Discharges
                          CORMIX Version 6.0GT
                       HYDRO3 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD289(2)550GPMdStratFinal6.0
 FILE NAME:         P:\...50GPMFinalRiver\JD289(2)550GPMdStratFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:04:09 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1257.79  QA    =    109.43  ICHREG= 1
 HA    =      7.94  HD    =      5.56
 Tidal Simulation at TIME =      1.250 h
 PERIOD=    12.40 h UAmax =      0.300 dUa/dt=      0.070 (m/s)/h
 UA    =      0.087 F     =      0.025 USTAR =0.4824E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1018.4032
 RHOAS = 1012.0000  RHOAB = 1022.0000  RHOAEF= 1012.0000  E     =0.0000E+00
 DRHOJ =   10.0000  HINT  =      3.56  ES    =0.2698E-01

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.91  Configuration: protruding_discharge
 SIGMA =     90.00  HDO   =      5.56  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.610 A0    =      0.180
 Dimensions of equivalent rectangular discharge:
 B0    =      0.479 H0    =      0.610 A0    =0.2919E+00  AR    =      1.273
 Reduced channel geometry due to intrusion:
 B0    =      0.479 H0    =      0.376 A0    =0.1801E+00  AR    =      0.786
 (All relevant parameters further below are based on this geometry.)
 U0    =      0.211 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.1230E+02  GP0   =0.1192E+00
 C0    =0.1800E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.8026E-02  J0    =0.4531E-02
 Associated length scales (meters)
 LQ    =      0.42  LM    =      0.40  Lm    =      1.03  Lb    =      6.84
 Tidal:             Tu    =   0.1725 h Lu    =      7.460 Lmin  =      0.299

NON-DIMENSIONAL PARAMETERS
 FR0   =      0.94  FRCH  =      1.00  R     =      2.43

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL1    3
 3  Applicable layer depth HS =     2.00  3
 333333333333333333333333333333333333333333
```

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1800E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.91 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.180E-01   0.38     0.24 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.180E-01   0.38     0.24 .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                SIGMAE=     86.89
       X        Y       Z        S       C       BV       BH        TT
      0.02     0.41    0.00     1.0 0.180E-01   0.21     0.45 .19670E+01
 Cumulative travel time =           1.9670 sec

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD331: UPSTREAM INTRUDING PLUME

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.02     0.41    0.00     1.0 0.180E-01   0.21     0.45 .19670E+01

 UPSTREAM INTRUSION PROPERTIES:
```

```
        Upstream intrusion length                =       3.69 m
        X-position of upstream stagnation point =      -3.69 m
        Thickness in intrusion region            =       0.08 m
        Half-width at downstream end             =       8.13 m
        Thickness at downstream end              =       0.08 m

 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
     -3.69     0.00    0.00  9527.2 0.000E+00   0.00     0.00 .19670E+01
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     -3.47     0.00    0.00     3.1 0.576E-02   0.02     1.15 .19670E+01
     -2.38     0.00    0.00     1.3 0.135E-01   0.06     2.79 .19670E+01
     -1.30     0.00    0.00     1.1 0.169E-01   0.07     3.78 .19670E+01
     -0.21     0.00    0.00     1.0 0.180E-01   0.08     4.55 .19670E+01
      0.87     0.00    0.00     1.0 0.178E-01   0.08     5.22 .11722E+02
      1.96     0.00    0.00     1.1 0.167E-01   0.08     5.81 .24198E+02
      3.04     0.00    0.00     1.2 0.154E-01   0.08     6.34 .36673E+02
      4.13     0.00    0.00     1.2 0.144E-01   0.08     6.83 .49148E+02
      5.21     0.00    0.00     1.3 0.139E-01   0.08     7.29 .61624E+02
      6.30     0.00    0.00     1.3 0.137E-01   0.08     7.72 .74099E+02
      7.38     0.00    0.00     1.3 0.137E-01   0.08     8.13 .86575E+02
 Cumulative travel time =          86.5748 sec

END OF MOD331: UPSTREAM INTRUDING PLUME
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD341: BUOYANT AMBIENT SPREADING

  Because of the WEAK VERTICAL MIXING, the surface plume in the far-field
    will be vertically limited WITHIN THE UPPER LAYER of the ambient
    stratification.
 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
      7.38    -0.91    0.00     1.3 0.137E-01   0.08     8.13 .86575E+02
     31.93    -0.91    0.00     2.0 0.913E-02   0.06    19.58 .36858E+03
     56.47    -0.91    0.00     3.3 0.538E-02   0.08    28.01 .65059E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
```

```
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     81.01    -0.91    0.00     5.6 0.324E-02   0.12    35.35 .93260E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    105.56    -0.91    0.00     8.7 0.207E-02   0.17    42.08 .12146E+04
    130.10    -0.91    0.00    12.8 0.140E-02   0.22    48.37 .14966E+04
    154.64    -0.91    0.00    18.2 0.990E-03   0.29    54.33 .17786E+04
    155.30    -0.91    0.00    18.4 0.983E-03   0.29    54.49
 Cumulative travel time =        1786.2314 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD341: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
3333333333333333333333333333333333333333333333333333333333333333333333333333333
3
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO3:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD289(2)550GPMdStratFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD289(2)550GPMdStra
tFinal6.0R.prd
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             03/26/2010--16:04:09
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 109.43 m^3/s
  Average depth                   HA     = 7.94 m
  Depth at discharge              HD     = 5.56 m
  Darcy-Weisbach friction factor  F      = 0.0246
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 1.25 hours
  Instantaneous ambient velocity  UA     = 0.087 m/s
  Maximum tidal velocity          UaMAX  = 0.3 m/s
Rate of tidal reversal          dUA/dt = 0.0696 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1012 kg/m^3
  Bottom density                  RHOAB  = 1022 kg/m^3
  Stratification height           HINT   = 3.56 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1022 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                   = right bank/shoreline
  Discharge configuration                = protruding discharge
  Distance from bank to outlet    DISTB  = 0.91 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 5.56 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Circular pipe diameter                 = 0.6096 m
    Equivalent rectangular discharge:
    Discharge cross-section area  A0     = 0.291864 m^2
    Discharge channel width       B0     = 0.478779 m
    Discharge channel depth       H0     = 0.6096 m
    Discharge aspect ratio        AR     = 1.273240
  Reduced discharge channel due to intrusion:
    Cross-section area            A0     = 0.1801 m^2
    Channel width                 B0     = 0.4788 m
    Channel depth                 H0     = 0.38 m
    Aspect ratio                  AR     = 0.79
  Discharge flowrate              Q0     = 0.038021 m^3/s
  Discharge velocity              U0     = 0.21 m/s
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 12.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.1192 m/s^2
```

```
  Discharge concentration         C0     = 0.018 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.42 m         Lm  = 1.03 m         Lbb = 6.84 m
  LM  = 0.40 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.1725 hours     Lu  = 7.46 m         Lmin= 0.30 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 0.94 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                  R      = 2.43
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = PL1 |
  *------------------------*
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0.91 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0124 mg/l
  Dilution at edge of NFR              s = 1.4
  NFR Location:                        x = 7.38 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 8.13 m
                          thickness (bv) = 0.08 m
Cumulative travel time:       86.5748 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  Due to WEAK VERTICAL MIXING the surface plume will be confined to
```

```
  the upper layer above the pycnocline!
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at -3.69 m downstream.
  Plume contacts second bank at 743.68 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 155.30 m
                                        y = -0.91 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 3.103448
The CMC was encountered at the following plume position:
  Plume location:                       x = -3.44 m
    (centerline coordinates)            y = 0.00 m
                                        z = 0 m
  Plume dimension:       half-width (bh) = 1.17 m
                          thickness (bv) = 0.02 m

 Computed distance from port opening to CMC location = 3.44 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.42 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 3.44 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.56 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 3.44 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 0.21 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.002664  mg/l
  Corresponding dilution                s = 6.8
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -0.91 m
                                        z = 0 m
  Plume dimensions:      half-width (bh) = 38.27 m
                          thickness (bv) = 0.14 m
Cumulative travel time:       1052.4069 sec.
```

```
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                   = 0.00373  mg/l
Corresponding dilution                  = 4.8
  Plume location:                     x = 73.99 m
    (centerline coordinates)          y = -0.91 m
                                      z = 0 m
  Plume dimensions:      half-width (bh) = 33.33 m
                          thickness (bv) = 0.11 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************

INTRUSION OF AMBIENT WATER into the discharge opening will occur!

For the present discharge/environment conditions the discharge densimetric
Froude number is well below unity. This is an UNDESIRABLE operating condition.

To prevent intrusion, change the discharge parameters (e.g. decrease the
discharge opening area) in order to increase the discharge Froude number.

In a future iteration, change the discharge parameters (e.g. decrease port
diameter) in order to increase the Froude number.
-----------------------------------------------------------------------------
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300550GPMa6.0
 FILE NAME:         P:\...\V.6.0\550GPMFinalRiver\JD300550GPMaFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:06:30 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    829.96  QA    =     95.45  ICHREG= 1
 HA    =      5.24  HD    =      3.67
 Tidal Simulation at TIME =     -1.500 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.077 (m/s)/h
 UA    =      0.115 F     =      0.028 USTAR =0.6834E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2144
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1019.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.47  ES    =0.1179E+00

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.01
 D0    =      0.082 A0    =      0.005 H0    =      3.67  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      7.263 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.1930E+02  GP0   =0.1857E+00
 C0    =0.1070E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.2761E+00  J0    =0.7061E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.07  LM    =      4.53  Lm    =      4.57  Lb    =      4.64
                                       Lmp   =      1.24  Lbp   =      0.65
 Tidal:             Tu    =   0.2918 h Lu    =     23.492 Lmin  =      0.202

NON-DIMENSIONAL PARAMETERS
 FR0   =     58.98  R     =     63.15

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.20  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1070E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.01 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.67     1.0 0.107E+00   0.04    7.263   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -88.91  SIGMAE=     69.92
  LE    =      0.39  XE    =      0.00  YE    =      0.01  ZE    =      3.28

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.67     1.0 0.107E+00   0.04    7.263   .00000E+00
      0.00     0.01    3.28     1.0 0.107E+00   0.04    7.263   .14796E-02
      0.00     0.01    3.19     1.1 0.101E+00   0.05    7.263   .11538E-01
      0.00     0.01    3.09     1.3 0.827E-01   0.06    6.607   .25837E-01
      0.01     0.01    2.99     1.5 0.702E-01   0.07    5.602   .42904E-01
      0.01     0.01    2.90     1.7 0.621E-01   0.08    4.954   .59743E-01
      0.01     0.02    2.80     2.0 0.548E-01   0.10    4.362   .81979E-01
      0.02     0.02    2.69     2.2 0.490E-01   0.11    3.894   .10702E+00
      0.02     0.02    2.61     2.4 0.449E-01   0.12    3.564   .13072E+00
      0.03     0.02    2.50     2.6 0.409E-01   0.13    3.241   .16101E+00
      0.03     0.02    2.40     2.8 0.376E-01   0.14    2.970   .19414E+00
      0.04     0.02    2.31     3.0 0.351E-01   0.15    2.769   .22483E+00
      0.05     0.03    2.21     3.3 0.326E-01   0.16    2.565   .26333E+00
      0.06     0.03    2.11     3.5 0.305E-01   0.17    2.387   .30475E+00
      0.06     0.03    2.02     3.7 0.288E-01   0.18    2.252   .34259E+00
      0.07     0.03    1.92     3.9 0.271E-01   0.19    2.111   .38951E+00
      0.09     0.03    1.82     4.2 0.256E-01   0.21    1.984   .43945E+00
      0.10     0.04    1.73     4.4 0.244E-01   0.22    1.886   .48467E+00
      0.11     0.04    1.63     4.6 0.232E-01   0.23    1.782   .54029E+00
      0.12     0.04    1.53     4.9 0.220E-01   0.24    1.687   .59904E+00
      0.13     0.04    1.44     5.1 0.211E-01   0.25    1.612   .65191E+00
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      0.15     0.04    1.34     5.3 0.202E-01   0.26    1.531   .71658E+00
      0.16     0.04    1.26     5.5 0.194E-01   0.27    1.467   .77461E+00
      0.18     0.05    1.15     5.8 0.186E-01   0.29    1.397   .84538E+00
      0.20     0.05    1.05     6.0 0.178E-01   0.30    1.332   .91952E+00
      0.22     0.05    0.97     6.2 0.172E-01   0.31    1.280   .98580E+00
      0.24     0.05    0.87     6.5 0.166E-01   0.32    1.223   .10664E+01
      0.26     0.05    0.77     6.7 0.159E-01   0.33    1.170   .11505E+01
      0.28     0.05    0.68     6.9 0.154E-01   0.35    1.127   .12255E+01
      0.30     0.06    0.58     7.2 0.149E-01   0.36    1.079   .13164E+01
      0.32     0.06    0.48     7.4 0.144E-01   0.37    1.033   .14112E+01
      0.35     0.06    0.40     7.7 0.140E-01   0.38    0.997   .14954E+01
 Cumulative travel time =           1.4954 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -75.29 deg
  Horizontal angle of layer/boundary impingement  =       4.31 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                =       3.04 m
        X-position of upstream stagnation point =      -2.69 m
        Thickness in intrusion region            =       0.45 m
        Half-width at downstream end             =       4.83 m
        Thickness at downstream end              =       0.45 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.35     0.06    0.40     7.7 0.140E-01   0.38 .14954E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -2.69     0.06    0.00  9997.3 0.000E+00   0.00     0.00    0.00    0.00
.22477E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -2.58     0.06    0.00    32.8 0.326E-02   0.10     0.68    0.10    0.00
.14954E+01
     -2.05     0.06    0.00    13.6 0.785E-02   0.25     1.66    0.25    0.00
.14954E+01
```

```
     -1.51     0.06    0.00    10.3 0.104E-01   0.33     2.24    0.33    0.00
.14954E+01
     -0.98     0.06    0.00     8.8 0.121E-01   0.39     2.70    0.39    0.00
.14954E+01
     -0.44     0.06    0.00     8.1 0.133E-01   0.42     3.10    0.42    0.00
.14954E+01
      0.09     0.06    0.00     7.7 0.139E-01   0.44     3.45    0.44    0.00
.14954E+01
      0.62     0.06    0.00     7.8 0.138E-01   0.45     3.76    0.45    0.00
.30680E+01
      1.16     0.06    0.00     9.3 0.115E-01   0.45     4.05    0.45    0.00
.79203E+01
      1.69     0.06    0.00    11.3 0.944E-02   0.45     4.33    0.45    0.00
.12773E+02
      2.22     0.06    0.00    12.5 0.855E-02   0.45     4.58    0.45    0.00
.17625E+02
      2.76     0.06    0.00    13.0 0.822E-02   0.45     4.83    0.45    0.00
.22477E+02
 Cumulative travel time =          22.4771 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.76    -1.01    0.00    13.0 0.822E-02   0.73     5.90    0.73    0.00
.22477E+02
     25.43    -1.01    0.00    17.3 0.619E-02   0.35    16.27    0.35    0.00
.21951E+03
     48.09    -1.01    0.00    20.5 0.522E-02   0.29    23.83    0.29    0.00
.41655E+03
```

```
     70.76    -1.01    0.00    24.4 0.439E-02   0.27    30.27    0.27    0.00
.61358E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     93.43    -1.01    0.00    29.3 0.365E-02   0.27    36.03    0.27    0.00
.81061E+03
    116.10    -1.01    0.00    35.6 0.301E-02   0.29    41.34    0.29    0.00
.10076E+04
    138.77    -1.01    0.00    43.3 0.247E-02   0.31    46.32    0.31    0.00
.12047E+04
    161.43    -1.01    0.00    52.5 0.204E-02   0.35    51.04    0.35    0.00
.14017E+04
    184.10    -1.01    0.00    63.4 0.169E-02   0.38    55.56    0.38    0.00
.15988E+04
    206.77    -1.01    0.00    76.1 0.141E-02   0.43    59.90    0.43    0.00
.17958E+04
    229.44    -1.01    0.00    90.5 0.118E-02   0.48    64.10    0.48    0.00
.19928E+04
    252.11    -1.01    0.00   106.8 0.100E-02   0.53    68.17    0.53    0.00
.21899E+04
    274.77    -1.01    0.00   125.0 0.856E-03   0.59    72.13    0.59    0.00
.23869E+04
    297.44    -1.01    0.00   145.2 0.737E-03   0.65    75.99    0.65    0.00
.25839E+04
    320.11    -1.01    0.00   167.5 0.639E-03   0.71    79.76    0.71    0.00
.27810E+04
    331.61    -1.01    0.00   179.8 0.598E-03   0.75    81.63    0.75    0.00
 Cumulative travel time =        2880.9121 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300550GPMa6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD300550GPMaFinal6.
0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--16:06:30
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 95.45 m^3/s
  Average depth                   HA     = 5.24 m
  Depth at discharge              HD     = 3.67 m
  Darcy-Weisbach friction factor  F      = 0.0283
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = -1.5 hours
  Instantaneous ambient velocity  UA     = 0.115 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0767 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 1.47 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 1.01 m
  Port diameter                   D0     = 0.0816 m
  Port cross-sectional area       A0     = 0.0052 m^2
  Discharge velocity              U0     = 7.26 m/s
  Discharge flowrate              Q0     = 0.038021 m^3/s
  Discharge port height           H0     = 3.67 m
  Vertical discharge angle        THETA  = -88.97 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 19.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.1857 m/s^2
  Discharge concentration         C0     = 0.107 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.07 m         Lm  = 4.57 m         Lb  = 4.64 m
  LM  = 4.53 m         Lm' = 1.24 m         Lb' = 0.65 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.2918 hours     Lu  = 23.49 m         Lmin= 0.20 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 58.98
  Velocity ratio                  R      = 63.15
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to lower stratified
  density layer at the discharge site.  The density jump at the pycnocline
  confines the flow to the lower layer.
  Applicable layer depth = lower layer depth = 2.20 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.01 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0082 mg/l
  Dilution at edge of NFR              s = 13.0
  NFR Location:                        x = 2.76 m
    (centerline coordinates)           y = 0.06 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 4.83 m
                          thickness (bv) = 0.45 m
Cumulative travel time:       22.4771 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified two layer ambient density stratification is dynamically
  important. The discharge near field flow will be confined to the lower
  layer by the ambient density stratification.
  Furthermore, it is trapped at the pycnocline by the ambient density
  jump.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

```
  discharge buoyancy.
  Intrusion length                        =  3.04 m
  Intrusion stagnation point              =  -2.69 m
  Intrusion thickness                     =  0.45 m
  Intrusion half width at impingement     =  4.83 m
  Intrusion half thickness at impingement =  0.45 m
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 2.76 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                      x = 331.61 m
                                      y = -1.01 m
                                      z = 0 m.
  For this condition BEFORE TIDAL REVERSAL, extensive re-entrainment
  of previously discharged is unlikely.
  To determine the minimum dilution, perform additional simulations
  after slack tide.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 18.448276
The CMC was encountered at the following plume position:
  Plume location:                     x = -1.09 m
    (centerline coordinates)          y = 0.06 m
                                      z = 0.10 m
  Plume dimension:       half-width (bh) = 1.43 m
                          thickness (bv) = 0.08 m

 Computed distance from port opening to CMC location = 3.73 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.07 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 1.09 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 3.67 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 3.73 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.52 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 7.26 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration             c = 0.003711  mg/l
  Corresponding dilution              s = 28.8
  Plume location:                     x = 91.44 m
    (centerline coordinates)          y = -1.01 m
                                      z = 0 m
```

```
  Plume dimensions:      half-width (bh) = 35.54 m
                          thickness (bv) = 0.27 m
Cumulative travel time:       793.3113 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                     = 0.00373  mg/l
Corresponding dilution                    = 28.7
  Plume location:                       x = -2.31 m
    (centerline coordinates)            y = 0.06 m
                                        z = 0.02 m
  Plume dimensions:      half-width (bh) = 0.82 m
                          thickness (bv) = 0.10 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

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CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333
3
                        CORMIX MIXING ZONE EXPERT SYSTEM
                  Subsystem CORMIX3:   Buoyant Surface Discharges
                           CORMIX Version 6.0GT
                         HYDRO3 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300550GPMb6.0
 FILE NAME:         P:\...ios\V.6.0\550GPMFinalRiver\JD300550GPMbFinalR.prd
 Time stamp:        Fri Mar 26 16:09:34 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1321.17  QA    =     26.42  ICHREG= 1
 HA    =      8.34  HD    =      5.83
 Tidal Simulation at TIME =      2.500 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.008 (m/s)/h
 UA    =      0.020 F     =      0.024 USTAR =0.1100E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2024
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAEF= 1001.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      2.33  ES    =0.7420E-01

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.91  Configuration: protruding_discharge
 SIGMA =     90.00  HDO   =      5.83  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.610 A0    =      0.292
 Dimensions of equivalent rectangular discharge:
 B0    =      0.479 H0    =      0.610 A0    =0.2919E+00  AR    =      1.273
 U0    =      0.217 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1500E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.1377E-01  J0    =0.8063E-03
 Associated length scales (meters)
 LQ    =      0.54  LM    =      1.42  Lm    =      5.87  Lb    =    100.06
 Tidal:             Tu    =   0.7986 h Lu    =     18.368 Lmin  =      0.327

NON-DIMENSIONAL PARAMETERS
 FR0   =      2.63  FRCH  =      2.48  R     =     10.86

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    FJ1    3
 3  Applicable layer depth HS =     3.50  3
 3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1500E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.91 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.150E-01   0.61     0.24 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.150E-01   0.61     0.24 .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=     89.31
       X        Y       Z        S       C       BV       BH        TT
      0.02     1.81    0.00     1.0 0.150E-01   0.30     0.68 .83153E+01
 Cumulative travel time =           8.3153 sec

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in deep crossflow with strong buoyancy effects.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

```
       X         Y        Z         S        C        BV        BH         TT
      0.02      1.81     0.00      1.0 0.150E-01   0.30      0.68 .83153E+01
      0.04      2.49     0.00      1.6 0.934E-02   0.40      1.22 .13206E+02
      0.06      3.14     0.00      1.7 0.879E-02   0.38      1.45 .18187E+02
      0.10      3.79     0.00      1.8 0.826E-02   0.37      1.69 .23520E+02
      0.14      4.45     0.00      1.9 0.780E-02   0.36      1.92 .29236E+02
      0.20      5.11     0.00      2.0 0.738E-02   0.35      2.18 .35474E+02
      0.27      5.76     0.00      2.1 0.702E-02   0.35      2.45 .41962E+02
      0.34      6.41     0.00      2.2 0.670E-02   0.34      2.72 .48833E+02
      0.43      7.06     0.00      2.3 0.639E-02   0.34      3.00 .56101E+02
      0.53      7.72     0.00      2.5 0.611E-02   0.34      3.30 .63953E+02
      0.63      8.36     0.00      2.6 0.585E-02   0.34      3.59 .72075E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      0.75      9.01     0.00      2.7 0.561E-02   0.34      3.89 .80635E+02
      0.87      9.65     0.00      2.8 0.540E-02   0.34      4.20 .89631E+02
      1.00     10.30     0.00      2.9 0.520E-02   0.34      4.52 .99273E+02
      1.14     10.94     0.00      3.0 0.502E-02   0.34      4.84 .10915E+03
      1.29     11.58     0.00      3.1 0.486E-02   0.34      5.17 .11946E+03
      1.45     12.21     0.00      3.2 0.470E-02   0.34      5.50 .13022E+03
      1.61     12.85     0.00      3.3 0.456E-02   0.34      5.84 .14141E+03
      1.79     13.49     0.00      3.4 0.442E-02   0.35      6.19 .15332E+03
      1.97     14.12     0.00      3.5 0.429E-02   0.35      6.55 .16544E+03
      2.16     14.74     0.00      3.6 0.417E-02   0.35      6.91 .17802E+03
      2.36     15.36     0.00      3.7 0.406E-02   0.35      7.27 .19109E+03
      2.57     16.00     0.00      3.8 0.394E-02   0.36      7.66 .20495E+03
      2.79     16.62     0.00      3.9 0.384E-02   0.36      8.04 .21904E+03
      3.01     17.23     0.00      4.0 0.374E-02   0.37      8.43 .23367E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
      3.24     17.84     0.00      4.1 0.364E-02   0.37      8.83 .24888E+03
      3.49     18.46     0.00      4.2 0.355E-02   0.38      9.25 .26505E+03
      3.74     19.07     0.00      4.3 0.346E-02   0.39      9.68 .28156E+03
      3.99     19.67     0.00      4.4 0.337E-02   0.40     10.12 .29887E+03
      4.26     20.27     0.00      4.6 0.329E-02   0.42     10.61 .31724E+03
      4.53     20.86     0.00      4.3 0.346E-02   0.26     11.23 .33481E+03
 Buoyant jet regime ends with local CRITICAL CONDITIONS.
 Cumulative travel time =         334.8125 sec

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
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** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------
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 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  1.56 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
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-------------------------------------------------------------------------------
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BEGIN MOD341: BUOYANT AMBIENT SPREADING

  Because of the WEAK VERTICAL MIXING, the surface plume in the far-field
    will be vertically limited WITHIN THE UPPER LAYER of the ambient
    stratification.
 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH        TT
      4.53    20.86    0.00     4.3 0.346E-02   0.41    17.56 .33481E+03
      4.59    20.86    0.00     4.3 0.345E-02   0.41    17.71 .33779E+03
      4.65    20.86    0.00     4.4 0.345E-02   0.40    17.86 .34076E+03
      4.71    20.86    0.00     4.4 0.344E-02   0.40    18.01 .34373E+03
      4.77    20.86    0.00     4.4 0.343E-02   0.40    18.15 .34671E+03
      4.83    20.86    0.00     4.4 0.342E-02   0.40    18.30 .34968E+03
      4.89    20.86    0.00     4.4 0.341E-02   0.39    18.45 .35265E+03
      4.95    20.86    0.00     4.4 0.340E-02   0.39    18.59 .35563E+03
      5.01    20.86    0.00     4.4 0.340E-02   0.39    18.74 .35860E+03
      5.07    20.86    0.00     4.4 0.339E-02   0.39    18.88 .36158E+03
      5.13    20.86    0.00     4.4 0.338E-02   0.39    19.02 .36455E+03
      5.19    20.86    0.00     4.4 0.337E-02   0.38    19.17 .36752E+03
      5.25    20.86    0.00     4.5 0.336E-02   0.38    19.31 .37050E+03
      5.30    20.86    0.00     4.5 0.336E-02   0.38    19.45 .37347E+03
      5.36    20.86    0.00     4.5 0.335E-02   0.38    19.59 .37644E+03
      5.42    20.86    0.00     4.5 0.334E-02   0.38    19.73 .37942E+03
      5.48    20.86    0.00     4.5 0.333E-02   0.38    19.87 .38239E+03
      5.54    20.86    0.00     4.5 0.333E-02   0.37    20.01 .38536E+03
      5.60    20.86    0.00     4.5 0.332E-02   0.37    20.15 .38834E+03
      5.66    20.86    0.00     4.5 0.331E-02   0.37    20.29 .39131E+03
      5.72    20.86    0.00     4.5 0.330E-02   0.37    20.43 .39428E+03
      5.78    20.86    0.00     4.5 0.330E-02   0.37    20.57 .39726E+03
      5.84    20.86    0.00     4.6 0.329E-02   0.37    20.71 .40023E+03
      5.90    20.86    0.00     4.6 0.328E-02   0.36    20.84 .40321E+03
      5.96    20.86    0.00     4.6 0.328E-02   0.36    20.98 .40618E+03
      6.02    20.86    0.00     4.6 0.327E-02   0.36    21.11 .40915E+03
      6.08    20.86    0.00     4.6 0.326E-02   0.36    21.25 .41213E+03
      6.14    20.86    0.00     4.6 0.326E-02   0.36    21.39 .41510E+03
      6.20    20.86    0.00     4.6 0.325E-02   0.36    21.52 .41807E+03
      6.26    20.86    0.00     4.6 0.324E-02   0.35    21.65 .42105E+03
      6.32    20.86    0.00     4.6 0.323E-02   0.35    21.79 .42402E+03
 Cumulative travel time =         424.0213 sec

-------------------------------------------------------------------------------
--
 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
      6.32    -0.91    0.00     4.8 0.313E-02   0.35    43.55 .42402E+03
      9.04    -0.91    0.00     5.1 0.296E-02   0.33    49.31 .55982E+03
     11.76    -0.91    0.00     5.4 0.280E-02   0.32    54.72 .69562E+03
     14.49    -0.91    0.00     5.7 0.265E-02   0.31    59.83 .83142E+03
```

```
    17.21    -0.91    0.00     6.0 0.250E-02   0.30    64.71 .96723E+03
    19.93    -0.91    0.00     6.4 0.236E-02   0.30    69.39 .11030E+04
    22.65    -0.91    0.00     6.8 0.222E-02   0.30    73.89 .12388E+04
    25.38    -0.91    0.00     7.2 0.208E-02   0.31    78.25 .13746E+04
    28.10    -0.91    0.00     7.7 0.195E-02   0.31    82.47 .15104E+04
    30.82    -0.91    0.00     8.2 0.183E-02   0.32    86.58 .16462E+04
    33.54    -0.91    0.00     8.7 0.172E-02   0.33    90.59 .17820E+04
    36.27    -0.91    0.00     9.3 0.161E-02   0.34    94.50 .19178E+04
    38.99    -0.91    0.00     9.9 0.151E-02   0.35    98.33 .20536E+04
    41.71    -0.91    0.00    10.6 0.141E-02   0.36   102.09 .21894E+04
    44.43    -0.91    0.00    11.3 0.133E-02   0.37   105.78 .23252E+04
    47.16    -0.91    0.00    12.1 0.124E-02   0.38   109.40 .24610E+04
    49.88    -0.91    0.00    12.9 0.117E-02   0.40   112.97 .25968E+04
    52.60    -0.91    0.00    13.7 0.109E-02   0.41   116.48 .27326E+04
    55.32    -0.91    0.00    14.6 0.103E-02   0.43   119.94 .28684E+04
    58.05    -0.91    0.00    15.5 0.968E-03   0.45   123.36 .30042E+04
    60.77    -0.91    0.00    16.5 0.911E-03   0.46   126.73 .31400E+04
    63.49    -0.91    0.00    17.5 0.858E-03   0.48   130.06 .32758E+04
    66.21    -0.91    0.00    18.5 0.809E-03   0.50   133.36 .34116E+04
    68.94    -0.91    0.00    19.6 0.764E-03   0.52   136.61 .35474E+04
    71.66    -0.91    0.00    20.8 0.722E-03   0.54   139.83 .36833E+04
    74.38    -0.91    0.00    22.0 0.683E-03   0.56   143.02 .38191E+04
    77.10    -0.91    0.00    23.2 0.646E-03   0.58   146.17 .39549E+04
    79.83    -0.91    0.00    24.5 0.613E-03   0.61   149.30 .40907E+04
    82.55    -0.91    0.00    25.8 0.581E-03   0.63   152.40 .42265E+04
    85.27    -0.91    0.00    27.2 0.552E-03   0.65   155.47 .43623E+04
    87.99    -0.91    0.00    28.6 0.525E-03   0.68   158.50 .44981E+04
 Cumulative travel time =        4498.0586 sec
 Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.287E-08 m^2/s
  Horizontal diffusivity (initial value) = 0.224E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
    87.99    -0.91    0.00    28.6 0.525E-03   0.68   158.50 .44981E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    90.00    -0.91    0.00    28.5 0.526E-03   0.68   158.50
 Cumulative travel time =        4598.0981 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
```

```
   Limiting time due to TIDAL REVERSAL has been reached.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
3
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO3:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300550GPMb6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD300550GPMbFinalR.
prd
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             03/26/2010--16:09:34
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 26.42 m^3/s
  Average depth                   HA     = 8.34 m
  Depth at discharge              HD     = 5.83 m
  Darcy-Weisbach friction factor  F      = 0.0242
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 2.5 hours
  Instantaneous ambient velocity  UA     = 0.02 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.008 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 2.33 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                   = right bank/shoreline
  Discharge configuration                = protruding discharge
  Distance from bank to outlet    DISTB  = 0.91 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 5.83 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Circular pipe diameter                 = 0.6096 m
    Equivalent rectangular discharge:
    Discharge cross-section area  A0     = 0.291864 m^2
    Discharge channel width       B0     = 0.478779 m
    Discharge channel depth       H0     = 0.6096 m
    Discharge aspect ratio        AR     = 1.273240
  Discharge flowrate              Q0     = 0.063399 m^3/s
  Discharge velocity              U0     = 0.22 m/s
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 1.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.0127 m/s^2
  Discharge concentration         C0     = 0.015 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.54 m         Lm  = 5.87 m         Lbb = 100.06 m
  LM  = 1.42 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.7986 hours     Lu  = 18.37 m         Lmin= 0.33 m
------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 2.63 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 2.48 (based on H0)
  Velocity ratio                  R      = 10.86
------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = FJ1 |
  *------------------------*
******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0.91 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0033 mg/l
  Dilution at edge of NFR              s = 4.5
  NFR Location:                        x = 4.53 m
    (centerline coordinates)           y = 20.86 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 11.23 m
                          thickness (bv) = 0.26 m
Cumulative travel time:       334.8125 sec.
------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
------------------------------------------------------------------------------
Stratification assessment:
  Due to WEAK VERTICAL MIXING the surface plume will be confined to
  the upper layer above the pycnocline!
------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes laterally fully mixed at 87.99 m downstream.
------------------------------------------------------------------------------
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PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 6.32 m downstream.
  Plume contacts second bank at 87.99 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 90 m
                                        y = -0.91 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 2.586207
The CMC was encountered at the following plume position:
  Plume location:                       x = 0.65 m
    (centerline coordinates)            y = 8.49 m
                                        z = 0 m
  Plume dimension:       half-width (bh) = 3.65 m
                          thickness (bv) = 0.34 m

 Computed distance from port opening to CMC location = 8.52 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.54 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.52 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.83 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.52 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 0.22 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.000527  mg/l
  Corresponding dilution                s = 28.5
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -0.91 m
                                        z = 0 m
  Plume dimensions:      half-width (bh) = 158.50 m
                          thickness (bv) = 0.68 m
Cumulative travel time:       4669.9258 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
```

```
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                   = 0.00373  mg/l
Corresponding dilution                  = 4.0
  Plume location:                     x = 3.04 m
    (centerline coordinates)          y = 17.29 m
                                      z = 0 m
  Plume dimensions:      half-width (bh) = 8.47 m
                          thickness (bv) = 0.37 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

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CORMIX3 PREDICTION FILE:
3333333333333333333333333333333333333333333333333333333333333333333333333333
3
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3:   Buoyant Surface Discharges
                          CORMIX Version 6.0GT
                       HYDRO3 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300550GPMcFinal6.0
 FILE NAME:         P:\...\V.6.0\550GPMFinalRiver\JD300550GPMcFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:20:37 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1329.09  QA    =    293.73  ICHREG= 1
 HA    =      8.39  HD    =      5.87
 Tidal Simulation at TIME =      3.000 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.074 (m/s)/h
 UA    =      0.221 F     =      0.024 USTAR =0.1214E-01
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2062
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAEF= 1001.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      2.35  ES    =0.7371E-01

DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      0.91  Configuration: protruding_discharge
 SIGMA =     90.00  HDO   =      5.87  SLOPE =    0.00 deg.
 Circular discharge pipe:
 D0    =      0.610 A0    =      0.292
 Dimensions of equivalent rectangular discharge:
 B0    =      0.479 H0    =      0.610 A0    =0.2919E+00  AR    =      1.273
 U0    =      0.217 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.8000E-02  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.1377E-01  J0    =0.8063E-03
 Associated length scales (meters)
 LQ    =      0.54  LM    =      1.42  Lm    =      0.53  Lb    =      0.07
 Tidal:             Tu    =   0.1818 h Lu    =      8.763 Lmin  =      0.327

NON-DIMENSIONAL PARAMETERS
 FR0   =      2.63  FRCH  =      2.48  R     =      0.98

FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    FJ2    3
 3  Applicable layer depth HS =     3.52  3
 3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8000E-02  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:      0.91 m  from the RIGHT bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.800E-02   0.61     0.24 .00000E+00

END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00    0.00     1.0 0.800E-02   0.61     0.24 .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

  Control volume outflow:                                  SIGMAE=     82.42
       X        Y       Z        S       C       BV       BH        TT
      0.07     0.49    0.00     1.0 0.800E-02   0.49     0.41 .22706E+01
 Cumulative travel time =           2.2706 sec

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
BEGIN CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION

 Surface jet in deep crossflow with weak buoyancy effects.

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time
```

```
       X        Y       Z        S       C       BV       BH        TT
      0.07     0.49    0.00     1.0 0.800E-02   0.49     0.41 .22706E+01
 JET REGION is INSIGNIFICANT in its spatial extent!
      0.07     0.49    0.00     1.0 0.800E-02   0.68     0.56 .22706E+01
 Buoyant jet regime ends with local CRITICAL CONDITIONS.
 Cumulative travel time =           2.2706 sec

END OF CORSURF (MOD310): BUOYANT SURFACE JET - NEAR-FIELD REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
--
** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------
--

 The initial plume WIDTH/THICKNESS VALUE in the next far-field module will be
  CORRECTED by a factor  0.61 to conserve the mass flux in the far-field!
-------------------------------------------------------------------------------
--
BEGIN MOD341: BUOYANT AMBIENT SPREADING

  Because of the WEAK VERTICAL MIXING, the surface plume in the far-field
    will be vertically limited WITHIN THE UPPER LAYER of the ambient
    stratification.
 Profile definitions:
   BV = top-hat thickness,measured vertically
   BH = top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH        TT
      0.07     0.49    0.00     1.0 0.800E-02   0.41     0.35 .22706E+01
      0.30     0.49    0.00     1.0 0.776E-02   0.37     0.40 .33465E+01
      0.54     0.49    0.00     1.1 0.755E-02   0.34     0.45 .44223E+01
      0.78     0.49    0.00     1.1 0.737E-02   0.32     0.50 .54981E+01
      1.02     0.49    0.00     1.1 0.722E-02   0.30     0.54 .65740E+01
      1.25     0.49    0.00     1.1 0.710E-02   0.28     0.58 .76498E+01
      1.49     0.49    0.00     1.1 0.699E-02   0.27     0.63 .87257E+01
      1.73     0.49    0.00     1.2 0.689E-02   0.25     0.67 .98015E+01
      1.97     0.49    0.00     1.2 0.680E-02   0.24     0.71 .10877E+02
      2.21     0.49    0.00     1.2 0.672E-02   0.24     0.74 .11953E+02
      2.44     0.49    0.00     1.2 0.664E-02   0.23     0.78 .13029E+02
      2.68     0.49    0.00     1.2 0.657E-02   0.22     0.82 .14105E+02
      2.92     0.49    0.00     1.2 0.651E-02   0.21     0.85 .15181E+02
      3.16     0.49    0.00     1.2 0.645E-02   0.21     0.89 .16257E+02
      3.39     0.49    0.00     1.3 0.639E-02   0.20     0.92 .17332E+02
      3.63     0.49    0.00     1.3 0.634E-02   0.20     0.96 .18408E+02
      3.87     0.49    0.00     1.3 0.629E-02   0.19     0.99 .19484E+02
      4.11     0.49    0.00     1.3 0.624E-02   0.19     1.02 .20560E+02
      4.35     0.49    0.00     1.3 0.619E-02   0.18     1.05 .21636E+02
      4.58     0.49    0.00     1.3 0.614E-02   0.18     1.08 .22712E+02
      4.82     0.49    0.00     1.3 0.610E-02   0.18     1.11 .23787E+02
      5.06     0.49    0.00     1.3 0.606E-02   0.17     1.15 .24863E+02
      5.30     0.49    0.00     1.3 0.601E-02   0.17     1.18 .25939E+02
      5.53     0.49    0.00     1.3 0.597E-02   0.17     1.21 .27015E+02
      5.77     0.49    0.00     1.3 0.593E-02   0.17     1.23 .28091E+02
```

```
      6.01     0.49    0.00     1.4 0.589E-02   0.16     1.26 .29167E+02
      6.25     0.49    0.00     1.4 0.586E-02   0.16     1.29 .30242E+02
      6.49     0.49    0.00     1.4 0.582E-02   0.16     1.32 .31318E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      6.72     0.49    0.00     1.4 0.578E-02   0.16     1.35 .32394E+02
      6.96     0.49    0.00     1.4 0.574E-02   0.16     1.38 .33470E+02
      7.20     0.49    0.00     1.4 0.571E-02   0.15     1.40 .34546E+02
 Cumulative travel time =          34.5458 sec

-------------------------------------------------------------------------------
--
 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
      7.20    -0.91    0.00     1.4 0.571E-02   0.15     2.81 .34546E+02
     15.85    -0.91    0.00     1.6 0.486E-02   0.15     3.73 .73693E+02
     24.51    -0.91    0.00     2.0 0.402E-02   0.16     4.54 .11284E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     33.16    -0.91    0.00     2.4 0.328E-02   0.17     5.29 .15199E+03
     41.81    -0.91    0.00     3.0 0.266E-02   0.20     5.99 .19113E+03
     50.47    -0.91    0.00     3.7 0.217E-02   0.23     6.64 .23028E+03
     59.12    -0.91    0.00     4.5 0.179E-02   0.27     7.27 .26943E+03
     67.77    -0.91    0.00     5.4 0.149E-02   0.30     7.87 .30857E+03
     76.43    -0.91    0.00     6.4 0.125E-02   0.35     8.45 .34772E+03
     85.08    -0.91    0.00     7.5 0.106E-02   0.40     9.02 .38687E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     93.73    -0.91    0.00     8.8 0.910E-03   0.45     9.56 .42602E+03
    102.39    -0.91    0.00    10.2 0.786E-03   0.50    10.09 .46516E+03
    111.04    -0.91    0.00    11.7 0.684E-03   0.56    10.61 .50431E+03
    119.69    -0.91    0.00    13.3 0.600E-03   0.62    11.11 .54346E+03
    128.35    -0.91    0.00    15.1 0.529E-03   0.68    11.60 .58260E+03
    137.00    -0.91    0.00    17.1 0.469E-03   0.75    12.09 .62175E+03
    145.65    -0.91    0.00    19.1 0.418E-03   0.82    12.56 .66090E+03
    154.31    -0.91    0.00    21.4 0.375E-03   0.89    13.03 .70004E+03
    162.96    -0.91    0.00    23.7 0.337E-03   0.97    13.48 .73919E+03
    171.61    -0.91    0.00    26.3 0.304E-03   1.05    13.93 .77834E+03
    180.27    -0.91    0.00    29.0 0.276E-03   1.13    14.38 .81748E+03
    188.92    -0.91    0.00    31.9 0.251E-03   1.21    14.81 .85663E+03
    197.57    -0.91    0.00    35.0 0.229E-03   1.30    15.24 .89578E+03
    206.23    -0.91    0.00    38.2 0.209E-03   1.38    15.66 .93493E+03
    214.88    -0.91    0.00    41.7 0.192E-03   1.47    16.08 .97407E+03
    223.53    -0.91    0.00    45.3 0.176E-03   1.57    16.50 .10132E+04
    232.19    -0.91    0.00    49.2 0.163E-03   1.66    16.90 .10524E+04
    240.84    -0.91    0.00    53.3 0.150E-03   1.76    17.31 .10915E+04
    249.49    -0.91    0.00    57.6 0.139E-03   1.86    17.70 .11307E+04
    258.15    -0.91    0.00    62.1 0.129E-03   1.96    18.10 .11698E+04
    266.80    -0.91    0.00    66.9 0.120E-03   2.07    18.49 .12090E+04
 Cumulative travel time =        1208.9542 sec
```

```
END OF MOD341: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
--
-------------------------------------------------------------------------------
--
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.940E-08 m^2/s
  Horizontal diffusivity (initial value) = 0.304E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to water depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction efects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH        TT
    266.80    -0.91    0.00    66.9 0.120E-03   2.07    18.49 .12090E+04
   1193.40    -0.91    0.00   172.4 0.561E-04   2.07    26.90
 Cumulative travel time =        5400.8115 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting time due to TIDAL REVERSAL has been reached.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX3: Buoyant Surface Discharges                    End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333333
3
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO3:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300550GPMcFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD300550GPMcFinal6.
0R.prd
  Using subsystem CORMIX3:     Buoyant Surface Discharges
  Start of session:             03/26/2010--16:20:37
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 293.73 m^3/s
  Average depth                   HA     = 8.39 m
  Depth at discharge              HD     = 5.87 m
  Darcy-Weisbach friction factor  F      = 0.0242
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 3 hours
  Instantaneous ambient velocity  UA     = 0.221 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0737 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 2.35 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Surface Discharge
  Discharge located on                   = right bank/shoreline
  Discharge configuration                = protruding discharge
  Distance from bank to outlet    DISTB  = 0.91 m
  Discharge angle                 SIGMA  = 90 deg
  Depth near discharge outlet     HD0    = 5.87 m
  Bottom slope at discharge       SLOPE  = 0 deg
  Circular pipe diameter                 = 0.6096 m
    Equivalent rectangular discharge:
    Discharge cross-section area  A0     = 0.291864 m^2
    Discharge channel width       B0     = 0.478779 m
    Discharge channel depth       H0     = 0.6096 m
    Discharge aspect ratio        AR     = 1.273240
  Discharge flowrate              Q0     = 0.063399 m^3/s
  Discharge velocity              U0     = 0.22 m/s
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 1.2981 kg/m^3
  Buoyant acceleration            GP0    = 0.0127 m/s^2
  Discharge concentration         C0     = 0.008 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
```

```
  LQ  = 0.54 m         Lm  = 0.53 m         Lbb = 0.07 m
  LM  = 1.42 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.1818 hours     Lu  = 8.76 m         Lmin= 0.33 m
-------------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 2.63 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 2.48 (based on H0)
  Velocity ratio                  R      = 0.98
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = FJ2 |
  *------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at water surface and at centerline of discharge channel:
    0.91 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.008 mg/l
  Dilution at edge of NFR              s = 1
  NFR Location:                        x = 0.07 m
    (centerline coordinates)           y = 0.49 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 0.57 m
                          thickness (bv) = 0.68 m
Cumulative travel time:       2.2706 sec.
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-------------------------------------------------------------------------------
Stratification assessment:
  Due to WEAK VERTICAL MIXING the surface plume will be confined to
  the upper layer above the pycnocline!
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 7.20 m downstream.
-------------------------------------------------------------------------------
```

```
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 1193.40 m
                                        y = -0.91 m
                                        z = 0 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 1.379310
The CMC was encountered at the following plume position:
  Plume location:                       x = 6.60 m
    (centerline coordinates)            y = 0.49 m
                                        z = 0 m
  Plume dimension:       half-width (bh) = 1.33 m
                          thickness (bv) = 0.16 m

 Computed distance from port opening to CMC location = 6.62 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.54 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 6.62 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.87 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 6.62 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 0.22 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY ************************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration               c = 0.000948  mg/l
  Corresponding dilution                s = 8.5
  Plume location:                       x = 91.44 m
    (centerline coordinates)            y = -0.91 m
                                        z = 0 m
  Plume dimensions:      half-width (bh) = 9.42 m
                          thickness (bv) = 0.43 m
Cumulative travel time:       415.6428 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
```

```
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 2.1
  Plume location:                      x = 27.72 m
    (centerline coordinates)           y = -0.91 m
                                       z = 0 m
  Plume dimensions:      half-width (bh) = 4.83 m
                          thickness (bv) = 0.16 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300550GPMeFinal6.0
 FILE NAME:         P:\...\V.6.0\550GPMFinalRiver\JD300550GPMeFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:22:42 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1004.26  QA    =    115.49  ICHREG= 1
 HA    =      6.34  HD    =      4.44
 Tidal Simulation at TIME =     -1.130 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.102 (m/s)/h
 UA    =      0.115 F     =      0.027 USTAR =0.6621E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2115
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1019.0000  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.78  ES    =0.9748E-01

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.99
 D0    =      0.093 A0    =      0.007 H0    =      4.44  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.583 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.1930E+02  GP0   =0.1857E+00
 C0    =0.1150E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.2123E+00  J0    =0.7061E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.08  LM    =      3.72  Lm    =      4.01  Lb    =      4.64
                                       Lmp   =      1.21  Lbp   =      0.69
 Tidal:             Tu    =   0.2312 h Lu    =     19.582 Lmin  =      0.230

NON-DIMENSIONAL PARAMETERS
 FR0   =     42.46  R     =     48.55

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IV5    1
 1  Applicable layer depth HS =     2.66  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1150E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.99 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.44     1.0 0.115E+00   0.05    5.583   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet/plume transition motion in weak crossflow.

 Zone of flow establishment:            THETAE=    -88.58  SIGMAE=     69.91
  LE    =      0.43  XE    =      0.00  YE    =      0.01  ZE    =      4.00

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.44     1.0 0.115E+00   0.05    5.583   .00000E+00
      0.00     0.01    4.00     1.0 0.115E+00   0.05    5.583   .23733E-02
      0.00     0.01    3.89     1.1 0.106E+00   0.06    5.583   .18654E-01
      0.01     0.02    3.77     1.3 0.865E-01   0.07    4.933   .42086E-01
      0.01     0.02    3.66     1.5 0.745E-01   0.09    4.243   .65995E-01
      0.01     0.02    3.53     1.8 0.642E-01   0.10    3.644   .98382E-01
      0.02     0.02    3.41     2.0 0.564E-01   0.11    3.189   .13565E+00
      0.03     0.03    3.30     2.3 0.510E-01   0.13    2.877   .17151E+00
      0.04     0.03    3.18     2.5 0.459E-01   0.14    2.579   .21798E+00
      0.05     0.03    3.05     2.8 0.418E-01   0.15    2.333   .26949E+00
      0.06     0.04    2.94     3.0 0.387E-01   0.17    2.154   .31771E+00
      0.07     0.04    2.82     3.2 0.357E-01   0.18    1.974   .37879E+00
      0.08     0.04    2.69     3.5 0.331E-01   0.20    1.818   .44516E+00
      0.10     0.04    2.59     3.7 0.312E-01   0.21    1.701   .50633E+00
      0.11     0.05    2.46     3.9 0.291E-01   0.22    1.579   .58279E+00
      0.13     0.05    2.34     4.2 0.274E-01   0.24    1.470   .66487E+00
      0.15     0.05    2.23     4.4 0.260E-01   0.25    1.386   .73980E+00
      0.17     0.06    2.11     4.7 0.245E-01   0.27    1.297   .83268E+00
      0.20     0.06    1.98     5.0 0.232E-01   0.28    1.215   .93162E+00
      0.22     0.06    1.88     5.2 0.222E-01   0.30    1.151   .10214E+01
      0.25     0.06    1.75     5.4 0.211E-01   0.31    1.082   .11321E+01
```

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      0.28     0.07    1.63     5.7 0.201E-01   0.33    1.018   .12494E+01
      0.30     0.07    1.53     6.0 0.193E-01   0.34    0.967   .13554E+01
      0.34     0.07    1.41     6.2 0.185E-01   0.36    0.911   .14857E+01
      0.37     0.08    1.29     6.5 0.177E-01   0.38    0.859   .16233E+01
      0.40     0.08    1.18     6.8 0.170E-01   0.39    0.817   .17475E+01
      0.44     0.08    1.06     7.0 0.163E-01   0.41    0.770   .18997E+01
      0.49     0.09    0.95     7.3 0.157E-01   0.43    0.726   .20602E+01
      0.52     0.09    0.84     7.6 0.151E-01   0.44    0.690   .22048E+01
      0.57     0.09    0.73     7.9 0.146E-01   0.46    0.650   .23820E+01
      0.62     0.10    0.61     8.2 0.140E-01   0.48    0.612   .25687E+01
      0.66     0.10    0.51     8.5 0.136E-01   0.50    0.581   .27367E+01
 Cumulative travel time =           2.7367 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING

  Vertical angle of layer/boundary impingement    =     -64.98 deg
  Horizontal angle of layer/boundary impingement  =       3.63 deg

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                =       2.64 m
        X-position of upstream stagnation point =      -1.98 m
        Thickness in intrusion region            =       0.55 m
        Half-width at downstream end             =       4.30 m
        Thickness at downstream end              =       0.55 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.66     0.10    0.51     8.5 0.136E-01   0.50 .27367E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -1.98     0.10    0.00  9997.5 0.000E+00   0.00     0.00    0.00    0.00
.21446E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -1.88     0.10    0.00    37.1 0.310E-02   0.13     0.61    0.13    0.00
.27367E+01
     -1.41     0.10    0.00    15.4 0.748E-02   0.30     1.48    0.30    0.00
.27367E+01
```

```
     -0.94     0.10    0.00    11.6 0.992E-02   0.40     2.00    0.40    0.00
.27367E+01
     -0.47     0.10    0.00     9.9 0.116E-01   0.47     2.41    0.47    0.00
.27367E+01
     -0.00     0.10    0.00     9.0 0.127E-01   0.52     2.76    0.52    0.00
.27367E+01
      0.47     0.10    0.00     8.6 0.134E-01   0.55     3.07    0.55    0.00
.27367E+01
      0.94     0.10    0.00     8.5 0.136E-01   0.55     3.36    0.55    0.00
.30603E+01
      1.41     0.10    0.00     9.9 0.116E-01   0.55     3.62    0.55    0.00
.76568E+01
      1.88     0.10    0.00    12.3 0.935E-02   0.55     3.86    0.55    0.00
.12253E+02
      2.35     0.10    0.00    13.8 0.834E-02   0.55     4.09    0.55    0.00
.16850E+02
      2.82     0.10    0.00    14.4 0.798E-02   0.55     4.30    0.55    0.00
.21446E+02
 Cumulative travel time =          21.4463 sec

END OF MOD132: LAYER BOUNDARY IMPINGEMENT/UPSTREAM SPREADING
-------------------------------------------------------------------------------
---------------
** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
---------------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.82    -0.99    0.00    14.4 0.798E-02   0.88     5.39    0.88    0.00
.21446E+02
     28.62    -0.99    0.00    19.8 0.580E-02   0.38    17.15    0.38    0.00
.24579E+03
     54.43    -0.99    0.00    23.7 0.484E-02   0.31    25.50    0.31    0.00
.47014E+03
```

```
     80.24    -0.99    0.00    28.6 0.402E-02   0.29    32.57    0.29    0.00
.69448E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
    106.05    -0.99    0.00    34.9 0.330E-02   0.30    38.90    0.30    0.00
.91883E+03
    131.86    -0.99    0.00    42.9 0.268E-02   0.32    44.72    0.32    0.00
.11432E+04
    157.67    -0.99    0.00    52.8 0.218E-02   0.35    50.18    0.35    0.00
.13675E+04
    183.47    -0.99    0.00    64.8 0.178E-02   0.39    55.35    0.39    0.00
.15919E+04
    209.28    -0.99    0.00    78.9 0.146E-02   0.44    60.30    0.44    0.00
.18162E+04
    235.09    -0.99    0.00    95.3 0.121E-02   0.50    65.06    0.50    0.00
.20406E+04
    255.00    -0.99    0.00   109.8 0.105E-02   0.54    68.60    0.54    0.00
 Cumulative travel time =        2213.6140 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting distance due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

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CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD300550GPMg2Final6.0
 FILE NAME:         P:\...\V.6.0\550GPMFinalRiver\JD300550GPMgFinal6.0R.prd
 Time stamp:        Fri Mar 26 16:25:44 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    770.54  QA    =     33.13  ICHREG= 1
 HA    =      4.86  HD    =      3.40
 Tidal Simulation at TIME =      1.120 h
 PERIOD=    12.40 h UAmax =      0.359 dUa/dt=      0.038 (m/s)/h
 UA    =      0.043 F     =      0.029 USTAR =0.2587E-02
 UW    =      8.500 UWSTAR=0.1074E-01
 Density stratified environment
 STRCND=  B         RHOAM = 1008.2064
 RHOAS = 1001.0000  RHOAB = 1019.0000  RHOAH0= 1008.2064  E     =0.0000E+00
 DRHOJ =   18.0000  HINT  =      1.36  ES    =0.1271E+00

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.09
 D0    =      0.102 A0    =      0.008 H0    =      3.40  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      7.754 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.8505E+01  GP0   =0.8272E-01
 C0    =0.9700E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.4916E+00  J0    =0.5244E-02  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.09  LM    =      8.11  Lm    =     16.31  Lb    =     65.96
                                       Lmp   =  99999.00  Lbp   =  99999.00
 Tidal:             Tu    =   0.5093 h Lu    =     35.854 Lmin  =      0.252

NON-DIMENSIONAL PARAMETERS
 FR0   =     84.40  R     =    180.33

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV5   1
 1  Applicable layer depth HS =     3.40  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.9700E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
```

```
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.09 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    3.40     1.0 0.970E-01   0.05    7.754   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

 INITIAL LOCAL VERTICAL INSTABILITY REGION:
   Bulk dilution (S =  16.10) occurs in a limited region (horizontal extent
   =    24.32 m) surrounding the discharge location.

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    3.40     1.0 0.970E-01   0.05 .00000E+00

  Control volume outflow:
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.00     0.00    3.40     1.0 0.970E-01   8.51     0.00    0.00    0.00
.00000E+00

END OF MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       6.55 m
        X-position of upstream stagnation point =      -6.55 m
        Thickness in intrusion region           =       1.50 m
        Half-width at downstream end            =     117.41 m
        Thickness at downstream end             =       0.21 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    1.70    16.1 0.603E-02   0.05 .00000E+00

 Profile definitions:
   BV = top-hat thickness, measured vertically
```

```
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -6.55     0.00    3.40  9984.4 0.000E+00   0.00     0.00    3.40    3.40
.13652E+04
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     -5.25     0.00    3.40    29.0 0.335E-02   0.83    16.60    3.40    2.57
.00000E+00
      1.15     0.00    3.40    16.1 0.602E-02   1.50    40.33    3.40    1.90
.26730E+02
      7.54     0.00    3.40    17.2 0.564E-02   1.42    54.57    3.40    1.98
.17545E+03
     13.94     0.00    3.40    19.6 0.496E-02   1.24    65.79    3.40    2.16
.32416E+03
     20.33     0.00    3.40    22.7 0.428E-02   1.01    75.36    3.40    2.39
.47288E+03
     26.73     0.00    3.40    25.8 0.376E-02   0.77    83.84    3.40    2.63
.62160E+03
     33.12     0.00    3.40    28.5 0.341E-02   0.57    91.55    3.40    2.83
.77032E+03
     39.52     0.00    3.40    30.5 0.318E-02   0.42    98.65    3.40    2.98
.91903E+03
     45.91     0.00    3.40    31.8 0.305E-02   0.32   105.27    3.40    3.08
.10678E+04
     52.31     0.00    3.40    32.5 0.299E-02   0.26   111.50    3.40    3.14
.12165E+04
     58.70     0.00    3.40    33.2 0.292E-02   0.21   117.41    3.40    3.19
.13652E+04
 Cumulative travel time =        1365.1862 sec

END OF MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY
--------------------------------------------------------------------------------
---------------
** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
--------------------------------------------------------------------------------
---------------
```

```
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     58.70    -1.09    3.40    33.2 0.292E-02   0.42   118.49    3.40    2.99
.13652E+04
     64.24    -1.09    3.40    36.1 0.269E-02   0.45   119.64    3.40    2.95
.14937E+04
     69.78    -1.09    3.40    39.1 0.248E-02   0.48   120.80    3.40    2.92
.16222E+04
     75.31    -1.09    3.40    42.2 0.230E-02   0.52   122.00    3.40    2.89
.17507E+04
     80.85    -1.09    3.40    45.3 0.214E-02   0.55   123.21    3.40    2.85
.18792E+04
     86.39    -1.09    3.40    48.5 0.200E-02   0.58   124.44    3.40    2.82
.20078E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     86.69    -1.09    3.40    48.6 0.199E-02   0.59   124.51    3.40    2.82
 Cumulative travel time =        2014.7571 sec

 CORMIX prediction has been TERMINATED at last prediction interval.
   Limiting time due to TIDAL REVERSAL has been reached.

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD300550GPMg2Final6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD300550GPMgFinal6.
0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--16:25:44
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA     = 33.13 m^3/s
  Average depth                   HA     = 4.86 m
  Depth at discharge              HD     = 3.40 m
  Darcy-Weisbach friction factor  F      = 0.0290
    Calculated from Manning's n          = 0.025
  Wind velocity                   UW     = 8.5 m/s
TIDAL SIMULATION at time          Tsim   = 1.12 hours
  Instantaneous ambient velocity  UA     = 0.043 m/s
  Maximum tidal velocity          UaMAX  = 0.359 m/s
Rate of tidal reversal          dUA/dt = 0.0384 (m/s)/hour
  Period of reversal              T      = 12.4 hours
  Stratification Type             STRCND = B
  Surface density                 RHOAS  = 1001.0000 kg/m^3
  Bottom density                  RHOAB  = 1019.0000 kg/m^3
  Stratification height           HINT   = 1.36 m (pycnocline level)
  Density below pycnocline        RHOAP  = 1019.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                           = right
  Distance to bank                DISTB  = 1.09 m
  Port diameter                   D0     = 0.1020 m
  Port cross-sectional area       A0     = 0.0082 m^2
  Discharge velocity              U0     = 7.75 m/s
  Discharge flowrate              Q0     = 0.063399 m^3/s
  Discharge port height           H0     = 3.40 m
  Vertical discharge angle        THETA  = -88.39 deg
  Horizontal discharge angle      SIGMA  = 90 deg
  Discharge temperature (freshwater)     = 10 degC
  Corresponding density           RHO0   = 999.7019 kg/m^3
  Density difference              DRHO   = 8.5045 kg/m^3
  Buoyant acceleration            GP0    = 0.0827 m/s^2
  Discharge concentration         C0     = 0.097 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.09 m         Lm  = 16.31 m         Lb  = 65.96 m
  LM  = 8.11 m         Lm' = 99999 m         Lb' = 99999 m
UNSTEADY TIDAL SCALES:
  Tu  = 0.5093 hours     Lu  = 35.85 m         Lmin= 0.25 m
-----------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 84.40
  Velocity ratio                  R      = 180.33
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration               CMC    = 0.0058 mg/l
  CCC concentration               CCC    = 0.00373 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.  The ambient density stratification at the
  discharge site is relatively weak and unimportant so the discharge flow
  penetrates to the surface and/or breaks down the existing stratification
  through vigorous mixing.
  Applicable layer depth = water depth = 3.40 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.09 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0029 mg/l
  Dilution at edge of NFR              s = 33.2
  NFR Location:                        x = 58.70 m
    (centerline coordinates)           y = 0 m
                                       z = 3.40 m
  NFR plume dimensions:  half-width (bh) = 117.41 m
                          thickness (bv) = 0.21 m
Cumulative travel time:       1365.1860 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified ambient density stratification is weak relative to the
  discharge conditions and is dynamically unimportant. The discharge will
  behave as if the ambient were unstratified.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
```

```
  discharge buoyancy.
  Intrusion length                        =  6.55 m
  Intrusion stagnation point              =  -6.55 m
  Intrusion thickness                     =  1.50 m
  Intrusion half width at impingement     =  117.41 m
  Intrusion half thickness at impingement =  0.21 m
-------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m
  downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 58.70 m downstream.
  Plume contacts second bank at 224.80 m downstream.
-------------------------------------------------------------------------------
UNSTEADY TIDAL ASSESSMENT:
 Because of the unsteadiness of the ambient current during the tidal
  reversal, CORMIX predictions have been TERMINATED at:
                                        x = 86.69 m
                                        y = -1.09 m
                                        z = 3.40 m.
  For this condition AFTER TIDAL REVERSAL, mixed water from the previous
  half-cycle becomes re-entrained into the near field of the discharge,
  increasing pollutant concentrations compared to steady-state predictions.
  A pool of mixed water formed at slack tide will be advected downstream
  in this phase.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 16.724138
The CMC was encountered at the following plume position:
  Plume location:                       x = -4.92 m
    (centerline coordinates)            y = 0 m
                                        z = 3.40 m
  Plume dimension:       half-width (bh) = 19.24 m
                          thickness (bv) = 0.81 m

 Computed distance from port opening to CMC location = 4.92 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.09 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 4.92 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 3.40 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 4.92 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 7.75 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
```

```
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.001886  mg/l
  Corresponding dilution               s = 51.4
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.09 m
                                       z = 3.40 m
  Plume dimensions:      half-width (bh) = 125.58 m
                          thickness (bv) = 0.62 m
Cumulative travel time:       2125.0576 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 26.0
  Plume location:                      x = -5.19 m
    (centerline coordinates)           y = 0 m
                                       z = 3.40 m
  Plume dimensions:      half-width (bh) = 17.01 m
                          thickness (bv) = 0.83 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
             Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
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CASE DESCRIPTION
 Site name/label:
 Design case:       JD309(2)550GPMaSteadyFinal
 FILE NAME:         P:\...0GPMFinalRiver\JD309(2)550GPMaSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:38:40 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    972.57  QA    =    109.90  ICHREG= 1
 HA    =      6.14  HD    =      4.30
 UA    =      0.113 F     =      0.027 USTAR =0.6540E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.99
 D0    =      0.090 A0    =      0.006 H0    =      4.30  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.924 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.9500E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.2252E+00  J0    =0.4835E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.08  LM    =     14.87  Lm    =      4.20  Lb    =      0.34
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    174.73  R     =     52.43

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =     4.30  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.9500E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

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X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.99 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.30     1.0 0.950E-01   0.05    5.924   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet-like motion in weak crossflow.
   UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
   Following MOD133 will include recirculation into jet region.

 Zone of flow establishment:            THETAE=    -88.66  SIGMAE=     70.24
  LE    =      0.42  XE    =      0.00  YE    =      0.01  ZE    =      3.87

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.30     1.0 0.950E-01   0.05    5.924   .00000E+00
      0.00     0.01    3.87     1.0 0.950E-01   0.05    5.924   .21572E-02
      0.00     0.01    3.77     1.1 0.878E-01   0.06    5.924   .16938E-01
      0.01     0.01    3.65     1.3 0.715E-01   0.07    5.257   .38170E-01
      0.01     0.02    3.52     1.6 0.602E-01   0.09    4.428   .63706E-01
      0.01     0.02    3.42     1.8 0.531E-01   0.10    3.899   .89032E-01
      0.02     0.02    3.30     2.0 0.466E-01   0.11    3.420   .12260E+00
      0.02     0.02    3.20     2.3 0.421E-01   0.12    3.092   .15484E+00
      0.03     0.03    3.07     2.5 0.379E-01   0.14    2.779   .19651E+00
      0.04     0.03    2.95     2.8 0.344E-01   0.15    2.521   .24259E+00
      0.05     0.03    2.85     3.0 0.319E-01   0.16    2.334   .28560E+00
      0.06     0.03    2.73     3.2 0.293E-01   0.17    2.147   .33992E+00
      0.07     0.04    2.61     3.5 0.272E-01   0.19    1.986   .39873E+00
      0.08     0.04    2.50     3.7 0.255E-01   0.20    1.864   .45275E+00
      0.10     0.04    2.38     4.0 0.238E-01   0.21    1.738   .52001E+00
      0.11     0.04    2.26     4.3 0.223E-01   0.23    1.627   .59190E+00
      0.13     0.05    2.16     4.5 0.212E-01   0.24    1.541   .65722E+00
      0.15     0.05    2.04     4.8 0.200E-01   0.26    1.451   .73782E+00
      0.17     0.05    1.92     5.0 0.189E-01   0.27    1.369   .82319E+00
      0.19     0.05    1.82     5.3 0.180E-01   0.28    1.304   .90022E+00
      0.21     0.06    1.70     5.6 0.171E-01   0.30    1.235   .99464E+00
      0.23     0.06    1.58     5.9 0.162E-01   0.31    1.172   .10940E+01
      0.26     0.06    1.48     6.1 0.156E-01   0.33    1.122   .11832E+01
      0.28     0.06    1.36     6.4 0.148E-01   0.34    1.067   .12921E+01
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      0.31     0.07    1.24     6.7 0.142E-01   0.36    1.016   .14061E+01
      0.34     0.07    1.14     7.0 0.136E-01   0.37    0.975   .15080E+01
      0.37     0.07    1.03     7.3 0.130E-01   0.39    0.931   .16320E+01
      0.40     0.07    0.91     7.6 0.125E-01   0.40    0.889   .17614E+01
      0.43     0.08    0.81     7.9 0.120E-01   0.42    0.855   .18768E+01
      0.47     0.08    0.69     8.2 0.116E-01   0.43    0.818   .20167E+01
      0.51     0.08    0.58     8.6 0.111E-01   0.45    0.783   .21623E+01
      0.54     0.08    0.48     8.9 0.107E-01   0.46    0.754   .22919E+01
 Cumulative travel time =           2.2919 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.54     0.08    0.48     8.9 0.107E-01   0.46 .22919E+01

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.08     0.22    4.30     8.9 0.107E-01   0.00     0.00    4.30    4.30
.22919E+01
      0.55     0.22    4.30     8.9 0.107E-01   4.30     0.15    4.30    0.00
.24020E+01
      1.03     0.22    4.30     9.0 0.105E-01   4.30     0.22    4.30    0.00
.66133E+01
      1.50     0.22    4.30     9.5 0.999E-02   4.30     0.27    4.30    0.00
.10825E+02
      1.98     0.22    4.30    10.1 0.936E-02   4.30     0.31    4.30    0.00
.15036E+02
      2.46     0.22    4.30    10.8 0.879E-02   4.30     0.34    4.30    0.00
.19247E+02
      2.93     0.22    4.30    11.4 0.835E-02   4.30     0.38    4.30    0.00
.23459E+02
      3.41     0.22    4.30    11.8 0.804E-02   4.30     0.41    4.30    0.00
.27670E+02
      3.88     0.22    4.30    12.1 0.786E-02   4.30     0.43    4.30    0.00
.31881E+02
      4.36     0.22    4.30    12.3 0.775E-02   4.30     0.46    4.30    0.00
.36093E+02
      4.84     0.22    4.30    12.4 0.766E-02   4.30     0.49    4.30    0.00
.40304E+02
 Cumulative travel time =          40.3039 sec

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      4.84     0.22    4.30    12.4 0.766E-02   4.30     0.49    4.30    0.00
.40304E+02
      4.91     0.22    4.30    12.6 0.754E-02   4.10     0.52    4.30    0.20
.40984E+02
      4.99     0.22    4.30    12.8 0.743E-02   3.93     0.55    4.30    0.37
.41664E+02
      5.07     0.22    4.30    13.0 0.733E-02   3.77     0.58    4.30    0.52
.42344E+02
      5.14     0.22    4.30    13.1 0.724E-02   3.64     0.61    4.30    0.66
.43024E+02
      5.22     0.22    4.30    13.3 0.716E-02   3.52     0.63    4.30    0.78
.43704E+02
      5.30     0.22    4.30    13.4 0.709E-02   3.41     0.66    4.30    0.89
.44384E+02
      5.37     0.22    4.30    13.5 0.702E-02   3.31     0.69    4.30    0.99
.45064E+02
      5.45     0.22    4.30    13.7 0.695E-02   3.21     0.72    4.30    1.08
.45744E+02
      5.53     0.22    4.30    13.8 0.689E-02   3.13     0.74    4.30    1.17
.46424E+02
      5.60     0.22    4.30    13.9 0.683E-02   3.05     0.77    4.30    1.25
.47103E+02
      5.68     0.22    4.30    14.0 0.677E-02   2.98     0.79    4.30    1.32
.47783E+02
      5.76     0.22    4.30    14.1 0.672E-02   2.91     0.82    4.30    1.39
.48463E+02
      5.83     0.22    4.30    14.2 0.667E-02   2.85     0.84    4.30    1.45
.49143E+02
      5.91     0.22    4.30    14.3 0.663E-02   2.79     0.87    4.30    1.51
.49823E+02
      5.99     0.22    4.30    14.4 0.658E-02   2.73     0.89    4.30    1.56
.50503E+02
      6.06     0.22    4.30    14.5 0.654E-02   2.68     0.91    4.30    1.62
.51183E+02
      6.14     0.22    4.30    14.6 0.650E-02   2.63     0.94    4.30    1.67
.51863E+02
      6.22     0.22    4.30    14.7 0.646E-02   2.58     0.96    4.30    1.71
.52543E+02
      6.30     0.22    4.30    14.8 0.642E-02   2.54     0.98    4.30    1.76
.53223E+02
      6.37     0.22    4.30    14.9 0.638E-02   2.50     1.00    4.30    1.80
.53903E+02
      6.45     0.22    4.30    15.0 0.635E-02   2.46     1.03    4.30    1.84
.54583E+02
```

```
      6.53     0.22    4.30    15.0 0.631E-02   2.42     1.05    4.30    1.88
.55263E+02
      6.60     0.22    4.30    15.1 0.628E-02   2.38     1.07    4.30    1.91
.55943E+02
      6.68     0.22    4.30    15.2 0.625E-02   2.35     1.09    4.30    1.95
.56623E+02
      6.76     0.22    4.30    15.3 0.622E-02   2.31     1.11    4.30    1.98
.57303E+02
      6.83     0.22    4.30    15.3 0.619E-02   2.28     1.13    4.30    2.02
.57983E+02
      6.91     0.22    4.30    15.4 0.616E-02   2.25     1.15    4.30    2.05
.58663E+02
      6.99     0.22    4.30    15.5 0.613E-02   2.22     1.17    4.30    2.08
.59343E+02
      7.06     0.22    4.30    15.6 0.611E-02   2.19     1.19    4.30    2.10
.60023E+02
      7.14     0.22    4.30    15.6 0.608E-02   2.16     1.21    4.30    2.13
.60703E+02
 Cumulative travel time =          60.7026 sec

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 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      7.14    -0.99    4.30    15.6 0.608E-02   2.16     2.43    4.30    2.13
.60703E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     15.87    -0.99    4.30    18.4 0.517E-02   1.42     4.34    4.30    2.87
.13789E+03
     24.59    -0.99    4.30    20.5 0.464E-02   1.17     5.87    4.30    3.12
.21509E+03
     33.32    -0.99    4.30    22.6 0.420E-02   1.06     7.19    4.30    3.24
.29228E+03
     42.04    -0.99    4.30    25.0 0.380E-02   1.00     8.39    4.30    3.29
.36947E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     50.77    -0.99    4.30    27.8 0.342E-02   0.99     9.50    4.30    3.31
.44666E+03
     59.49    -0.99    4.30    31.0 0.306E-02   0.99    10.53    4.30    3.30
.52385E+03
     68.22    -0.99    4.30    34.7 0.274E-02   1.01    11.51    4.30    3.28
.60104E+03
     76.95    -0.99    4.30    38.9 0.244E-02   1.05    12.45    4.30    3.24
.67823E+03
     85.67    -0.99    4.30    43.7 0.217E-02   1.10    13.35    4.30    3.19
.75542E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
```

```
 This is the extent of the REGULATORY MIXING ZONE.
     94.40    -0.99    4.30    49.1 0.193E-02   1.16    14.22    4.30    3.13
.83262E+03
    103.12    -0.99    4.30    55.1 0.172E-02   1.23    15.06    4.30    3.06
.90981E+03
    111.85    -0.99    4.30    61.7 0.154E-02   1.31    15.88    4.30    2.99
.98700E+03
    120.57    -0.99    4.30    69.0 0.138E-02   1.39    16.68    4.30    2.90
.10642E+04
    129.30    -0.99    4.30    76.9 0.123E-02   1.48    17.46    4.30    2.81
.11414E+04
    138.03    -0.99    4.30    85.6 0.111E-02   1.58    18.23    4.30    2.72
.12186E+04
    146.75    -0.99    4.30    95.0 0.100E-02   1.68    18.98    4.30    2.61
.12958E+04
    155.48    -0.99    4.30   105.1 0.904E-03   1.79    19.72    4.30    2.50
.13730E+04
    164.20    -0.99    4.30   115.9 0.820E-03   1.91    20.45    4.30    2.39
.14501E+04
    172.93    -0.99    4.30   127.5 0.745E-03   2.03    21.16    4.30    2.27
.15273E+04
    181.65    -0.99    4.30   139.9 0.679E-03   2.15    21.87    4.30    2.14
.16045E+04
    190.38    -0.99    4.30   153.1 0.620E-03   2.28    22.56    4.30    2.01
.16817E+04
    199.11    -0.99    4.30   167.1 0.568E-03   2.42    23.25    4.30    1.88
.17589E+04
    207.83    -0.99    4.30   182.0 0.522E-03   2.56    23.93    4.30    1.74
.18361E+04
    216.56    -0.99    4.30   197.7 0.481E-03   2.70    24.60    4.30    1.59
.19133E+04
    225.28    -0.99    4.30   214.2 0.443E-03   2.85    25.26    4.30    1.44
.19905E+04
    234.01    -0.99    4.30   231.6 0.410E-03   3.01    25.91    4.30    1.29
.20677E+04
    242.73    -0.99    4.30   249.9 0.380E-03   3.17    26.56    4.30    1.13
.21449E+04
    251.46    -0.99    4.30   269.1 0.353E-03   3.33    27.20    4.30    0.97
.22221E+04
    260.18    -0.99    4.30   289.2 0.328E-03   3.50    27.84    4.30    0.80
.22993E+04
    268.91    -0.99    4.30   310.3 0.306E-03   3.67    28.47    4.30    0.63
.23764E+04
 Cumulative travel time =        2376.4431 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -1.84m
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.108E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.135E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
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        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    268.91    -0.99    4.30   310.3 0.306E-03   3.67    28.47    4.30    0.63
.23764E+04
    376.61    -0.99    4.30   430.3 0.221E-03   4.96    29.17    4.30   -0.67
.33292E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    484.32    -0.99    4.30   544.4 0.175E-03   6.14    29.85    4.30   -1.84
.42820E+04
    592.02    -0.99    4.30   556.6 0.171E-03   6.14    30.52    4.30   -1.84
.52348E+04
    699.72    -0.99    4.30   568.5 0.167E-03   6.14    31.17    4.30   -1.84
.61876E+04
    807.43    -0.99    4.30   580.2 0.164E-03   6.14    31.81    4.30   -1.84
.71404E+04
    915.13    -0.99    4.30   591.7 0.161E-03   6.14    32.44    4.30   -1.84
.80932E+04
   1022.83    -0.99    4.30   602.9 0.158E-03   6.14    33.06    4.30   -1.84
.90460E+04
   1130.53    -0.99    4.30   613.9 0.155E-03   6.14    33.66    4.30   -1.84
.99988E+04
   1238.24    -0.99    4.30   624.8 0.152E-03   6.14    34.26    4.30   -1.84
.10952E+05
   1345.94    -0.99    4.30   635.4 0.150E-03   6.14    34.84    4.30   -1.84
.11904E+05
   1453.64    -0.99    4.30   645.9 0.147E-03   6.14    35.42    4.30   -1.84
.12857E+05
   1561.35    -0.99    4.30   656.2 0.145E-03   6.14    35.98    4.30   -1.84
.13810E+05
   1669.05    -0.99    4.30   666.4 0.143E-03   6.14    36.54    4.30   -1.84
.14763E+05
   1776.75    -0.99    4.30   676.3 0.140E-03   6.14    37.09    4.30   -1.84
.15716E+05
   1884.46    -0.99    4.30   686.2 0.138E-03   6.14    37.63    4.30   -1.84
.16668E+05
   1992.16    -0.99    4.30   695.9 0.137E-03   6.14    38.16    4.30   -1.84
.17621E+05
   2099.86    -0.99    4.30   705.5 0.135E-03   6.14    38.68    4.30   -1.84
.18574E+05
   2207.56    -0.99    4.30   714.9 0.133E-03   6.14    39.20    4.30   -1.84
.19527E+05
   2315.27    -0.99    4.30   724.3 0.131E-03   6.14    39.71    4.30   -1.84
.20480E+05
   2422.97    -0.99    4.30   733.5 0.130E-03   6.14    40.22    4.30   -1.84
.21432E+05
   2530.67    -0.99    4.30   742.6 0.128E-03   6.14    40.72    4.30   -1.84
.22385E+05
   2638.38    -0.99    4.30   751.6 0.126E-03   6.14    41.21    4.30   -1.84
.23338E+05
```

```
   2746.08    -0.99    4.30   760.4 0.125E-03   6.14    41.70    4.30   -1.84
.24291E+05
   2853.78    -0.99    4.30   769.2 0.124E-03   6.14    42.18    4.30   -1.84
.25243E+05
   2961.48    -0.99    4.30   777.9 0.122E-03   6.14    42.65    4.30   -1.84
.26196E+05
   3069.19    -0.99    4.30   786.5 0.121E-03   6.14    43.13    4.30   -1.84
.27149E+05
   3176.89    -0.99    4.30   795.0 0.120E-03   6.14    43.59    4.30   -1.84
.28102E+05
   3284.59    -0.99    4.30   803.4 0.118E-03   6.14    44.05    4.30   -1.84
.29055E+05
   3392.30    -0.99    4.30   811.7 0.117E-03   6.14    44.51    4.30   -1.84
.30007E+05
   3500.00    -0.99    4.30   819.9 0.116E-03   6.14    44.96    4.30   -1.84
.30960E+05
 Cumulative travel time =       30960.2695 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309(2)550GPMaSteadyFinal
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD309(2)550GPMaStea
dyFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:38:40
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 109.90 m^3/s
  Average depth                   HA      = 6.14 m
  Depth at discharge              HD      = 4.30 m
  Ambient velocity                UA      = 0.113 m/s
  Darcy-Weisbach friction factor  F       = 0.0268
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.99 m
  Port diameter                   D0      = 0.0904 m
  Port cross-sectional area       A0      = 0.0064 m^2
  Discharge velocity              U0      = 5.92 m/s
  Discharge flowrate              Q0      = 0.038021 m^3/s
  Discharge port height           H0      = 4.30 m
  Vertical discharge angle        THETA   = -88.74 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.095 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.08 m         Lm  = 4.20 m         Lb  = 0.34 m
  LM  = 14.87 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 174.73
  Velocity ratio                  R       = 52.43
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

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  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV4 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.30 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.99 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0077 mg/l
  Dilution at edge of NFR              s = 12.4
  NFR Location:                        x = 4.84 m
    (centerline coordinates)           y = 0.22 m
                                       z = 4.30 m
  NFR plume dimensions:  half-width (bh) = 0.49 m
                          thickness (bv) = 4.30 m
Cumulative travel time:       40.3039 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 484.32 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 7.14 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 16.379310
```

```
The CMC was encountered at the following plume position:
  Plume location:                      x = 9.08 m
    (centerline coordinates)           y = -0.99 m
                                       z = 4.30 m
  Plume dimension:       half-width (bh) = 2.91 m
                          thickness (bv) = 1.90 m

 Computed distance from port opening to CMC location = 9.13 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.08 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 9.13 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.30 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 9.13 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.92 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002013  mg/l
  Corresponding dilution               s = 47.2
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.99 m
                                       z = 4.30 m
  Plume dimensions:      half-width (bh) = 13.92 m
                          thickness (bv) = 1.14 m
Cumulative travel time:       806.4537 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 25.5
  Plume location:                      x = 43.54 m
    (centerline coordinates)           y = -0.99 m
                                       z = 4.30 m
  Plume dimensions:      half-width (bh) = 8.58 m
                          thickness (bv) = 1.00 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
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1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:
 Design case:       JD309(2)550GPMbSteadyFinal6.0
 FILE NAME:         P:\...\550GPMFinalRiver\JD309(2)550GPMbSteadyFinalR.prd
 Time stamp:        Fri Mar 26 15:41:16 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    964.65  QA    =    171.71  ICHREG= 1
 HA    =      6.09  HD    =      4.26
 UA    =      0.178 F     =      0.027 USTAR =0.1032E-01
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.05
 D0    =      0.116 A0    =      0.011 H0    =      4.26  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      6.009 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.7800E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.3810E+00  J0    =0.8063E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.10  LM    =     17.08  Lm    =      3.47  Lb    =      0.14
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    156.52  R     =     33.76

FLOW CLASSIFICATION
 1111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =     4.26  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.7800E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.05 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.26     1.0 0.780E-01   0.06    6.009   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet-like motion in weak crossflow.
   UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
   Following MOD133 will include recirculation into jet region.

 Zone of flow establishment:            THETAE=    -87.81  SIGMAE=     71.25
  LE    =      0.52  XE    =      0.00  YE    =      0.02  ZE    =      3.74

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time
```

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	4.26	1.0	0.780E-01	0.06	6.009	.00000E+00
0.00	0.02	3.74	1.0	0.780E-01	0.06	6.009	.20348E-02
0.00	0.02	3.64	1.0	0.764E-01	0.07	6.009	.15566E-01
0.01	0.03	3.52	1.2	0.645E-01	0.08	5.861	.34224E-01
0.01	0.03	3.42	1.4	0.570E-01	0.10	5.169	.52688E-01
0.02	0.03	3.30	1.6	0.500E-01	0.11	4.539	.77126E-01
0.02	0.04	3.18	1.7	0.446E-01	0.12	4.042	.10470E+00
0.03	0.04	3.08	1.9	0.408E-01	0.13	3.693	.13085E+00
0.04	0.05	2.97	2.1	0.370E-01	0.15	3.351	.16432E+00
0.05	0.05	2.85	2.3	0.339E-01	0.16	3.063	.20099E+00
0.06	0.05	2.75	2.5	0.316E-01	0.17	2.851	.23500E+00
0.08	0.06	2.63	2.7	0.292E-01	0.18	2.635	.27773E+00
0.09	0.06	2.52	2.9	0.272E-01	0.20	2.446	.32377E+00
0.10	0.07	2.42	3.0	0.256E-01	0.21	2.302	.36589E+00
0.12	0.07	2.30	3.3	0.240E-01	0.22	2.152	.41820E+00
0.14	0.08	2.19	3.5	0.225E-01	0.24	2.017	.47395E+00
0.16	0.08	2.09	3.6	0.214E-01	0.25	1.912	.52453E+00
0.18	0.08	1.97	3.9	0.202E-01	0.26	1.801	.58683E+00
0.21	0.09	1.86	4.1	0.191E-01	0.28	1.699	.65276E+00
0.23	0.09	1.74	4.3	0.181E-01	0.29	1.605	.72237E+00
0.26	0.09	1.65	4.5	0.173E-01	0.31	1.531	.78502E+00
0.29	0.10	1.53	4.8	0.164E-01	0.32	1.451	.86168E+00
0.32	0.10	1.42	5.0	0.156E-01	0.34	1.376	.94224E+00
0.35	0.11	1.32	5.2	0.150E-01	0.35	1.316	.10145E+01

```
      0.38     0.11    1.21     5.5 0.143E-01   0.37    1.251   .11025E+01
      0.42     0.11    1.10     5.7 0.136E-01   0.38    1.189   .11947E+01
      0.45     0.12    1.01     6.0 0.131E-01   0.40    1.140   .12772E+01
      0.49     0.12    0.90     6.2 0.125E-01   0.41    1.085   .13774E+01
      0.53     0.13    0.79     6.5 0.120E-01   0.43    1.034   .14821E+01
      0.57     0.13    0.69     6.8 0.115E-01   0.45    0.992   .15754E+01
      0.62     0.13    0.59     7.1 0.110E-01   0.46    0.945   .16887E+01
      0.67     0.14    0.48     7.3 0.106E-01   0.48    0.907   .17896E+01
 Cumulative travel time =           1.7896 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.67     0.14    0.48     7.3 0.106E-01   0.48 .17896E+01

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.19     0.31    4.26     7.3 0.106E-01   0.00     0.00    4.26    4.26
.17896E+01
      0.66     0.31    4.26     7.3 0.106E-01   4.26     0.14    4.26    0.00
.17896E+01
      1.13     0.31    4.26     7.5 0.104E-01   4.26     0.19    4.26    0.00
.44213E+01
      1.61     0.31    4.26     7.8 0.994E-02   4.26     0.23    4.26    0.00
.70842E+01
      2.08     0.31    4.26     8.4 0.931E-02   4.26     0.27    4.26    0.00
.97470E+01
      2.56     0.31    4.26     8.9 0.874E-02   4.26     0.30    4.26    0.00
.12410E+02
      3.03     0.31    4.26     9.4 0.830E-02   4.26     0.33    4.26    0.00
.15073E+02
      3.50     0.31    4.26     9.8 0.799E-02   4.26     0.36    4.26    0.00
.17736E+02
      3.98     0.31    4.26    10.0 0.780E-02   4.26     0.38    4.26    0.00
.20399E+02
      4.45     0.31    4.26    10.1 0.770E-02   4.26     0.41    4.26    0.00
.23061E+02
      4.93     0.31    4.26    10.3 0.760E-02   4.26     0.43    4.26    0.00
.25724E+02
 Cumulative travel time =          25.7242 sec

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      4.93     0.31    4.26    10.3 0.760E-02   4.26     0.43    4.26    0.00
.25724E+02
      5.08     0.31    4.26    10.5 0.742E-02   3.97     0.47    4.26    0.29
.26581E+02
      5.23     0.31    4.26    10.7 0.727E-02   3.73     0.51    4.26    0.53
.27438E+02
      5.38     0.31    4.26    10.9 0.714E-02   3.52     0.55    4.26    0.74
.28295E+02
      5.54     0.31    4.26    11.1 0.702E-02   3.35     0.59    4.26    0.91
.29152E+02
      5.69     0.31    4.26    11.3 0.691E-02   3.20     0.63    4.26    1.06
.30009E+02
      5.84     0.31    4.26    11.4 0.682E-02   3.07     0.66    4.26    1.19
.30866E+02
      5.99     0.31    4.26    11.6 0.673E-02   2.96     0.70    4.26    1.30
.31723E+02
      6.15     0.31    4.26    11.7 0.665E-02   2.85     0.73    4.26    1.41
.32580E+02
      6.30     0.31    4.26    11.9 0.658E-02   2.76     0.77    4.26    1.50
.33437E+02
      6.45     0.31    4.26    12.0 0.651E-02   2.67     0.80    4.26    1.59
.34294E+02
      6.60     0.31    4.26    12.1 0.644E-02   2.60     0.83    4.26    1.66
.35151E+02
      6.76     0.31    4.26    12.2 0.638E-02   2.53     0.86    4.26    1.73
.36008E+02
      6.91     0.31    4.26    12.3 0.633E-02   2.46     0.89    4.26    1.80
.36864E+02
      7.06     0.31    4.26    12.4 0.627E-02   2.40     0.92    4.26    1.86
.37721E+02
      7.21     0.31    4.26    12.5 0.622E-02   2.34     0.95    4.26    1.92
.38578E+02
      7.37     0.31    4.26    12.6 0.618E-02   2.29     0.98    4.26    1.97
.39435E+02
      7.52     0.31    4.26    12.7 0.613E-02   2.24     1.01    4.26    2.02
.40292E+02
      7.67     0.31    4.26    12.8 0.609E-02   2.20     1.04    4.26    2.06
.41149E+02
      7.83     0.31    4.26    12.9 0.605E-02   2.15     1.07    4.26    2.11
.42006E+02
      7.98     0.31    4.26    13.0 0.601E-02   2.11     1.09    4.26    2.15
.42863E+02
      8.13     0.31    4.26    13.1 0.597E-02   2.07     1.12    4.26    2.19
.43720E+02
```

```
      8.28     0.31    4.26    13.1 0.593E-02   2.04     1.15    4.26    2.22
.44577E+02
      8.44     0.31    4.26    13.2 0.590E-02   2.00     1.18    4.26    2.26
.45434E+02
      8.59     0.31    4.26    13.3 0.587E-02   1.97     1.20    4.26    2.29
.46291E+02
      8.74     0.31    4.26    13.4 0.583E-02   1.94     1.23    4.26    2.32
.47148E+02
      8.89     0.31    4.26    13.4 0.580E-02   1.91     1.25    4.26    2.35
.48005E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
      9.05     0.31    4.26    13.5 0.577E-02   1.88     1.28    4.26    2.38
.48862E+02
      9.20     0.31    4.26    13.6 0.574E-02   1.85     1.30    4.26    2.41
.49719E+02
      9.35     0.31    4.26    13.7 0.571E-02   1.83     1.33    4.26    2.43
.50576E+02
      9.50     0.31    4.26    13.7 0.569E-02   1.80     1.35    4.26    2.46
.51433E+02
 Cumulative travel time =          51.4325 sec

--------------------------------------------------------------------------------
---------------
 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      9.50    -1.05    4.26    13.7 0.569E-02   1.80     2.71    4.26    2.46
.51433E+02
     19.51    -1.05    4.26    15.5 0.503E-02   1.34     4.13    4.26    2.92
.10760E+03
     29.51    -1.05    4.26    17.1 0.457E-02   1.14     5.32    4.26    3.12
.16378E+03
     39.51    -1.05    4.26    18.6 0.419E-02   1.04     6.37    4.26    3.22
.21995E+03
     49.51    -1.05    4.26    20.4 0.383E-02   0.99     7.33    4.26    3.27
.27612E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     59.52    -1.05    4.26    22.3 0.349E-02   0.97     8.23    4.26    3.29
.33229E+03
     69.52    -1.05    4.26    24.6 0.317E-02   0.97     9.07    4.26    3.29
.38847E+03
     79.52    -1.05    4.26    27.2 0.287E-02   0.98     9.87    4.26    3.28
.44464E+03
     89.52    -1.05    4.26    30.0 0.260E-02   1.01    10.63    4.26    3.25
.50081E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
```

```
     99.53    -1.05    4.26    33.3 0.234E-02   1.04    11.37    4.26    3.22
.55698E+03
    109.53    -1.05    4.26    36.9 0.211E-02   1.09    12.08    4.26    3.17
.61315E+03
    119.53    -1.05    4.26    40.9 0.191E-02   1.14    12.77    4.26    3.12
.66933E+03
    129.53    -1.05    4.26    45.3 0.172E-02   1.20    13.44    4.26    3.06
.72550E+03
    139.53    -1.05    4.26    50.1 0.156E-02   1.27    14.10    4.26    2.99
.78167E+03
    149.54    -1.05    4.26    55.4 0.141E-02   1.34    14.74    4.26    2.92
.83784E+03
    159.54    -1.05    4.26    61.1 0.128E-02   1.42    15.37    4.26    2.84
.89402E+03
    169.54    -1.05    4.26    67.2 0.116E-02   1.50    15.98    4.26    2.76
.95019E+03
    179.54    -1.05    4.26    73.8 0.106E-02   1.59    16.59    4.26    2.68
.10064E+04
    189.55    -1.05    4.26    80.9 0.964E-03   1.68    17.19    4.26    2.58
.10625E+04
    199.55    -1.05    4.26    88.5 0.882E-03   1.77    17.77    4.26    2.49
.11187E+04
    209.55    -1.05    4.26    96.5 0.808E-03   1.87    18.35    4.26    2.39
.11749E+04
    219.55    -1.05    4.26   105.1 0.742E-03   1.98    18.92    4.26    2.28
.12310E+04
    229.56    -1.05    4.26   114.1 0.683E-03   2.09    19.48    4.26    2.17
.12872E+04
    239.56    -1.05    4.26   123.7 0.630E-03   2.20    20.04    4.26    2.06
.13434E+04
    249.56    -1.05    4.26   133.9 0.583E-03   2.32    20.59    4.26    1.94
.13996E+04
    259.56    -1.05    4.26   144.5 0.540E-03   2.44    21.13    4.26    1.82
.14557E+04
    269.56    -1.05    4.26   155.7 0.501E-03   2.56    21.67    4.26    1.70
.15119E+04
    279.57    -1.05    4.26   167.5 0.466E-03   2.69    22.20    4.26    1.57
.15681E+04
    289.57    -1.05    4.26   179.8 0.434E-03   2.82    22.72    4.26    1.44
.16243E+04
    299.57    -1.05    4.26   192.7 0.405E-03   2.95    23.24    4.26    1.31
.16804E+04
    309.57    -1.05    4.26   206.2 0.378E-03   3.09    23.76    4.26    1.17
.17366E+04
 Cumulative travel time =        1736.6000 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
---------------
 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -1.83m
-------------------------------------------------------------------------------
---------------
BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.120E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.150E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
```

```
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
      X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    309.57    -1.05    4.26   206.2 0.378E-03   3.09    23.76    4.26    1.17
.17366E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
   1465.92    -1.05    4.26   504.2 0.155E-03   6.09    29.51    4.26   -1.83
.82305E+04
   2622.27    -1.05    4.26   586.2 0.133E-03   6.09    34.31    4.26   -1.83
.14724E+05
   3778.62    -1.05    4.26   658.1 0.119E-03   6.09    38.51    4.26   -1.83
.21218E+05
   4934.96    -1.05    4.26   722.9 0.108E-03   6.09    42.30    4.26   -1.83
.27712E+05
   6091.31    -1.05    4.26   782.3 0.997E-04   6.09    45.78    4.26   -1.83
.34206E+05
   7247.66    -1.05    4.26   837.5 0.931E-04   6.09    49.01    4.26   -1.83
.40700E+05
   8404.01    -1.05    4.26   889.3 0.877E-04   6.09    52.04    4.26   -1.83
.47194E+05
   9560.36    -1.05    4.26   938.2 0.831E-04   6.09    54.90    4.26   -1.83
.53688E+05
  10716.70    -1.05    4.26   984.7 0.792E-04   6.09    57.63    4.26   -1.83
.60182E+05
  11873.05    -1.05    4.26  1029.1 0.758E-04   6.09    60.22    4.26   -1.83
.66676E+05
  13029.40    -1.05    4.26  1071.7 0.728E-04   6.09    62.72    4.26   -1.83
.73170E+05
  14185.75    -1.05    4.26  1112.6 0.701E-04   6.09    65.11    4.26   -1.83
.79664E+05
  15342.09    -1.05    4.26  1152.1 0.677E-04   6.09    67.42    4.26   -1.83
.86158E+05
  16498.44    -1.05    4.26  1190.3 0.655E-04   6.09    69.66    4.26   -1.83
.92652E+05
  17654.79    -1.05    4.26  1227.3 0.636E-04   6.09    71.82    4.26   -1.83
.99146E+05
  18811.14    -1.05    4.26  1263.2 0.617E-04   6.09    73.92    4.26   -1.83
.10564E+06
  19967.48    -1.05    4.26  1298.1 0.601E-04   6.09    75.96    4.26   -1.83
.11213E+06
  21123.83    -1.05    4.26  1332.1 0.586E-04   6.09    77.95    4.26   -1.83
.11863E+06
  22280.18    -1.05    4.26  1365.2 0.571E-04   6.09    79.89    4.26   -1.83
.12512E+06
  23436.53    -1.05    4.26  1397.6 0.558E-04   6.09    81.79    4.26   -1.83
.13162E+06
  24592.88    -1.05    4.26  1429.2 0.546E-04   6.09    83.64    4.26   -1.83
.13811E+06
  25749.22    -1.05    4.26  1460.2 0.534E-04   6.09    85.45    4.26   -1.83
.14460E+06
```

```
  26905.57    -1.05    4.26  1490.5 0.523E-04   6.09    87.22    4.26   -1.83
.15110E+06
  28061.92    -1.05    4.26  1520.2 0.513E-04   6.09    88.96    4.26   -1.83
.15759E+06
  29218.27    -1.05    4.26  1549.3 0.503E-04   6.09    90.67    4.26   -1.83
.16409E+06
  30374.61    -1.05    4.26  1577.9 0.494E-04   6.09    92.34    4.26   -1.83
.17058E+06
  31530.96    -1.05    4.26  1606.0 0.486E-04   6.09    93.98    4.26   -1.83
.17707E+06
  32687.31    -1.05    4.26  1633.6 0.477E-04   6.09    95.60    4.26   -1.83
.18357E+06
  33843.66    -1.05    4.26  1660.7 0.470E-04   6.09    97.19    4.26   -1.83
.19006E+06
  35000.00    -1.05    4.26  1687.4 0.462E-04   6.09    98.75    4.26   -1.83
.19655E+06
 Cumulative travel time =      196554.6875 sec

 Simulation limit based on maximum specified distance =  35000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309(2)550GPMbSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD309(2)550GPMbStea
dyFinalR.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:41:16
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 171.71 m^3/s
  Average depth                   HA      = 6.09 m
  Depth at discharge              HD      = 4.26 m
  Ambient velocity                UA      = 0.178 m/s
  Darcy-Weisbach friction factor  F       = 0.0269
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 1.05 m
  Port diameter                   D0      = 0.1159 m
  Port cross-sectional area       A0      = 0.0106 m^2
  Discharge velocity              U0      = 6.01 m/s
  Discharge flowrate              Q0      = 0.063399 m^3/s
  Discharge port height           H0      = 4.26 m
  Vertical discharge angle        THETA   = -87.93 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.078 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.10 m         Lm  = 3.47 m         Lb  = 0.14 m
  LM  = 17.08 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 156.52
  Velocity ratio                  R       = 33.76
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV4 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.26 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.05 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0076 mg/l
  Dilution at edge of NFR              s = 10.3
  NFR Location:                        x = 4.93 m
    (centerline coordinates)           y = 0.31 m
                                       z = 4.26 m
  NFR plume dimensions:  half-width (bh) = 0.43 m
                          thickness (bv) = 4.26 m
Cumulative travel time:       25.7242 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 1465.92 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 9.50 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 13.448276
```

```
The CMC was encountered at the following plume position:
  Plume location:                      x = 8.90 m
    (centerline coordinates)           y = 0.31 m
                                       z = 4.26 m
  Plume dimension:       half-width (bh) = 1.26 m
                          thickness (bv) = 1.91 m

 Computed distance from port opening to CMC location = 8.91 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.10 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.91 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.26 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.91 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 6.01 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002546  mg/l
  Corresponding dilution               s = 30.7
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.05 m
                                       z = 4.26 m
  Plume dimensions:      half-width (bh) = 10.78 m
                          thickness (bv) = 1.01 m
Cumulative travel time:       511.5782 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 20.9
  Plume location:                      x = 52.39 m
    (centerline coordinates)           y = -1.05 m
                                       z = 4.26 m
  Plume dimensions:      half-width (bh) = 7.60 m
                          thickness (bv) = 0.98 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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CASE DESCRIPTION
 Site name/label:   SIM
 Design case:       JD309550GPMcSteadyFinal6.0
 FILE NAME:         P:\...\550GPMFinalRiver\JD309550GPMcSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:42:44 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1226.10  QA    =    138.55  ICHREG= 1
 HA    =      7.74  HD    =      5.42
 UA    =      0.113 F     =      0.025 USTAR =0.6293E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.94
 D0    =      0.158 A0    =      0.020 H0    =      5.42  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      1.930 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1230E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.7337E-01  J0    =0.4835E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.14  LM    =      6.41  Lm    =      2.40  Lb    =      0.34
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     42.99  R     =     17.08

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV3   1
 1  Applicable layer depth HS =     5.42  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1230E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.94 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
---------------
-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    5.42     1.0 0.123E+00   0.08    1.930   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION


 Zone of flow establishment:            THETAE=    -85.89  SIGMAE=     70.24
  LE    =      0.64  XE    =      0.01  YE    =      0.04  ZE    =      4.77

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    5.42     1.0 0.123E+00   0.08    1.930   .00000E+00
      0.01     0.04    4.77     1.0 0.123E+00   0.08    1.930   .92464E-02
      0.01     0.05    4.63     1.0 0.119E+00   0.10    1.930   .71209E-01
      0.02     0.07    4.46     1.2 0.992E-01   0.12    1.823   .15772E+00
      0.03     0.08    4.31     1.4 0.867E-01   0.13    1.588   .24429E+00
      0.05     0.09    4.14     1.6 0.754E-01   0.15    1.374   .36016E+00
      0.08     0.10    3.98     1.9 0.665E-01   0.17    1.205   .49251E+00
      0.11     0.11    3.81     2.1 0.592E-01   0.20    1.066   .64196E+00
      0.13     0.12    3.66     2.3 0.539E-01   0.21    0.965   .78421E+00
      0.17     0.13    3.50     2.5 0.486E-01   0.24    0.863   .96742E+00
      0.22     0.14    3.33     2.8 0.441E-01   0.26    0.775   .11701E+01
      0.26     0.15    3.20     3.0 0.407E-01   0.28    0.708   .13601E+01
      0.32     0.16    3.03     3.3 0.371E-01   0.30    0.639   .16019E+01
      0.37     0.17    2.90     3.6 0.344E-01   0.33    0.585   .18272E+01
      0.44     0.18    2.74     3.9 0.315E-01   0.35    0.528   .21124E+01
      0.51     0.19    2.59     4.2 0.290E-01   0.38    0.477   .24230E+01
      0.58     0.20    2.46     4.6 0.270E-01   0.40    0.438   .27105E+01
      0.67     0.21    2.32     4.9 0.249E-01   0.43    0.396   .30720E+01
      0.77     0.22    2.17     5.4 0.230E-01   0.46    0.357   .34629E+01
      0.85     0.23    2.06     5.7 0.215E-01   0.49    0.328   .38222E+01
      0.96     0.24    1.92     6.2 0.199E-01   0.52    0.297   .42706E+01
      1.07     0.25    1.79     6.6 0.185E-01   0.55    0.269   .47513E+01
      1.17     0.26    1.69     7.1 0.174E-01   0.57    0.247   .51893E+01
      1.29     0.27    1.57     7.6 0.163E-01   0.60    0.224   .57310E+01
      1.42     0.28    1.45     8.1 0.152E-01   0.63    0.204   .63054E+01
      1.53     0.28    1.36     8.5 0.144E-01   0.66    0.189   .68237E+01
      1.66     0.29    1.25     9.1 0.136E-01   0.69    0.173   .74579E+01
```

```
      1.80     0.30    1.15     9.6 0.128E-01   0.71    0.159   .81232E+01
      1.94     0.31    1.06    10.1 0.122E-01   0.74    0.146   .88186E+01
      2.06     0.31    0.98    10.6 0.116E-01   0.76    0.137   .94377E+01
      2.21     0.32    0.89    11.1 0.111E-01   0.79    0.126   .10186E+02
      2.36     0.32    0.81    11.6 0.106E-01   0.81    0.119   .10849E+02
 Cumulative travel time =          10.8487 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      2.36     0.32    0.81    11.6 0.106E-01   0.81 .10849E+02

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      1.55     0.31    5.42    11.6 0.106E-01   0.03     0.00    5.42    5.38
.10849E+02
      1.79     0.31    5.42    11.6 0.106E-01   1.14     0.57    5.42    4.27
.10849E+02
      2.04     0.32    5.42    11.6 0.106E-01   1.36     0.81    5.42    4.06
.10849E+02
      2.28     0.32    5.42    11.6 0.106E-01   1.49     1.00    5.42    3.92
.10849E+02
      2.52     0.33    5.42    11.9 0.104E-01   1.59     1.15    5.42    3.82
.12287E+02
      2.77     0.33    5.42    13.4 0.921E-02   1.67     1.29    5.42    3.75
.14438E+02
      3.01     0.34    5.42    15.4 0.799E-02   1.72     1.41    5.42    3.69
.16589E+02
      3.25     0.34    5.42    17.2 0.713E-02   1.77     1.52    5.42    3.65
.18740E+02
      3.49     0.35    5.42    18.5 0.664E-02   1.80     1.63    5.42    3.62
.20891E+02
      3.74     0.35    5.42    19.2 0.641E-02   1.81     1.72    5.42    3.60
.23042E+02
      3.98     0.36    5.42    19.7 0.626E-02   1.82     1.82    5.42    3.60
.25192E+02
 Cumulative travel time =          25.1924 sec

END OF MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH
-------------------------------------------------------------------------------
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
```

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   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
---------------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      3.98    -0.94    5.42    19.7 0.626E-02   2.12     3.12    5.42    3.29
.25192E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     12.28    -0.94    5.42    22.3 0.552E-02   1.56     4.81    5.42    3.86
.98655E+02
     20.59    -0.94    5.42    24.5 0.502E-02   1.32     6.23    5.42    4.09
.17212E+03
     28.89    -0.94    5.42    26.8 0.459E-02   1.20     7.50    5.42    4.21
.24558E+03
     37.20    -0.94    5.42    29.3 0.420E-02   1.14     8.66    5.42    4.28
.31904E+03
     45.50    -0.94    5.42    32.1 0.383E-02   1.11     9.74    5.42    4.31
.39250E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     53.80    -0.94    5.42    35.4 0.348E-02   1.11    10.76    5.42    4.31
.46597E+03
     62.11    -0.94    5.42    39.1 0.315E-02   1.12    11.73    5.42    4.29
.53943E+03
     70.41    -0.94    5.42    43.3 0.284E-02   1.15    12.66    5.42    4.27
.61289E+03
     78.71    -0.94    5.42    48.0 0.256E-02   1.19    13.56    5.42    4.22
.68635E+03
     87.02    -0.94    5.42    53.2 0.231E-02   1.24    14.42    5.42    4.17
.75982E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
```

```
 This is the extent of the REGULATORY MIXING ZONE.
     95.32    -0.94    5.42    59.1 0.208E-02   1.30    15.26    5.42    4.11
.83328E+03
    103.62    -0.94    5.42    65.5 0.188E-02   1.37    16.08    5.42    4.04
.90674E+03
    111.93    -0.94    5.42    72.6 0.170E-02   1.45    16.87    5.42    3.97
.98020E+03
    120.23    -0.94    5.42    80.2 0.153E-02   1.53    17.65    5.42    3.89
.10537E+04
    128.53    -0.94    5.42    88.6 0.139E-02   1.62    18.41    5.42    3.80
.11271E+04
    136.84    -0.94    5.42    97.6 0.126E-02   1.71    19.16    5.42    3.70
.12006E+04
    145.14    -0.94    5.42   107.3 0.115E-02   1.81    19.90    5.42    3.60
.12741E+04
    153.44    -0.94    5.42   117.7 0.105E-02   1.92    20.62    5.42    3.49
.13475E+04
    161.75    -0.94    5.42   128.8 0.955E-03   2.03    21.33    5.42    3.38
.14210E+04
    170.05    -0.94    5.42   140.6 0.875E-03   2.15    22.02    5.42    3.27
.14944E+04
    178.36    -0.94    5.42   153.2 0.803E-03   2.27    22.71    5.42    3.15
.15679E+04
    186.66    -0.94    5.42   166.5 0.739E-03   2.40    23.39    5.42    3.02
.16414E+04
    194.96    -0.94    5.42   180.6 0.681E-03   2.53    24.06    5.42    2.89
.17148E+04
    203.27    -0.94    5.42   195.5 0.629E-03   2.66    24.72    5.42    2.75
.17883E+04
    211.57    -0.94    5.42   211.2 0.582E-03   2.80    25.37    5.42    2.61
.18618E+04
    219.87    -0.94    5.42   227.7 0.540E-03   2.94    26.02    5.42    2.47
.19352E+04
    228.18    -0.94    5.42   245.0 0.502E-03   3.09    26.66    5.42    2.32
.20087E+04
    236.48    -0.94    5.42   263.1 0.467E-03   3.24    27.29    5.42    2.17
.20821E+04
    244.78    -0.94    5.42   282.1 0.436E-03   3.40    27.91    5.42    2.01
.21556E+04
    253.09    -0.94    5.42   301.9 0.407E-03   3.56    28.53    5.42    1.85
.22291E+04
 Cumulative travel time =        2229.0645 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -2.32m
-------------------------------------------------------------------------------
---------------
BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.135E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.169E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
```

```
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    253.09    -0.94    5.42   301.9 0.407E-03   3.56    28.53    5.42    1.85
.22291E+04
    361.32    -0.94    5.42   402.9 0.305E-03   4.61    29.41    5.42    0.81
.31866E+04
    469.55    -0.94    5.42   531.5 0.231E-03   5.91    30.26    5.42   -0.50
.41441E+04
    577.78    -0.94    5.42   679.6 0.181E-03   7.36    31.09    5.42   -1.94
.51017E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    686.01    -0.94    5.42   733.3 0.168E-03   7.74    31.90    5.42   -2.32
.60592E+04
    794.24    -0.94    5.42   751.4 0.164E-03   7.74    32.68    5.42   -2.32
.70167E+04
    902.47    -0.94    5.42   769.1 0.160E-03   7.74    33.45    5.42   -2.32
.79742E+04
   1010.70    -0.94    5.42   786.4 0.156E-03   7.74    34.20    5.42   -2.32
.89318E+04
   1118.93    -0.94    5.42   803.3 0.153E-03   7.74    34.94    5.42   -2.32
.98893E+04
   1227.16    -0.94    5.42   819.9 0.150E-03   7.74    35.66    5.42   -2.32
.10847E+05
   1335.39    -0.94    5.42   836.1 0.147E-03   7.74    36.37    5.42   -2.32
.11804E+05
   1443.62    -0.94    5.42   852.1 0.144E-03   7.74    37.06    5.42   -2.32
.12762E+05
   1551.85    -0.94    5.42   867.7 0.142E-03   7.74    37.74    5.42   -2.32
.13719E+05
   1660.08    -0.94    5.42   883.0 0.139E-03   7.74    38.41    5.42   -2.32
.14677E+05
   1768.31    -0.94    5.42   898.1 0.137E-03   7.74    39.07    5.42   -2.32
.15634E+05
   1876.54    -0.94    5.42   913.0 0.135E-03   7.74    39.71    5.42   -2.32
.16592E+05
   1984.77    -0.94    5.42   927.6 0.133E-03   7.74    40.35    5.42   -2.32
.17550E+05
   2093.00    -0.94    5.42   942.0 0.131E-03   7.74    40.97    5.42   -2.32
.18507E+05
   2201.24    -0.94    5.42   956.2 0.129E-03   7.74    41.59    5.42   -2.32
.19465E+05
   2309.47    -0.94    5.42   970.1 0.127E-03   7.74    42.20    5.42   -2.32
.20422E+05
   2417.70    -0.94    5.42   983.9 0.125E-03   7.74    42.79    5.42   -2.32
.21380E+05
   2525.93    -0.94    5.42   997.4 0.123E-03   7.74    43.38    5.42   -2.32
.22337E+05
   2634.16    -0.94    5.42  1010.8 0.122E-03   7.74    43.97    5.42   -2.32
.23295E+05
   2742.39    -0.94    5.42  1024.1 0.120E-03   7.74    44.54    5.42   -2.32
.24252E+05
```

```
   2850.62    -0.94    5.42  1037.1 0.119E-03   7.74    45.11    5.42   -2.32
.25210E+05
   2958.85    -0.94    5.42  1050.0 0.117E-03   7.74    45.67    5.42   -2.32
.26167E+05
   3067.08    -0.94    5.42  1062.7 0.116E-03   7.74    46.22    5.42   -2.32
.27125E+05
   3175.31    -0.94    5.42  1075.3 0.114E-03   7.74    46.77    5.42   -2.32
.28082E+05
   3283.54    -0.94    5.42  1087.7 0.113E-03   7.74    47.31    5.42   -2.32
.29040E+05
   3391.77    -0.94    5.42  1100.0 0.112E-03   7.74    47.85    5.42   -2.32
.29997E+05
   3500.00    -0.94    5.42  1112.2 0.111E-03   7.74    48.37    5.42   -2.32
.30955E+05
 Cumulative travel time =       30954.9277 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:                SIM
  DESIGN CASE:                  JD309550GPMcSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD309550GPMcSteadyF
inal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:42:44
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 138.55 m^3/s
  Average depth                   HA      = 7.74 m
  Depth at discharge              HD      = 5.42 m
  Ambient velocity                UA      = 0.113 m/s
  Darcy-Weisbach friction factor  F       = 0.0248
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.94 m
  Port diameter                   D0      = 0.1584 m
  Port cross-sectional area       A0      = 0.0197 m^2
  Discharge velocity              U0      = 1.93 m/s
  Discharge flowrate              Q0      = 0.038021 m^3/s
  Discharge port height           H0      = 5.42 m
  Vertical discharge angle        THETA   = -86.13 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.123 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.14 m         Lm  = 2.40 m         Lb  = 0.34 m
  LM  = 6.41 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 42.99
  Velocity ratio                  R       = 17.08
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV3 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 5.42 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.94 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0063 mg/l
  Dilution at edge of NFR              s = 19.7
  NFR Location:                        x = 3.98 m
    (centerline coordinates)           y = 0.36 m
                                       z = 5.42 m
  NFR plume dimensions:  half-width (bh) = 1.82 m
                          thickness (bv) = 1.82 m
Cumulative travel time:       25.1924 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed at 686.01 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 3.98 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 21.206897
The CMC was encountered at the following plume position:
  Plume location:                      x = 8.56 m
    (centerline coordinates)           y = -0.94 m
                                       z = 5.42 m
  Plume dimension:       half-width (bh) = 4.10 m
                          thickness (bv) = 1.74 m
```

```
 Computed distance from port opening to CMC location = 8.61 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.14 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.61 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.42 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.61 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.44 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 1.93 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
 **** This MAY be caused by the low discharge velocity for this design. *****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002186  mg/l
  Corresponding dilution               s = 56.3
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.94 m
                                       z = 5.42 m
  Plume dimensions:      half-width (bh) = 14.87 m
                          thickness (bv) = 1.27 m
Cumulative travel time:       798.9540 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 33.0
  Plume location:                      x = 47.80 m
    (centerline coordinates)           y = -0.94 m
                                       z = 5.42 m
  Plume dimensions:      half-width (bh) = 10.03 m
                          thickness (bv) = 1.11 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
             Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:
 Design case:       JD309550GPMdSteadyFinal6.0
 FILE NAME:         P:\...\550GPMFinalRiver\JD309550GPMdSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:44:17 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1210.25  QA    =    215.42  ICHREG= 1
 HA    =      7.64  HD    =      5.35
 UA    =      0.178 F     =      0.025 USTAR =0.9934E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.97
 D0    =      0.184 A0    =      0.027 H0    =      5.35  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      2.390 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1150E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.1516E+00  J0    =0.8063E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.16  LM    =      8.55  Lm    =      2.19  Lb    =      0.14
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     49.45  R     =     13.43

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV3   1
 1  Applicable layer depth HS =     5.35  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1150E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =  35000.00  XMAX  =  35000.00
```

```
X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.97 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    5.35     1.0 0.115E+00   0.09    2.390   .00000E+00

END OF MOD101: DISCHARGE MODULE
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-------------------------------------------------------------------------------
---------------
BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION


 Zone of flow establishment:            THETAE=    -84.50  SIGMAE=     71.25
  LE    =      0.70  XE    =      0.01  YE    =      0.06  ZE    =      4.65

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time
```

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	5.35	1.0	0.115E+00	0.09	2.390	.00000E+00
0.01	0.06	4.65	1.0	0.115E+00	0.09	2.390	.75503E-02
0.02	0.08	4.50	1.0	0.114E+00	0.11	2.390	.57545E-01
0.03	0.09	4.33	1.2	0.963E-01	0.13	2.340	.12620E+00
0.05	0.11	4.16	1.4	0.832E-01	0.15	2.013	.20630E+00
0.07	0.12	4.01	1.5	0.743E-01	0.17	1.788	.28435E+00
0.09	0.14	3.84	1.8	0.657E-01	0.19	1.572	.38681E+00
0.13	0.15	3.67	2.0	0.586E-01	0.21	1.391	.50210E+00
0.16	0.17	3.53	2.2	0.534E-01	0.23	1.258	.61164E+00
0.21	0.18	3.36	2.4	0.481E-01	0.26	1.123	.75263E+00
0.27	0.20	3.20	2.6	0.435E-01	0.28	1.004	.90864E+00
0.32	0.21	3.06	2.9	0.400E-01	0.30	0.913	.10550E+01
0.39	0.22	2.90	3.2	0.364E-01	0.33	0.818	.12415E+01
0.45	0.24	2.77	3.4	0.336E-01	0.35	0.745	.14156E+01
0.53	0.25	2.62	3.8	0.306E-01	0.38	0.667	.16362E+01
0.62	0.27	2.47	4.1	0.280E-01	0.41	0.598	.18766E+01
0.70	0.28	2.35	4.4	0.260E-01	0.44	0.545	.20992E+01
0.80	0.29	2.21	4.8	0.238E-01	0.47	0.489	.23789E+01
0.91	0.30	2.07	5.2	0.219E-01	0.50	0.439	.26808E+01
1.01	0.31	1.96	5.6	0.205E-01	0.52	0.401	.29575E+01
1.13	0.32	1.84	6.1	0.190E-01	0.56	0.362	.33015E+01
1.26	0.34	1.72	6.5	0.176E-01	0.59	0.327	.36682E+01
1.37	0.34	1.62	6.9	0.166E-01	0.61	0.301	.40004E+01
1.51	0.36	1.52	7.4	0.155E-01	0.64	0.274	.44084E+01
1.64	0.37	1.41	7.9	0.145E-01	0.67	0.250	.48377E+01
1.77	0.37	1.33	8.3	0.138E-01	0.69	0.232	.52222E+01
1.91	0.38	1.23	8.8	0.130E-01	0.72	0.214	.56890E+01

```
      2.06     0.39    1.14     9.3 0.123E-01   0.75    0.197   .61746E+01
      2.19     0.40    1.07     9.7 0.118E-01   0.77    0.185   .66051E+01
      2.34     0.41    0.99    10.2 0.112E-01   0.79    0.172   .71230E+01
      2.49     0.41    0.91    10.7 0.107E-01   0.82    0.161   .76570E+01
      2.65     0.42    0.83    11.1 0.103E-01   0.83    0.152   .81266E+01
 Cumulative travel time =           8.1266 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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---------------
BEGIN MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      2.65     0.42    0.83    11.1 0.103E-01   0.83 .81266E+01

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      1.82     0.40    5.35    11.1 0.103E-01   0.03     0.00    5.35    5.31
.81266E+01
      2.07     0.41    5.35    11.1 0.103E-01   1.15     0.58    5.35    4.19
.81266E+01
      2.32     0.41    5.35    11.1 0.103E-01   1.37     0.82    5.35    3.98
.81266E+01
      2.57     0.42    5.35    11.1 0.103E-01   1.51     1.00    5.35    3.84
.81266E+01
      2.82     0.43    5.35    11.4 0.101E-01   1.61     1.16    5.35    3.74
.90678E+01
      3.07     0.43    5.35    12.8 0.896E-02   1.68     1.30    5.35    3.66
.10474E+02
      3.32     0.44    5.35    14.8 0.777E-02   1.74     1.42    5.35    3.61
.11881E+02
      3.57     0.44    5.35    16.6 0.694E-02   1.78     1.53    5.35    3.56
.13288E+02
      3.82     0.45    5.35    17.8 0.646E-02   1.81     1.64    5.35    3.53
.14694E+02
      4.07     0.45    5.35    18.5 0.623E-02   1.83     1.74    5.35    3.52
.16101E+02
      4.32     0.46    5.35    18.9 0.609E-02   1.83     1.83    5.35    3.51
.17507E+02
 Cumulative travel time =          17.5075 sec

END OF MOD131: LAYER BOUNDARY/TERMINAL LAYER APPROACH
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
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   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      4.32    -0.97    5.35    18.9 0.609E-02   2.06     3.26    5.35    3.28
.17507E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     14.12    -0.97    5.35    20.9 0.550E-02   1.63     4.57    5.35    3.72
.72535E+02
     23.91    -0.97    5.35    22.7 0.507E-02   1.41     5.71    5.35    3.93
.12756E+03
     33.71    -0.97    5.35    24.5 0.470E-02   1.29     6.74    5.35    4.05
.18259E+03
     43.51    -0.97    5.35    26.4 0.436E-02   1.22     7.69    5.35    4.12
.23762E+03
     53.31    -0.97    5.35    28.5 0.403E-02   1.18     8.58    5.35    4.16
.29265E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     63.11    -0.97    5.35    31.0 0.372E-02   1.17     9.43    5.35    4.18
.34767E+03
     72.90    -0.97    5.35    33.6 0.342E-02   1.17    10.23    5.35    4.17
.40270E+03
     82.70    -0.97    5.35    36.7 0.314E-02   1.19    11.01    5.35    4.16
.45773E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     92.50    -0.97    5.35    40.0 0.287E-02   1.21    11.75    5.35    4.13
.51276E+03
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    102.30    -0.97    5.35    43.7 0.263E-02   1.25    12.47    5.35    4.10
.56778E+03
    112.09    -0.97    5.35    47.8 0.241E-02   1.29    13.17    5.35    4.05
.62281E+03
    121.89    -0.97    5.35    52.3 0.220E-02   1.34    13.85    5.35    4.00
.67784E+03
    131.69    -0.97    5.35    57.2 0.201E-02   1.40    14.52    5.35    3.94
.73287E+03
    141.49    -0.97    5.35    62.5 0.184E-02   1.47    15.17    5.35    3.88
.78789E+03
    151.29    -0.97    5.35    68.2 0.169E-02   1.54    15.81    5.35    3.81
.84292E+03
    161.08    -0.97    5.35    74.3 0.155E-02   1.61    16.43    5.35    3.73
.89795E+03
    170.88    -0.97    5.35    80.9 0.142E-02   1.69    17.04    5.35    3.65
.95298E+03
    180.68    -0.97    5.35    88.0 0.131E-02   1.78    17.65    5.35    3.57
.10080E+04
    190.48    -0.97    5.35    95.5 0.120E-02   1.87    18.24    5.35    3.48
.10630E+04
    200.27    -0.97    5.35   103.5 0.111E-02   1.96    18.82    5.35    3.39
.11181E+04
    210.07    -0.97    5.35   112.0 0.103E-02   2.06    19.40    5.35    3.29
.11731E+04
    219.87    -0.97    5.35   121.0 0.950E-03   2.16    19.96    5.35    3.19
.12281E+04
    229.67    -0.97    5.35   130.5 0.881E-03   2.27    20.52    5.35    3.08
.12831E+04
    239.47    -0.97    5.35   140.5 0.818E-03   2.37    21.08    5.35    2.97
.13382E+04
    249.26    -0.97    5.35   151.1 0.761E-03   2.49    21.62    5.35    2.86
.13932E+04
    259.06    -0.97    5.35   162.1 0.709E-03   2.61    22.16    5.35    2.74
.14482E+04
    268.86    -0.97    5.35   173.7 0.662E-03   2.73    22.69    5.35    2.62
.15033E+04
    278.66    -0.97    5.35   185.8 0.619E-03   2.85    23.22    5.35    2.50
.15583E+04
    288.46    -0.97    5.35   198.5 0.579E-03   2.98    23.74    5.35    2.37
.16133E+04
    298.25    -0.97    5.35   211.7 0.543E-03   3.11    24.26    5.35    2.24
.16683E+04
 Cumulative travel time =        1668.3339 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -2.29m
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.149E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.186E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
```

```
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    298.25    -0.97    5.35   211.7 0.543E-03   3.11    24.26    5.35    2.24
.16683E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
   1454.98    -0.97    5.35   666.8 0.172E-03   7.64    31.10    5.35   -2.29
.81649E+04
   2611.70    -0.97    5.35   786.6 0.146E-03   7.64    36.69    5.35   -2.29
.14661E+05
   3768.43    -0.97    5.35   890.5 0.129E-03   7.64    41.54    5.35   -2.29
.21158E+05
   4925.15    -0.97    5.35   983.4 0.117E-03   7.64    45.87    5.35   -2.29
.27655E+05
   6081.88    -0.97    5.35  1068.3 0.108E-03   7.64    49.83    5.35   -2.29
.34151E+05
   7238.60    -0.97    5.35  1146.9 0.100E-03   7.64    53.50    5.35   -2.29
.40648E+05
   8395.33    -0.97    5.35  1220.5 0.942E-04   7.64    56.93    5.35   -2.29
.47144E+05
   9552.05    -0.97    5.35  1289.8 0.892E-04   7.64    60.16    5.35   -2.29
.53641E+05
  10708.78    -0.97    5.35  1355.7 0.848E-04   7.64    63.23    5.35   -2.29
.60137E+05
  11865.50    -0.97    5.35  1418.4 0.811E-04   7.64    66.16    5.35   -2.29
.66634E+05
  13022.22    -0.97    5.35  1478.6 0.778E-04   7.64    68.97    5.35   -2.29
.73130E+05
  14178.95    -0.97    5.35  1536.3 0.749E-04   7.64    71.66    5.35   -2.29
.79627E+05
  15335.67    -0.97    5.35  1592.0 0.722E-04   7.64    74.26    5.35   -2.29
.86123E+05
  16492.40    -0.97    5.35  1645.8 0.699E-04   7.64    76.77    5.35   -2.29
.92620E+05
  17649.12    -0.97    5.35  1697.9 0.677E-04   7.64    79.20    5.35   -2.29
.99116E+05
  18805.85    -0.97    5.35  1748.4 0.658E-04   7.64    81.55    5.35   -2.29
.10561E+06
  19962.57    -0.97    5.35  1797.5 0.640E-04   7.64    83.84    5.35   -2.29
.11211E+06
  21119.30    -0.97    5.35  1845.3 0.623E-04   7.64    86.07    5.35   -2.29
.11861E+06
  22276.02    -0.97    5.35  1891.9 0.608E-04   7.64    88.25    5.35   -2.29
.12510E+06
  23432.75    -0.97    5.35  1937.4 0.594E-04   7.64    90.37    5.35   -2.29
.13160E+06
  24589.47    -0.97    5.35  1981.8 0.580E-04   7.64    92.44    5.35   -2.29
.13810E+06
  25746.20    -0.97    5.35  2025.3 0.568E-04   7.64    94.47    5.35   -2.29
.14459E+06
  26902.92    -0.97    5.35  2067.8 0.556E-04   7.64    96.45    5.35   -2.29
.15109E+06
```

```
  28059.64    -0.97    5.35  2109.5 0.545E-04   7.64    98.40    5.35   -2.29
.15759E+06
  29216.37    -0.97    5.35  2150.4 0.535E-04   7.64   100.30    5.35   -2.29
.16408E+06
  30373.09    -0.97    5.35  2190.5 0.525E-04   7.64   102.18    5.35   -2.29
.17058E+06
  31529.82    -0.97    5.35  2229.9 0.516E-04   7.64   104.01    5.35   -2.29
.17707E+06
  32686.54    -0.97    5.35  2268.6 0.507E-04   7.64   105.82    5.35   -2.29
.18357E+06
  33843.27    -0.97    5.35  2306.7 0.499E-04   7.64   107.59    5.35   -2.29
.19007E+06
  35000.00    -0.97    5.35  2344.1 0.491E-04   7.64   109.34    5.35   -2.29
.19656E+06
 Cumulative travel time =      196564.6094 sec

 Simulation limit based on maximum specified distance =  35000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309550GPMdSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD309550GPMdSteadyF
inal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:44:14
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 215.42 m^3/s
  Average depth                   HA      = 7.64 m
  Depth at discharge              HD      = 5.35 m
  Ambient velocity                UA      = 0.178 m/s
  Darcy-Weisbach friction factor  F       = 0.0249
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.97 m
  Port diameter                   D0      = 0.1838 m
  Port cross-sectional area       A0      = 0.0265 m^2
  Discharge velocity              U0      = 2.39 m/s
  Discharge flowrate              Q0      = 0.063399 m^3/s
  Discharge port height           H0      = 5.35 m
  Vertical discharge angle        THETA   = -84.79 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.115 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.16 m         Lm  = 2.19 m         Lb  = 0.14 m
  LM  = 8.55 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 49.45
  Velocity ratio                  R       = 13.43
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
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  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 35000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV3 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 5.35 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.97 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0061 mg/l
  Dilution at edge of NFR              s = 18.9
  NFR Location:                        x = 4.32 m
    (centerline coordinates)           y = 0.46 m
                                       z = 5.35 m
  NFR plume dimensions:  half-width (bh) = 1.83 m
                          thickness (bv) = 1.83 m
Cumulative travel time:       17.5075 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed at 1454.98 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 4.32 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 19.827586
The CMC was encountered at the following plume position:
  Plume location:                      x = 8.62 m
    (centerline coordinates)           y = -0.97 m
                                       z = 5.35 m
  Plume dimension:       half-width (bh) = 3.87 m
                          thickness (bv) = 1.83 m
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 Computed distance from port opening to CMC location = 8.67 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.16 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.67 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 5.35 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.67 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 2.39 m/s.
 This is below the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
 **** This MAY be caused by the low discharge velocity for this design. *****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002902  mg/l
  Corresponding dilution               s = 39.6
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.97 m
                                       z = 5.35 m
  Plume dimensions:      half-width (bh) = 11.67 m
                          thickness (bv) = 1.21 m
Cumulative travel time:       506.8061 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 30.8
  Plume location:                      x = 62.65 m
    (centerline coordinates)           y = -0.97 m
                                       z = 5.35 m
  Plume dimensions:      half-width (bh) = 9.39 m
                          thickness (bv) = 1.17 m
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
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CORMIX1 PREDICTION FILE:
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1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
              Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
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CASE DESCRIPTION
 Site name/label:
 Design case:       JD309(4)550GPMeSteadyFinal6.0
 FILE NAME:         P:\...0GPMFinalRiver\JD309(4)550GPMeSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:47:03 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =    996.34  QA    =     49.82  ICHREG= 1
 HA    =      6.29  HD    =      4.40
 UA    =      0.050 F     =      0.027 USTAR =0.2882E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      1.04
 D0    =      0.119 A0    =      0.011 H0    =      4.40  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      5.673 Q0    =      0.063       =0.6340E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.5200E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.6340E-01  M0    =0.3597E+00  J0    =0.8063E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.11  LM    =     16.36  Lm    =     11.99  Lb    =      6.45
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    145.66  R     =    113.46

FLOW CLASSIFICATION
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 1  Flow class (CORMIX1)      =    IPV5   1
 1  Applicable layer depth HS =     4.40  1
 1111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.5200E-01  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
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X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         1.04 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
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BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.40     1.0 0.520E-01   0.06    5.673   .00000E+00

END OF MOD101: DISCHARGE MODULE
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BEGIN MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH

 INITIAL LOCAL VERTICAL INSTABILITY REGION:
   Bulk dilution (S =  13.25) occurs in a limited region (horizontal extent
   =    49.07 m) surrounding the discharge location.

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    4.40     1.0 0.520E-01   0.06 .00000E+00

** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   due to mixing in this control volume.
 The actual extent of the TOXIC DILUTION ZONE will be smaller than control
   volume outflow values predicted below.

  Control volume outflow:
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.00     0.00    4.40     1.0 0.520E-01  11.00     0.00    0.00    0.00
.00000E+00

END OF MOD134: UNSTABLE RECIRCULATION REGION OVER LAYER DEPTH
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BEGIN MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length               =       0.64 m
        X-position of upstream stagnation point =      -0.64 m
        Thickness in intrusion region           =       4.40 m
        Half-width at downstream end            =      70.76 m
        Thickness at downstream end             =       0.42 m

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.00     0.00    2.20    13.2 0.393E-02   0.06 .00000E+00

 Profile definitions:
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   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     -0.64     0.00    4.40  9999.9 0.000E+00   0.00     0.00    4.40    4.40
.70759E+03
      0.08     0.00    4.40    13.2 0.393E-02   4.40    10.01    4.40    0.00
.15598E+01
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
      3.61     0.00    4.40    14.6 0.355E-02   4.40    24.31    4.40    0.00
.72163E+02
      7.14     0.00    4.40    18.3 0.283E-02   4.40    32.89    4.40    0.00
.14277E+03
     10.67     0.00    4.40    23.6 0.220E-02   4.40    39.65    4.40    0.00
.21337E+03
     14.20     0.00    4.40    29.4 0.177E-02   4.40    45.42    4.40    0.00
.28397E+03
     17.73     0.00    4.40    34.7 0.150E-02   4.40    50.53    4.40    0.00
.35457E+03
     21.26     0.00    4.40    39.2 0.133E-02   4.40    55.17    4.40    0.00
.42518E+03
     24.79     0.00    4.40    42.4 0.123E-02   2.97    59.45    4.40    1.44
.49578E+03
     28.32     0.00    4.40    44.5 0.117E-02   1.82    63.45    4.40    2.58
.56638E+03
     31.85     0.00    4.40    45.8 0.113E-02   1.13    67.20    4.40    3.27
.63698E+03
     35.38     0.00    4.40    47.2 0.110E-02   0.42    70.76    4.40    3.98
.70759E+03
 Cumulative travel time =         707.5879 sec

END OF MOD134a: UPSTREAM SPREADING AFTER NEAR-FIELD INSTABILITY
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some boundary interaction occurs at end of near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to RIGHT bank/shore.
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   Plume width is now determined from RIGHT bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
     35.38    -1.04    4.40    47.2 0.110E-02   0.83    71.80    4.40    3.57
.70759E+03
     38.75    -1.04    4.40    54.0 0.963E-03   0.95    72.25    4.40    3.45
.77498E+03
     42.13    -1.04    4.40    61.0 0.853E-03   1.06    72.72    4.40    3.34
.84237E+03
     45.50    -1.04    4.40    68.0 0.764E-03   1.18    73.19    4.40    3.22
.90976E+03
     48.87    -1.04    4.40    75.2 0.691E-03   1.29    73.68    4.40    3.11
.97715E+03
     52.25    -1.04    4.40    82.5 0.630E-03   1.41    74.18    4.40    2.99
.10445E+04
     55.62    -1.04    4.40    89.9 0.579E-03   1.53    74.68    4.40    2.87
.11119E+04
     59.00    -1.04    4.40    97.4 0.534E-03   1.64    75.20    4.40    2.76
.11793E+04
     62.37    -1.04    4.40   105.0 0.495E-03   1.76    75.71    4.40    2.64
.12467E+04
     65.74    -1.04    4.40   112.7 0.461E-03   1.87    76.23    4.40    2.53
.13141E+04
     69.12    -1.04    4.40   120.6 0.431E-03   1.99    76.76    4.40    2.41
.13815E+04
     72.49    -1.04    4.40   128.5 0.405E-03   2.11    77.29    4.40    2.29
.14489E+04
     75.86    -1.04    4.40   136.6 0.381E-03   2.23    77.82    4.40    2.17
.15163E+04
     79.24    -1.04    4.40   144.8 0.359E-03   2.34    78.36    4.40    2.06
.15837E+04
     82.61    -1.04    4.40   153.2 0.339E-03   2.46    78.90    4.40    1.94
.16510E+04
     85.99    -1.04    4.40   161.6 0.322E-03   2.58    79.44    4.40    1.82
.17184E+04
     89.36    -1.04    4.40   170.2 0.305E-03   2.70    79.98    4.40    1.70
.17858E+04
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
 This is the extent of the REGULATORY MIXING ZONE.
     92.73    -1.04    4.40   178.9 0.291E-03   2.82    80.53    4.40    1.58
.18532E+04
     96.11    -1.04    4.40   187.8 0.277E-03   2.94    81.08    4.40    1.46
.19206E+04
     99.48    -1.04    4.40   196.8 0.264E-03   3.06    81.62    4.40    1.34
.19880E+04
    102.86    -1.04    4.40   205.9 0.253E-03   3.18    82.17    4.40    1.22
.20554E+04
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    106.23    -1.04    4.40   215.1 0.242E-03   3.30    82.72    4.40    1.10
.21228E+04
    109.60    -1.04    4.40   224.5 0.232E-03   3.42    83.27    4.40    0.98
.21902E+04
    112.98    -1.04    4.40   234.0 0.222E-03   3.54    83.83    4.40    0.86
.22576E+04
    116.35    -1.04    4.40   243.6 0.213E-03   3.66    84.38    4.40    0.74
.23250E+04
    119.72    -1.04    4.40   253.4 0.205E-03   3.78    84.93    4.40    0.62
.23923E+04
    123.10    -1.04    4.40   263.3 0.198E-03   3.91    85.48    4.40    0.49
.24597E+04
    126.47    -1.04    4.40   273.3 0.190E-03   4.03    86.03    4.40    0.37
.25271E+04
    129.85    -1.04    4.40   283.5 0.183E-03   4.15    86.59    4.40    0.25
.25945E+04
    133.22    -1.04    4.40   293.8 0.177E-03   4.28    87.14    4.40    0.12
.26619E+04
    136.59    -1.04    4.40   304.3 0.171E-03   4.40    87.69    4.40    0.00
.27293E+04
 Cumulative travel time =        2729.2898 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -1.89m
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.106E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.132E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    136.59    -1.04    4.40   304.3 0.171E-03   4.40    87.69    4.40    0.00
.27293E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    248.71    -1.04    4.40   437.4 0.119E-03   6.29    88.22    4.40   -1.89
.49687E+04
    360.82    -1.04    4.40   440.0 0.118E-03   6.29    88.75    4.40   -1.89
.72081E+04
    472.93    -1.04    4.40   442.6 0.117E-03   6.29    89.27    4.40   -1.89
.94476E+04
    585.05    -1.04    4.40   445.1 0.117E-03   6.29    89.78    4.40   -1.89
.11687E+05
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    697.16    -1.04    4.40   447.7 0.116E-03   6.29    90.30    4.40   -1.89
.13926E+05
    809.27    -1.04    4.40   450.2 0.115E-03   6.29    90.81    4.40   -1.89
.16166E+05
    921.39    -1.04    4.40   452.7 0.115E-03   6.29    91.32    4.40   -1.89
.18405E+05
   1033.50    -1.04    4.40   455.3 0.114E-03   6.29    91.83    4.40   -1.89
.20645E+05
   1145.62    -1.04    4.40   457.8 0.114E-03   6.29    92.33    4.40   -1.89
.22884E+05
   1257.73    -1.04    4.40   460.2 0.113E-03   6.29    92.83    4.40   -1.89
.25124E+05
   1369.84    -1.04    4.40   462.7 0.112E-03   6.29    93.33    4.40   -1.89
.27363E+05
   1481.96    -1.04    4.40   465.2 0.112E-03   6.29    93.83    4.40   -1.89
.29602E+05
   1594.07    -1.04    4.40   467.6 0.111E-03   6.29    94.32    4.40   -1.89
.31842E+05
   1706.18    -1.04    4.40   470.0 0.111E-03   6.29    94.81    4.40   -1.89
.34081E+05
   1818.30    -1.04    4.40   472.5 0.110E-03   6.29    95.30    4.40   -1.89
.36321E+05
   1930.41    -1.04    4.40   474.9 0.110E-03   6.29    95.79    4.40   -1.89
.38560E+05
   2042.52    -1.04    4.40   477.3 0.109E-03   6.29    96.27    4.40   -1.89
.40799E+05
   2154.64    -1.04    4.40   479.7 0.108E-03   6.29    96.75    4.40   -1.89
.43039E+05
   2266.75    -1.04    4.40   482.0 0.108E-03   6.29    97.23    4.40   -1.89
.45278E+05
   2378.86    -1.04    4.40   484.4 0.107E-03   6.29    97.70    4.40   -1.89
.47518E+05
   2490.98    -1.04    4.40   486.7 0.107E-03   6.29    98.18    4.40   -1.89
.49757E+05
   2603.09    -1.04    4.40   489.1 0.106E-03   6.29    98.65    4.40   -1.89
.51997E+05
   2715.20    -1.04    4.40   491.4 0.106E-03   6.29    99.12    4.40   -1.89
.54236E+05
   2827.32    -1.04    4.40   493.7 0.105E-03   6.29    99.59    4.40   -1.89
.56475E+05
   2939.43    -1.04    4.40   496.0 0.105E-03   6.29   100.05    4.40   -1.89
.58715E+05
   3051.55    -1.04    4.40   498.3 0.104E-03   6.29   100.51    4.40   -1.89
.60954E+05
   3163.66    -1.04    4.40   500.6 0.104E-03   6.29   100.97    4.40   -1.89
.63194E+05
   3275.77    -1.04    4.40   502.9 0.103E-03   6.29   101.43    4.40   -1.89
.65433E+05
   3387.89    -1.04    4.40   505.1 0.103E-03   6.29   101.89    4.40   -1.89
.67672E+05
   3500.00    -1.04    4.40   507.4 0.102E-03   6.29   102.34    4.40   -1.89
.69912E+05
 Cumulative travel time =       69911.9297 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
11111111111111111111111111111111111111111111111111111111111111111111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309(4)550GPMeSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD309(4)550GPMeStea
dyFinal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:47:03
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 49.82 m^3/s
  Average depth                   HA      = 6.29 m
  Depth at discharge              HD      = 4.40 m
  Ambient velocity                UA      = 0.05 m/s
  Darcy-Weisbach friction factor  F       = 0.0266
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 1.04 m
  Port diameter                   D0      = 0.1193 m
  Port cross-sectional area       A0      = 0.0112 m^2
  Discharge velocity              U0      = 5.67 m/s
  Discharge flowrate              Q0      = 0.063399 m^3/s
  Discharge port height           H0      = 4.40 m
  Vertical discharge angle        THETA   = -87.81 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.052 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.11 m         Lm  = 11.99 m         Lb  = 6.45 m
  LM  = 16.36 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 145.66
  Velocity ratio                  R       = 113.46
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
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  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV5 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.40 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    1.04 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0011 mg/l
  Dilution at edge of NFR              s = 47.2
  NFR Location:                        x = 35.38 m
    (centerline coordinates)           y = 0 m
                                       z = 4.40 m
  NFR plume dimensions:  half-width (bh) = 70.76 m
                          thickness (bv) = 0.42 m
Cumulative travel time:       707.5878 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong
  discharge buoyancy.
  Intrusion length                        =  0.64 m
  Intrusion stagnation point              =  -0.64 m
  Intrusion thickness                     =  18.54 m
  Intrusion half width at impingement     =  70.76 m
  Intrusion half thickness at impingement =  0.42 m
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 248.71 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 35.38 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
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  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 8.965517
The CMC was encountered within a control volume describing a portion
  of the discharge plume.
Therefore, the following plume conditions are a conservative estimate (with
  lower concentrations or with larger dimensions) for the region at whose
  boundary the CMC is met:
  Local boundary concentration           = 0.003925  mg/l
Corresponding dilution                   = 13.2476
  Plume location:                      x = 0 m
    (centerline coordinates)           y = 0 m
                                       z = 2.20 m
  Plume dimension:       half-width (bh) = 11.00 m
                          thickness (bv) = 0 m

 Computed distance from port opening to CMC location = 2.20 m.
 CRITERION 1: This location is within 50 times the discharge length scale of
              Lq = 0.11 m.
 +++++ The discharge length scale TEST for the TDZ has been SATISFIED. ++++++

 Computed horizontal distance from port opening to CMC location = 0 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.40 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 2.20 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 5.67 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** All three CMC criteria for the TDZ are SATISFIED for this discharge. ***
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.000296  mg/l
  Corresponding dilution               s = 175.6
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -1.04 m
                                       z = 4.40 m
  Plume dimensions:      half-width (bh) = 80.32 m
                          thickness (bv) = 2.77 m
Cumulative travel time:       1827.375 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 13.9
  Plume location:                      x = 1.94 m
    (centerline coordinates)           y = 0 m
                                       z = 4.40 m
  Plume dimensions:      half-width (bh) = 17.53 m
                          thickness (bv) = 18.15 m
```

********** FINAL DESIGN ADVICE AND COMMENTS **********

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.

Extensive comparison with field and laboratory data has shown that the CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).

As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
                        CORMIX MIXING ZONE EXPERT SYSTEM
             Subsystem CORMIX1:  Single Port Discharges
                          CORMIX Version 6.0GT
                       HYDRO1 Version 6.0.0.0 October 2009
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
CASE DESCRIPTION
 Site name/label:
 Design case:       JD309550GPMfSteadyFinal6.0
 FILE NAME:         P:\...\550GPMFinalRiver\JD309550GPMfSteadyFinal6.0R.prd
 Time stamp:        Fri Mar 26 15:48:52 2010

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =    158.50  AS    =   1087.45  QA    =    122.88  ICHREG= 1
 HA    =      6.86  HD    =      4.80
 UA    =      0.113 F     =      0.026 USTAR =0.6420E-02
 UW    =      9.300 UWSTAR=0.1193E-01
 Uniform density environment
 STRCND=  U         RHOAM = 1001.0000

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  RIGHT     DISTB =      0.98
 D0    =      0.103 A0    =      0.008 H0    =      4.80  SUB0  =      0.00
 THETA =      0.00  SIGMA =     90.00
 U0    =      4.570 Q0    =      0.038       =0.3802E-01
 RHO0  =  999.7019  DRHO0 =0.1298E+01  GP0   =0.1272E-01
 C0    =0.1010E+00  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.3802E-01  M0    =0.1737E+00  J0    =0.4835E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.09  LM    =     12.24  Lm    =      3.69  Lb    =      0.34
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =    126.30  R     =     40.44

FLOW CLASSIFICATION
 111111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =     4.80  1
 111111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1010E+00  CUNITS=  mg/l
 NTOX  =  1         CMC   =0.5800E-02  CCC   =  CSTD
 NSTD  =  1         CSTD  =0.3730E-02
 REGMZ =  1
 REGSPC=  1         XREG  =     91.44  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00
```

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X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.98 m  from the RIGHT bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =  30 display intervals per module
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
---------------
BEGIN MOD101: DISCHARGE MODULE

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.80     1.0 0.101E+00   0.05    4.570   .00000E+00

END OF MOD101: DISCHARGE MODULE
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
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BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

 Jet-like motion in weak crossflow.
   UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
   Following MOD133 will include recirculation into jet region.

 Zone of flow establishment:            THETAE=    -88.26  SIGMAE=     70.24
  LE    =      0.47  XE    =      0.00  YE    =      0.01  ZE    =      4.33

 Profile definitions:
   B = Gaussian 1/e (37%) half-width, normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)
  Uc = Local centerline excess velocity (above ambient)
  TT = Cumulative travel time

       X        Y       Z        S       C       B        Uc        TT
      0.00     0.00    4.80     1.0 0.101E+00   0.05    4.570   .00000E+00
      0.00     0.01    4.33     1.0 0.101E+00   0.05    4.570   .31512E-02
      0.00     0.02    4.21     1.1 0.936E-01   0.07    4.570   .24721E-01
      0.01     0.02    4.08     1.3 0.762E-01   0.08    4.065   .55667E-01
      0.01     0.02    3.96     1.5 0.657E-01   0.09    3.503   .87169E-01
      0.02     0.03    3.82     1.8 0.566E-01   0.11    3.014   .12976E+00
      0.03     0.03    3.69     2.0 0.497E-01   0.13    2.642   .17867E+00
      0.04     0.04    3.57     2.2 0.449E-01   0.14    2.386   .22566E+00
      0.05     0.04    3.43     2.5 0.403E-01   0.15    2.142   .28646E+00
      0.06     0.04    3.30     2.8 0.366E-01   0.17    1.940   .35374E+00
      0.07     0.05    3.18     3.0 0.339E-01   0.18    1.793   .41664E+00
      0.09     0.05    3.04     3.2 0.311E-01   0.20    1.645   .49618E+00
      0.11     0.05    2.91     3.5 0.288E-01   0.22    1.517   .58245E+00
      0.13     0.06    2.79     3.7 0.270E-01   0.23    1.421   .66183E+00
      0.15     0.06    2.66     4.0 0.251E-01   0.25    1.321   .76088E+00
      0.17     0.07    2.52     4.3 0.235E-01   0.26    1.232   .86699E+00
      0.20     0.07    2.41     4.5 0.222E-01   0.28    1.163   .96365E+00
      0.22     0.07    2.27     4.8 0.209E-01   0.29    1.090   .10832E+01
      0.26     0.08    2.14     5.1 0.197E-01   0.31    1.023   .12103E+01
      0.28     0.08    2.03     5.4 0.187E-01   0.33    0.971   .13252E+01
      0.32     0.08    1.90     5.7 0.177E-01   0.34    0.915   .14666E+01
      0.36     0.09    1.76     6.0 0.168E-01   0.36    0.863   .16159E+01
      0.39     0.09    1.65     6.3 0.160E-01   0.38    0.822   .17504E+01
      0.43     0.09    1.52     6.6 0.152E-01   0.40    0.777   .19151E+01
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      0.48     0.10    1.39     7.0 0.145E-01   0.42    0.735   .20884E+01
      0.52     0.10    1.28     7.3 0.138E-01   0.43    0.701   .22440E+01
      0.57     0.10    1.15     7.7 0.132E-01   0.45    0.664   .24338E+01
      0.62     0.11    1.03     8.0 0.126E-01   0.47    0.629   .26330E+01
      0.67     0.11    0.92     8.4 0.121E-01   0.49    0.601   .28112E+01
      0.72     0.12    0.80     8.8 0.115E-01   0.51    0.570   .30283E+01
      0.78     0.12    0.67     9.2 0.110E-01   0.53    0.541   .32554E+01
      0.84     0.12    0.55     9.6 0.106E-01   0.55    0.517   .34582E+01
 Cumulative travel time =           3.4582 sec

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
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---------------
BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

  Control volume inflow:
       X        Y       Z        S       C       B        TT
      0.84     0.12    0.55     9.6 0.106E-01   0.55 .34582E+01

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.29     0.26    4.80     9.6 0.106E-01   0.00     0.00    4.80    4.80
.34582E+01
      0.83     0.26    4.80     9.6 0.106E-01   4.80     0.15    4.80    0.00
.34582E+01
      1.36     0.26    4.80     9.7 0.104E-01   4.80     0.21    4.80    0.00
.80558E+01
      1.90     0.26    4.80    10.2 0.988E-02   4.80     0.26    4.80    0.00
.12794E+02
      2.43     0.26    4.80    10.9 0.926E-02   4.80     0.30    4.80    0.00
.17533E+02
      2.97     0.26    4.80    11.6 0.869E-02   4.80     0.33    4.80    0.00
.22271E+02
      3.50     0.26    4.80    12.3 0.824E-02   4.80     0.36    4.80    0.00
.27009E+02
      4.04     0.26    4.80    12.7 0.794E-02   4.80     0.39    4.80    0.00
.31748E+02
      4.58     0.26    4.80    13.0 0.775E-02   4.80     0.42    4.80    0.00
.36486E+02
      5.11     0.26    4.80    13.2 0.765E-02   4.80     0.44    4.80    0.00
.41225E+02
      5.65     0.26    4.80    13.4 0.755E-02   4.80     0.47    4.80    0.00
.45963E+02
 Cumulative travel time =          45.9630 sec

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      5.65     0.26    4.80    13.4 0.755E-02   4.80     0.47    4.80    0.00
.45963E+02
      5.73     0.26    4.80    13.6 0.742E-02   4.56     0.50    4.80    0.24
.46675E+02
      5.81     0.26    4.80    13.8 0.731E-02   4.35     0.53    4.80    0.45
.47388E+02
      5.89     0.26    4.80    14.0 0.720E-02   4.17     0.57    4.80    0.63
.48100E+02
      5.97     0.26    4.80    14.2 0.711E-02   4.01     0.60    4.80    0.79
.48812E+02
      6.05     0.26    4.80    14.4 0.702E-02   3.86     0.63    4.80    0.94
.49525E+02
      6.13     0.26    4.80    14.5 0.694E-02   3.74     0.66    4.80    1.07
.50237E+02
      6.21     0.26    4.80    14.7 0.687E-02   3.62     0.68    4.80    1.18
.50949E+02
      6.29     0.26    4.80    14.8 0.680E-02   3.51     0.71    4.80    1.29
.51662E+02
      6.37     0.26    4.80    15.0 0.674E-02   3.41     0.74    4.80    1.39
.52374E+02
      6.45     0.26    4.80    15.1 0.668E-02   3.32     0.77    4.80    1.48
.53086E+02
      6.53     0.26    4.80    15.3 0.662E-02   3.24     0.79    4.80    1.56
.53799E+02
      6.61     0.26    4.80    15.4 0.657E-02   3.16     0.82    4.80    1.64
.54511E+02
      6.69     0.26    4.80    15.5 0.652E-02   3.09     0.84    4.80    1.71
.55223E+02
      6.77     0.26    4.80    15.6 0.647E-02   3.02     0.87    4.80    1.78
.55936E+02
      6.85     0.26    4.80    15.7 0.642E-02   2.96     0.89    4.80    1.84
.56648E+02
      6.93     0.26    4.80    15.8 0.638E-02   2.90     0.92    4.80    1.90
.57360E+02
      7.01     0.26    4.80    15.9 0.634E-02   2.85     0.94    4.80    1.96
.58073E+02
      7.10     0.26    4.80    16.0 0.630E-02   2.79     0.97    4.80    2.01
.58785E+02
      7.18     0.26    4.80    16.1 0.626E-02   2.74     0.99    4.80    2.06
.59497E+02
      7.26     0.26    4.80    16.2 0.622E-02   2.70     1.01    4.80    2.11
.60210E+02
      7.34     0.26    4.80    16.3 0.619E-02   2.65     1.04    4.80    2.15
.60922E+02
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```
      7.42     0.26    4.80    16.4 0.616E-02   2.61     1.06    4.80    2.19
.61634E+02
      7.50     0.26    4.80    16.5 0.612E-02   2.57     1.08    4.80    2.23
.62347E+02
      7.58     0.26    4.80    16.6 0.609E-02   2.53     1.10    4.80    2.27
.63059E+02
      7.66     0.26    4.80    16.7 0.606E-02   2.49     1.12    4.80    2.31
.63771E+02
      7.74     0.26    4.80    16.7 0.603E-02   2.46     1.15    4.80    2.35
.64483E+02
      7.82     0.26    4.80    16.8 0.600E-02   2.42     1.17    4.80    2.38
.65196E+02
      7.90     0.26    4.80    16.9 0.597E-02   2.39     1.19    4.80    2.41
.65908E+02
      7.98     0.26    4.80    17.0 0.595E-02   2.36     1.21    4.80    2.44
.66620E+02
      8.06     0.26    4.80    17.1 0.592E-02   2.33     1.23    4.80    2.47
.67333E+02
 Cumulative travel time =          67.3328 sec

--------------------------------------------------------------------------------
---------------
 Plume is ATTACHED to RIGHT bank/shore.
   Plume width is now determined from RIGHT bank/shore.

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      8.06    -0.98    4.80    17.1 0.592E-02   2.33     2.46    4.80    2.47
.67333E+02
** CMC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below CMC value of 0.580E-02
   in the current prediction interval.
 This is the extent of the TOXIC DILUTION ZONE.
     16.81    -0.98    4.80    20.0 0.505E-02   1.54     4.37    4.80    3.26
.14476E+03
     25.56    -0.98    4.80    22.2 0.454E-02   1.27     5.91    4.80    3.54
.22218E+03
     34.32    -0.98    4.80    24.5 0.413E-02   1.14     7.24    4.80    3.67
.29960E+03
     43.07    -0.98    4.80    27.0 0.375E-02   1.07     8.44    4.80    3.73
.37703E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.373E-02 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     51.82    -0.98    4.80    29.8 0.339E-02   1.05     9.56    4.80    3.75
.45445E+03
     60.57    -0.98    4.80    33.1 0.305E-02   1.05    10.60    4.80    3.75
.53187E+03
     69.32    -0.98    4.80    36.9 0.274E-02   1.07    11.58    4.80    3.73
.60930E+03
     78.07    -0.98    4.80    41.2 0.245E-02   1.11    12.53    4.80    3.70
.68672E+03
     86.83    -0.98    4.80    46.0 0.219E-02   1.15    13.43    4.80    3.65
.76415E+03
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM  distance meets or exceeds
 the regulatory value =    91.44 m.
```

```
 This is the extent of the REGULATORY MIXING ZONE.
     95.58    -0.98    4.80    51.5 0.196E-02   1.21    14.31    4.80    3.59
.84157E+03
    104.33    -0.98    4.80    57.5 0.176E-02   1.28    15.15    4.80    3.53
.91899E+03
    113.08    -0.98    4.80    64.2 0.157E-02   1.35    15.98    4.80    3.45
.99642E+03
    121.83    -0.98    4.80    71.6 0.141E-02   1.44    16.78    4.80    3.37
.10738E+04
    130.58    -0.98    4.80    79.6 0.127E-02   1.53    17.57    4.80    3.28
.11513E+04
    139.34    -0.98    4.80    88.4 0.114E-02   1.62    18.34    4.80    3.18
.12287E+04
    148.09    -0.98    4.80    97.8 0.103E-02   1.72    19.10    4.80    3.08
.13061E+04
    156.84    -0.98    4.80   108.0 0.935E-03   1.83    19.84    4.80    2.97
.13835E+04
    165.59    -0.98    4.80   119.0 0.849E-03   1.95    20.57    4.80    2.86
.14610E+04
    174.34    -0.98    4.80   130.7 0.773E-03   2.07    21.29    4.80    2.74
.15384E+04
    183.09    -0.98    4.80   143.2 0.705E-03   2.19    21.99    4.80    2.61
.16158E+04
    191.84    -0.98    4.80   156.5 0.645E-03   2.32    22.69    4.80    2.48
.16932E+04
    200.60    -0.98    4.80   170.6 0.592E-03   2.46    23.38    4.80    2.35
.17707E+04
    209.35    -0.98    4.80   185.6 0.544E-03   2.60    24.06    4.80    2.21
.18481E+04
    218.10    -0.98    4.80   201.4 0.502E-03   2.74    24.73    4.80    2.06
.19255E+04
    226.85    -0.98    4.80   218.1 0.463E-03   2.89    25.40    4.80    1.91
.20029E+04
    235.60    -0.98    4.80   235.6 0.429E-03   3.04    26.06    4.80    1.76
.20803E+04
    244.35    -0.98    4.80   254.0 0.398E-03   3.20    26.71    4.80    1.60
.21578E+04
    253.11    -0.98    4.80   273.3 0.370E-03   3.36    27.35    4.80    1.44
.22352E+04
    261.86    -0.98    4.80   293.6 0.344E-03   3.53    27.99    4.80    1.27
.23126E+04
    270.61    -0.98    4.80   314.7 0.321E-03   3.70    28.62    4.80    1.10
.23900E+04
 Cumulative travel time =        2390.0427 sec

END OF MOD141: BUOYANT AMBIENT SPREADING
-------------------------------------------------------------------------------
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 Bottom coordinate for FAR-FIELD is determined by average depth, ZFB = -2.06m
-------------------------------------------------------------------------------
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.120E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.150E-01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
```

```
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
    270.61    -0.98    4.80   314.7 0.321E-03   3.70    28.62    4.80    1.10
.23900E+04
    378.26    -0.98    4.80   428.9 0.235E-03   4.91    29.39    4.80   -0.11
.33424E+04
    485.90    -0.98    4.80   565.6 0.179E-03   6.31    30.15    4.80   -1.51
.42947E+04
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
    593.55    -0.98    4.80   629.8 0.160E-03   6.86    30.88    4.80   -2.06
.52470E+04
    701.19    -0.98    4.80   644.5 0.157E-03   6.86    31.60    4.80   -2.06
.61994E+04
    808.84    -0.98    4.80   658.8 0.153E-03   6.86    32.31    4.80   -2.06
.71517E+04
    916.49    -0.98    4.80   672.9 0.150E-03   6.86    33.00    4.80   -2.06
.81040E+04
   1024.13    -0.98    4.80   686.6 0.147E-03   6.86    33.67    4.80   -2.06
.90563E+04
   1131.78    -0.98    4.80   700.1 0.144E-03   6.86    34.33    4.80   -2.06
.10009E+05
   1239.43    -0.98    4.80   713.3 0.142E-03   6.86    34.98    4.80   -2.06
.10961E+05
   1347.07    -0.98    4.80   726.3 0.139E-03   6.86    35.62    4.80   -2.06
.11913E+05
   1454.72    -0.98    4.80   739.1 0.137E-03   6.86    36.25    4.80   -2.06
.12866E+05
   1562.37    -0.98    4.80   751.7 0.134E-03   6.86    36.86    4.80   -2.06
.13818E+05
   1670.01    -0.98    4.80   764.0 0.132E-03   6.86    37.47    4.80   -2.06
.14770E+05
   1777.66    -0.98    4.80   776.2 0.130E-03   6.86    38.06    4.80   -2.06
.15723E+05
   1885.30    -0.98    4.80   788.1 0.128E-03   6.86    38.65    4.80   -2.06
.16675E+05
   1992.95    -0.98    4.80   799.9 0.126E-03   6.86    39.23    4.80   -2.06
.17627E+05
   2100.60    -0.98    4.80   811.5 0.124E-03   6.86    39.80    4.80   -2.06
.18580E+05
   2208.24    -0.98    4.80   823.0 0.123E-03   6.86    40.36    4.80   -2.06
.19532E+05
   2315.89    -0.98    4.80   834.2 0.121E-03   6.86    40.91    4.80   -2.06
.20484E+05
   2423.54    -0.98    4.80   845.4 0.119E-03   6.86    41.46    4.80   -2.06
.21437E+05
   2531.18    -0.98    4.80   856.4 0.118E-03   6.86    42.00    4.80   -2.06
.22389E+05
   2638.83    -0.98    4.80   867.2 0.116E-03   6.86    42.53    4.80   -2.06
.23341E+05
```

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   2746.48    -0.98    4.80   878.0 0.115E-03   6.86    43.06    4.80   -2.06
.24294E+05
   2854.12    -0.98    4.80   888.5 0.114E-03   6.86    43.57    4.80   -2.06
.25246E+05
   2961.77    -0.98    4.80   899.0 0.112E-03   6.86    44.09    4.80   -2.06
.26198E+05
   3069.42    -0.98    4.80   909.4 0.111E-03   6.86    44.60    4.80   -2.06
.27151E+05
   3177.06    -0.98    4.80   919.6 0.110E-03   6.86    45.10    4.80   -2.06
.28103E+05
   3284.71    -0.98    4.80   929.7 0.109E-03   6.86    45.59    4.80   -2.06
.29055E+05
   3392.35    -0.98    4.80   939.7 0.107E-03   6.86    46.08    4.80   -2.06
.30008E+05
   3500.00    -0.98    4.80   949.6 0.106E-03   6.86    46.57    4.80   -2.06
.30960E+05
 Cumulative travel time =       30959.8828 sec

 Simulation limit based on maximum specified distance =   3500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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-------------------------------------------------------------------------------
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CORMIX1: Single Port Discharges              End of Prediction File
1111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 6.0GT
                       HYDRO1:Version-6.0.0.0  October,2009
SITE NAME/LABEL:
  DESIGN CASE:                  JD309550GPMfSteadyFinal6.0
  FILE NAME:
P:\Mixing\CriticalDischargeScenarios\V.6.0\550GPMFinalRiver\JD309550GPMfSteadyF
inal6.0R.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             03/26/2010--15:48:52
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 158.50 m
  Channel regularity              ICHREG = 1
  Ambient flowrate                QA      = 122.88 m^3/s
  Average depth                   HA      = 6.86 m
  Depth at discharge              HD      = 4.80 m
  Ambient velocity                UA      = 0.113 m/s
  Darcy-Weisbach friction factor  F       = 0.0258
    Calculated from Manning's n           = 0.025
  Wind velocity                   UW      = 9.30 m/s
  Stratification Type             STRCND = U
  Surface density                 RHOAS   = 1001.0000 kg/m^3
  Bottom density                  RHOAB   = 1001.0000 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Single Port Discharge
  Nearest bank                            = right
  Distance to bank                DISTB   = 0.98 m
  Port diameter                   D0      = 0.1029 m
  Port cross-sectional area       A0      = 0.0083 m^2
  Discharge velocity              U0      = 4.57 m/s
  Discharge flowrate              Q0      = 0.038021 m^3/s
  Discharge port height           H0      = 4.80 m
  Vertical discharge angle        THETA   = -88.37 deg
  Horizontal discharge angle      SIGMA   = 90 deg
  Discharge temperature (freshwater)      = 10 degC
  Corresponding density           RHO0    = 999.7019 kg/m^3
  Density difference              DRHO    = 1.2981 kg/m^3
  Buoyant acceleration            GP0     = 0.0127 m/s^2
  Discharge concentration         C0      = 0.101 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.09 m         Lm  = 3.69 m         Lb  = 0.34 m
  LM  = 12.24 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0     = 126.30
  Velocity ratio                  R       = 40.44
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = yes
  CMC concentration               CMC     = 0.0058 mg/l
  CCC concentration               CCC     = 0.00373 mg/l
```

```
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 91.44 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = IPV4 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 4.80 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    0.98 m from the right bank/shore.
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0076 mg/l
  Dilution at edge of NFR              s = 13.4
  NFR Location:                        x = 5.65 m
    (centerline coordinates)           y = 0.26 m
                                       z = 4.80 m
  NFR plume dimensions:  half-width (bh) = 0.47 m
                          thickness (bv) = 4.80 m
Cumulative travel time:       45.9630 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
  but RE-STRATIFIES LATER.
  Plume becomes vertically fully mixed again at 593.55 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts one bank only at 8.06 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.0058  mg/l
Corresponding dilution                   = 17.413793
```

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The CMC was encountered at the following plume position:
  Plume location:                      x = 8.88 m
    (centerline coordinates)           y = -0.98 m
                                       z = 4.80 m
  Plume dimension:       half-width (bh) = 2.67 m
                          thickness (bv) = 2.20 m

 Computed distance from port opening to CMC location = 8.93 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
              Lq = 0.09 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.93 m.
 CRITERION 2: This location is within 5 times the ambient water depth of
              HD = 4.80 m.
 ++++++++++ The ambient depth TEST for the TDZ has been SATISFIED. ++++++++++

 Computed distance from port opening to CMC location = 8.93 m.
 CRITERION 3: This location is within one tenth the distance of the extent
              of the Regulatory Mixing Zone of 91.45 m in any
              spatial direction from the port opening.
 +++++ The Regulatory Mixing Zone TEST for the TDZ has been SATISFIED. ++++++

 The diffuser discharge velocity is equal to 4.57 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 0.002069  mg/l
  Corresponding dilution               s = 48.8
  Plume location:                      x = 91.44 m
    (centerline coordinates)           y = -0.98 m
                                       z = 4.80 m
  Plume dimensions:      half-width (bh) = 13.90 m
                          thickness (bv) = 1.18 m
Cumulative travel time:       804.9655 sec.
At this position, the plume is CONTACTING the RIGHT bank.
Furthermore, the CCC for the toxic pollutant has indeed been met
  within the RMZ. In particular:
The CCC was encountered at the following plume position:
The CCC for the toxic pollutant was encountered at the following
  plume position:
  CCC                                    = 0.00373  mg/l
Corresponding dilution                   = 27.1
  Plume location:                      x = 43.44 m
    (centerline coordinates)           y = -0.98 m
                                       z = 4.80 m
  Plume dimensions:      half-width (bh) = 8.49 m
                          thickness (bv) = 1.07 m
********************* FINAL DESIGN ADVICE AND COMMENTS *********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```