APPENDICE II: risultati di CORMIX III

In questa appendice riporteremo i risultati ottenuti con il codice CORMIX III in condizioni probabili nella zona dello scarico ILVA 1. Secondo la nostra opinione, data la complessa geometria della zona e date le difficili condizioni di corrente, i risultati ottenuti con CORMIX III sono poco rappresentativi.

Qui di seguito sono riportate le condizioni generali e quelle specifiche dei vari casi. Bisogna precisare che CORMIX non permette di considerare esattamente le condizioni di uscita del canale di scarico perché ci sono dei vincoli sul rapporto larghezza/profondità, in cui i nostri canali di scarico non rientrano. A tal fine si è cercato di riprodurre le condizioni di uscita portando il rapporto larghezza/profondità a valori accettabili ma mantenendo costante la sezione di uscita in modo da riprodurre le stesse velocità di uscita dal canale di scarico.

Si sono studiate 10 diverse condizioni modificando solo uno dei parametri. Si noti che CORMIX non può distinguere la direzione della corrente marina.

DATI GENERALI:
AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Average depth HA = 5 m
Depth at discharge HD = 5 m
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Calculated FRESH-WATER DENSITY values:
density RHOAS = 999.3789 kg/m^3
DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge flowrate Q0 = 28 m^3/s
Density RHO0 = 999.3789 kg/m^3
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
Toxic discharge = no
Water quality standard specified = no
Regulatory mixing zone = no
Region of interest = 10000 m downstream
Acaso1-5
Ambient velocity UA = 0.1 m/s
Depth near discharge outlet HD0 = 5 m
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
1 C= 5 mg/l
2 C= 1 mg/l

3 C= .1 mg/l
4 C= .01 mg/l
5 C= .001 mg/l

Acaso6-7

C= 5 mg/l
Depth near discharge outlet HD0 = 5 m
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
6 Ambient velocity UA = 0.01 m/s
7 Ambient velocity UA = 0.5 m/s

Acaso8-10

C= 5 mg/l
Ambient velocity UA = 0.1 m/s
Depth near discharge outlet HD0 = 5 m
Discharge channel depth H0 = 5 m
8 Discharge channel width B0 = 50 m
9 Discharge channel width B0 = 30 m
10 Discharge channel width B0 = 10 m

Caso 1

CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b
SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:36:49
****
SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 500 m^2
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.05
Reduced discharge channel due to intrusion:
Cross-section area A0 = 137.2680 m^2
Channel width B0 = 100 m
Channel depth H0 = 1.37 m
Aspect ratio AR = 0.01
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.20 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 5 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m       Lm  = 23.90 m       Lbb = 848.56 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 2.04
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 1.1888 mg/l
  Dilution at edge of NFR             = 4.2
  NFR Location:                  x = 784.59 m
    (centerline coordinates)     y = 0 m
                                 z = 0 m
  NFR plume dimensions:       half-width = 1000 m
                              thickness = 1.18 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 840.49 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -392.30 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
333333333333333333333333333333333333333333333333333333333333333333333333333
33

CORNELL MIXING ZONE EXPERT SYSTEM

```
Subsystem CORMIX3:                          Subsystem version:
 Buoyant Surface Discharges              CORMIX-GI Version 4.01b
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:            ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:    08/17/2004--15:36:49
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =  1000.00  AS    =  5000.00  QA    =   500.00  ICHREG= 1
 HA    =     5.00  HD    =     5.00
 UA    =     .100 F     =     .018 USTAR = .4796E-02
 UW    =     .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U        RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT    DISTB =      .00  Configuration: flush_discharge
 SIGMA =    90.00  HD0   =     5.00  SLOPE =      .00
 Rectangular channel geometry:
 B0    =   100.000 H0    =     5.000 A0    = .5000E+03  AR    =      .050
 Reduced channel geometry due to intrusion:
 B0    =   100.000 H0    =     1.373 A0    = .1373E+03  AR    =      .014
 (All relevant parameters further below are based on this geometry.)
 U0    =      .204 Q0    =    28.000       = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0    = .5000E+01  CUNITS=  mg/l
 IPOLL =  1        KS    = .0000E+00  KD    = .0000E+00
FLUX VARIABLES (metric units)
 Q0    = .2800E+02  M0    = .5711E+01  J0    = .8486E+00
 Associated length scales (meters)
 LQ    =    11.72  LM    =     4.01  Lm    =    23.90  Lb    =   848.56
NON-DIMENSIONAL PARAMETERS
 FR0   =      .34  FRCH  =     1.00  R     =     2.04
FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL1    3
 3  Applicable layer depth HS =     5.00  3
 333333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    = .5000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .500E+01   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .500E+01   1.37    50.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .203E+01   5.00   141.32
 Cumulative travel time =         145. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .203E+01   5.00   141.32
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     392.30 m
       X-position of upstream stagnation point =    -392.30 m
       Thickness in intrusion region         =       1.18 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       1.18 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

This may be caused by a very small ambient velocity, perhaps in
combination with large discharge buoyancy.
If the ambient conditions are strongly transient (e.g. tidal), then the
CORMIX steady-state predictions of upstream intrusion are probably
unrealistic.
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)

X	Y	Z	S	C	BV	BH	
-392.30	.00	0.00	9999.9	.000E+00	.00	.00	
-368.76	.00	0.00	8.1	.621E+00	.36	141.42	
-253.42	.00	0.00	3.4	.147E+01	.85	343.51	
-138.09	.00	0.00	2.7	.187E+01	1.08	464.76	
-22.75	.00	0.00	2.5	.203E+01	1.17	560.36	
92.58	.00	0.00	2.5	.196E+01	1.18	641.87	
207.92	.00	0.00	2.9	.174E+01	1.18	714.14	
323.25	.00	0.00	3.3	.151E+01	1.18	779.74	
438.59	.00	0.00	3.7	.135E+01	1.18	840.24	
553.92	.00	0.00	4.0	.126E+01	1.18	896.66	
669.26	.00	0.00	4.1	.122E+01	1.18	949.74	
784.59	.00	0.00	4.2	.119E+01	1.18	1000.00	

Cumulative travel time = 7957. sec
END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: 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 from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	
784.59	.00	0.00	4.2	.119E+01	1.15	973.12	
790.18	.00	0.00	4.2	.119E+01	1.14	975.84	
795.77	.00	0.00	4.2	.119E+01	1.14	978.55	
801.36	.00	0.00	4.2	.119E+01	1.14	981.25	
806.95	.00	0.00	4.2	.118E+01	1.14	983.95	
812.54	.00	0.00	4.2	.118E+01	1.14	986.64	
818.13	.00	0.00	4.2	.118E+01	1.13	989.32	
823.72	.00	0.00	4.2	.118E+01	1.13	992.00	
829.31	.00	0.00	4.2	.118E+01	1.13	994.67	

```
   834.90      .00    0.00     4.2  .118E+01   1.13   997.34
   840.49      .00    0.00     4.2  .118E+01   1.13  1000.00
 Cumulative travel time =        8486. 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)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
       X        Y       Z        S       C        BV       BH
    840.49      .00    0.00     4.2  .118E+01   1.13  1000.00
   1756.44      .00    0.00     4.2  .118E+01   1.13  1000.00
   2672.39      .00    0.00     4.2  .118E+01   1.13  1000.00
   3588.34      .00    0.00     4.2  .118E+01   1.13  1000.00
   4504.29      .00    0.00     4.2  .118E+01   1.13  1000.00
   5420.24      .00    0.00     4.2  .118E+01   1.13  1000.00
   6336.19      .00    0.00     4.2  .118E+01   1.13  1000.00
   7252.15      .00    0.00     4.3  .118E+01   1.13  1000.00
   8168.10      .00    0.00     4.3  .118E+01   1.13  1000.00
   9084.05      .00    0.00     4.3  .118E+01   1.13  1000.00
  10000.00      .00    0.00     4.3  .118E+01   1.13  1000.00
 Cumulative travel time =       95224. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333
33
```

Caso 2

CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b

SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:41:04

****

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 500 m^2
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.05
Reduced discharge channel due to intrusion:
Cross-section area A0 = 137.2680 m^2
Channel width B0 = 100 m
Channel depth H0 = 1.37 m
Aspect ratio AR = 0.01
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.20 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 1 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m       Lm  = 23.90 m       Lbb = 848.56 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 2.04
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 0.2378 mg/l
  Dilution at edge of NFR             = 4.2
  NFR Location:                   x = 784.59 m
    (centerline coordinates)      y = 0 m
                                  z = 0 m
  NFR plume dimensions:       half-width = 1000 m
                              thickness = 1.18 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 840.49 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -392.30 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
33333333333333333333333333333333333333333333333333333333333333333333333333333
33
CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3: Subsystem version:
Buoyant Surface Discharges CORMIX-GI Version 4.01b

CASE DESCRIPTION
Site name/label: ILVA_A
Design case: ILVA_A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA_A.prd
Time of Fortran run: 08/17/2004--15:42:16
ENVIRONMENT PARAMETERS (metric units)
Bounded section
BS = 1000.00 AS = 5000.00 QA = 500.00 ICHREG= 1
HA = 5.00 HD = 5.00
UA = .100 F = .018 USTAR = .4796E-02
UW = .000 UWSTAR= .0000E+00
Uniform density environment
STRCND= U RHOAM = 999.3789
DISCHARGE PARAMETERS (metric units)
BANK = RIGHT DISTB = .00 Configuration: flush_discharge
SIGMA = 90.00 HD0 = 5.00 SLOPE = .00
Rectangular channel geometry:
B0 = 100.000 H0 = 5.000 A0 = .5000E+03 AR = .050
Reduced channel geometry due to intrusion:
B0 = 100.000 H0 = 1.373 A0 = .1373E+03 AR = .014
(All relevant parameters further below are based on this geometry.)
U0 = .204 Q0 = 28.000 = .2800E+02
RHO0 = 996.2905 DRHO0 = .3088E+01 GP0 = .3031E-01
C0 = .1000E+01 CUNITS= mg/l
IPOLL = 1 KS = .0000E+00 KD = .0000E+00
FLUX VARIABLES (metric units)
Q0 = .2800E+02 M0 = .5711E+01 J0 = .8486E+00
Associated length scales (meters)
LQ = 11.72 LM = 4.01 Lm = 23.90 Lb = 848.56
NON-DIMENSIONAL PARAMETERS
FR0 = .34 FRCH = 1.00 R = 2.04
FLOW CLASSIFICATION
333333333333333333333333333333333333333333
3 Flow class (CORMIX3) = PL1 3
3 Applicable layer depth HS = 5.00 3
333333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
C0 = .1000E+01 CUNITS= mg/l
NTOX = 0
NSTD = 0
REGMZ = 0

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E+01   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E+01   1.37    50.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E+00   5.00   141.32
 Cumulative travel time =         145. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E+00   5.00   141.32
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     392.30 m
       X-position of upstream stagnation point =    -392.30 m
       Thickness in intrusion region         =       1.18 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       1.18 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

This may be caused by a very small ambient velocity, perhaps in
combination with large discharge buoyancy.
If the ambient conditions are strongly transient (e.g. tidal), then the
CORMIX steady-state predictions of upstream intrusion are probably
unrealistic.
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)

X	Y	Z	S	C	BV	BH	
-392.30	.00	0.00	9999.9	.000E+00	.00	.00	
-368.76	.00	0.00	8.1	.124E+00	.36	141.42	
-253.42	.00	0.00	3.4	.294E+00	.85	343.51	
-138.09	.00	0.00	2.7	.374E+00	1.08	464.76	
-22.75	.00	0.00	2.5	.405E+00	1.17	560.36	
92.58	.00	0.00	2.5	.392E+00	1.18	641.87	
207.92	.00	0.00	2.9	.347E+00	1.18	714.14	
323.25	.00	0.00	3.3	.302E+00	1.18	779.74	
438.59	.00	0.00	3.7	.270E+00	1.18	840.24	
553.92	.00	0.00	4.0	.252E+00	1.18	896.66	
669.26	.00	0.00	4.1	.243E+00	1.18	949.74	
784.59	.00	0.00	4.2	.238E+00	1.18	1000.00	

Cumulative travel time = 7957. sec
END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: 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 from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	
784.59	.00	0.00	4.2	.238E+00	1.15	973.12	
790.18	.00	0.00	4.2	.238E+00	1.14	975.84	
795.77	.00	0.00	4.2	.237E+00	1.14	978.55	
801.36	.00	0.00	4.2	.237E+00	1.14	981.25	
806.95	.00	0.00	4.2	.237E+00	1.14	983.95	
812.54	.00	0.00	4.2	.237E+00	1.14	986.64	
818.13	.00	0.00	4.2	.236E+00	1.13	989.32	
823.72	.00	0.00	4.2	.236E+00	1.13	992.00	
829.31	.00	0.00	4.2	.236E+00	1.13	994.67	

```
   834.90      .00    0.00     4.2  .236E+00   1.13   997.34
   840.49      .00    0.00     4.2  .236E+00   1.13  1000.00
 Cumulative travel time =        8486. 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)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
       X        Y       Z        S       C        BV       BH
    840.49      .00    0.00     4.2  .236E+00   1.13  1000.00
   1756.44      .00    0.00     4.2  .236E+00   1.13  1000.00
   2672.39      .00    0.00     4.2  .236E+00   1.13  1000.00
   3588.34      .00    0.00     4.2  .235E+00   1.13  1000.00
   4504.29      .00    0.00     4.2  .235E+00   1.13  1000.00
   5420.24      .00    0.00     4.2  .235E+00   1.13  1000.00
   6336.19      .00    0.00     4.2  .235E+00   1.13  1000.00
   7252.15      .00    0.00     4.3  .235E+00   1.13  1000.00
   8168.10      .00    0.00     4.3  .235E+00   1.13  1000.00
   9084.05      .00    0.00     4.3  .235E+00   1.13  1000.00
  10000.00      .00    0.00     4.3  .235E+00   1.13  1000.00
 Cumulative travel time =       95224. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
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```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM

CORMIX-GI Version 4.01b

SITE NAME/LABEL: ILVA A

DESIGN CASE: ILVA A

FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd

Using subsystem CORMIX3: Buoyant Surface Discharges

Start of session: 08/17/2004--15:43:23

****

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

```
  Cross-section                      = bounded
  Width                        BS     = 1000 m
  Channel regularity           ICHREG = 1
  Ambient flowrate             QA     = 500 m^3/s
  Average depth                HA     = 5 m
  Depth at discharge           HD     = 5 m
  Ambient velocity             UA     = 0.1 m/s
  Darcy-Weisbach friction factor  F   = 0.0184
  Wind velocity                UW     = 0 m/s
Stratification Type            STRCND = U
  Surface density              RHOAS  = 999.3789 kg/m^3
  Bottom density               RHOAB  = 999.3789 kg/m^3
```

DISCHARGE PARAMETERS: Buoyant Surface Discharge

```
  Discharge located on               = right bank/shoreline
  Discharge configuration            = flush discharge
  Distance from bank to outlet  DISTB  = 0 m
  Discharge angle               SIGMA  = 90 deg
  Depth near discharge outlet   HD0    = 5 m
  Bottom slope at discharge     SLOPE  = 0 deg
  Rectangular discharge:
    Discharge cross-section area  A0   = 500 m^2
    Discharge channel width       B0   = 100 m
    Discharge channel depth       H0   = 5 m
    Discharge aspect ratio        AR   = 0.05
  Reduced discharge channel due to intrusion:
    Cross-section area            A0   = 137.2680 m^2
    Channel width                 B0   = 100 m
    Channel depth                 H0   = 1.37 m
    Aspect ratio                  AR   = 0.01
  Discharge flowrate            Q0     = 28 m^3/s
  Discharge velocity            U0     = 0.20 m/s
  Discharge density             RHO0   = 996.2905 kg/m^3
```

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 0.1 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m       Lm  = 23.90 m       Lbb = 848.56 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 2.04
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 0.0238 mg/l
  Dilution at edge of NFR             = 4.2
  NFR Location:                   x = 784.59 m
    (centerline coordinates)      y = 0 m
                                  z = 0 m
  NFR plume dimensions:       half-width = 1000 m
                              thickness = 1.18 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 840.49 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -392.30 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
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CORNELL MIXING ZONE EXPERT SYSTEM

Subsystem CORMIX3: Subsystem version:
Buoyant Surface Discharges CORMIX-GI Version 4.01b

CASE DESCRIPTION
Site name/label: ILVA_A
Design case: ILVA_A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA_A.prd
Time of Fortran run: 08/17/2004--15:43:23

ENVIRONMENT PARAMETERS (metric units)
Bounded section
BS = 1000.00 AS = 5000.00 QA = 500.00 ICHREG= 1
HA = 5.00 HD = 5.00
UA = .100 F = .018 USTAR = .4796E-02
UW = .000 UWSTAR= .0000E+00
Uniform density environment
STRCND= U RHOAM = 999.3789

DISCHARGE PARAMETERS (metric units)
BANK = RIGHT DISTB = .00 Configuration: flush_discharge
SIGMA = 90.00 HD0 = 5.00 SLOPE = .00
Rectangular channel geometry:
B0 = 100.000 H0 = 5.000 A0 = .5000E+03 AR = .050
Reduced channel geometry due to intrusion:
B0 = 100.000 H0 = 1.373 A0 = .1373E+03 AR = .014
(All relevant parameters further below are based on this geometry.)
U0 = .204 Q0 = 28.000 = .2800E+02
RHO0 = 996.2905 DRHO0 = .3088E+01 GP0 = .3031E-01
C0 = .1000E+00 CUNITS= mg/l
IPOLL = 1 KS = .0000E+00 KD = .0000E+00

FLUX VARIABLES (metric units)
Q0 = .2800E+02 M0 = .5711E+01 J0 = .8486E+00
Associated length scales (meters)
LQ = 11.72 LM = 4.01 Lm = 23.90 Lb = 848.56

NON-DIMENSIONAL PARAMETERS
FR0 = .34 FRCH = 1.00 R = 2.04

FLOW CLASSIFICATION
3333333333333333333333333333333333333333
3 Flow class (CORMIX3) = PL1 3
3 Applicable layer depth HS = 5.00 3
3333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
C0 = .1000E+00 CUNITS= mg/l
NTOX = 0
NSTD = 0
REGMZ = 0

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E+00   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E+00   1.37    50.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E-01   5.00   141.32
 Cumulative travel time =         145. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E-01   5.00   141.32
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     392.30 m
       X-position of upstream stagnation point =    -392.30 m
       Thickness in intrusion region         =       1.18 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       1.18 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

```
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
   CORMIX steady-state predictions of upstream intrusion are probably
   unrealistic.
 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)
      X       Y       Z       S       C       BV       BH
  -392.30     .00    0.00  9999.9  .000E+00    .00      .00
  -368.76     .00    0.00     8.1  .124E-01    .36   141.42
  -253.42     .00    0.00     3.4  .294E-01    .85   343.51
  -138.09     .00    0.00     2.7  .374E-01   1.08   464.76
   -22.75     .00    0.00     2.5  .405E-01   1.17   560.36
    92.58     .00    0.00     2.5  .392E-01   1.18   641.87
   207.92     .00    0.00     2.9  .347E-01   1.18   714.14
   323.25     .00    0.00     3.3  .302E-01   1.18   779.74
   438.59     .00    0.00     3.7  .270E-01   1.18   840.24
   553.92     .00    0.00     4.0  .252E-01   1.18   896.66
   669.26     .00    0.00     4.1  .243E-01   1.18   949.74
   784.59     .00    0.00     4.2  .238E-01   1.18  1000.00
 Cumulative travel time =        7957. sec
END OF MOD331: UPSTREAM INTRUDING PLUME
------------------------------------------------------------------------------
------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD341: 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 from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
 Plume Stage 2 (bank attached):
      X       Y       Z       S       C       BV       BH
   784.59     .00    0.00     4.2  .238E-01   1.15   973.12
   790.18     .00    0.00     4.2  .238E-01   1.14   975.84
   795.77     .00    0.00     4.2  .237E-01   1.14   978.55
   801.36     .00    0.00     4.2  .237E-01   1.14   981.25
   806.95     .00    0.00     4.2  .237E-01   1.14   983.95
   812.54     .00    0.00     4.2  .237E-01   1.14   986.64
   818.13     .00    0.00     4.2  .236E-01   1.13   989.32
   823.72     .00    0.00     4.2  .236E-01   1.13   992.00
   829.31     .00    0.00     4.2  .236E-01   1.13   994.67
```

```
   834.90      .00    0.00     4.2  .236E-01   1.13   997.34
   840.49      .00    0.00     4.2  .236E-01   1.13  1000.00
 Cumulative travel time =        8486. 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)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
       X        Y       Z        S       C        BV       BH
    840.49      .00    0.00     4.2  .236E-01   1.13  1000.00
   1756.44      .00    0.00     4.2  .236E-01   1.13  1000.00
   2672.39      .00    0.00     4.2  .236E-01   1.13  1000.00
   3588.34      .00    0.00     4.2  .235E-01   1.13  1000.00
   4504.29      .00    0.00     4.2  .235E-01   1.13  1000.00
   5420.24      .00    0.00     4.2  .235E-01   1.13  1000.00
   6336.19      .00    0.00     4.2  .235E-01   1.13  1000.00
   7252.15      .00    0.00     4.3  .235E-01   1.13  1000.00
   8168.10      .00    0.00     4.3  .235E-01   1.13  1000.00
   9084.05      .00    0.00     4.3  .235E-01   1.13  1000.00
  10000.00      .00    0.00     4.3  .235E-01   1.13  1000.00
 Cumulative travel time =       95224. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM

CORMIX-GI Version 4.01b

SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:44:49

****

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 500 m^2
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.05
Reduced discharge channel due to intrusion:
Cross-section area A0 = 137.2680 m^2
Channel width B0 = 100 m
Channel depth H0 = 1.37 m
Aspect ratio AR = 0.01
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.20 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 0.01 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m       Lm  = 23.90 m       Lbb = 848.56 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 2.04
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 0.0024 mg/l
  Dilution at edge of NFR             = 4.2
  NFR Location:                   x = 784.59 m
    (centerline coordinates)      y = 0 m
                                  z = 0 m
  NFR plume dimensions:       half-width = 1000 m
                              thickness = 1.18 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 840.49 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -392.30 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
3333333333333333333333333333333333333333333333333333333333333333333333333
33
                CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3:                              Subsystem version:
 Buoyant Surface Discharges              CORMIX-GI Version 4.01b
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:            ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:    08/17/2004--15:44:49
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS   =  1000.00  AS   =  5000.00  QA   =   500.00  ICHREG= 1
 HA   =     5.00  HD   =     5.00
 UA   =     .100 F    =     .018 USTAR = .4796E-02
 UW   =     .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U        RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT    DISTB =     .00  Configuration: flush_discharge
 SIGMA =    90.00  HD0   =    5.00  SLOPE =     .00
 Rectangular channel geometry:
 B0   =   100.000 H0   =    5.000 A0   = .5000E+03  AR   =     .050
 Reduced channel geometry due to intrusion:
 B0   =   100.000 H0   =    1.373 A0   = .1373E+03  AR   =     .014
 (All relevant parameters further below are based on this geometry.)
 U0   =     .204 Q0   =    28.000      = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0   = .1000E-01  CUNITS=  mg/l
 IPOLL =  1        KS   = .0000E+00  KD   = .0000E+00
FLUX VARIABLES (metric units)
 Q0   = .2800E+02  M0   = .5711E+01  J0   = .8486E+00
 Associated length scales (meters)
 LQ   =    11.72  LM   =    4.01  Lm   =    23.90  Lb   =   848.56
NON-DIMENSIONAL PARAMETERS
 FR0  =     .34  FRCH =    1.00  R    =    2.04
FLOW CLASSIFICATION
 333333333333333333333333333333333333333
 3  Flow class (CORMIX3)     =   PL1   3
 3  Applicable layer depth HS =    5.00  3
 333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0   = .1000E-01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E-01   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E-01   1.37    50.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E-02   5.00   141.32
 Cumulative travel time =         145. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E-02   5.00   141.32
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     392.30 m
       X-position of upstream stagnation point =    -392.30 m
       Thickness in intrusion region         =       1.18 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       1.18 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

```
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
   CORMIX steady-state predictions of upstream intrusion are probably
   unrealistic.
 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)
      X       Y       Z       S       C       BV       BH
  -392.30     .00    0.00  9999.9  .000E+00    .00      .00
  -368.76     .00    0.00     8.1  .124E-02    .36   141.42
  -253.42     .00    0.00     3.4  .294E-02    .85   343.51
  -138.09     .00    0.00     2.7  .374E-02   1.08   464.76
   -22.75     .00    0.00     2.5  .405E-02   1.17   560.36
    92.58     .00    0.00     2.5  .392E-02   1.18   641.87
   207.92     .00    0.00     2.9  .347E-02   1.18   714.14
   323.25     .00    0.00     3.3  .302E-02   1.18   779.74
   438.59     .00    0.00     3.7  .270E-02   1.18   840.24
   553.92     .00    0.00     4.0  .252E-02   1.18   896.66
   669.26     .00    0.00     4.1  .243E-02   1.18   949.74
   784.59     .00    0.00     4.2  .238E-02   1.18  1000.00
 Cumulative travel time =        7957. sec
END OF MOD331: UPSTREAM INTRUDING PLUME
------------------------------------------------------------------------------
------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD341: 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 from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
 Plume Stage 2 (bank attached):
      X       Y       Z       S       C       BV       BH
   784.59     .00    0.00     4.2  .238E-02   1.15   973.12
   790.18     .00    0.00     4.2  .238E-02   1.14   975.84
   795.77     .00    0.00     4.2  .237E-02   1.14   978.55
   801.36     .00    0.00     4.2  .237E-02   1.14   981.25
   806.95     .00    0.00     4.2  .237E-02   1.14   983.95
   812.54     .00    0.00     4.2  .237E-02   1.14   986.64
   818.13     .00    0.00     4.2  .236E-02   1.13   989.32
   823.72     .00    0.00     4.2  .236E-02   1.13   992.00
   829.31     .00    0.00     4.2  .236E-02   1.13   994.67
```

```
   834.90      .00    0.00     4.2  .236E-02   1.13   997.34
   840.49      .00    0.00     4.2  .236E-02   1.13  1000.00
 Cumulative travel time =        8486. 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)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
       X        Y       Z        S       C        BV       BH
    840.49      .00    0.00     4.2  .236E-02   1.13  1000.00
   1756.44      .00    0.00     4.2  .236E-02   1.13  1000.00
   2672.39      .00    0.00     4.2  .236E-02   1.13  1000.00
   3588.34      .00    0.00     4.2  .235E-02   1.13  1000.00
   4504.29      .00    0.00     4.2  .235E-02   1.13  1000.00
   5420.24      .00    0.00     4.2  .235E-02   1.13  1000.00
   6336.19      .00    0.00     4.2  .235E-02   1.13  1000.00
   7252.15      .00    0.00     4.3  .235E-02   1.13  1000.00
   8168.10      .00    0.00     4.3  .235E-02   1.13  1000.00
   9084.05      .00    0.00     4.3  .235E-02   1.13  1000.00
  10000.00      .00    0.00     4.3  .235E-02   1.13  1000.00
 Cumulative travel time =       95224. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b
SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:45:29
****
SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 500 m^2
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.05
Reduced discharge channel due to intrusion:
Cross-section area A0 = 137.2680 m^2
Channel width B0 = 100 m
Channel depth H0 = 1.37 m
Aspect ratio AR = 0.01
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.20 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration           GP0    = 0.0303 m/s^2
  Discharge concentration        C0     = 0.001 mg/l
  Surface heat exchange coeff.   KS     = 0 m/s
  Coefficient of decay           KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m        Lm  = 23.90 m        Lbb = 848.56 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number      FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no. FRCH   = 1 (based on H0)
  Velocity ratio                 R      = 2.04
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                       = no
  Water quality standard specified      = no
  Regulatory mixing zone                = no
  Region of interest                    = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 0.0002 mg/l
  Dilution at edge of NFR               = 4.2
  NFR Location:                    x = 784.59 m
    (centerline coordinates)       y = 0 m
                                   z = 0 m
  NFR plume dimensions:       half-width = 1000 m
                              thickness = 1.18 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 840.49 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -392.30 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
333333333333333333333333333333333333333333333333333333333333333333333333333
33
                 CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3:                              Subsystem version:
 Buoyant Surface Discharges              CORMIX-GI Version 4.01b
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:           ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:     08/17/2004--15:45:29
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =  1000.00  AS    =   5000.00  QA    =    500.00  ICHREG= 1
 HA    =      5.00  HD    =      5.00
 UA    =      .100 F     =      .018 USTAR = .4796E-02
 UW    =      .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U        RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT     DISTB =      .00  Configuration: flush_discharge
 SIGMA =     90.00  HD0   =      5.00  SLOPE =       .00
 Rectangular channel geometry:
 B0    =    100.000 H0    =      5.000 A0    = .5000E+03  AR    =      .050
 Reduced channel geometry due to intrusion:
 B0    =    100.000 H0    =      1.373 A0    = .1373E+03  AR    =      .014
 (All relevant parameters further below are based on this geometry.)
 U0    =      .204 Q0    =    28.000        = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0    = .1000E-02  CUNITS=  mg/l
 IPOLL =  1        KS    = .0000E+00  KD    = .0000E+00
FLUX VARIABLES (metric units)
 Q0    = .2800E+02  M0    = .5711E+01  J0    = .8486E+00
 Associated length scales (meters)
 LQ    =     11.72  LM    =      4.01  Lm    =     23.90  Lb    =    848.56
NON-DIMENSIONAL PARAMETERS
 FR0   =       .34  FRCH  =      1.00  R     =      2.04
FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL1    3
 3  Applicable layer depth HS =      5.00  3
 3333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    = .1000E-02  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E-02   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .100E-02   1.37    50.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E-03   5.00   141.32
 Cumulative travel time =         145. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    3.42    29.44    0.00     2.5  .406E-03   5.00   141.32
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     392.30 m
       X-position of upstream stagnation point =    -392.30 m
       Thickness in intrusion region         =       1.18 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       1.18 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

```
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
   CORMIX steady-state predictions of upstream intrusion are probably
   unrealistic.
 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)
      X       Y       Z       S       C       BV       BH
  -392.30     .00    0.00  9999.9  .000E+00    .00      .00
  -368.76     .00    0.00     8.1  .124E-03    .36   141.42
  -253.42     .00    0.00     3.4  .294E-03    .85   343.51
  -138.09     .00    0.00     2.7  .374E-03   1.08   464.76
   -22.75     .00    0.00     2.5  .405E-03   1.17   560.36
    92.58     .00    0.00     2.5  .392E-03   1.18   641.87
   207.92     .00    0.00     2.9  .347E-03   1.18   714.14
   323.25     .00    0.00     3.3  .302E-03   1.18   779.74
   438.59     .00    0.00     3.7  .270E-03   1.18   840.24
   553.92     .00    0.00     4.0  .252E-03   1.18   896.66
   669.26     .00    0.00     4.1  .243E-03   1.18   949.74
   784.59     .00    0.00     4.2  .238E-03   1.18  1000.00
 Cumulative travel time =        7957. sec
END OF MOD331: UPSTREAM INTRUDING PLUME
------------------------------------------------------------------------------
------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD341: 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 from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
 Plume Stage 2 (bank attached):
      X       Y       Z       S       C       BV       BH
   784.59     .00    0.00     4.2  .238E-03   1.15   973.12
   790.18     .00    0.00     4.2  .238E-03   1.14   975.84
   795.77     .00    0.00     4.2  .237E-03   1.14   978.55
   801.36     .00    0.00     4.2  .237E-03   1.14   981.25
   806.95     .00    0.00     4.2  .237E-03   1.14   983.95
   812.54     .00    0.00     4.2  .237E-03   1.14   986.64
   818.13     .00    0.00     4.2  .236E-03   1.13   989.32
   823.72     .00    0.00     4.2  .236E-03   1.13   992.00
   829.31     .00    0.00     4.2  .236E-03   1.13   994.67
```

```
   834.90      .00    0.00     4.2  .236E-03   1.13   997.34
   840.49      .00    0.00     4.2  .236E-03   1.13  1000.00
 Cumulative travel time =        8486. 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)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
       X        Y       Z        S       C        BV       BH
    840.49      .00    0.00     4.2  .236E-03   1.13  1000.00
   1756.44      .00    0.00     4.2  .236E-03   1.13  1000.00
   2672.39      .00    0.00     4.2  .236E-03   1.13  1000.00
   3588.34      .00    0.00     4.2  .235E-03   1.13  1000.00
   4504.29      .00    0.00     4.2  .235E-03   1.13  1000.00
   5420.24      .00    0.00     4.2  .235E-03   1.13  1000.00
   6336.19      .00    0.00     4.2  .235E-03   1.13  1000.00
   7252.15      .00    0.00     4.3  .235E-03   1.13  1000.00
   8168.10      .00    0.00     4.3  .235E-03   1.13  1000.00
   9084.05      .00    0.00     4.3  .235E-03   1.13  1000.00
  10000.00      .00    0.00     4.3  .235E-03   1.13  1000.00
 Cumulative travel time =       95224. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333
33
```

Caso 6

CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b
SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:46:44
****
SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 50 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.01 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 500 m^2
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.05
Reduced discharge channel due to intrusion:
Cross-section area A0 = 137.2680 m^2
Channel width B0 = 100 m
Channel depth H0 = 1.37 m
Aspect ratio AR = 0.01
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.20 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 5 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m       Lm  = 238.99 m       Lbb = 99999 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 20.40
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 1.8693 mg/l
  Dilution at edge of NFR             = 2.7
  NFR Location:                  x = 21854.88 m
    (centerline coordinates)     y = 0 m
                                 z = 0 m
  NFR plume dimensions:       half-width = 1000 m
                              thickness = 7.49 m
-------------------------------------------------------------------------
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.

The REGION OF INTEREST (ROI) specification occurs before the near-field
mixing (NFR) regime has been completed. Specification of ROI is highly
restrictive.

FAR-FIELD MIXING SUMMARY:
Plume becomes laterally fully mixed at 0 m downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts one bank only at -10927.44 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

At the end of the NFR, the plume POSITION EXCEEDS SPECIFIED LIMITS for
the regulatory mixing zone (RMZ) and/or the region of interest (ROI).
Specifications for the ROI may be overly restrictive.
Use a larger ROI value in a subsequent iteration!

********** 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.

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:
3333333333333333333333333333333333333333333333333333333333333333333333333
33
                CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3:                              Subsystem version:
 Buoyant Surface Discharges              CORMIX-GI Version 4.01b
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:            ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:    08/17/2004--15:46:44
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS   =  1000.00  AS   =  5000.00  QA   =    50.00  ICHREG= 1
 HA   =     5.00  HD   =     5.00
 UA   =     .010 F    =     .018 USTAR = .4796E-03
 UW   =     .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U        RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT    DISTB =     .00  Configuration: flush_discharge
 SIGMA =    90.00  HD0   =    5.00  SLOPE =     .00
 Rectangular channel geometry:
 B0   =   100.000 H0   =    5.000 A0   = .5000E+03  AR   =     .050
 Reduced channel geometry due to intrusion:
 B0   =   100.000 H0   =    1.373 A0   = .1373E+03  AR   =     .014
 (All relevant parameters further below are based on this geometry.)
 U0   =     .204 Q0   =    28.000      = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0   = .5000E+01  CUNITS=  mg/l
 IPOLL =  1        KS   = .0000E+00  KD   = .0000E+00
FLUX VARIABLES (metric units)
 Q0   = .2800E+02  M0   = .5711E+01  J0   = .8486E+00
 Associated length scales (meters)
 LQ   =    11.72  LM   =    4.01  Lm   =   238.99  Lb   =  99999.00
NON-DIMENSIONAL PARAMETERS
 FR0  =     .34  FRCH =    1.00  R    =    20.40
FLOW CLASSIFICATION
 333333333333333333333333333333333333333
 3  Flow class (CORMIX3)     =   PL1   3
 3  Applicable layer depth HS =    5.00  3
 333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0   = .5000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
      .00     .00    0.00     1.0  .500E+01   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
      .00     .00    0.00     1.0  .500E+01   1.37    50.00
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
      .52    45.14    0.00     1.1  .436E+01   2.65    57.83
 Cumulative travel time =         221. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
      .52    45.14    0.00     1.1  .436E+01   2.65    57.83
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =   10927.44 m
       X-position of upstream stagnation point =  -10927.44 m
       Thickness in intrusion region         =       7.49 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       7.49 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
 This may be caused by a very small ambient velocity, perhaps in
```

```
  combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
  CORMIX steady-state predictions of upstream intrusion are probably
  unrealistic.
 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)
      X       Y      Z       S       C       BV       BH
-10927.44     .00    0.00  9999.9  .000E+00    .00      .00
-10271.79     .00    0.00     3.7  .134E+01   2.30   141.42
 -7059.13     .00    0.00     1.6  .317E+01   5.44   343.51
 -3846.46     .00    0.00     1.2  .402E+01   6.91   464.76
  -633.79     .00    0.00     1.1  .435E+01   7.47   560.36
  2578.88     .00    0.00     1.2  .407E+01   7.49   641.87
  5791.54     .00    0.00     1.5  .329E+01   7.49   714.14
  9004.21     .00    0.00     1.9  .263E+01   7.49   779.74
 12216.88     .00    0.00     2.2  .224E+01   7.49   840.24
 15429.55     .00    0.00     2.5  .203E+01   7.49   896.66
 18642.21     .00    0.00     2.6  .193E+01   7.49   949.74
 21854.88     .00    0.00     2.7  .187E+01   7.49  1000.00
 Cumulative travel time =     2185658. sec
END OF MOD331: UPSTREAM INTRUDING PLUME
------------------------------------------------------------------------------
------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
------------------------------------------------------------------------------
 At the end of the NFR, the plume POSITION EXCEEDS SPECIFIED LIMITS
  for the regulatory mixing zone (RMZ) and/or the region of interest (ROI).
 Specifications may be overly restrictive.
  Use larger ROI values in subsequent iteration!
 SIMULATION ENDS.
 Simulation limit based on maximum specified distance =  10000.00 m.
  This is the REGION OF INTEREST limitation.
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                End of Prediction File
333333333333333333333333333333333333333333333333333333333333333333333333333
33
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXX

CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b

SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:48:24

****
**

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:

Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 2500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.5 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge

Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 500 m^2
Discharge channel width B0 = 100 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.05
Reduced discharge channel due to intrusion:
Cross-section area A0 = 137.2680 m^2
Channel width B0 = 100 m
Channel depth H0 = 1.37 m
Aspect ratio AR = 0.01
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.20 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 5 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 11.72 m       Lm  = 4.78 m       Lbb = 6.79 m
  LM  = 4.01 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.34 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 0.41
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
HYDRODYNAMIC CLASSIFICATION:
  *----------------------*
  | FLOW CLASS   = PL2 |
  *----------------------*
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 1.6667 mg/l
  Dilution at edge of NFR             = 3
  NFR Location:                    x = 50 m
    (centerline coordinates)       y = 0 m
                                   z = 0 m
  NFR plume dimensions:       half-width = 24.20 m
                                thickness = 6.94 m
-------------------------------------------------------------------------
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 is vertically fully mixed WITHIN NEAR-FIELD (or a fraction thereof),
but RE-STRATIFIES LATER.
Plume becomes vertically fully mixed again at 5224.53 m downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts one bank only at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
3333333333333333333333333333333333333333333333333333333333333333333333333333
33
                CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3:                              Subsystem version:
 Buoyant Surface Discharges              CORMIX-GI Version 4.01b
---------------------------------------------------------------------------
---------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:            ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:     08/17/2004--15:48:24
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =  1000.00  AS    =  5000.00  QA    =  2500.00  ICHREG= 1
 HA    =     5.00  HD    =     5.00
 UA    =     .500 F     =     .018 USTAR = .2398E-01
 UW    =     .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U        RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT    DISTB =      .00  Configuration: flush_discharge
 SIGMA =    90.00  HD0   =     5.00  SLOPE =      .00
 Rectangular channel geometry:
 B0    =   100.000 H0    =     5.000 A0    = .5000E+03  AR    =     .050
 Reduced channel geometry due to intrusion:
 B0    =   100.000 H0    =     1.373 A0    = .1373E+03  AR    =     .014
 (All relevant parameters further below are based on this geometry.)
 U0    =     .204 Q0    =    28.000       = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0    = .5000E+01  CUNITS=  mg/l
 IPOLL =  1        KS    = .0000E+00  KD    = .0000E+00
FLUX VARIABLES (metric units)
 Q0    = .2800E+02  M0    = .5711E+01  J0    = .8486E+00
 Associated length scales (meters)
 LQ    =    11.72  LM    =     4.01  Lm    =     4.78  Lb    =     6.79
NON-DIMENSIONAL PARAMETERS
 FR0   =      .34  FRCH  =     1.00  R     =      .41
FLOW CLASSIFICATION
 3333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL2    3
 3  Applicable layer depth HS =     5.00  3
 3333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    = .5000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
      .00      .00    0.00     1.0  .500E+01   1.37    50.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
      .00      .00    0.00     1.0  .500E+01   1.37    50.00
 RAPID DEFLECTION by ambient current:
 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)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    50.00      .00    0.00     3.0  .167E+01   6.94    24.20
 Cumulative travel time =         100. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-------------------------------------------------------------------------------
 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.37 to conserve the mass flux in the far-field!
-------------------------------------------------------------------------------
BEGIN MOD341: 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 from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
 Plume Stage 2 (bank attached):
      X       Y       Z       S       C       BV       BH
```

```
   50.00      .00    0.00     3.0  .167E+01   5.00    33.23
  514.39      .00    0.00     4.5  .112E+01   1.94   127.46
  978.79      .00    0.00     5.8  .858E+00   1.68   192.18
 1443.18      .00    0.00     7.8  .642E+00   1.75   246.71
 1907.57      .00    0.00    10.5  .475E+00   1.97   295.50
 2371.96      .00    0.00    14.2  .353E+00   2.30   340.50
 2836.36      .00    0.00    18.8  .267E+00   2.71   382.76
 3300.75      .00    0.00    24.4  .205E+00   3.20   422.90
 3765.14      .00    0.00    31.2  .160E+00   3.74   461.31
 4229.53      .00    0.00    39.1  .128E+00   4.34   498.29
 4693.93      .00    0.00    48.1  .104E+00   4.99   534.03
 Cumulative travel time =        9285. sec
END OF MOD341: BUOYANT AMBIENT SPREADING
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
  Vertical diffusivity (initial value)   =  .240E-01 m^2/s
  Horizontal diffusivity (initial value) =  .300E-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 effects, if any)
 Plume Stage 2 (bank attached):
      X        Y       Z       S       C       BV       BH
  4693.93      .00    0.00    48.1  .104E+00   4.99   534.03
 Plume interacts with BOTTOM.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
  5224.53      .00    0.00    48.2  .104E+00   5.00   534.12
  5755.14      .00    0.00    48.2  .104E+00   5.00   534.22
  6285.75      .00    0.00    48.2  .104E+00   5.00   534.31
  6816.36      .00    0.00    48.2  .104E+00   5.00   534.40
  7346.96      .00    0.00    48.3  .104E+00   5.00   534.49
  7877.57      .00    0.00    48.3  .104E+00   5.00   534.59
  8408.18      .00    0.00    48.3  .104E+00   5.00   534.68
  8938.79      .00    0.00    48.3  .104E+00   5.00   534.77
  9469.39      .00    0.00    48.3  .104E+00   5.00   534.86
 10000.00      .00    0.00    48.3  .104E+00   5.00   534.96
 Cumulative travel time =       19780. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                End of Prediction File
```

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b
SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:50:29
****

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 250 m^2
Discharge channel width B0 = 50 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.1
Reduced discharge channel due to intrusion:
Cross-section area A0 = 108.9522 m^2
Channel width B0 = 50 m
Channel depth H0 = 2.18 m
Aspect ratio AR = 0.04
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.26 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference              DRHO   = 3.0884 kg/m^3
  Buoyant acceleration             GP0    = 0.0303 m/s^2
  Discharge concentration          C0     = 5 mg/l
  Surface heat exchange coeff.     KS     = 0 m/s
  Coefficient of decay             KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 10.44 m        Lm  = 26.83 m        Lbb = 848.56 m
  LM  = 4.77 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 0.46 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                  R      = 2.57
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = no
  Water quality standard specified       = no
  Regulatory mixing zone                 = no
  Region of interest                     = 10000 m downstream
************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 1.3257 mg/l
  Dilution at edge of NFR                = 3.8
  NFR Location:                    x = 778.47 m
    (centerline coordinates)       y = 0 m
                                   z = 0 m
  NFR plume dimensions:        half-width = 1000 m
                               thickness = 1.06 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 835.65 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -389.24 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
333333333333333333333333333333333333333333333333333333333333333333333333333
33
                CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3:                              Subsystem version:
 Buoyant Surface Discharges             CORMIX-GI Version 4.01b
---------------------------------------------------------------------------
---------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:            ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:    08/17/2004--15:50:29
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =  1000.00  AS    =  5000.00  QA    =   500.00  ICHREG= 1
 HA    =     5.00  HD    =     5.00
 UA    =     .100 F     =     .018 USTAR = .4796E-02
 UW    =     .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U       RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT    DISTB =      .00  Configuration: flush_discharge
 SIGMA =    90.00  HD0   =     5.00  SLOPE =      .00
 Rectangular channel geometry:
 B0    =    50.000 H0    =     5.000 A0    = .2500E+03  AR    =     .100
 Reduced channel geometry due to intrusion:
 B0    =    50.000 H0    =     2.179 A0    = .1090E+03  AR    =     .044
 (All relevant parameters further below are based on this geometry.)
 U0    =      .257 Q0    =    28.000       = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0    = .5000E+01  CUNITS=  mg/l
 IPOLL =  1        KS    = .0000E+00  KD    = .0000E+00
FLUX VARIABLES (metric units)
 Q0    = .2800E+02  M0    = .7196E+01  J0    = .8486E+00
 Associated length scales (meters)
 LQ    =    10.44  LM    =     4.77  Lm    =    26.83  Lb    =   848.56
NON-DIMENSIONAL PARAMETERS
 FR0   =      .46  FRCH  =     1.00  R     =     2.57
FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)       =    PL1    3
 3  Applicable layer depth HS =     5.00  3
 333333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    = .5000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .500E+01   2.18    25.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .500E+01   2.18    25.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    2.71    29.44    0.00     2.2  .231E+01   5.00    86.61
 Cumulative travel time =         115. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    2.71    29.44    0.00     2.2  .231E+01   5.00    86.61
   The PLUME EXTENDS ACROSS THE ENTIRE CHANNEL width at the point
     of discharge. For this reason the following predictions
     may be INACCURATE.
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     389.24 m
       X-position of upstream stagnation point =    -389.24 m
       Thickness in intrusion region         =       1.06 m
       Half-width at downstream end          =    1000.00 m
       Thickness at downstream end           =       1.06 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
```

```
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
   CORMIX steady-state predictions of upstream intrusion are probably
   unrealistic.
 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)
      X       Y       Z       S       C       BV       BH
  -389.24     .00    0.00  9999.9  .000E+00    .00      .00
  -365.88     .00    0.00     7.1  .707E+00    .32   141.42
  -251.45     .00    0.00     3.0  .167E+01    .76   343.51
  -137.01     .00    0.00     2.3  .213E+01    .97   464.76
   -22.58     .00    0.00     2.2  .231E+01   1.05   560.36
    91.86     .00    0.00     2.2  .223E+01   1.06   641.87
   206.30     .00    0.00     2.5  .196E+01   1.06   714.14
   320.73     .00    0.00     3.0  .169E+01   1.06   779.74
   435.17     .00    0.00     3.3  .151E+01   1.06   840.24
   549.60     .00    0.00     3.6  .141E+01   1.06   896.66
   664.04     .00    0.00     3.7  .136E+01   1.06   949.74
   778.47     .00    0.00     3.8  .133E+01   1.06  1000.00
 Cumulative travel time =        7873. sec
END OF MOD331: UPSTREAM INTRUDING PLUME
------------------------------------------------------------------------------
------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD341: 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 from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
 Plume Stage 2 (bank attached):
      X       Y       Z       S       C       BV       BH
   778.47     .00    0.00     3.8  .133E+01   1.03   973.12
   784.19     .00    0.00     3.8  .132E+01   1.03   975.84
   789.91     .00    0.00     3.8  .132E+01   1.02   978.56
   795.63     .00    0.00     3.8  .132E+01   1.02   981.27
   801.35     .00    0.00     3.8  .132E+01   1.02   983.97
   807.06     .00    0.00     3.8  .132E+01   1.02   986.67
   812.78     .00    0.00     3.8  .132E+01   1.02   989.36
   818.50     .00    0.00     3.8  .132E+01   1.01   992.04
   824.22     .00    0.00     3.8  .132E+01   1.01   994.72
```

```
   829.94      .00    0.00     3.8  .131E+01   1.01   997.39
   835.65      .00    0.00     3.8  .131E+01   1.01  1000.00
 Cumulative travel time =        8414. 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)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
      X        Y       Z        S       C        BV       BH
    835.65      .00    0.00     3.8  .131E+01   1.01  1000.00
   1752.09      .00    0.00     3.8  .131E+01   1.01  1000.00
   2668.52      .00    0.00     3.8  .131E+01   1.01  1000.00
   3584.96      .00    0.00     3.8  .131E+01   1.01  1000.00
   4501.39      .00    0.00     3.8  .131E+01   1.01  1000.00
   5417.83      .00    0.00     3.8  .131E+01   1.01  1000.00
   6334.26      .00    0.00     3.8  .131E+01   1.01  1000.00
   7250.70      .00    0.00     3.8  .131E+01   1.01  1000.00
   8167.13      .00    0.00     3.8  .131E+01   1.01  1000.00
   9083.57      .00    0.00     3.8  .131E+01   1.01  1000.00
  10000.00      .00    0.00     3.8  .131E+01   1.01  1000.00
 Cumulative travel time =       95198. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b
SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:51:18
****

SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 150 m^2
Discharge channel width B0 = 30 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.166667
Reduced discharge channel due to intrusion:
Cross-section area A0 = 91.8954 m^2
Channel width B0 = 30 m
Channel depth H0 = 3.06 m
Aspect ratio AR = 0.10
Discharge flowrate Q0 = 28 m^3/s
Discharge velocity U0 = 0.30 m/s
Discharge density RHO0 = 996.2905 kg/m^3

```
  Density difference            DRHO   = 3.0884 kg/m^3
  Buoyant acceleration          GP0    = 0.0303 m/s^2
  Discharge concentration       C0     = 5 mg/l
  Surface heat exchange coeff.  KS     = 0 m/s
  Coefficient of decay          KD     = 0 /s
-------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 9.59 m       Lm  = 29.21 m       Lbb = 848.56 m
  LM  = 5.42 m
-------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number     FR0    = 0.57 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1 (based on H0)
  Velocity ratio                R      = 3.05
-------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                     = no
  Water quality standard specified    = no
  Regulatory mixing zone              = no
  Region of interest                  = 10000 m downstream
*************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 1.4268 mg/l
  Dilution at edge of NFR             = 3.5
  NFR Location:                   x = 774.36 m
    (centerline coordinates)      y = 0 m
                                  z = 0 m
  NFR plume dimensions:       half-width = 977.09 m
                              thickness = 1.00 m
-------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m
downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 880.07 m
downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -387.18 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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.

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:
3333333333333333333333333333333333333333333333333333333333333333333333333333
33
                CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3:                              Subsystem version:
 Buoyant Surface Discharges              CORMIX-GI Version 4.01b
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:        ILVA_A
 Design case:            ILVA_A
 FILE NAME:              C:\WINDOWS\Desktop\ilva\ILVA_A.prd
 Time of Fortran run:    08/17/2004--15:51:18
ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =  1000.00  AS    =  5000.00  QA    =    500.00  ICHREG= 1
 HA    =     5.00  HD    =     5.00
 UA    =     .100 F     =     .018 USTAR = .4796E-02
 UW    =     .000 UWSTAR= .0000E+00
 Uniform density environment
 STRCND=  U       RHOAM =  999.3789
DISCHARGE PARAMETERS (metric units)
 BANK  =  RIGHT    DISTB =      .00  Configuration: flush_discharge
 SIGMA =    90.00  HD0   =     5.00  SLOPE =      .00
 Rectangular channel geometry:
 B0    =    30.000 H0    =     5.000 A0    = .1500E+03  AR    =      .167
 Reduced channel geometry due to intrusion:
 B0    =    30.000 H0    =     3.063 A0    = .9190E+02  AR    =      .102
 (All relevant parameters further below are based on this geometry.)
 U0    =      .305 Q0    =    28.000       = .2800E+02
 RHO0  =  996.2905  DRHO0 = .3088E+01  GP0   = .3031E-01
 C0    = .5000E+01  CUNITS=  mg/l
 IPOLL =  1        KS    = .0000E+00  KD    = .0000E+00
FLUX VARIABLES (metric units)
 Q0    = .2800E+02  M0    = .8531E+01  J0    = .8486E+00
 Associated length scales (meters)
 LQ    =     9.59  LM    =     5.42  Lm    =    29.21  Lb    =    848.56
NON-DIMENSIONAL PARAMETERS
 FR0   =      .57  FRCH  =     1.00  R     =     3.05
FLOW CLASSIFICATION
 333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL1    3
 3  Applicable layer depth HS =     5.00  3
 333333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    = .5000E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
```

```
 XINT  =  10000.00  XMAX  =  10000.00
X-Y-Z COORDINATE SYSTEM:
   ORIGIN is located at the WATER SURFACE and at center of discharge
     channel/outlet:       .00 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 = 10 display intervals per module
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .500E+01   3.06    15.00
END OF MOD301: DISCHARGE MODULE
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     .00      .00    0.00     1.0  .500E+01   3.06    15.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
    2.23    28.82    0.00     2.0  .252E+01   5.00    61.35
 Cumulative travel time =          95. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
    2.23    28.82    0.00     2.0  .252E+01   5.00    61.35
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     387.18 m
       X-position of upstream stagnation point =    -387.18 m
       Thickness in intrusion region         =       1.00 m
       Half-width at downstream end          =     977.09 m
       Thickness at downstream end           =       1.00 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
```

```
  CORMIX steady-state predictions of upstream intrusion are probably
  unrealistic.
 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)
     X       Y       Z       S       C       BV       BH
  -387.18     .00    0.00  9999.9  .000E+00    .00      .00
  -363.95     .00    0.00     6.5  .772E+00    .31   138.18
  -250.12     .00    0.00     2.7  .183E+01    .73   335.64
  -136.29     .00    0.00     2.2  .232E+01    .92   454.11
   -22.46     .00    0.00     2.0  .252E+01   1.00   547.52
    91.37     .00    0.00     2.1  .243E+01   1.00   627.17
   205.21     .00    0.00     2.3  .213E+01   1.00   697.79
   319.04     .00    0.00     2.7  .183E+01   1.00   761.88
   432.87     .00    0.00     3.1  .163E+01   1.00   820.99
   546.70     .00    0.00     3.3  .152E+01   1.00   876.12
   660.53     .00    0.00     3.4  .146E+01   1.00   927.98
   774.36     .00    0.00     3.5  .143E+01   1.00   977.09
 Cumulative travel time =        7816. sec
END OF MOD331: UPSTREAM INTRUDING PLUME
------------------------------------------------------------------------------
------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD341: 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 from bank/shoreline
  S  = hydrodynamic average (bulk) dilution
  C  = average (bulk) concentration (includes reaction effects, if any)
 Plume Stage 2 (bank attached):
     X       Y       Z       S       C       BV       BH
   774.36     .00    0.00     3.5  .143E+01    .98   950.83
   784.93     .00    0.00     3.5  .142E+01    .97   955.89
   795.50     .00    0.00     3.5  .142E+01    .97   960.93
   806.07     .00    0.00     3.5  .142E+01    .97   965.94
   816.65     .00    0.00     3.5  .142E+01    .96   970.93
   827.22     .00    0.00     3.5  .141E+01    .96   975.90
   837.79     .00    0.00     3.5  .141E+01    .96   980.85
   848.36     .00    0.00     3.5  .141E+01    .95   985.77
   858.93     .00    0.00     3.6  .141E+01    .95   990.68
   869.50     .00    0.00     3.6  .140E+01    .95   995.57
   880.07     .00    0.00     3.6  .140E+01    .94  1000.00
 Cumulative travel time =        8817. 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) = .480E-02 m^2/s
Horizontal diffusivity (initial value) = .600E-02 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 effects, if any)
Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH
880.07	.00	0.00	3.6	.140E+01	.94	1000.00
1792.06	.00	0.00	3.6	.140E+01	.94	1000.00
2704.06	.00	0.00	3.6	.140E+01	.95	1000.00
3616.05	.00	0.00	3.6	.140E+01	.95	1000.00
4528.04	.00	0.00	3.6	.140E+01	.95	1000.00
5440.03	.00	0.00	3.6	.140E+01	.95	1000.00
6352.03	.00	0.00	3.6	.140E+01	.95	1000.00
7264.02	.00	0.00	3.6	.140E+01	.95	1000.00
8176.01	.00	0.00	3.6	.140E+01	.95	1000.00
9088.01	.00	0.00	3.6	.140E+01	.95	1000.00
10000.00	.00	0.00	3.6	.140E+01	.95	1000.00

Cumulative travel time = 95180. sec
Simulation limit based on maximum specified distance = 10000.00 m.
This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX3: Buoyant Surface Discharges End of Prediction File
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33

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CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX: CORNELL MIXING ZONE EXPERT SYSTEM
CORMIX-GI Version 4.01b
SITE NAME/LABEL: ILVA A
DESIGN CASE: ILVA A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA A.prd
Using subsystem CORMIX3: Buoyant Surface Discharges
Start of session: 08/17/2004--15:52:28
****
SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 1000 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 500 m^3/s
Average depth HA = 5 m
Depth at discharge HD = 5 m
Ambient velocity UA = 0.1 m/s
Darcy-Weisbach friction factor F = 0.0184
Wind velocity UW = 0 m/s
Stratification Type STRCND = U
Surface density RHOAS = 999.3789 kg/m^3
Bottom density RHOAB = 999.3789 kg/m^3

DISCHARGE PARAMETERS: Buoyant Surface Discharge
Discharge located on = right bank/shoreline
Discharge configuration = flush discharge
Distance from bank to outlet DISTB = 0 m
Discharge angle SIGMA = 90 deg
Depth near discharge outlet HD0 = 5 m
Bottom slope at discharge SLOPE = 0 deg
Rectangular discharge:
Discharge cross-section area A0 = 50 m^2
Discharge channel width B0 = 10 m
Discharge channel depth H0 = 5 m
Discharge aspect ratio AR = 0.5
Discharge flowrate Q0 = 28.000000 m^3/s
Discharge velocity U0 = 0.56 m/s
Discharge density RHO0 = 996.2905 kg/m^3
Density difference DRHO = 3.0884 kg/m^3
Buoyant acceleration GP0 = 0.0303 m/s^2
Discharge concentration C0 = 5 mg/l
Surface heat exchange coeff. KS = 0 m/s
Coefficient of decay KD = 0 /s

```
---------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 7.07 m        Lm  = 39.60 m        Lbb = 848.56 m
  LM  = 8.55 m
---------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    = 1.21 (based on LQ)
  Channel densimetric Froude no.  FRCH   = 1.44 (based on H0)
  Velocity ratio                  R      = 5.60
---------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                      = no
  Water quality standard specified     = no
  Regulatory mixing zone               = no
  Region of interest                   = 10000 m downstream
***************************************************************************
**
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 m from the right bank/shore.
  Number of display steps NSTEP = 10 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 edge of NFR = 1.7682 mg/l
  Dilution at edge of NFR              = 2.8
  NFR Location:                    x = 762.48 m
    (centerline coordinates)       y = 0 m
                                   z = 0 m
  NFR plume dimensions:       half-width = 883.82 m
                              thickness = 0.90 m
---------------------------------------------------------------------------
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 WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.
Plume becomes laterally fully mixed at 1061.31 m downstream.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section contacts nearest bank at -381.24 m downstream.
Plume contacts second bank at 0 m downstream.

********** TOXIC DILUTION ZONE SUMMARY **********

No TDZ was specified for this simulation.

********** REGULATORY MIXING ZONE SUMMARY **********

No RMZ and no ambient water quality standard have been specified.

********** 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:
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CORNELL MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX3: Subsystem version:
Buoyant Surface Discharges CORMIX-GI Version 4.01b

CASE DESCRIPTION
Site name/label: ILVA_A
Design case: ILVA_A
FILE NAME: C:\WINDOWS\Desktop\ilva\ILVA_A.prd
Time of Fortran run: 08/17/2004--15:52:28
ENVIRONMENT PARAMETERS (metric units)
Bounded section
BS = 1000.00 AS = 5000.00 QA = 500.00 ICHREG= 1
HA = 5.00 HD = 5.00
UA = .100 F = .018 USTAR = .4796E-02
UW = .000 UWSTAR= .0000E+00
Uniform density environment
STRCND= U RHOAM = 999.3789
DISCHARGE PARAMETERS (metric units)
BANK = RIGHT DISTB = .00 Configuration: flush_discharge
SIGMA = 90.00 HD0 = 5.00 SLOPE = .00
Rectangular channel geometry:
B0 = 10.000 H0 = 5.000 A0 = .5000E+02 AR = .500
U0 = .560 Q0 = 28.000 = .2800E+02
RHO0 = 996.2905 DRHO0 = .3088E+01 GP0 = .3031E-01
C0 = .5000E+01 CUNITS= mg/l
IPOLL = 1 KS = .0000E+00 KD = .0000E+00
FLUX VARIABLES (metric units)
Q0 = .2800E+02 M0 = .1568E+02 J0 = .8486E+00
Associated length scales (meters)
LQ = 7.07 LM = 8.55 Lm = 39.60 Lb = 848.56
NON-DIMENSIONAL PARAMETERS
FR0 = 1.21 FRCH = 1.44 R = 5.60
FLOW CLASSIFICATION
333333333333333333333333333333333333
3 Flow class (CORMIX3) = PL1 3
3 Applicable layer depth HS = 5.00 3
333333333333333333333333333333333333
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
C0 = .5000E+01 CUNITS= mg/l
NTOX = 0
NSTD = 0
REGMZ = 0
XINT = 10000.00 XMAX = 10000.00
X-Y-Z COORDINATE SYSTEM:
ORIGIN is located at the WATER SURFACE and at center of discharge

```
      channel/outlet:       .00 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 = 10 display intervals per module
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE
 Efflux conditions:
      X       Y       Z       S       C       BV       BH
      .00     .00    0.00     1.0  .500E+01   5.00     5.00
END OF MOD301: DISCHARGE MODULE
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
      .00     .00    0.00     1.0  .500E+01   5.00     5.00
 VERTICAL MIXING occurs in the initial zone of flow establishment.
 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 effects, if any)
  Control volume outflow:
      X       Y       Z       S       C       BV       BH
     1.03    24.47    0.00     1.5  .326E+01   5.00    20.03
 Cumulative travel time =          44. sec
END OF MOD302: ZONE OF FLOW ESTABLISHMENT
------------------------------------------------------------------------------
------------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME
  Control volume inflow:
      X       Y       Z       S       C       BV       BH
     1.03    24.47    0.00     1.5  .326E+01   5.00    20.03
 UPSTREAM INTRUSION PROPERTIES:
       Upstream intrusion length             =     381.24 m
       X-position of upstream stagnation point =    -381.24 m
       Thickness in intrusion region         =        .90 m
       Half-width at downstream end          =     883.82 m
       Thickness at downstream end           =        .90 m
 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
   CORMIX steady-state predictions of upstream intrusion are probably
   unrealistic.
 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)

X	Y	Z	S	C	BV	BH	
-381.24	.00	0.00	9999.9	.000E+00	.00	.00	
-358.36	.00	0.00	5.0	.998E+00	.27	124.99	
-246.28	.00	0.00	2.1	.236E+01	.65	303.60	
-134.20	.00	0.00	1.7	.300E+01	.83	410.76	
-22.11	.00	0.00	1.5	.325E+01	.89	495.25	
89.97	.00	0.00	1.6	.312E+01	.90	567.30	
202.06	.00	0.00	1.8	.270E+01	.90	631.17	
314.14	.00	0.00	2.2	.230E+01	.90	689.15	
426.22	.00	0.00	2.5	.204E+01	.90	742.62	
538.31	.00	0.00	2.7	.189E+01	.90	792.49	
650.39	.00	0.00	2.8	.181E+01	.90	839.40	
762.48	.00	0.00	2.8	.177E+01	.90	883.82	

Cumulative travel time = 7658. sec
END OF MOD331: UPSTREAM INTRUDING PLUME

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD341: 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 from bank/shoreline
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	
762.48	.00	0.00	2.8	.177E+01	.87	860.07	
792.36	.00	0.00	2.8	.176E+01	.86	874.98	
822.24	.00	0.00	2.9	.175E+01	.85	889.68	
852.12	.00	0.00	2.9	.174E+01	.84	904.19	
882.01	.00	0.00	2.9	.173E+01	.83	918.49	
911.89	.00	0.00	2.9	.172E+01	.83	932.61	
941.77	.00	0.00	2.9	.171E+01	.82	946.55	
971.66	.00	0.00	2.9	.170E+01	.81	960.32	
1001.54	.00	0.00	2.9	.170E+01	.80	973.92	
1031.42	.00	0.00	3.0	.169E+01	.80	987.35	
1061.31	.00	0.00	3.0	.168E+01	.79	1000.00	

Cumulative travel time = 10488. sec
Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.
END OF MOD341: BUOYANT AMBIENT SPREADING

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BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
  Vertical diffusivity (initial value)   =  .480E-02 m^2/s
  Horizontal diffusivity (initial value) =  .600E-02 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 effects, if any)
 Plume Stage 2 (bank attached):
      X       Y      Z       S       C        BV       BH
   1061.31     .00    0.00     3.0  .168E+01    .79  1000.00
   1955.18     .00    0.00     3.0  .168E+01    .79  1000.00
   2849.04     .00    0.00     3.0  .168E+01    .79  1000.00
   3742.91     .00    0.00     3.0  .168E+01    .79  1000.00
   4636.78     .00    0.00     3.0  .168E+01    .79  1000.00
   5530.65     .00    0.00     3.0  .168E+01    .79  1000.00
   6424.52     .00    0.00     3.0  .168E+01    .79  1000.00
   7318.39     .00    0.00     3.0  .168E+01    .79  1000.00
   8212.26     .00    0.00     3.0  .168E+01    .79  1000.00
   9106.13     .00    0.00     3.0  .168E+01    .79  1000.00
  10000.00     .00    0.00     3.0  .168E+01    .79  1000.00
 Cumulative travel time =       95135. sec
 Simulation limit based on maximum specified distance =  10000.00 m.
   This is the REGION OF INTEREST limitation.
END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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--------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                  End of Prediction File
```