

```

CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 9.0GTD
DYDRO:Version-9.0.0.0 September,2014
SITE NAME/LABEL: Santa Maria
DESIGN CASE: Modelamiento Efluente de PROVISUR v01
FILE NAME: C:\Program Files (x86)\CORMIX 9.0\PROYECTO PROVISUR\REVISION 1.prd
Using subsystem BCORMIX2: Multiport Diffuser Brine Discharges
Start of session: 06/15/2016--23:34:15
*****
SUMMARY OF INPUT DATA:
-----
AMBIENT PARAMETERS:
Cross-section = unbounded
Average depth HA = 20.11 m
Depth at discharge HD = 20.11m
Bottom slope (single slope only) SLOPE = 1.5 deg
Ambient velocity UA = 0.05 m/s
Darcy-Weisbach friction factor F = 0.03
Wind velocity UW = 2 m/s
Stratification Type STRCND = U
Surface density RHOAS = 1024.8300 kg/m^3
Bottom density RHOAB = 1024.8300 kg/m^3
-----
DISCHARGE PARAMETERS: Submerged Multiport Diffuser Discharge
Diffuser type DITYPE = unidirectional perpendicular
Diffuser length LD = 22.5 m
Nearest bank = left
Diffuser endpoints YB1 = 756.90 m; YB2 = 779.40 m
Number of openings NOPEN = 10
Number of Risers NRISER = 5
Ports/Nozzles per Riser NPPERR = 2
Spacing between risers/openings SPAC = 5.63 m
Port/Nozzle diameter D0 = 0.147 m
with contraction ratio = 1
Equivalent slot width B0 = 0.0075 m
Total area of openings TAO = 0.1697 m^2
Discharge velocity U0 = 5.81 m/s
Total discharge flowrate Q0 = 0.9866 m^3/s
Discharge port height H0 = 1.9 m
Nozzle arrangement BETYPE = unidirectional without fanning
Diffuser alignment angle GAMMA = 90 deg
Vertical discharge angle THETA = 60 deg
Actual Vertical discharge angle THEAC = 60 deg
Horizontal discharge angle SIGMA = 0 deg
Relative orientation angle BETA = 90 deg
Discharge density RHO0 = 1031.8300 kg/m^3
Density difference DRHO = -7 kg/m^3
Buoyant acceleration GP0 = -0.067 m/s^2
Discharge concentration C0 = 280 bacteria-counts
Surface heat exchange coeff. KS = 0 m/s
Coefficient of decay KD = 0 /s
-----
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
Discharge (volume flux) q0 = 0.043849 m^2/s
Momentum flux m0 = 0.254903 m^3/s^2
Buoyancy flux j0 = -0.002937 m^3/s^3
-----
DISCHARGE/ENVIRONMENT LENGTH SCALES:
LQ = 0.01 m Lm = 101.96 m LM = 12.40 m
lm' = 99999 m Lb' = 99999 m La = 99999 m
(These refer to the actual discharge/environment length scales.)
-----
NON-DIMENSIONAL PARAMETERS:
Slot Froude number FR0 = 258.62
Port/nozzle Froude number FRD0 = 58.58
Velocity ratio R = 116.26
-----
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
Toxic discharge = no
Water quality standard specified = yes
Water quality standard CSTD = 12 bacteria-counts
Regulatory mixing zone = yes
Regulatory mixing zone specification = distance
Regulatory mixing zone value = 500 m (m^2 if area)
Region of interest = 1200 m
*****
HYDRODYNAMIC CLASSIFICATION:
*-----*
| FLOW CLASS = MNU7 |
*-----*
This flow configuration applies to a layer corresponding to the full water
depth at the discharge site.
Applicable layer depth = water depth = 20.11 m
*****
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):
-----
X-Y-Z Coordinate system:

```

Origin is located at the SURFACE:  
1) directly above the port/diffuser center for submerged discharges, OR:  
2) at the point of entry into the water for above surface discharges,  
768.15 m from the left bank/shore.  
Number of display steps NSTEP = 100 per module.

-----  
NEAR-FIELD REGION (NFR) CONDITIONS :

Note: The NFR is the zone of strong initial mixing. It has no regulatory implication. However, this information may be useful for the discharge designer because the mixing in the NFR is usually sensitive to the discharge design conditions.

Pollutant concentration at NFR edge c = 4.0793 bacteria-counts  
Dilution at edge of NFR s = 68.6  
NFR Location: x = 238.82 m  
(centerline coordinates) y = 0 m  
z = -20.11 m

NFR plume dimensions: half-width (bh) = 172.88 m  
thickness (bv) = 2.19 m

Cumulative travel time: 11523.9033 sec.  
-----

Buoyancy assessment:

The effluent density is greater than the surrounding ambient water density at the discharge level.

Therefore, the effluent is NEGATIVELY BUOYANT and will tend to sink towards the bottom.  
-----

Near-field instability behavior:

The diffuser flow will experience instabilities with full vertical mixing in the near-field.

There may be benthic impact of high pollutant concentrations.  
-----

FAR-FIELD MIXING SUMMARY:

Plume becomes vertically fully mixed WITHIN NEAR-FIELD at 0 m downstream, but RE-STRATIFIES LATER and is not mixed in the far-field.  
-----

PLUME BANK CONTACT SUMMARY:

Plume in unbounded section does not contact bank in this simulation.

\*\*\*\*\* TOXIC DILUTION ZONE SUMMARY \*\*\*\*\*  
No TDZ was specified for this simulation.

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

The plume conditions at the boundary of the specified RMZ are as follows:

Pollutant concentration c = 3.17332 bacteria-counts  
Corresponding dilution s = 88.2  
Plume location: x = 500 m  
(centerline coordinates) y = -6.24 m  
z = -20.28 m

Plume dimensions: half-width (bh) = 201.06 m  
thickness (bv) = 2.10 m

Cumulative travel time: 16747.5117 sec.  
-----

Note:

Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.

At this position, the plume is NOT IN CONTACT with any bank.

Furthermore, the specified water quality standard has indeed been met within the RMZ. In particular:

The ambient water quality standard was encountered at the following

plume position:

Water quality standard = 12 bacteria-counts  
Corresponding dilution s = 23.2  
Plume location: x = 3.63 m  
(centerline coordinates) y = 0 m  
z = -17.85 m

Plume dimensions: half-width (bh) = 8.55 m  
thickness (bv) = 6.50 m

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

CORMIX2 uses the TWO-DIMENSIONAL SLOT DIFFUSER CONCEPT to represent the actual three-dimensional diffuser geometry. Thus, it approximates the details of the merging process of the individual jets from each port/nozzle.

In the present design, the spacing between adjacent ports/nozzles (or riser assemblies) is of the order of, or less than, the local water depth so that the slot diffuser approximation holds well.

Nevertheless, if this is a final design, the user is advised to use a final CORMIX1 (single port discharge) analysis, with discharge data for an individual diffuser jet/plume, in order to compare to the present near-field prediction.  
-----

DIFFUSER DESIGN DETAILS: The two nozzle group for each riser was treated as ONE EQUIVALENT SINGLE NOZZLE with an orientation that represents an average for the two nozzles.  
-----

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  $\pm 50\%$  (standard deviation).

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