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Technical Report

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LD Celulose S.A.

Dissolving Pulp Mill, in Indianópolis- Minas Gerais State

TREATED EFFLUENT DISPERSION STUDY

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SUMMARY

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1 INTRODUCTION

This document consists of the Treated Effluent Dispersion Study from the future dissolving pulp mill of LD CELULOSE, which will be discharged in Araguari River.

In general, the most relevant issues facing contemporary society are the preservation of water resources. In Brazil, the concern about this issue is evidenced, among others, in Law No. 9433/1997 (establishes the National Water Resources Policy and creates the National Water Resources Management System) that disciplines the use of water in the country, and in CONAMA Resolutions No. 357/2005 and CONAMA No. 430/2011, which provide for the classification of water bodies and environmental guidelines for their setting, as well as establishing the conditions and standards for the discharge of effluents.

Among the control instruments foreseen in our legislation, we highlight the monitoring and diagnosis of the quality of water resources, especially rivers and estuaries. In this particular, water quality mathematical models can be useful tools.

These models consist of a set of equations that, solved, provide the space-time distribution of constituents that are transported in solution and in suspension by the water body. These equations, as a rule, are solved numerically, generating what is called a numerical simulation, and the model, once calibrated, allows to draw future and past scenarios according to the inputs that are prescribed. Thus, mixing zones, pollutant feather behavior and dispersion can be properly calculated and predicted by the simulation.

In order to complement CONAMA Resolution No. 357/2005, CONAMA Resolution No. 430/2011 provides the conditions and standards for the discharge of effluents. As established by this Resolution, the need for a study of the mixing zone of a treated effluent in the receiving body is established.

In compliance with this Resolution, the objective of this study is to know the approximate distance that the complete mixing of treated effluent with the waters of the Araguari River occurs, that is, to know its mixing zone.

This knowledge is considered important to meet one of the requirements of CONAMA Resolution No. 430/2011, which in its Article 13 says: *"In the mixing zone will be admitted concentrations of substances in disagreement with the quality standards established for the receiving body, provided that they do not compromise the intended uses". "The extent and concentrations of substances in the mixing zone shall be subject to study, when determined by the competent environmental agency, at the expense of the launching entrepreneur".*

In Article 4, item XIV, the mixing zone is defined as "*region of the receiving body, estimated on the basis of theoretical models accepted by the competent environmental agency, which extends from the point of effluent discharge, and delimited by the surface on which it is reached the equilibrium of the mixture between the physical and chemical parameters, as well as the biological balance of the effluent and those of the receiving body, being specific for each parameter*".

Therefore, this document presents the Treated Effluent Dispersion Study, aiming to know the zone of mixture of treated effluents from the project of the dissolving pulp of LD CELULOSE mill in the Araguari River.

In order to know the dispersion of the effluent from the project of the mentioned mill, simulations were carried out through the mathematical model CORMIX, developed by Cornell University in conjunction with the US Environmental Protection Agency (USEPA), mainly in terms of load (measured in BOD), color and total phosphorus, the results of which are presented in this report.

This Study is comprised by folowing chapters:

- Introduction
- Project Information
- Effluent Dispersion Model
- Mixing Zone Modeling
- Conclusions
- References

2 PROJECT INFORMATION

2.1 General Description

The LD CELULOSE mill will have the capacity to produce 540,000 t/y of dissolving pulp, which will be exported and used as raw material for the production of viscose yarns and others. In addition, a cogeneration unit with a nominal capacity of 132 MW will be installed.

The dissolving pulp mill will be located in the municipality of Indianópolis and Araguari (MG), along Highway BR 365,35 km away from Uberlândia.

The operating regime of the dissolving pulp mill will be 24 hours a day, 7 days a week and 12 months a year. The actual production period will be approximately 352 days, considering the annual general maintenance stoppage of the equipment.

Regard to environmental control systems, the implementation of the industrial plant will adopt the Best Available Technologies (BAT), aiming at reducing, controlling and monitoring liquid effluent emissions, atmospheric emissions and solid waste generated.

2.2 Description of the Effluent Treatment System

2.2.1 Sources of Generation and Untreated Effluent Characteristics

Basically, the liquid effluents generation sources, that will correspond to the activities of the pulp mill process and other support activities, are listed below:

- Effluents from wood handling area
- Effluents from cooking area and brown pulp washing area
- Filtered alkaline and filtered acid form bleaching
- Effluents from drying machine
- Effluent from evaporation and recovery

- Effluents from recausticizing area and lime kiln
- Contaminated condensate
- Sewage effluent
- Contaminated rainwater; and
- Others (spills, leaks, areas cleaning etc.)

The predicted characteristics of the untreated effluent from the dissolving pulp mill are presented in the following table.

Table 1 – Untreated effluent characteristics

Parameters	Unit	Value
Flow	m^3/h	1,900
	m^3/s	0.53
pH	-	3 – 11
Temperature	ºC	50 - 60
BOD	mg/L	504
COD	mg/L	1,257
TSS	mg/L	349
Color	mg/L	877

Source: LD Celulose (2019).

2.2.2 Description of the Effluent Treatment Plant (ETE)

The effluent treatment system of LD CELULOSE will basically consist of two steps: removal of solids and removal of organic load. The main units of this system are listed and described below.

- Railing
- Primary clarifier
- Emergency pond
- Neutralization
- Cooling
- Activated sludge - aeration tank
- Secund Secondary clarifier
- Emissary

<u>Railing</u>

Effluent streams containing suspended solids will be gravity driven to a railing system to remove coarse materials. This system will be provided with 2 sets consisting of a mechanized grid and a manual grid, which will be used in the maintenance of the mechanized grid.

Primary Clarifier

After passing through the grid and flow measurement system, the raw effluent will be sent to primary clarifier to reduce the amount of suspended solids. These clarifiers will be equipped with a scraper to remove sedimented solids and scum accumulated on the surface thereof. The sedimented solids and scum will be withdrawn by pumps to be sent to the primary sludge dewatering system. The clarified effluent will be sent to the neutralization system.

Primary Sludge Dewatering System

The primary sludge dewatering system will be comprised of a mechanical drum or gravity table type thickener and a screw type dewatering press. The expected final consistency of dewatered sludge is between 35 to 45%.

Emergency Pond

In addition to the expected collection and spill leakage and spill systems in each department of the mill, there will be a set of emergency tanks at the effluent treatment plant. The objective of this pond will be to receive all effluents with characteristics outside the specification. Once diverted to the emergency lagoon, the contents of the pond will be dosed to the inlet of the neutralization tank, so that no disturbance is created in the biological treatment.

The operation of this will be controlled by online monitoring of pH, temperature and conductivity. When levels outside the acceptable range occur, the valves will be closed and the effluent will be diverted to the emergency pond.

The pond will be constructed as an excavated pond with the bottom adequately waterproofed and inclined to the drainage pumps.

Contaminated Rainwater

Rainwater with possibility of contamination will be sent to the contaminated rainwater retention pond to avoid hydraulic overload at the treatment plant due to high rainfall. Once diverted to the retention pond, rainwater will be treated and added slowly at the entrance to the station.

Effluent Neutralization

The effluent from the primary clarifiers will be sent to a neutralization tank which will also receive effluents without suspended solids. The purpose of this step will be to neutralize the combined effluent through the addition of caustic soda or sulfuric acid, aiming to maintain a pH between 6 and 8, making it suitable for biological treatment. The neutralization tank will be equipped with mechanical stirrers.

Effluent Cooling

The neutralized effluent still has a temperature considered to be high for biological treatment, then should be cooled to a temperature that does not adversely affect the performance of the biological treatment. The effluents cooling will be carried out through a cooling tower, being sized to an approximate temperature of 60 ºC, and an exit temperature of around 35 ºC.

Activated Sludge

The biological treatment system adopted in the LD Celulose will be of the aerobic type by activated sludge. The activated sludge process is a technology proven and commonly used in the pulp and paper industries worldwide.

The biological process requires, for optimum performance, sufficient concentrations of nitrogen and phosphorus in the effluent. The quantities required will be related to the amount of biodegradable organic matter, ie, BOD (Biochemical Oxygen Demand) present in the untreated effluent.

Urea and phosphoric acid are being considered as sources of nitrogen and phosphorus and will be added, if necessary, before the effluent enters the selector tank. The amount required will be dependent on the amount present in the effluent (only the minimum quantities required should be added so that the discharges are minimized).

After the dosage of nutrients, the effluents will be sent to the selector tank, which will have high capacity of oxygenation and aims to eliminate the filamentous organisms. From this tank, the effluents will go to the aeration tank, where they will be submitted to the degradation of the organic matter present in the soluble and colloidal form through the activity of the aerobic microorganisms. The air injection into the system will be performed by fine bubble diffusers that will be installed in the bottom of the aeration tank. These diffusers will provide oxygen necessary for the development of the bacteria and promote mixing of the liquid mass contained in the aeration tank, keeping the mixture in suspension.

The aeration tank will have diffusers which will be fed by air blowers.

In the activated sludge process, there will be the formation of the biological mass (sludge) that must be physically separated from the liquid mass (clarified effluent), which will occur through secondary clarifiers. The treated and clarified effluent will be released through emissary and diffusers in the river. It should be noted that the discharge site will be upstream of the raw water intake point for the mill.

Secondary (biological) sludge will be constantly removed from the bottom of the clarifiers through scrapers and directed by gravity into a sludge pit, from where it will be repressed through pumps to the selector tank, and recirculated. The excess biological sludge will be sent to the secondary sludge dewatering system.

Secondary Sludge Dewatering System

The secondary sludge dewatering system will consist of mechanical and centrifugal type thickeners. The expected final consistency of dewatered sludge is between 15 to 20%.

2.2.3 Treated Effluent Characteristics

The predicted characteristics of the treated effluent from the dissolving pulp mill are presented in the table below.

Table 2 – Treated effluent characteristics

Parameters	Unit	Value
Flow	m^3/h	1,900
	m^3/s	0.53
pH	-	6 – 8
Temperature	ºC	< 40
BOD	mg/L	25
COD	mg/L	250
TSS	mg/L	30
Total nitrogen	mg/L	6
Total phosphorus	mg/L	0.9
Color	mg/L	500

2.3 Treated Effluent Discharge

The discharge of treated effluents from the future dissolving pulp mill will be carried out in the Araguari River by subaquatic emissary, perpendicular to the right bank of the Araguari River, as shown in the following figure.

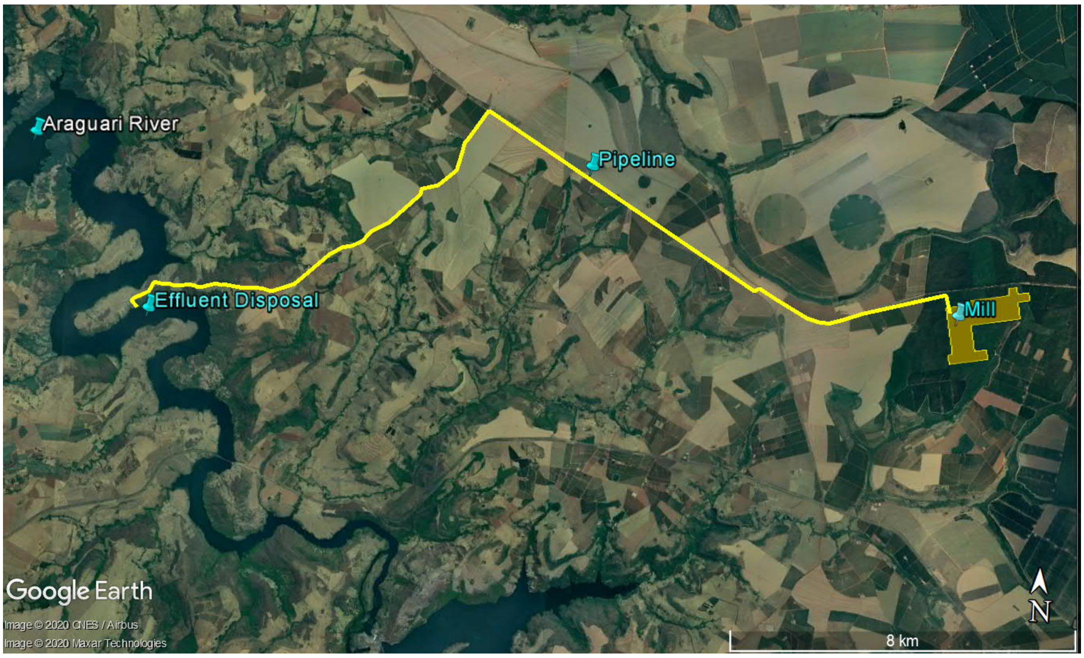

Figure 1 – Location of treated effluent discharge. Source: Adapted *Google Earth* (2020).

2.4 Araguaia River

The Araguari river is a water course of the state of Minas Gerais, that crosses the region of Triângulo Mineiro and has extension of 475 km. Its source is located in the Serra da Canastra National Park, in the municipality of São Roque de Minas. The river crosses important cities of the region like Araxá, Uberlândia and Araguari, before emptying into the Paranaíba river, on the border with Goiás.

The Araguari is a river of dark but clean water, with several stone rapids and canyons. Due to its conformation, the river presents good potential for electric power generation. The main hydroelectric plants existing in its course are UHE Nova Ponte, UHE Miranda, UHE Capim Branco I, UHE Capim Branco II all operated by CEMIG.

The Araguari River is classified as Class 2, according to the standards established by CONAMA Resolution No. 357/2005.

2.4.1 Flow rate

The average flow (Q_m) and minimum flow ($Q_{7,10}$) of Araguari river were calculated as a function of the flows obtained from the stations near the point of emission of treated effluents from the mill, and are presented below.

- Minimum flow ($Q_{7,10}$) = 40 m³/s
- Average flow (Q_m) = 430 m³/s

NOTE: Regarding to minimum flow ($Q_{7,10}$) of Araguari River, it is important to mention that the value considered for the present study (40 m³/s) is very conservative, in function of the guaranteed value downstream of the Miranda Hydroelectric Plant not less than 64 m³/s (70% of $Q_{7,10}$), according to the report “Inventory of Hydraulic Operative Restrictions on Hydroelectric Operations” prepared in 2016 by ONS (National Electric System Operator).

2.4.2 Water Quality

In the studies of this EIA/RIMA, 2 (two) campaigns of collection and analysis of surface water were carried out, one during the dry season (07/18/2017 to 08/11/2017) and one during the rainy season (04/03/2018 to 04/26/2018), with the objective of defining the surface water quality of the Araguari river before the operation of the project (background and reference for future monitoring studies).

The analyzes encompassed the main parameters established in COPAM Normative Resolution 01/2008 and CONAMA Resolution 357/2005, however there was also a collection in each campaign to analyze all the parameters.

The results showed that most of the analyzed parameters are within the conditions required for Class 2 water bodies and in accordance with current legislation; and it stands out that the Araguari River presents homogeneity and good condition of quality.

Some parameters were in disagreement with the legislation, in the 1st campaign: manganese, BOD, pH, total phosphorus and dissolved oxygen; and in the 2nd campaign: total dissolved solids, sulfate, sulfide and phosphorus.

Regarding the results of the analyzes in the 1st campaign, the P01 point presented the pH value of 5.7 mg/L, BOD of 5.2 mg/L, phosphorus of 0.07 mg/L and manganese with values above of 0.1 mg/L. For P02, dissolved oxygen presented a value of 4.5 mg/L, and the manganese also had values in disagreement with CONAMA Resolution 357/2005 and COPAM Resolution 01/2008.

In the 2nd campaign, on 04/16/18 the total dissolved solids had a value of 539 mg/L; on 04/14/18 the sulfate parameter presented a value of 1,213 mg/L; on 04/26/18 the sulfide parameter presented a value of 1.96 mg/L and in some days the total phosphorus presented values above 0.03 mg/L; all in disagreement with CONAMA Resolution 357/2005 and COPAM Resolution 01/2008.

It is important to note that with the exception of manganese in the 1st campaign and phosphorus in the 2nd season, the other parameters in disagreement were identified in only 1 (one) sampling within the period, that is, occasional cases that may have been due to some collection problem or analysis of the parameter, and therefore, should be followed up in the next monitoring.

According to IGAM (2014), manganese is an important constituent of the substrate layer of soils in the state of Minas Gerais and can be considered natural of surface waters, as well as iron, which was also present in surface water.

Phosphorus is a nutrient, originated naturally from the dissolution of compounds present in the soil and the decomposition of organic matter. Its presence in surface water may probably be related to the contribution of diffuse loads due to the use of fertilizers, and to a lesser extent related to the contribution of sanitary sewage and industrial effluents.

3 EFFLUENT DISPERSION MODEL

3.1 Mixing Zone Concept

The mixing zone is defined as the region of the receiving body extending from the effluent discharge point and bounded by the surface at which the mixing equilibrium between the physical and chemical parameters is reached, as well as the biological balance of the effluent and the receiver body, being specific to each parameter.

Inside the mixing zone, the water quality level of the receiving body is lower compared to a point upstream of the effluent discharge. In this way, the water quality standards of the receiving body are applied outside the mixing zone, not inside the mixing zone.

3.2 Cormix Model (Mixing Zone Simulation)

The Cornell Mixing Zone Expert System (Cormix) is a system of computational models developed for the analysis, forecasting and planning of the discharge of effluents into different bodies of water. It was developed through the union between the EPA and Cornell University during the period 1985-1995.

It is a powerful analysis tool in the licensing process of industrial activities regarding the discharge of effluents in the receiving bodies. Although the system places great emphasis on predicting the geometry and dilution characteristics of the initial mixing zone, in order to verify the conformity of water quality with regulatory limits, the system also predicts the behavior of the discharge over longer distances.

CORMIX is composed of three subsystems: (a) CORMIX1, used for the analysis of single port discharges; (b) CORMIX2, for the analysis of multiple multiport diffuser discharges; and (c) CORMIX3, for the analysis of buoyant surface discharges.

Although the CORMIX methodology considers stationary environmental conditions, the system represents an adequate tool for predicting both qualitative features (flow classification, etc.) and quantitative aspects (dilution rates, plume trajectories, etc.) of the processes hydrodynamic mixtures resulting from different discharge configurations and in various types of water bodies, including small streams, large rivers, lakes, reservoirs, estuaries and coastal waters.

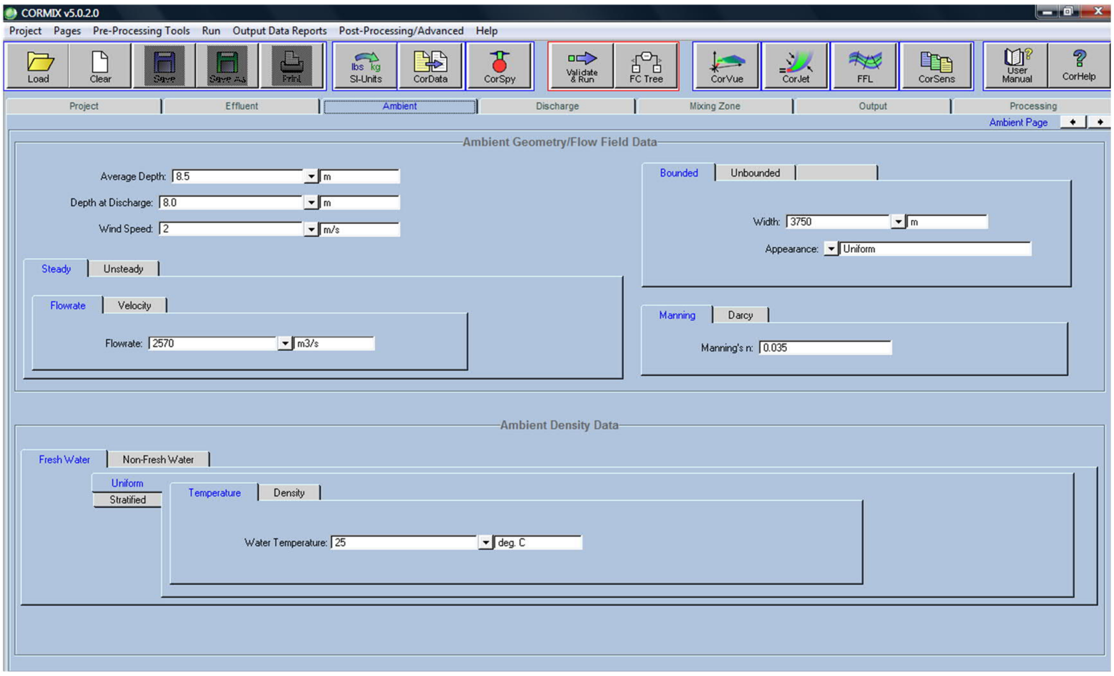

Figure 2 – Screen of CORMIX software

3.2.1 Hydrodynamic Mixing Processes

The mixing behavior of any wastewater discharge is governed by the interaction of the ambient conditions of the receiving body and the discharge characteristics.

The modeling of the transport of an effluent plume comprises near-field and far-field modeling. The near-field corresponds to the initial dilution zone, where the effects of the initial ejection velocity and the density difference between the effluent and the medium prevail. By far-field, it is understood the region where the effects of the local dynamics in the transport and dispersion of the plume predominate. In order to represent the behavior of the effluent plume, the process must be separated into modeling of the near-field and modeling of the far-field.

This report is limited to the study of near-field interactions, since the objective is to know the initial dilution zone.

3.2.2 Type of Discharge

The discharge of effluent from the Rio Araguari will have the following design: 3 underwater branches (emissaries) with multipoint pens (3 diffusers each) below the surface of the water.

The emissary is intended for the launching of treated effluents in Rio Araguari in a controlled and safe way through the underwater launch under conditions that prevent the formation of foams and promote dispersion in the most efficient way in the receiving body.

The complete system consists of: (a) one treated effluent well; (b) emissary of treated effluents to the margin of the Araguari River, at the point of launch; (c) control valves; (d) emissary piping in the riverbed; (e) vertical risers with nozzles for underwater launching and dispersal in river waters.

The underwater pipelines will consist of 3 parallel lines (emissaries) of HDPE in the river bed, only 2 of which will be in operant mode and 1 will remain as a reserve. In certain locations favoring better dispersion in the river waters and homogenization of the mixture, there will be steel risers, which will conduct the treated effluent from buried pipelines approximately 50 cm above the river bed. The following figure gives an overview of the system.

At the end of each riser there will be a 90 ° turn to the horizontal. At the end of this curve, a special check valve (duckbill type) will be installed, allowing the discharge of effluent jets optimally, as well as prevent sand and foreign bodies from entering the system. The following figure shows details of the riser and check valve (duckbill type).

Figure 3 – Exemple of special check valve (duckbill type).

The trated effluent is discharged parallel to the flow of the river, remaining initially as cylindrical jets, and later as a single flat jet. The following figure illustrates this type of dilution.

For the present study, CORMIX 2 was used, which analyzes the discharges below the surface of the water, discharged by a subaquactic emissary with multiple diffusers.

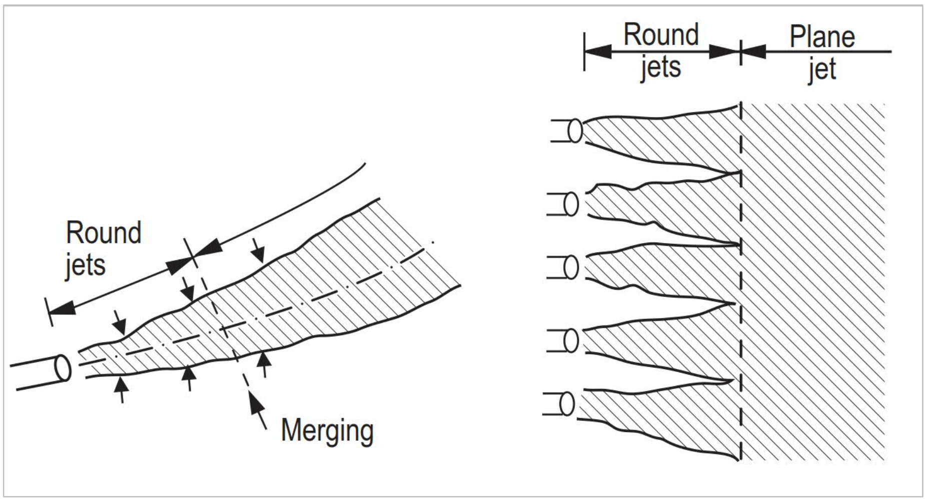

Figure 4 – Discharge of effluent by diffusers.

3.2.3 CORMIX Parameters

CORMIX allows you to work with three types of parameters:

- Conservative: the parameter does not undergo any decay process
- Non-conservative: the parameter suffers a decay of the first order
- High temperature discharge

In the present case it was adopted that the treated effluent of the mill is of the conservative type for BOD, that is, it was not considered a decay of the organic load by reaeration or biological degradation.

4 MIXING ZONE MODELING

4.1 Premises

The type of discharge of the treated effluents in the Araguari River will be of the jet type of mixture by multiple multipoint diffuser discharges (submerged multiport diffuser discharges). Depending on the type of discharge, CORMIX 2 was used, that is, when an effluent is released through multiple multipoint discharges (diffusers).

4.2 Input Data

There are three types of input data that are required to use the CORMIX model: environmental data, effluent data, and disposal type information.

Environmental data consist of information on temperature, Manning coefficient, river depth, river flow, distance between river banks, among others.

Some physico-chemical properties of the trated effluent are included, such as: concentration of the parameters, flow rate and temperature.

The last set of input data of the model is composed of information about the type of discharge, characteristics of the diffuser, depth and discharge flow, etc.

In this study were used the data presented in the tables below.

Table 3 – Environmental data

Parameters	Unit	Value
Minimum flow ($Q_{7,10}$)	m³/s	40
Average flow ($Q_{Média}$)	m³/s	430
Depth for minimum flow $Q_{7,10}$	m	11
Depth for average flow Q_m	m	12
River width	m	600
Water temperature	°C	25

Table 4 – Treated effluent data

Parameters	Unit	Value
Flow	m³/s	0.53
BOD concentration	mg/L	25
Color concentration	mg/L	500
Phosphorus concentration	mg/L	0.9
Effluent temperature	°C	35

Table 5 – Subaquatic emissary data

Parameters	Unit	Value
Type of discharge	-	CORMIX2
River bank	-	right
Distance from river bank	m	70
Parallel lines (emissaries)	-	2+1 (reserve)
Duckbill per line (emissary)	-	3
Duckbill height	m	0.50
Duckbill diameter	m	0.56

The concentrations of BOD, color and total phosphorus of treated effluent, considered in this study, are the maximum values, that is, peak design.

The mathematical model takes into account the organic, color and phosphorus concentration of the Araguari River in the initial situation as zero, that is, it does not consider the concentration of the river along the section under study. Thus, the model presents the results of what happens with the treated effluent of the mill and the increase that it causes in this river in terms of organic load, color and phosphorus.

For this study, 6 scenarios were considered, varying the river flow (minimum flow of 40 m³/s and average flow of 430 m³/s) and the studied variables (BOD, color and total phosphorus), as shown in the table below.

Table 6 – Scenarios evaluated in the present study

Parameter	Scenario nº	River flow (m³/s)
BOD	1	40 ($Q_{7,10}$)
	2	430 (Q_m)
Color	3	40 ($Q_{7,10}$)
	4	430 (Q_m)
Total phosphorus	5	40 ($Q_{7,10}$)
	6	430 (Q_m)

4.3 Results of Evaluated Scenarios

4.3.1 Scenario 1 (BOD, Minimum flow - $Q_{7,10}$)

The data used in scenario 1 are presented in the table below.

Table 7 – Data used in the scenario 1

Parameter	River flow	Effluent flow	BOD concentration
BOD	40 m³/s	0.53 m³/s	25 mg/L

The results of the simulation are shown in the figures and table below.

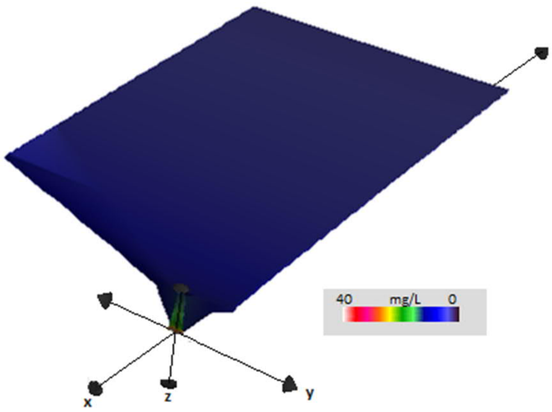

Figure 5 – Simulation of the dispersion plume in 3 dimensions

Figure 6 – Simulation of the dispersion plume in top view

Table 8 – Scenario results 1

Parameter	Quality standard[1]	Plume width to achieve the quality standard (mixing zone)
BOD	5 mg/L	1.3 m

[1]Quality standard for river class 2, according to CONAMA Resolution No. 357/2005 and COPAM Normative Resolution No. 01/2008.

4.3.2 Scenario 2 (BOD, Average flow - Q_m)

The data used in scenario 2 are presented in the table below.

Table 9 – Data used in the scenario 2

Parameter	River flow	Effluent flow	BOD concentration
BOD	430 m^3/s	0.53 m^3/s	25 mg/L

The results of the simulation are shown in the figures and table below.

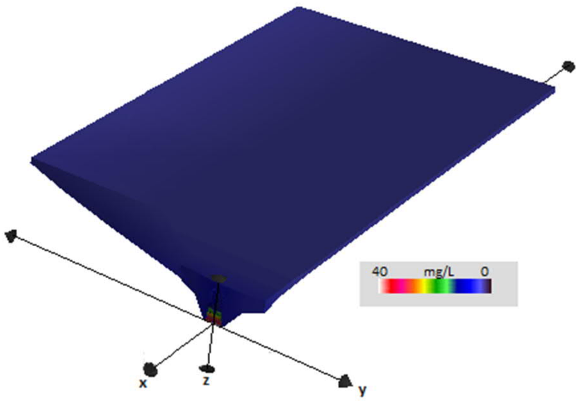

Figure 7 – Simulation of the dispersion plume in 3 dimensions

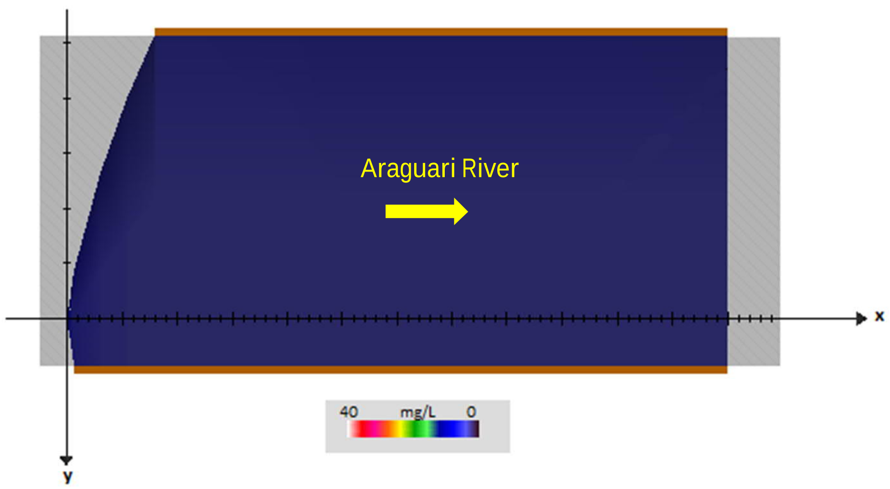

Figure 8 – Simulation of the dispersion plume in top view

Table 10 – Scenario results 2

Parameter	Quality standard[1]	Plume width to achieve the quality standard (mixing zone)
BOD	5 mg/L	0.1 m

[1]Quality standard for river class 2, according to CONAMA Resolution No. 357/2005 and COPAM Normative Resolution No. 01/2008.

4.3.3 Scenario 3 (Color, Minimum flow rate - $Q_{7,10}$)

The data used in scenario 3 are presented in the table below.

Table 11 – Data used in the scenario 3

Parameter	River flow	Effluent flow	Color concentration
Color	40 m³/s	0.53 m³/s	500 mg/L

The results of the simulation are shown in the figures and table below.

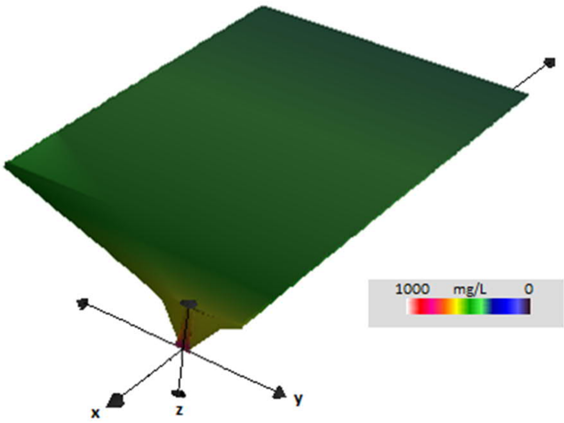

Figure 9 – Simulation of the dispersion plume in 3 dimensions

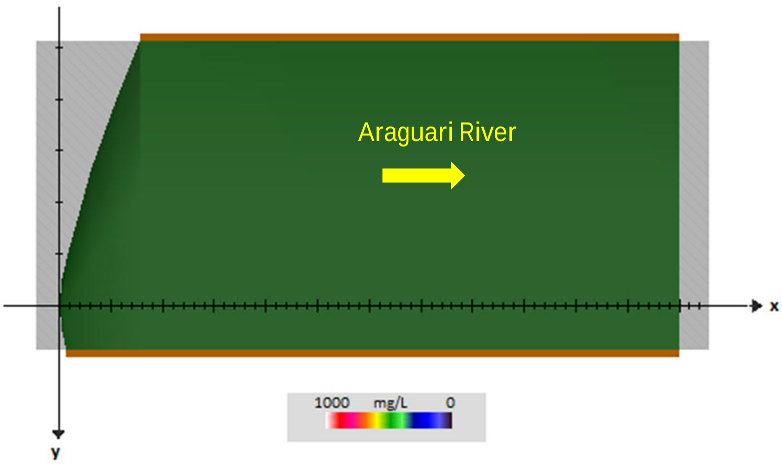

Figure 10 – Simulation of the dispersion plume in top view

Table 12 – Scenario results 3

Parameter	Quality standard[1]	Plume width to achieve the quality standard (mixing zone)
Color	75 mg/L	2.4 m

[1]Quality standard for river class 2, according to CONAMA Resolution No. 357/2005 and COPAM Normative Resolution No. 01/2008.

4.3.4 Scenario 4 (Color, Average flow - Q_m)

The data used in scenario 4 are presented in the table below.

Table 13 – Data used in the scenario 4

Parameter	River flow	Effluent flow	Color concentration
Color	430 m^3/s	0.53 m^3/s	500 mg/L

The results of the simulation are shown in the figures and table below.

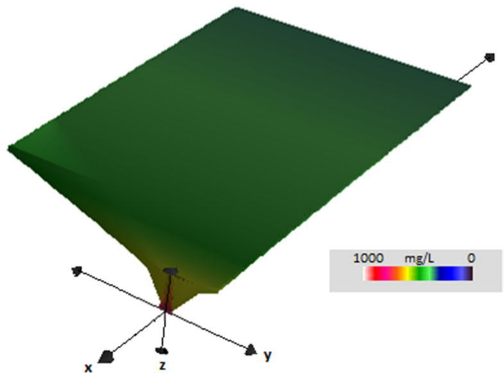

Figure 11 – Simulation of the dispersion plume in 3 dimensions

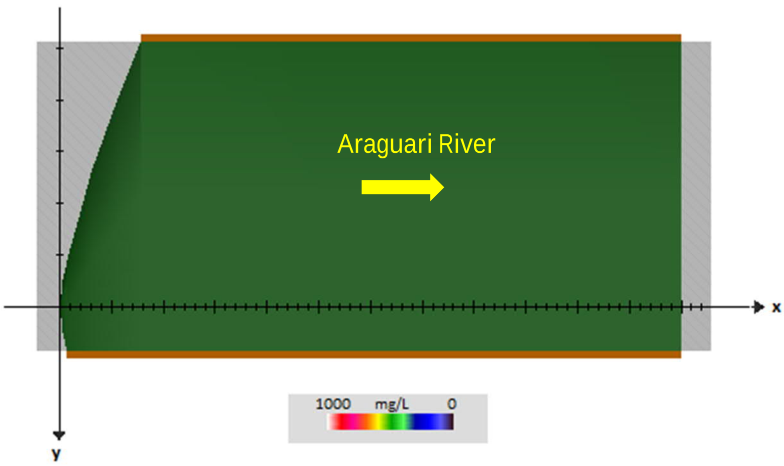

Figure 12 – Simulation of the dispersion plume in top view

Table 14 – Scenario results 4

Parameter	Quality standard[1]	Plume width to achieve the quality standard (mixing zone)
Color	75 mg/L	0.7 m

[1]Quality standard for river class 2, according to CONAMA Resolution 357/2005 and COPAM Normative Resolution 01/2008.

4.3.5 Scenario 5 (Phosphorus, Minimum flow - $Q_{7,10}$)

The data used in scenario 5 are presented in the table below.

Table 15 – Data used in the scenario 5

Parameter	River flow	Effluent flow	Phosphorus concentration
Phosphorus	40 m³/s	0.53 m³/s	1.5 mg/L

The results of the simulation are shown in the figures and table below.

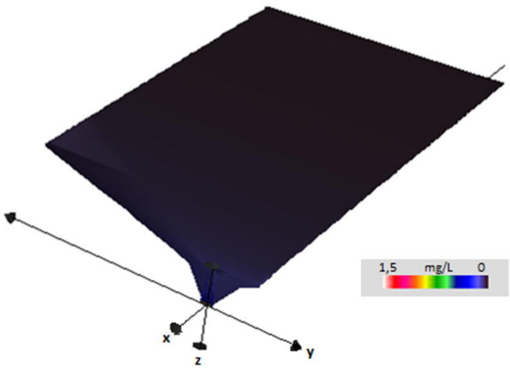

Figure 13 – Simulation of the dispersion plume in 3 dimensions

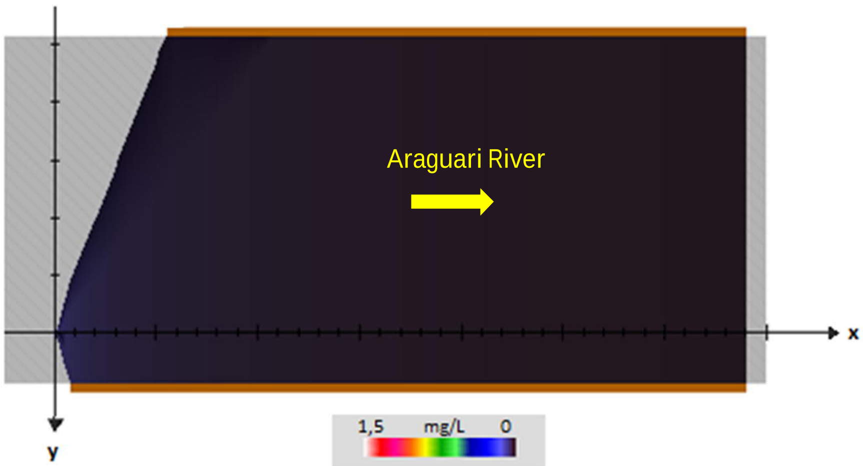

Figure 14 – Simulation of the dispersion plume in top view

Table 16 – Scenario results 5

Parameter	Quality standard[1]	Plume width to achieve the quality standard (mixing zone)
Phosphorus	0.03 mg/L	313.4 m

[1]Quality standard for river class 2, according to CONAMA Resolution 357/2005 and COPAM Normative Resolution 01/2008.

4.3.6 Scenario 6 (Phosphorus, Average flow - Q_m)

The data used in scenario 6 are presented in the table below.

Table 17 – Data used in the scenario 6

Parameter	River flow	Effluent flow	Phosphorus concentration
Phosphorus	430 m³/s	0.53 m³/s	0.9 mg/L

The results of the simulation are shown in the figures and table below.

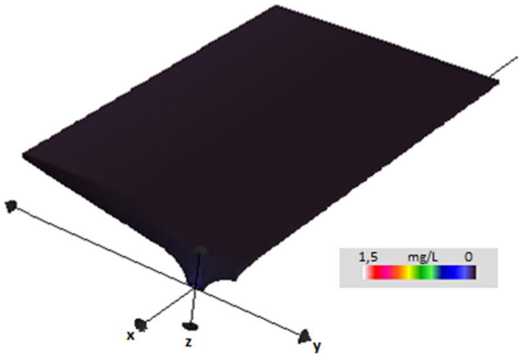

Figure 15 – Simulation of the dispersion plume in 3 dimensions

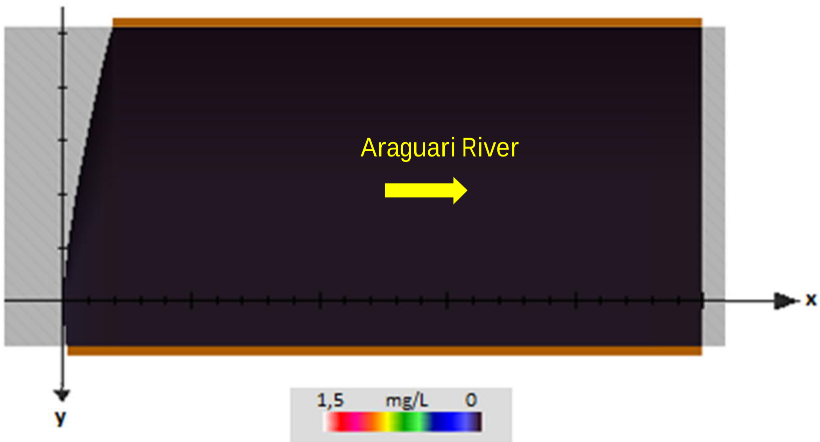

Figure 16 – Simulation of the dispersion plume in top vi

Table 18 – Scenario results 6

Parameter	Quality standard[1]	Plume width to achieve the quality standard (mixing zone)
Phosphorus	0.03 mg/L	7.0 m

[1]Quality standard for river class 2, according to CONAMA Resolution 357/2005 and COPAM Normative Resolution 01/2008.

5 CONCLUSIONS

For the study of the mixing zone of the Araguari river, 6 simulations were performed, varying the flow of the river (mean flow of 430 m^3/s and $Q_{7,10}$ of 40 m^3/s), the parameters under study (BOD, and total phosphorus), in which the distances were verified in which the quality of the river complies with the parameters established by CONAMA Resolution 357/2005 and COPAM/CERH Normative Resolution 01/2008 for rivers class 2. The results of the modeling are presented in table below.

Table 19 – Results of the CORMIX simulations

Parameter	Scenario No.	Effluent concentration	River flow (m^3/s)	Plume width to achieve the quality standard (mixing zone)[1]
BOD	1	25 mg/L	40 ($Q_{7.10}$)	1.3 m
	2	25 mg/L	430 (Q_m)	0.1 m
Color	3	500 mg/L	40 ($Q_{7.10}$)	2.4m
	4	500 mg/L	430 (Q_m)	0.7 m
Phosphorus	5	0.9 mg/L	40 ($Q_{7.10}$)	313.4 m
	6	0.9 mg/L	430 (Q_m)	7.0 m

[1]Quality standard for river class 2, according to CONAMA Resolution 357/2005 and COPAM Normative Resolution 01/2008. BOD = 5 mg/L, Color = 75 mg/L and Total phosphorus = 0.03 mg/L (lentic environment).

According to the results of the simulations, it is verified that in order to meet the quality standards established by CONAMA Resolution 357/2005 and COPAM/CERH Normative Resolution 01/2008, regarding the parameters BOD, Color and Total Phosphorus both in the (minimum flow $Q_{7,10}$) and in the average flow conditions, the necessary distances for the mixing zone of the LD CELULOSE treated effluents in the Araguari river ranges from 0.1 a 313.4 m.

The most critical scenarios are the total phosphorous scenario, both in the minimum and in the average flow. In the minimum flow scenario, the plume length needed to meet the total phosphorus quality standard (0.030 mg/L) was 313.4 m.

According to the results of the water quality campaigns of the Araguari River conducted for the EIA/RIMA of the plant project, the total phosphorus concentration is already in disagreement with the quality standard for river class 2 (lentic environment), according to Resolution CONAMA 357/2005 and Normative Resolution COPAM/CERH 01/2008.

It can be concluded from the simulations carried out in the present study that the BOD and the color present in the treated effluent from the LD CELULOSE plant will not impact the water quality of the Araguari River, being demonstrated that it rapidly reaches the established water quality standard environmental legislation. In the case of total phosphorus, it was verified that it would take more than 300 m to reach the quality standard of total phosphorus (0.030 mg/L), without considering the phosphorus concentration in the Araguari River, which is already above quality standard.

In terms of public supply, it was found that downstream of the point of discharge, up to 8.0 km, there is no water intake for supply. In this sense it is important to point out that phosphorus does not present sanitary problems in the water supply (VON SPERLING, 2007).

6 REFERENCES

DONEKER, R. L.; JIRKA, G. H. Cormix User Manual - A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters. Washington D. C: MixZon Inc, 2007.

MATO GROSSO DO SUL. COPAM Normative Resolution No. 01/2008 – Provides for the classification of water bodies and environmental guidelines for their classification, as well as establishes the conditions and standards for the discharge of effluents, and provides other measures

MMA. CONAMA Resolution No. 357/2005 – Provides for the classification of water bodies and environmental guidelines for their classification, as well as establishing the conditions and standards for effluent releases.

VON SPERLING, M. Studies and Modeling of Water Quality of Rivers. Belo Horizonte: DESA, 2007. 588 p.

ANNEX I
PREDICTION REPORT

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 9.0E
                       HYDRO2:Version-9.0.0.0  September,2014
SITE NAME/LABEL:                LD CELULOSE
  DESIGN CASE:                  DBO
  FILE NAME:                    C:\Program Files\CORMIX 9.0\Sample Files\Sample2
  Using subsystem CORMIX2:     Multiport Diffuser Discharges
  Start of session:             11/11/2019--20:20:00
******************************************************************************
SUMMARY OF INPUT DATA:
------------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                           BS     = 600 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA     = 40 m^3/s
  Average depth                   HA     = 11 m
  Depth at discharge              HD     = 10.5 m
  Ambient velocity                UA     = 0.0061 m/s
  Darcy-Weisbach friction factor  F      = 0.0432
    Calculated from Manning's n          = 0.035
  Wind velocity                   UW     = 2 m/s
  Stratification Type             STRCND = U
  Surface temperature                    = 25 degC
  Bottom temperature                     = 25 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 997.0456 kg/m^3
  Bottom density                  RHOAB  = 997.0456 kg/m^3
------------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE = unidirectional perpendicular
  Diffuser length                 LD     = 30 m
  Nearest bank                           = right
  Diffuser endpoints              YB1    = 70 m;    YB2 = 100 m
  Number of openings              NOPEN  = 6
  Number of Risers                NRISER = 6
  Ports/Nozzles per Riser         NPPERR  = 1
  Spacing between risers/openings SPAC   = 6 m
  Port/Nozzle diameter            D0     = 0.4338 m
    with contraction ratio                = 0.6
  Equivalent slot width           B0      = 0.0296 m
  Total area of openings          TA0     = 0.8867 m^2
  Discharge velocity              U0      = 0.60 m/s
  Total discharge flowrate        Q0      = 0.53 m^3/s
  Discharge port height           H0      = 0.5 m
  Nozzle arrangement              BETYPE  = unidirectional without fanning
  Diffuser alignment angle        GAMMA   = 90 deg
  Vertical discharge angle        THETA   = 0 deg
  Actual Vertical discharge angle THEAC   = 0 deg
  Horizontal discharge angle      SIGMA   = 0 deg
  Relative orientation angle      BETA    = 90 deg
  Discharge temperature (freshwater)      = 35 degC
  Corresponding density           RHO0    = 994.0294 kg/m^3
  Density difference              DRHO    = 3.0161 kg/m^3
  Buoyant acceleration            GP0     = 0.0297 m/s^2
  Discharge concentration         C0      = 25 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
------------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)         q0      = 0.017667 m^2/s
  Momentum flux                   m0      = 0.010560 m^3/s^2
  Buoyancy flux                   j0      = 0.000524 m^3/s^3
------------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.03 m         Lm  = 287.49 m         LM  = 1.62 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    = 20.19
  Port/nozzle Froude number         FRD0   = 5.27
  Velocity ratio                    R      = 98.63
----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = yes
  Water quality standard            CSTD   = 5 mg/l
  Regulatory mixing zone                   = no
  Region of interest                       = 10000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = MU2 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 10.5 m

  Limiting Dilution S = (QA/Q0)+ 1.0 = 76.5

*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the BOTTOM below the port/diffuser center:
    85 m from the right bank/shore.
  Number of display steps NSTEP = 20 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.333 mg/l
  Dilution at edge of NFR              s = 75.1
  NFR Location:                        x = 2377.58 m
    (centerline coordinates)           y = 0 m
                                       z = 10.5 m
  NFR plume dimensions:  half-width (bh) = 3411.31 m
                          thickness (bv) = 0.47 m
Cumulative travel time:       838351.375 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The 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.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ has been specified.
However:
The ambient water quality standard was encountered at the following
  plume position:
```

```
  Water quality standard                  = 5  mg/l
  Corresponding dilution                s = 5.1
  Plume location:                       x = 1.26 m
    (centerline coordinates)            y = 0 m
                                        z = 0.61 m
  Plume dimensions:      half-width (bh) = 13.57 m
                          thickness (bv) = 0.88 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.
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 9.0E
                       HYDRO2:Version-9.0.0.0  September,2014
SITE NAME/LABEL:                LD CELULOSE
  DESIGN CASE:                  DBO
  FILE NAME:                    C:\Program Files\CORMIX 9.0\Sample Files\Sample2
  Using subsystem CORMIX2:     Multiport Diffuser Discharges
  Start of session:             11/14/2019--11:53:09
****************************************************************************
SUMMARY OF INPUT DATA:
----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                              = bounded
  Width                           BS         = 600 m
  Channel regularity              ICHREG     = 2
  Ambient flowrate                QA         = 430 m^3/s
  Average depth                   HA         = 12 m
  Depth at discharge              HD         = 11.5 m
  Ambient velocity                UA         = 0.0597 m/s
  Darcy-Weisbach friction factor  F          = 0.0420
    Calculated from Manning's n              = 0.035
  Wind velocity                   UW         = 2 m/s
  Stratification Type             STRCND     = U
  Surface temperature                        = 25 degC
  Bottom temperature                         = 25 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS      = 997.0456 kg/m^3
  Bottom density                  RHOAB      = 997.0456 kg/m^3
----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE = unidirectional perpendicular
  Diffuser length                 LD     = 30 m
  Nearest bank                           = right
  Diffuser endpoints              YB1    = 70 m;    YB2 = 100 m
  Number of openings              NOPEN  = 6
  Number of Risers                NRISER = 6
  Ports/Nozzles per Riser         NPPERR  = 1
  Spacing between risers/openings SPAC   = 6 m
  Port/Nozzle diameter            D0     = 0.4338 m
  Discharge velocity              U0     = 0.60 m/s
  Total discharge flowrate        Q0     = 0.53 m^3/s
  Discharge port height           H0     = 0.5 m
  Nozzle arrangement              BETYPE = unidirectional without fanning
  Diffuser alignment angle        GAMMA  = 90 deg
  Vertical discharge angle        THETA  = 0 deg
  Actual Vertical discharge angle THEAC  = 0 deg
  Horizontal discharge angle      SIGMA  = 0 deg
  Relative orientation angle      BETA   = 90 deg
  Discharge temperature (freshwater)     = 35 degC
  Corresponding density           RHO0   = 994.0294 kg/m^3
  Density difference              DRHO   = 3.0161 kg/m^3
  Buoyant acceleration            GP0    = 0.0297 m/s^2
  Discharge concentration         C0     = 25 mg/l
  Surface heat exchange coeff.    KS     = 0 m/s
  Coefficient of decay            KD     = 0 /s
----------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)         q0     = 0.017667 m^2/s
  Momentum flux                   m0     = 0.010560 m^3/s^2
  Buoyancy flux                   j0     = 0.000524 m^3/s^3
----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.03 m        Lm  = 2.96 m        LM  = 1.62 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     = 20.19
  Port/nozzle Froude number       FRD0    = 5.27
  Velocity ratio                  R       = 10.01
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = no
  Water quality standard specified        = yes
  Water quality standard          CSTD    = 5 mg/l
  Regulatory mixing zone                  = no
  Region of interest                      = 10000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS    = MU2 |
  *-------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 11.5 m

  Limiting Dilution S = (QA/Q0)+ 1.0 = 812.3

*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the BOTTOM below the port/diffuser center:
    85 m from the right 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 = 0.5765 mg/l
  Dilution at edge of NFR               s = 43.4
  NFR Location:                         x = 15 m
    (centerline coordinates)            y = 0 m
                                        z = 11.5 m
  NFR plume dimensions:  half-width (bh) = 13.60 m
                          thickness (bv) = 11.5 m
Cumulative travel time:       204.0624 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The 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 becomes laterally fully mixed at 1585.95 m
  downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 126.70 m downstream.
  Plume contacts second bank at 1585.95 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ has been specified.
However:
```

```
however:
The ambient water quality standard was encountered at the following
  plume position:
  Water quality standard                  = 5  mg/l
  Corresponding dilution                s = 5.2
  Plume location:                       x = 0.15 m
    (centerline coordinates)            y = 0 m
                                        z = 0.51 m
  Plume dimensions:      half-width (bh) = 14.96 m
                          thickness (bv) = 0.11 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.
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 9.0E
                       HYDRO2:Version-9.0.0.0  September,2014
SITE NAME/LABEL:                LD CELULOSE
  DESIGN CASE:                  COR
  FILE NAME:                    C:\Program Files\CORMIX 9.0\Sample Files\Sample2.
  Using subsystem CORMIX2:     Multiport Diffuser Discharges
  Start of session:             11/11/2019--20:23:38
****************************************************************************
SUMMARY OF INPUT DATA:
----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 600 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA      = 40 m^3/s
  Average depth                   HA      = 11 m
  Depth at discharge              HD      = 10.5 m
  Ambient velocity                UA      = 0.0061 m/s
  Darcy-Weisbach friction factor  F       = 0.0432
    Calculated from Manning's n           = 0.035
  Wind velocity                   UW      = 2 m/s
  Stratification Type             STRCND = U
  Surface temperature                     = 25 degC
  Bottom temperature                      = 25 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 997.0456 kg/m^3
  Bottom density                  RHOAB  = 997.0456 kg/m^3
----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE = unidirectional perpendicular
  Diffuser length                 LD      = 30 m
  Nearest bank                            = right
  Diffuser endpoints              YB1     = 70 m;     YB2 = 100 m
  Number of openings              NOPEN  = 6
  Number of Risers                NRISER = 6
  Ports/Nozzles per Riser         NPPERR  = 1
  Spacing between risers/openings SPAC    = 6 m
  Port/Nozzle diameter            D0      = 0.4338 m
    with contraction ratio                 = 0.6
  Equivalent slot width           B0      = 0.0296 m
  Total area of openings          TA0     = 0.8867 m^2
  Discharge velocity              U0      = 0.60 m/s
  Total discharge flowrate        Q0      = 0.53 m^3/s
  Discharge port height           H0      = 0.5 m
  Nozzle arrangement              BETYPE = unidirectional without fanning
  Diffuser alignment angle        GAMMA   = 90 deg
  Vertical discharge angle        THETA   = 0 deg
  Actual Vertical discharge angle THEAC   = 0 deg
  Horizontal discharge angle      SIGMA   = 0 deg
  Relative orientation angle      BETA    = 90 deg
  Discharge temperature (freshwater)       = 35 degC
  Corresponding density           RHO0    = 994.0294 kg/m^3
  Density difference              DRHO    = 3.0161 kg/m^3
  Buoyant acceleration            GP0     = 0.0297 m/s^2
  Discharge concentration         C0      = 500 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
----------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)         q0      = 0.017667 m^2/s
  Momentum flux                   m0      = 0.010560 m^3/s^2
  Buoyancy flux                   j0      = 0.000524 m^3/s^3
----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.03 m          Lm  = 287.49 m          LM  = 1.62 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    = 20.19
  Port/nozzle Froude number        FRD0   = 5.27
  Velocity ratio                   R      = 98.63
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = no
  Water quality standard specified        = yes
  Water quality standard           CSTD   = 75 mg/l
  Regulatory mixing zone                  = no
  Region of interest                      = 10000 m downstream
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = MU2 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 10.5 m

  Limiting Dilution S = (QA/Q0)+ 1.0 = 76.5

*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the BOTTOM below the port/diffuser center:
    85 m from the right bank/shore.
  Number of display steps NSTEP = 20 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 = 6.6595 mg/l
  Dilution at edge of NFR              s = 75.1
  NFR Location:                        x = 2377.58 m
    (centerline coordinates)           y = 0 m
                                       z = 10.5 m
  NFR plume dimensions:  half-width (bh) = 3411.31 m
                          thickness (bv) = 0.47 m
Cumulative travel time:       838351.375 sec.
-------------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-------------------------------------------------------------------------------
Near-field instability behavior:
  The 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.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ has been specified.
However:
The ambient water quality standard was encountered at the following
  plume position:
  Water quality standard                = 75  mg/l
```

```
  Corresponding dilution                 s = 6.7
  Plume location:                        x = 2.39 m
    (centerline coordinates)             y = 0 m
                                         z = 0.72 m
  Plume dimensions:      half-width (bh) = 12.53 m
                          thickness (bv) = 1.68 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.
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                     CORMIX MIXING ZONE EXPERT SYSTEM
                         CORMIX Version 9.0E
                      HYDRO2:Version-9.0.0.0  September,2014
SITE NAME/LABEL:               LD CELULOSE
  DESIGN CASE:                 COR
  FILE NAME:                   C:\Program Files\CORMIX 9.0\Sample Files\Sample2.
  Using subsystem CORMIX2:    Multiport Diffuser Discharges
  Start of session:            11/11/2019--20:29:50
***************************************************************************
SUMMARY OF INPUT DATA:
---------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 600 m
  Channel regularity              ICHREG  = 2
  Ambient flowrate                QA      = 430 m^3/s
  Average depth                   HA      = 12 m
  Depth at discharge              HD      = 11.5 m
  Ambient velocity                UA      = 0.0597 m/s
  Darcy-Weisbach friction factor  F       = 0.0420
    Calculated from Manning's n           = 0.035
  Wind velocity                   UW      = 2 m/s
  Stratification Type             STRCND  = U
  Surface temperature                     = 25 degC
  Bottom temperature                      = 25 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS   = 997.0456 kg/m^3
  Bottom density                  RHOAB   = 997.0456 kg/m^3
---------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE  = unidirectional perpendicular
  Diffuser length                 LD      = 30 m
  Nearest bank                            = right
  Diffuser endpoints              YB1     = 70 m;    YB2 = 100 m
  Number of openings              NOPEN   = 6
  Number of Risers                NRISER  = 6
  Ports/Nozzles per Riser         NPPERR  = 1
  Spacing between risers/openings SPAC    = 6 m
  Port/Nozzle diameter            D0      = 0.4338 m
    with contraction ratio                = 0.6
  Equivalent slot width           B0      = 0.0296 m
  Total area of openings          TA0     = 0.8867 m^2
  Discharge velocity              U0      = 0.60 m/s
  Total discharge flowrate        Q0      = 0.53 m^3/s
  Discharge port height           H0      = 0.5 m
  Nozzle arrangement              BETYPE  = unidirectional without fanning
  Diffuser alignment angle        GAMMA   = 90 deg
  Vertical discharge angle        THETA   = 0 deg
  Actual Vertical discharge angle THEAC   = 0 deg
  Horizontal discharge angle      SIGMA   = 0 deg
  Relative orientation angle      BETA    = 90 deg
  Discharge temperature (freshwater)      = 35 degC
  Corresponding density           RHO0    = 994.0294 kg/m^3
  Density difference              DRHO    = 3.0161 kg/m^3
  Buoyant acceleration            GP0     = 0.0297 m/s^2
  Discharge concentration         C0      = 500 mg/l
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
---------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)         q0      = 0.017667 m^2/s
  Momentum flux                   m0      = 0.010560 m^3/s^2
  Buoyancy flux                   j0      = 0.000524 m^3/s^3
---------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.03 m          Lm  = 2.96 m          LM  = 1.62 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    = 20.19
  Port/nozzle Froude number       FRD0   = 5.27
  Velocity ratio                  R      = 10.01
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = no
  Water quality standard specified       = yes
  Water quality standard          CSTD   = 75 mg/l
  Regulatory mixing zone                 = no
  Region of interest                     = 10000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = MU2 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 11.5 m

  Limiting Dilution S = (QA/Q0)+ 1.0 = 812.3

*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the BOTTOM below the port/diffuser center:
    85 m from the right bank/shore.
  Number of display steps NSTEP = 20 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 = 11.530800 mg/l
  Dilution at edge of NFR              s = 43.4
  NFR Location:                        x = 15 m
    (centerline coordinates)           y = 0 m
                                       z = 11.5 m
  NFR plume dimensions:  half-width (bh) = 13.60 m
                          thickness (bv) = 11.5 m
Cumulative travel time:       204.0626 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The 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 becomes laterally fully mixed at 1586.27 m
  downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 126.69 m downstream.
  Plume contacts second bank at 1586.27 m downstream.
*********************** TOXIC DILUTION ZONE SUMMARY ************************
```

```
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ has been specified.
However:
The ambient water quality standard was encountered at the following
  plume position:
  Water quality standard                 = 75  mg/l
  Corresponding dilution               s = 9.9
  Plume location:                      x = 0.70 m
    (centerline coordinates)           y = 0 m
                                       z = 0.56 m
  Plume dimensions:      half-width (bh) = 14.82 m
                          thickness (bv) = 0.54 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.
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 9.0E
                       HYDRO2:Version-9.0.0.0  September,2014
SITE NAME/LABEL:                LD CELULOSE
  DESIGN CASE:                  COR
  FILE NAME:                    C:\Program Files\CORMIX 9.0\Sample Files\Sample2
  Using subsystem CORMIX2:      Multiport Diffuser Discharges
  Start of session:             11/11/2019--20:25:18
****************************************************************************
SUMMARY OF INPUT DATA:
----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = bounded
  Width                           BS      = 600 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA      = 40 m^3/s
  Average depth                   HA      = 11 m
  Depth at discharge              HD      = 10.5 m
  Ambient velocity                UA      = 0.0061 m/s
  Darcy-Weisbach friction factor  F       = 0.0432
    Calculated from Manning's n           = 0.035
  Wind velocity                   UW      = 2 m/s
  Stratification Type             STRCND = U
  Surface temperature                     = 25 degC
  Bottom temperature                      = 25 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 997.0456 kg/m^3
  Bottom density                  RHOAB  = 997.0456 kg/m^3
----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE = unidirectional perpendicular
  Diffuser length                 LD      = 30 m
  Nearest bank                            = right
  Diffuser endpoints              YB1     = 70 m;    YB2 = 100 m
  Number of openings              NOPEN  = 6
  Number of Risers                NRISER = 6
  Ports/Nozzles per Riser         NPPERR  = 1
  Spacing between risers/openings SPAC    = 6 m
  Port/Nozzle diameter            D0      = 0.4338 m
    with contraction ratio                 = 0.6
  Equivalent slot width            B0      = 0.0296 m
  Total area of openings           TA0     = 0.8867 m^2
  Discharge velocity               U0      = 0.60 m/s
  Total discharge flowrate         Q0      = 0.53 m^3/s
  Discharge port height            H0      = 0.5 m
  Nozzle arrangement               BETYPE = unidirectional without fanning
  Diffuser alignment angle         GAMMA   = 90 deg
  Vertical discharge angle         THETA   = 0 deg
  Actual Vertical discharge angle THEAC   = 0 deg
  Horizontal discharge angle       SIGMA   = 0 deg
  Relative orientation angle       BETA    = 90 deg
  Discharge temperature (freshwater)       = 35 degC
  Corresponding density            RHO0    = 994.0294 kg/m^3
  Density difference               DRHO    = 3.0161 kg/m^3
  Buoyant acceleration             GP0     = 0.0297 m/s^2
  Discharge concentration          C0      = 0.9 mg/l
  Surface heat exchange coeff.     KS      = 0 m/s
  Coefficient of decay             KD      = 0 /s
-----------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)          q0      = 0.017667 m^2/s
  Momentum flux                    m0      = 0.010560 m^3/s^2
  Buoyancy flux                    j0      = 0.000524 m^3/s^3
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.03 m         Lm  = 287.49 m        LM  = 1.62 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     = 20.19
  Port/nozzle Froude number       FRD0    = 5.27
  Velocity ratio                  R       = 98.63
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                         = no
  Water quality standard specified        = yes
  Water quality standard          CSTD    = 0.03 mg/l
  Regulatory mixing zone                  = no
  Region of interest                      = 10000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = MU2 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 10.5 m

  Limiting Dilution S = (QA/Q0)+ 1.0 = 76.5

*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the BOTTOM below the port/diffuser center:
    85 m from the right bank/shore.
  Number of display steps NSTEP = 20 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.012 mg/l
  Dilution at edge of NFR              s = 75.1
  NFR Location:                        x = 2377.58 m
    (centerline coordinates)           y = 0 m
                                       z = 10.5 m
  NFR plume dimensions:  half-width (bh) = 3411.31 m
                          thickness (bv) = 0.47 m
Cumulative travel time:       838351.375 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The 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.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY **********************
No RMZ has been specified.
However:
The ambient water quality standard was encountered at the following
  plume position:
```

```
  -     -
  Water quality standard                  = 0.03  mg/l
  Corresponding dilution                s = 30.2
  Plume location:                       x = 313.40 m
    (centerline coordinates)            y = 0 m
                                        z = 10.5 m
  Plume dimensions:      half-width (bh) = 401.48 m
                          thickness (bv) = 0.88 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.
-----------------------------------------------------------------------------
```

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 9.0E
                       HYDRO2:Version-9.0.0.0  September,2014
SITE NAME/LABEL:                LD CELULOSE
  DESIGN CASE:                  COR
  FILE NAME:                    C:\Program Files\CORMIX 9.0\Sample Files\Sample2.
  Using subsystem CORMIX2:     Multiport Diffuser Discharges
  Start of session:             11/11/2019--20:27:40
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                               = bounded
  Width                           BS          = 600 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA          = 430 m^3/s
  Average depth                   HA          = 12 m
  Depth at discharge              HD          = 11.5 m
  Ambient velocity                UA          = 0.0597 m/s
  Darcy-Weisbach friction factor  F           = 0.0420
    Calculated from Manning's n               = 0.035
  Wind velocity                   UW          = 2 m/s
  Stratification Type             STRCND = U
  Surface temperature                         = 25 degC
  Bottom temperature                          = 25 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS  = 997.0456 kg/m^3
  Bottom density                  RHOAB  = 997.0456 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE = unidirectional perpendicular
  Diffuser length                 LD          = 30 m
  Nearest bank                                = right
  Diffuser endpoints              YB1         = 70 m;     YB2 = 100 m
  Number of openings              NOPEN  = 6
  Number of Risers                NRISER = 6
  Ports/Nozzles per Riser         NPPERR  = 1
  Spacing between risers/openings SPAC   = 6 m
  Port/Nozzle diameter            D0          = 0.4338 m
    with contraction ratio                     = 0.6
  Equivalent slot width            B0          = 0.0296 m
  Total area of openings           TA0         = 0.8867 m^2
  Discharge velocity               U0          = 0.60 m/s
  Total discharge flowrate         Q0          = 0.53 m^3/s
  Discharge port height            H0          = 0.5 m
  Nozzle arrangement               BETYPE = unidirectional without fanning
  Diffuser alignment angle         GAMMA   = 90 deg
  Vertical discharge angle         THETA   = 0 deg
  Actual Vertical discharge angle THEAC   = 0 deg
  Horizontal discharge angle       SIGMA   = 0 deg
  Relative orientation angle       BETA    = 90 deg
  Discharge temperature (freshwater)       = 35 degC
  Corresponding density            RHO0    = 994.0294 kg/m^3
  Density difference               DRHO    = 3.0161 kg/m^3
  Buoyant acceleration             GP0     = 0.0297 m/s^2
  Discharge concentration          C0      = 0.9 mg/l
  Surface heat exchange coeff.     KS      = 0 m/s
  Coefficient of decay             KD      = 0 /s
-------------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)          q0      = 0.017667 m^2/s
  Momentum flux                    m0      = 0.010560 m^3/s^2
  Buoyancy flux                    j0      = 0.000524 m^3/s^3
-------------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.03 m          Lm  = 2.96 m          LM  = 1.62 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    = 20.19
  Port/nozzle Froude number       FRD0   = 5.27
  Velocity ratio                  R      = 10.01
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = no
  Water quality standard specified       = yes
  Water quality standard          CSTD   = 0.03 mg/l
  Regulatory mixing zone                 = no
  Region of interest                     = 10000 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = MU2 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 11.5 m

  Limiting Dilution S = (QA/Q0)+ 1.0 = 812.3

*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the BOTTOM below the port/diffuser center:
    85 m from the right bank/shore.
  Number of display steps NSTEP = 20 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0208 mg/l
  Dilution at edge of NFR              s = 43.4
  NFR Location:                        x = 15 m
    (centerline coordinates)           y = 0 m
                                       z = 11.5 m
  NFR plume dimensions:  half-width (bh) = 13.60 m
                          thickness (bv) = 11.5 m
Cumulative travel time:       204.0626 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The 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 becomes laterally fully mixed at 1586.27 m
  downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 126.69 m downstream.
  Plume contacts second bank at 1586.27 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
```

```
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ has been specified.
However:
The ambient water quality standard was encountered at the following
  plume position:
  Water quality standard                   = 0.03  mg/l
  Corresponding dilution                 s = 30.0
  Plume location:                        x = 7.04 m
    (centerline coordinates)             y = 0 m
                                         z = 1.14 m
  Plume dimensions:      half-width (bh) = 13.89 m
                          thickness (bv) = 5.40 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.
```