DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES

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Code	Description
MOD_LA_PTO_ANT_56_Demanda	Demand, use and exploitation of natural resources
MOD_LA_PTO_ANT_01_LG	General location of the project

7 DEMAND, USE, EXPLOITATION AND / OR AFFECTION OF NATURAL RESOURCES

This chapter presents the renewable natural resources that will be used, exploited or affected during the construction and operation phases of the solid bulk cargoes port terminal in the municipality of Turbo, which obtained an Environmental License through Resolution No. 0032 of 2012[1], which will be modified by a multipurpose port terminal called "Puerto Bahía Colombia de Urabá" (see Chapter 3 Description of the Project, of the current environmental impact study).

The modification of the Environmental License object of application, already has the permits of concession of waters and dumping for the operative stage, and forest exploitation for the execution of the project, which were granted by Resolution No. 0032 of 2012 for the project[2] "*Construction and Operation of a Port Terminal of Solid Bulk Cargoes of Big Draft in Bahía Colombia* ", however, in the present modification it is required to request the use of the same flow granted in the operative stage, for the construction stage of the project.

Likewise, it is required to correct the coordinates of the location of the concession points and spillways, due to an error in the origin of the project´s coordinates.

In terms of forest exploitation, an increase in the volume to be used is required, in the areas where the works contemplated in the modification of the environmental license will be executed and, additionally, it is required to process a permit of atmospheric emissions during the operation of the port terminal for the management of solid bulk cargoes, during the activities of loading and unloading in the onshore terminal and maritime quay.

On the map MOD_LA_PTO_ANT_56_Demanda, the location of the sites for the exploitation of natural resources is presented and in Annex 7.1 FUN, the completed forms of the water concession permit, dumping permit with minor modifications, permit for forest exploitation and permit of atmospheric emissions is presented as well.

[1] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). By means of which an environmental license is granted. Bogotá, D.C. 135 p..
[2] Ibíd.

Additionally, Annex 7.2 presents the saving and efficient use of water program for the requested concessions and in Annex 7.3, the rational use of energy program.

7.1 Superficial waters

Because the district of Nueva Colonia does not have a good aqueduct to meet the project´s needs, the terminal will require capturing superficial water from the León River during the construction phase for industrial use and in the operation phase for domestic and industrial use.

The conceptual engineering for the capture, transportation, distribution, treatment and adequate disposal of water resources was prepared by PIO SAS[3], which served as the main source of information for the numerals 7.1 and 7.3 of this chapter regarding superficial waters and spillways respectively.

7.1.1 Required superficial water flow

According to the Environmental License granted by Resolution No. 0032 of 2012[4], a grant of superficial water for industrial and domestic use of the León River was granted to the Puerto Bahía Colombia SA Port Society, for a maximum flow rate of 1.5 L / s, 24 hours a day, 7 days a week, for a total volume of 907.2 m^3 / week.

The flow authorized in the aforementioned resolution was distributed as indicated below in Table No. 7.1:

Table No. 7.1 Flow authorized by Resolution No. 0032 of 2012[5]

Capture source	Project phase	Type of Use	Flow Awarded L / s
Río León	Operation	Domestic (personal hygiene, cleaning of cafeteria´s elements and utensils and in the terminal´s toilets)	0,5
		Industrial (Use against fire)	0,2
		Industrial (Cleaning of facilities and minor uses)	0,8

[3] PIO S.A.S. Conceptual Engineering Report: Integrated management of water resources in Puerto Antioquia. Santiago de Cali, 2015.
[4] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.
[5] Ibíd.

Source: Resolution No 0032 of 2012[6]

In accordance with the above, in Resolution No. 0032 of 2012[7], this concession was authorized for the operation phase of the project, however, in the present study for the Modification of Environmental License of the project, it is requested that the same maximum flow of 1.5 L / s is included in the construction phase, for industrial use, taking into account that the necessary measures will be taken to avoid generating additional impacts to those identified in the current Environmental License.

It is worth mentioning that during the construction of the project, the water for human consumption will be supplied with water bottles, water tankers or drinking water service companies, provided they are duly authorized and have the water concession duly granted for the provision of the service.

The flow requested in this project´s Modification of Environmental License, will be distributed for industrial use in the production of concrete and environmental management (humidifying of accesses and intervention areas) in the construction phase, as presented in Table No. 7.2.

Table No. 7.2 Flow requested in the current Modification of the current Environmental License.

Capture source	Project phase	Type of Use	Flow Awarded L / s
Río León	Construction	Industrial (Concrete plant for the production of simple and reinforced concrete)	1,37
		Industrial (Humidification of the access road from the Nueva Colonia district - Puerto Antioquia site and property area)	0,13

Source: Aqua & Terra Consultores Asociados., S.A.S, 2015

- Required volume for the production of simple and reinforced concrete

According to recognized authors[8] [9] [10] and experience in the field, it is possible to estimate that the volume of water per square meter built on site consumed, is in the

[6]Ibíd.
[7] Ibíd.
[8] FILHO, E. C., Da SILVA, S. R., BRITO, I. G. G. Water Consumption in Construction Site From Metropolitan Region of Recife: Encontro Latinoamericano de Edificações e comunidades sustentáveis, 2013
[9] GALVÍN, R.M. *Physicochemistry and microbiology of aquatic media. Treatment and quality control of water*: Díaz de Santos, 2003.
[10] PESARRELLO, R. G. *Estudo exploratório quanto ao consumo de água na produção de obras de edifícios: avaliação e fatores influenciadores*: Escola Politécnica da Universidade de São Paulo., 2008

range of 0.2 to 0.25 m^3 / m^2 of work, and the water consumption in the preparation and adaptation of simple and reinforced concrete, is approximately of 200 L / m^3 of concrete.

Taking these data into account, the volume of water consumption was estimated for the execution of the work as detailed in Table No. 7.3. To estimate the volume required for concrete fabrication, the following considerations, for concrete slabs, were considered:

a) CBR of subgrade design = 10%

b) Concrete Strength f'c = 245 kg / cm^2 with a breaking module of 4 MPa

c) Slab thickness of 30 cm with 20 kg / m^3 of steel fiber and 600gr / m^3 of polypropylene fiber.

d) Truck for design: 30 t

Table No. 7.3 Estimated volume of water consumption in construction phase

Projected area (m^2)	**Water consumption (m^3)**	**Total estimated volume of water (m^3)**
350.080	0,2	70016
Projected volume of concrete (m^3)	**Water consumption (m^3)**	**Total estimated volume of water (m^3)**
123.018	0,2	24.604
	Total water volume estimated for construction phase (m^3)	**94.620**

Source: PIO S.A.S. Conceptual Engineering Report: Integrated management of water resources in Puerto Antioquia., 2015.

According to what is presented in Table No. 7.2, a total flow for the construction stage of 1.5 L / s is requested in the current Environmental License Modification, which is equal to the flow approved by the Environmental License in the Resolution No. 0032 of 2012[11] for the operation phase.

[11] Ibíd.

In order to supply the estimated water demand for the construction phase, it is necessary to initially build a storage tank of 300 m^3, with its respective pumping system in the projected capture.

Due to the above, with a flow rate of 1.5 L / s, it is possible to capture 129.6 m^3 of water in one day for its use in the construction process, related to the production activities of simple and reinforced concrete and humidification of the areas of intervention.

- Volume required for humidification

According to the characteristics of the access road and the project intervention areas in the onshore terminal, a flow of 0.13 L / s was considered for the humidification activity during the construction of the project (see Table No. 7.2).

The estimated frequency of humidification will be two (2) times a day, which will be carried out by means of a 3000-gallon tank car with a speed of 10 km / h, for a performance of 16 km.

This frequency can be modified, because the weather conditions in the area, there is high rainfall, so it will be possible to adjust the frequency ensuring the prevention of dust and particulate material generated by different construction and transit activities of the vehicles associated with the project, such as trucks, heavy machinery and light vehicles (see Table No. 7.4).

Table No. 7.4 Volume of water for humidification

Description	Units	Values
Tank car capacity	Gallons	3000
Tank car speed	km/h	10
Tank truck nozzle flow	L/s	0,2
Number of nozzles	Unit	10
Total flow nozzles	L/s	2
Tank car emptying time	Hours	1,6
Tank car Performance	km	16
Tank car filling	Times/day	1
Volume needed	Liters	11356,24
Concession flow	L/s	0,13
Tank car filling time (45 minutes)	s	2700

Description	Units	Values
Flow required for filling	L/s	4,21

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

7.1.2 Source Identification and location of the capture site

Currently, the project has a water concession granted through Resolution No. 0032 of 2012[12], whose capture was located in the coordinates presented in Table No. 7.5.

Table No. 7.5 Location coordinates of the superficial water capture granted by Resolution No. 0032 of 2012

Description	Name of the source	Flat Coordinates, Magna Sirgas Origin Bogotá		Geographical coordinates	
		North	East	Latitude	Longitude
superficial water capture	Río León	1.368.584,06	706.355,75	7°55`14,34	76°44`22,81

Source: Resolution 032 of 2012[13]

Due to the more detailed designs of the project, for the current Modification of Environmental License, it is requested to modify the location of the capture point in relation to the one previously granted in Resolution No. 0032 of 2012[14] for the operation stage, due to an error in the origin of the coordinates since this point was located in the middle channel of the Leon River and not on its shore.

The change of location coordinates of the water concession is requested, considering it as a minor change, because it continues to be located in the León River approximately 124 m from the originally granted location and does not generate different impacts to the ones identified in the Environmental Impact Study, nor are nearby communities affected, since the use of the León River as a source of supply to populations downstream of the capture was not identified.

The request for the relocation of the coordinates of the capture for the construction and operation stage will be made on the León River downstream of the confluence of this with the Nueva Colonia canal, as presented in Table No. 7.6 and Figure No. 7.1.

[12] Ibíd.
[13] Ibíd.
[14] Ibíd.

According to the identification of the IDEAM, the subzone of the León River corresponds to the identification 1201. The property through which the concession is accessed is located in the Nueva Colonia Village, municipality of Turbo.

Table No. 7.6 Location coordinates of the superficial water capture requested in the current Environmental License Modification and change of coordinates for the operation

Description	Name of the source	Flat Coordinates, Magna Sirgas Origin Bogotá	
		North	East
superficial water capture	León River	1.368.707,6	706.348,01

Source: Aqua & Terra Consultores Asociados., S.A.S, 2015

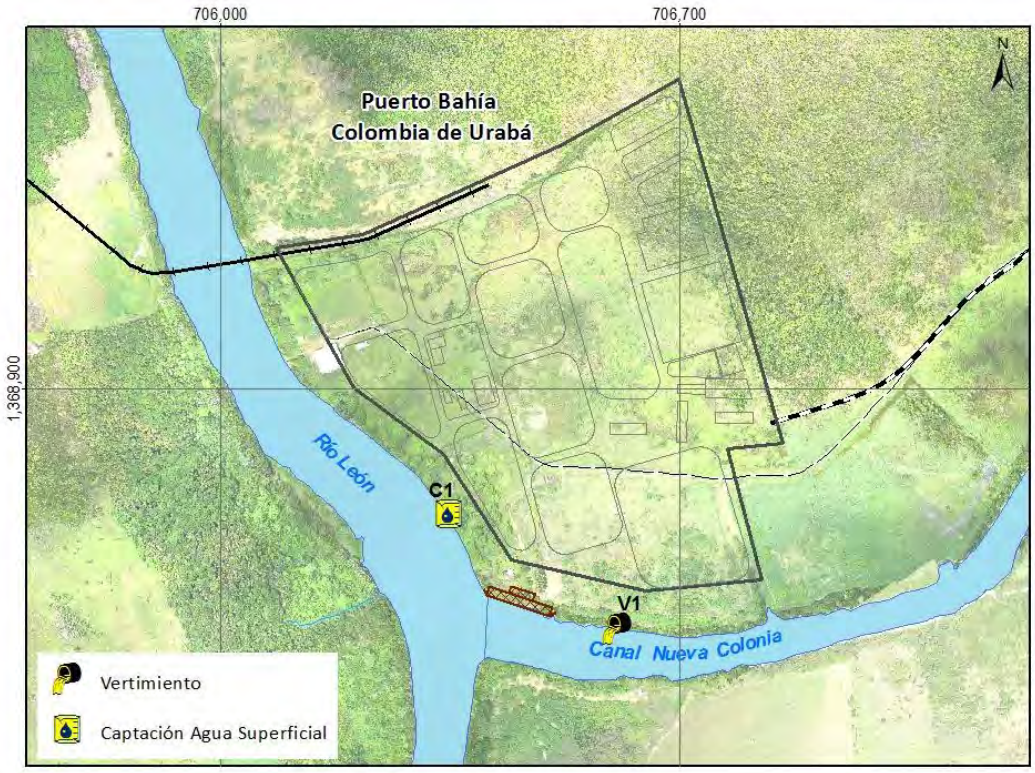

Figure No. 7.1 Location of the capture and spillway point in the León River
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

7.1.3 Design of infrastructure and capture, derivation, conduction and distribution system

For the onshore installations, a lateral type collection structure is projected, due to the fluvial conditions of the León River. The point of capture located in the flat coordinates (Magna Sirgas, origin Bogotá) presented in Table No. 7.6, detailed as point 1 within Figure No. 7.2, is used.

This point also incorporates a desanding unit and a pumping unit, which allows to raise the raw water to its treatment in the Projected Drinking Water Treatment Plant, which will henceforth be called PTAP.

From this capture, the pipe adduction leads to a compact Potable Water Treatment Plant (PTAP), illustrated as point 2 of the potable water infrastructure in Figure No. 7.2.

The PTAP, in addition to executing the conventional processes of sedimentation, coagulation, filtration and disinfection, must have a flow rate to treat 1.30 L / s of water, which is the daily maximum plus 4% of the average daily flow.

A 300m^3 water storage tank is projected, which will supply the fluctuating demands of potable water in the port facilities, represented in point 3 (see Figure No. 7.2), which will also work as a reserve for the needs of the system against fire.

The adequacy of a raw water pumping station is necessary, due to the topographic conditions and architectural layout, just after a sand trap.

The networks and hydraulic points, the connections and other hydraulic elements of the aqueduct network, coded with blue color (see Figure No. 7.2), must be designed and constructed under the RAS norms and others that correspond. It must have pneumatic pressure equipment that allows to provide the entire network of aqueduct with the necessary pressure within the normal operating ranges, at all points of the network.

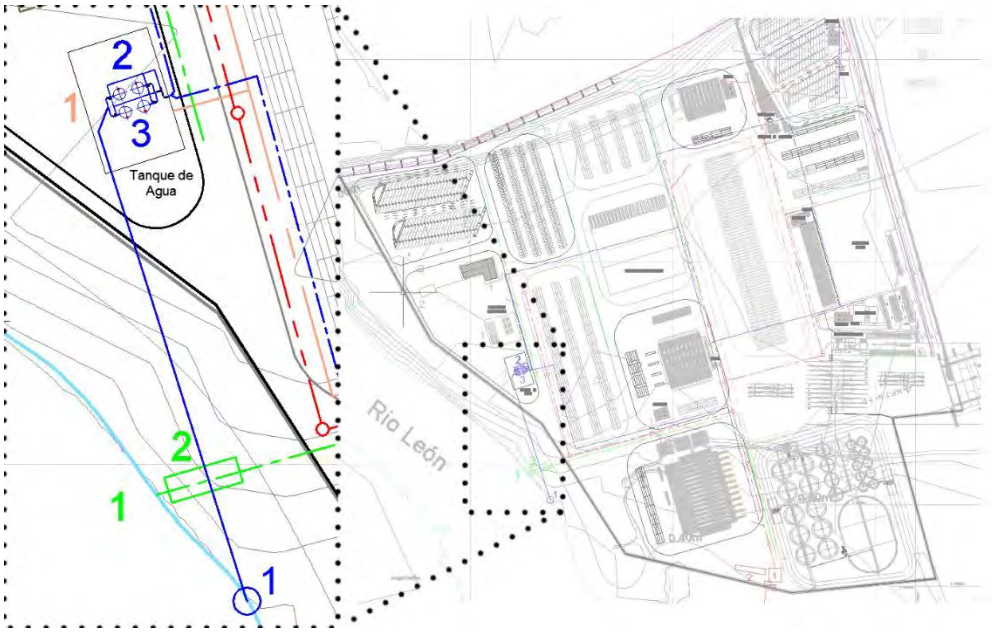

Figure No. 7.2 Location of infrastructure for potable water in onshore facilities
Fuente: PIO S.A.S, 2015.[15]

Table No. 7.7 Identification of the infrastructure of Figure No. 7.2

Identification, ID in blue	Infrastructure
1	Intake
2	PTAP, above the projected Tank
3	Projected tank

Source: PIO S.A.S, 2015[16].

It should be mentioned that the definitive designs of the potable water treatment plant will be delivered to the competent environmental authority 90 days before the start of the construction phase of the project.

[15] PIO S.A.S. Conceptual Engineering Report: Integrated management of water resources in Puerto Antioquia. Santiago from cali, 2015.
[16] Ibíd.

- Capture of continental superficial waters

A pre-dimensioning of the capture structure is presented, detailed in the following items. A lateral type intake is established on the previously defined point and an approximate scheme is illustrated in Figure No. 7. 3..

- Grid design

Losses in the grid

To determine the losses in the grid the Kirshmmer equation is used, see Equation No. 7.1:

$$h = B\left(W/b\right)^{4/3} hv * sin\,\theta$$

Equation No. 7.1 Kirshmmer Equation
Source: Information of PIO S.A.S, 2015

Where:

h: Loss of Load (m)

B: Form factor (B = 1.79 for circular bars, B = 2.42 for rectangular bars)

W: thickness of the bar (m)

b: minimum space between bars (m)

v: approach speed (m/s)

hv: speed loading (m)

ɵ: angle of the bar with the horizontal

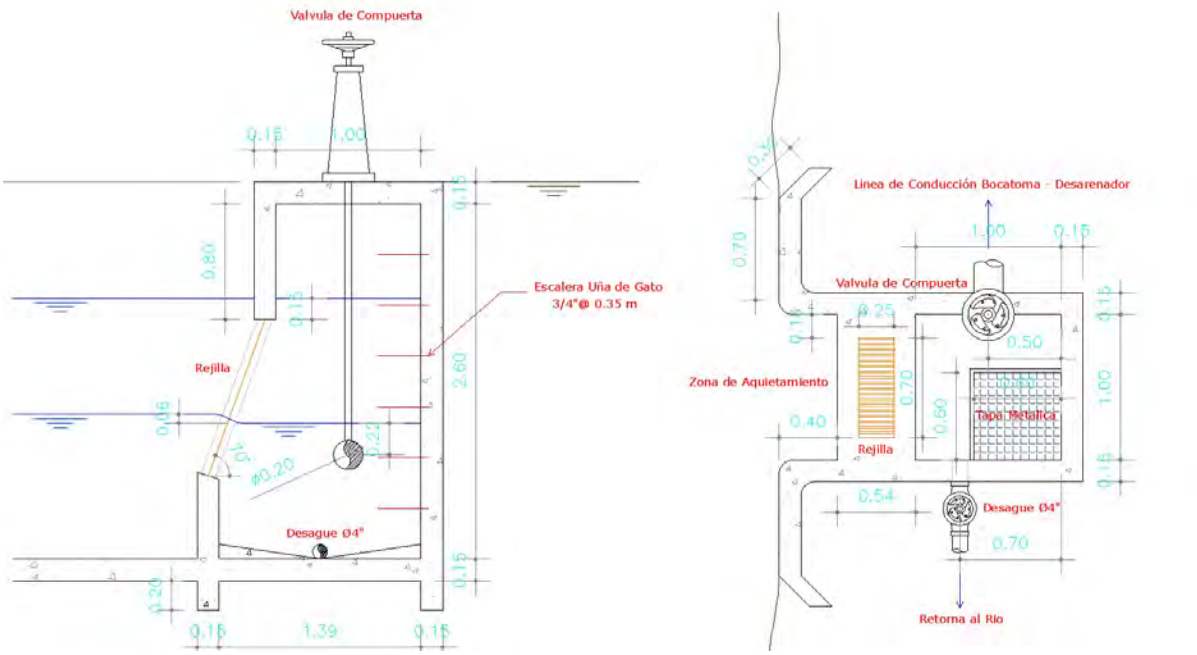

Figure No. 7.3 Scheme of the Lateral Intake to design
Source: PIO S.A.S, 2015

In this design, the bars are circular, with a thickness of ½ inch and a separation of 1 inch, in order to avoid the entry of sticks and coarse solids of more than 1 inch; and an angle of inclination of 70 ° with respect to the horizontal to facilitate the maintenance. Assuming an approach speed of 0.6 m / s, the losses in the grid are equivalent to, see Equation No. 7.2.

$$h = 1{,}79\left({}^{0{,}0127}/_{0{,}0254}\right)^{4/3} 0{,}01836 * sin\,70 = 0{,}0123\ m$$

Equation No. 7.2 Equation of losses
Source: Information of PIO S.A.S, 2015

The minimum losses in the grid should be 0.06 m, due to the accumulation and dragging of floating and suspended material; in this case, the losses calculated with the Kirshmmer equation are less than the minimum, so for the design 6 cm will be used as the losses in the grid.

Flow in the Free spillway

Assuming a load of H = 0.20 m above the spillway, the water level is inside the derivation chamber and its respective height:

Water Level within the Derivation Chamber
H – 0,06m = 0,20 – 0,06 = 0,14 m

Since the water level inside the derivation chamber indicates that the spillway is submerged, the flow rate that can be captured in this condition should be calculated by applying the Villemonte equation, see Equation No. 7.3:

$$Q_1 = Q/(1 - S^n)^{0.385}$$

$$S = {(H - pérdidas)}/{H}$$

Equation No. 7.3 Villemonte equation
Source: Information of PIO S.A.S, 2015

Where:

Q: Flow rate that we need to capture (Design flow Q = 3 * QMD = 0.00475 m^3 / s)

Q_1: Flow rate captured if the spillway was free (not submerged) (m^3 / s)

S: Submergence

n: exponent of the formula as a free spillway (n = 1,5)

H: load on the spillway (m)

Using the equations, the collected flow is determined as if the spillway was free:

$$S = {(0{,}20 - 0{,}06)}/{0{,}20} = 0{,}70$$

$$Q_1 = Q/(1 - S^{1,5})^{0,385} = 0{,}006662\ m^3/s$$

Total Length of the Grid

The length of the grid is determined by the Francis equation for free spillway, see Equation No. 7.4:

$$Q = 1{,}84 * Le * H^{3/2}$$

Equation No. 7.4 Francis equation

Source: Information of PIO S.A.S, 2015

Where:
Q: captured flow if the spillway was free (m^3/s)
H: load (H = 0,20)
Le: equivalent length (m)

Using Equation 19 and clearing the equivalent length, is found:

$$Le = \frac{Q}{1{,}84H^{\frac{3}{2}}} = \frac{0{,}008599\ {}^{m^3}/_{s}}{1{,}84 * 0{,}2^{3/2}} = 0{,}0404\ m$$

The number of spaces and the number of rods is determined by the following equations, as presented below:

N°of spaces = Le / rods diameter = 0,0404 / 0,0127m = 3 spaces

N°of r4ods = N° spaces – 1 = 3 - 1 = 2 rods

Finally, the total length of the grid is found

Total Length = (N ° spaces * distance between rods) + (N ° rods * rod diameter)

Ec. 22

= (3 spaces* 0,0254m) + (2 rods* 0,0127m) = 0,10875 m

In order to verify the total length of the grid, the Engels equation for lateral spillway is used, see Equation No. 7.5.

$$Q = 1{,}86 * Le^{0{,}9} * H^{1{,}6}$$

Equation No. 7.5 Engels equation
Source: Information of PIO S.A.S, 2015

Where:
Q: captured flow (m^3/s)
Le: Effective length (m)
H: load on the crest (m)

Clearing Le you get:

$$\text{Le} = [\text{Q}/1{,}86\text{H}^{1,6}]^{1/0,9} = [0{,}008599\text{m}^3/1{,}86(0{,}20)^{1,6}]^{1/0,9} = 0{,}03349\ \text{m}$$

Comparing the values of Le obtained by the Francis (0.00404m) and Engels equation (0.003349 m) it is observed that they do not vary significantly, in such a way that the grid will have a total length of 0.10875 m.

- Derivation chamber design

In order that the person in charge of the maintenance of the structure can enter and maneuver comfortably, dimensions of 1.0 m wide and 1.0 m long are recommended in the upper base. To facilitate the entry, it must also be provided with a 0.6 m x 0.6 m stainless steel metal gate and inch cat's claw ladders, spaced 0.35 m apart.

For the outlet of the water to the intake-desander conduction, a pipe is designed that works as a submerged orifice, whose design flow would correspond to twice the maximum daily flow.

Qdesign = 2 * QMD = 0,003 m^3/s = 3,16 L/s

Using the submerged orifice equation for the design flow, a 2-inch diameter pipe and a contraction coefficient of 0.61, see Equation No. 7.6.

$$Q = Cd \cdot A \cdot \sqrt{2g \cdot H}$$

Equation No. 7.6 Submerged orifice equation for design flow
Source: Information of PIO S.A.S, 2015

Where:

Q: design flow (m^3/s)
Cd: contraction coefficient
A: pipe area (m^2)
H: Pipeline depth (m)

By clearing the depth at which the pipeline should be located, you get:

$$H = \left(\frac{0{,}003\ {}^{m^3}/_{s}}{0{,}61 \cdot \left(\frac{\pi \cdot 0{,}00202 m^2}{4} \right)} \right)^2 \cdot \frac{1}{2 \cdot \left(9{,}81\ {}^{m}/_{s^2} \right)} = 0{,}334 m$$

- Adduction

For the design of the adduction, the QMH (1,457 L / s) is taken as the design base flow. It is considered that the desander to be projected is 2 meters away from the intake.

Table 7-8 shows the pre-dimensioning of the adduction.

Table No. 7.8 Pre-dimensioning of the adduction

Component	Estimated value	Unit
Slope between intake and sand trap	1,5	%
Distance	2	m
Value of "n" for PVC pipe	0,010	-
Required diameter for Adduction	2,32=3	Inch
Full pipe flow	0,004	m^3/s
Full flow speed	0,874	m/s
Design Flow / Full Flow	0,898	-
Vreal relationship	0,476	m^3/s
Yreal relationship	0,019	m/s
Energy check at the desander´s point of arrival	0,036	m
The maximum excess flow expected on arrival at the sand trap is	1,980	L/s

Source: PIO S.A.S, 2015

- Sand trap

A desanding structure is projected to remove the sediments or sands of a certain size that the Leon River capture allows to pass and that could hinder the proper functioning of the projected treatment processes, drastically reducing their efficiency or the same obstruction of the conduction pipelines.

This structure is calculated with the flow rate required for purification plus the projected flow for the fire system and what is determined as flow for other operations, ie, (1,457 L / s). Table No. 7.9 details the predimensioning of the desander.

Table No. 7.9 Predimensioning of the desander

Component	Estimated value	Unit
Particle removal	0,005	Cm
Removal percentage	80	%
Temperature	28	C
Kinematic viscosity	0,00839	--
Hazen number for% removal of 80	4	Theta/time

Component	Estimated value	Unit
Density of the estimated sand	2,65	g/cm^3
Useful depth	1,20	m
Maximum sludge depth	0,20	m
Free edge settler	0,30	m
Sedimentation Speed (Vs)	0,268	cm/s
Sedimentation time (ts)	448	s
Hydraulic Retention Period (Tr)	0,50	h
Tank volume (Vt)	3,60	m^3
Surface area (As)	3,00	m^2
Tank Dimensions, Length	1,00	m
Tank dimensions, Width	3,00	m
Tank´s Surface Hydraulic Load(q)	57,88	m^3/m^2.day
Theoretical speed (Vo)	0,000670	cm/s
Diameter of particles removed	0,001	cm
Horizontal Speed (Vh)	0,206	cm/s
Drag Speed (Varr)	9,29	cm/s

Source: PIO S.A.S.

- Pumping

A pumping structure is projected to transport the raw decanted water to the storage tank for the potable Water Treatment Plant.

It is justified to carry out the treatment of potable water to later dispose a part in the fire system, because the storage of untreated water and with color, odor and microbiological properties of a water decanted from this surface source can affect the properties of the fire protection system.

Although there is no clear regulation regarding the required quality of the water to be used in said system, there is an international regulation that exhorts to pre-treat this water to prevent transmission of *legionella*.[17].

Table No. 7.10 details the pre-dimensioning of the pumping. It is necessary to indicate that two emergency pumps with the same characteristics must be available.

Table No. 7.10 Predimensioning of pumping

[17] MARÍN, Rafael. Physicochemistry and microbiology of aquatic media. Water quality treatment and control. Díaz de Santos Colombia, Madrid 2003.

Component	Estimated value	Unit	
Suction Diameter			
Flow	0.001457	m^3/s	
Pumping flow rate	0.000911	m^3/s	
Partition of the pumps	100%	Each one	
Flow per pump	0.000911	m^3/s	
Design speed	1	m/s	
Pipe diameter	1,34	inches	
Commercial diameter	2	inches	
Speed check	0,46	m/s	
Impulsion Diameter			
Flow	**0,001457**	**m^3/s**	
Pumping hours	24	horas	
Pumping flow rate	0,000911	m^3/s	
Partition of the pumps	100%	Each one	
Flow per pump	0,001255	m^3/s	
K factor for pumping 24 h	0,90	-	
Economic diameter	1,07	inches	
Commercial diameter	2	inches	
Speed check	0,46	m/s	
Data for the system curve			
Suction			
Pipe length	1	m	
ΣK (Accessories)	1,9	-	
accessories	**Quantity**	**K**	**K Total**
Foot valve	1	1,75	1,75
Eccentric reduction	1	0,15	0,15
Impulsion			
Pipe length	2	m	
ΣK (Accessories)	37,75	-	
accessories	**Quantity**	**K**	**K Total**
90 ° long elbow	19	0,75	14,25
Measurer	1	1	1
Meter accessories	-	-	22,5
Pumping flow	0,000910625	m^3/s	
Losses in Pumping	0.339	m	
Pumping height	5.899	m	
Pumping Static height of	5.5	m	

Source: PIO S.A.S, 2015

- Storage

A storage tank is pre-dimensioned according to the criteria expressed by RAS 2000[18] in its titles B.8.4.2 and B.9.4.4, detailed in Table No. 7.11.

Table No. 7.11 Minimum pre-dimensioning of the storage tank for potable water treatment

Component	Estimated value	Unit
Considerable flow	1,647	L/s
Volume	52,07	m^3
Height	2,20	m
Superficial area	23,67	m^2
Length, Width	4,90	m
Free edge	0,30	m
Walls Height	2,50	m

Source: PIO S.A.S., 2015

The storage tank dimensioned for the fire-fighting system, must have a minimum volume of 85200 L, so adding the volume of 52.07 m^3 and 85.2 m^3, 137.27 m^3 are obtained, in order to supply all the projected demand and with a safety factor for the washing of containers, with the criterion of the use of 3 pressure washers for the washing of 200 containers a day, spending an average of 7.5 L / min, for 5 minutes of washing; it is necessary to adjust the storage tank dimensioning as expressed in Table No. 7.12.

Under these conditions a water storage tank of 300 m^3 is obtained.

Table No. 7.12 Predimensioning the water storage tank

Component	Estimated value	Unit
Volume for use as potable Water	52,07	m^3
Volume for fire system use	85,2	m^3
Estimated volume for washing operations	7,5	m^3
Total estimated volumes	144,77	m^3
Security factor (2)	289,54	m^3
Total net volume for constructive ease	300	m^3

Source: PIO S.A.S.

[18] TECHNICAL REGULATION OF THE DRINKING WATER AND BASIC SANITATION SECTOR - RAS 2000. Titulo B. Sistemas de Acueucto. Bogotá D.C., 2000. 206 p.

- Hydro pneumatic system

The necessary pressure of the hydro pneumatic system is pre-dimensioned to provide drinking water for the onshore installations. A pipe diameter for potable water pipeline of 4 inches is estimated, and a piezo metric level required for the system of minimum 27.1 m.c.a, with a planned pipe length of 2,456 m, as detailed in Table No. 7.13

Table No. 7.13 Predimensioning for hydro pneumatic system

		CAUDAL	DIAMETRO TUBERIA		VEL.	PERDIDAS	ACCESORIOS				Long.	Perdida t.	Perdida	COTA PIEZOMETRICA
Numero	Factor de Simultaneidad. Nº grifos uso residencial	MAXIMO			V =Q/ A	UNITARIAS	TIPO	NUM.	Valor K parcial	Perdida accesorios	Tuberia	Recto	total	COTA PIEZOMETRICA REQUERIDA
de		PROBABLE	NOM	REAL		J (m/m)					Lh + Lv	J x L	ht + hm	
grifos						J (m/m) = (Q/(0.2785CD^2.83))^(1/.54)	DESCRI	N	Tablas	(K x V^2/2g)	m	mca	mca	mca
acumulado		L/ s	pulg.	metro	m/ s		PCION							
100	0,10	3,27	4	0,1016	0,40	0,001705756	CODO 90	22	0,9	0,17	2705	4,61	4,78	27,1

Source: PIO S.A.S.

- Dock´s Water supply

A system is projected for the supply that consists of 4 water exits in the dock, with its hydro pneumatic equipment that allows the arrival of drinking water from the onshore facilities; It will be composed of:

a) Splice with 100 mm PVC pipe to 3 "impulsion pipe.

b) 100 mm expansion isolation valve.

c) Distribution network composed of 100 mm PVC pipes. With flanged joints according to the norm. These pipes will be hung on the underside of the slab of the dock, with a transport capacity of approximately 8 L / s and a maximum load loss of 10.00 m.c.a.

d) Four (4) 65 mm underground water outlets, protected by a cast iron box and attached to the side of the dock slab.

e) It also establishes the installation of a potable water tank of 15 m^3 for an estimated consumption of 80 people and its provision through the network described.

f) Pumping water to the dock for industrial use

g) A pumping system is projected that allows water to be transported from the projected storage to the dock area.

h) The suction of the pumping system will be carried out by means of an elastomeric hose that, together with the assembly in HD (ductile iron) of the pumping, will develop a total length of 4.7m in Ø4 "at the exit of the storage. The impulsion will be made in Ø90mm Polyethylene pipe (4100m), carbon steel in Ø3 "(28.8m) for the pumping assembly obtaining a total length of approximately 4133.5m, until reaching the dock area. A pumping flow rate of 4 L / s is estimated

i) e presents the pre-dimensioning of the pumping below.

- Checks

Input data, Table No. 7.14 details the input data of the pumping system.

Table No. 7.14 Input data of the pumping system towards the Dock

Data	Value and Unity
* Flow to be pumped; QMD =	4.00 L/s
* Daily pumping time; t =	12.0 hours
* Average water temperature; Tº =	26 ºC
* Acceleration of gravity; g =	9.81 m/s²

Source: PIO S.A.S., 2015.

Equation No. 7.7 presents the check of the suction pipe according to the following equations, see Table No. 7.15:

$$Qs = [Qb/\ Nb\ ]; Qs = [\ As\ x\ Vs\ ]; As = [(\ p\ x\ Øs\text{^}2)/4]$$

Equation No. 7.7 Check of suction pipe equation

Source: Information of PIO S.A.S, 2015

Table No. 7.15 Check of the suction pipe of the pumping system towards the Dock

Data	Value	Unit	Comment
* Pumps in operation; Nb =	1		
* Pumping check flow rate; Qb =	8.00	L/s	
* Diameter of the suction pipe; Øs =	4.00	Inches	Corresponds to the diameter of a pipeline in HD
* Area of the suction pipe; As =	0.008	m²	
* Speed in the suction pipe; Vs =	0.99	m/s	Complies with Literal B.8.5.6.1 of the RAS / 2,000
* Max. Speed. recommended by the RAS / 2,000	1.30	m / s (Value obtained from Table B.8.2, of the RAS / 2,000)	
* Minimum recommended speed =	0.45	m / s (Value suggested in reference 1)	

Source: PIO S.A.S., 2015

The projected suction pipe will be 4 inches, through which will pass 8 L / s, which generates a speed of 0.99 m / s.

Equation No. 7.8 presents the impulse pipe check according to the following equations:

$$Qs = [Qb/\ Nb\ ]; Qs = [\ As\ x\ Vs\ ]; As = [(\ p\ x\ Øs\text{^}2)/4]; R\ =\ [\ Øs\ /\ Øi\ ] >\ 1$$

Equation No. 7.8 Check of impulse pipe equation
Source: Information of PIO S.A.S, 2015

Table No. 7.16 Check of the piping of the pumping system towards the dock.

Data	Value	Unit	Comments
* Flow to boost; Qi =	8.00	L/s	
* Diameter of the impulse pipe; Øi =	3.12	inches	Corresponds to the diameter of a PE pipe (internal 79.2mm)
* Area of the suction pipe; As =	0.005	m²	
* Speed in the impulse pipe; Vi =	1.62	m/s	Complies with Literal B.8.5.6.2 of the RAS / 2,000, 1> Vi> 3m / s
* Verif. of the relationship between Øi and Øs; R =	1.28	Complies with Literal B.8.5.6.3 del RAS/2.000, Øs > Øi	
* Pumping check flow rate; Qb =	8.00	L/s	
* Diameter of the impulse pipe; Øs =	3.00	inches in Elastomeric	
* Impulse pipe area; As =	0.005	m²	
* Speed in the impulse pipe; Vs =	1.75	m/s	
* Verif. of the relationship between Øi and Øs; R =	1.33	Complies with Literal B.8.5.6.3 of RAS / 2,000, Øs> Øi	
* Flow rate of pumping check; Qb =	8.00	L/s	
* Diameter of the impulse pipe; Øs =	3.00	inches in Carbon Steel, HD	
* Impulse pipe area; As =	0.005	m²	
* Impulse pipe Speed; Vs =	1.75	m/s	
* Verif. of the relationship between Øi and Øs; R =	1.33	Complies with Literal B.8.5.6.3 of RAS / 2,000, Øs> Øi	

Source: PIO S.A.S., 2015

Total dynamic height, NPSHd and Power

A total dynamic height of 165.25m is established, Net head of positive suction available; NSPHd of 7.80m, and a required power of 40 HP motor.

The technical support of the designs is presented in Annex 7.4 Hydrosanitary Designs.

7.1.4 Average monthly flow of the León River

According to the SENER study[19], the Atrato River is the main tributary of the Urabá Gulf basin, located on the western margin of the Gulf, has a length of 670 km and a drainage basin of approximately 35,700 km². The annual average flow that the Atrato pours into the gulf is approximately 4,500 m³ / s, as shown in Table No. 7.17.

The second river in importance for its flow and navigability is the León River, followed by the Suriquí, and, with less flow, the Turbo, the Cayman, the Bobal, Necoclí, Guadalito and Currulao.

During the less rainy period, the rivers reduce their flow and do not drain easily, due to the presence of berms, and some even find their mouths obstructed, which makes their contribution become null.

Table No. 7.17 Fluvial system of the Gulf of Urabá: flow and area of the river basin

River	Average flow rate (m³ / s)	Area of the basin (km²)
Atrato	4.750,00	35.700
León	40,00	2.250
Suriquí	20,00	71
Turbo	5,50	95
Caimán Viejo	4,00	97
Caimán Nuevo	3,70	85
Bobal	3,50	59
Necoclí	3,50	0
Guadualito	2,30	0
Currulao	2,10	0

Source: SENER. Feasibility study of the development of the port system in Urabá. 2007.

The climate determines the volume of precipitations that receive the basins of the rivers that end at the Gulf of Urabá, what influences directly in the flow of the same ones and in the contribution of the terrigenous material that decant in the Gulf of Urabá and in Bahia Colombia.

The León River has a basin of approximately 2,250 km² and runs from its source, in the south-western foothills of the Abibe mountain range, north of the municipality of Mutatá, to its mouth at 83 km in Bahia Colombia, receiving the contributions of the

[19] SENER. Estudio de viabilidad del desarrollo del sistema portuario en Urabá. 2007.

Carepa , Apartadó, Chigorodó, Zungo, Vijagual and Grande rivers, being characterized almost all these affluents for presenting a very similar altitudinal segmentation, manifesting in their headwaters as mountain currents with torrential regimes and potential instability of their canyons, until crossing terraced areas and hills, developing narrow alluvial valleys in the piedmont of the mountains, until reaching the alluvial plain of León, where they blur in many arms, forming a very complex network[20].

Its main channel appears as an arch that curves on the alluvial plane where it is blurred in networks of very complex channels, propitious for hydrophilic formations that run largely through the Turbo territory on the floodplain units and coastal marine complex.[21].

The distribution of flows of the Leon River with its tributaries is bimodal, registering during the rainiest months of September and October, episodes of overflow with average flow values of more than 100 m³ / s, which exceeds by several days the capacity of the cross sections that, in the alluvial section of the Barranquillita station, is between 180 and 200 m³ / s.

During the less rainy period corresponding to the months of January to March, the flows are lower than 30 m³ / s with a monthly minimum in March of 16 m³ / s (see Figure No. 7.4)[22].

The yields during the first months of the year are of the order of 20 / s / km², compared to values higher than 120 l / s / km² in the wettest period, due to the fact that during this last period a hydrological continuity is established in the wetlands systems of Bajo Atrato and León, thus increasing surface runoff in the basin[23].

The annual average flow in the Villarteaga River (upper part of the León River) is 18 m³ / s, while in Barranquillita it is 70.8 m³ / s, which implies an average water yield for the basin that varies from 135 to 93 l / s / km², values that are considered high (see Figure No. 7.4 and Figure No. 7.5)[24].

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[20] COLOMBIA. MUNICIPALITY OF TURBO. Land Management Plan: physical-environmental diagnosis. Turbo, 2000. Book 1. Part 1. Page 31.
[21] Ibíd. Book 1, Comp. 2 (Biotic). Page 21.
[22] Ibíd.
[23] Ibíd.
[24] Ibíd.

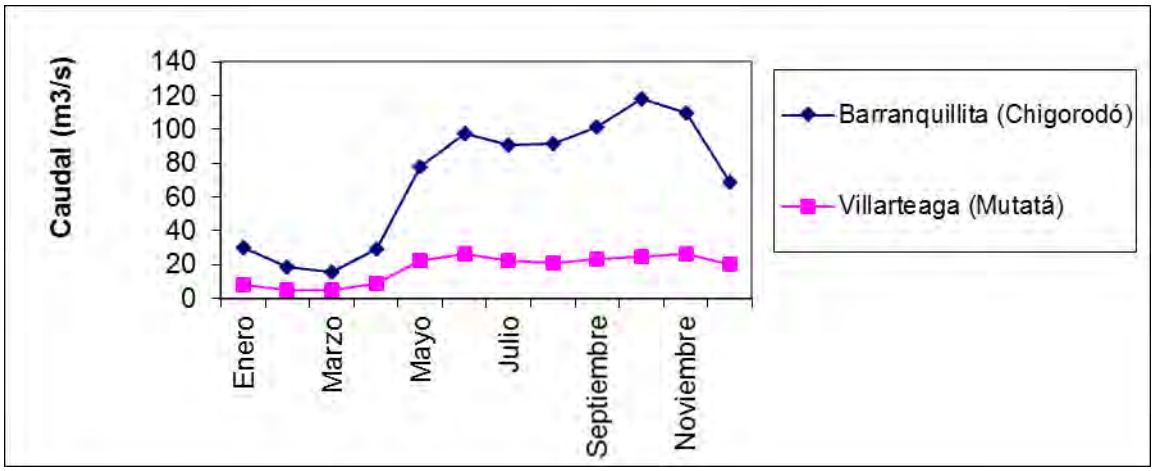

Figure No. 7.4 Average monthly flows of the León River at the Barranquillita and Villarteaga stations

Source: POT Turbo, 2000[25].

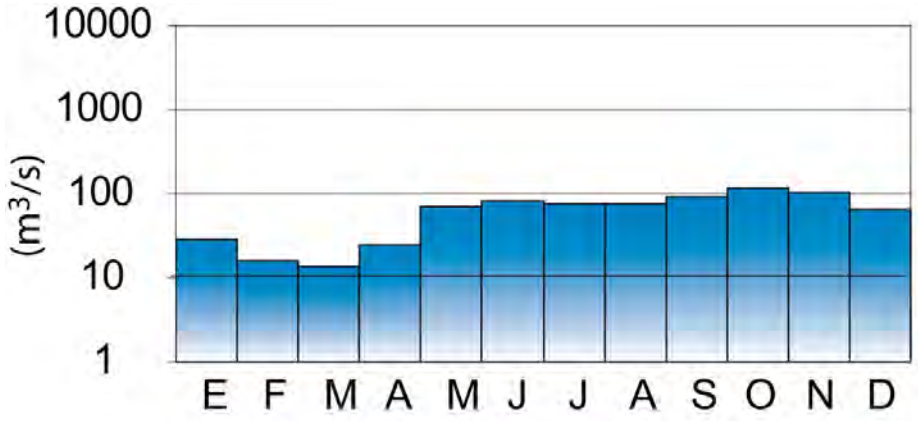

Figure No. 7.5 Average monthly flow of the León River at the Barranquillita station (statistics 1989-1993)

Source: Atlas of the Gulf of Urabá [26]

[25] COLOMBIA. MUNICIPALITY OF TURBO. Territorial Planning Plan, 2000. Op Cit.

[26] INSTITUTE OF MARINE AND COASTAL INVESTIGATIONS JOSÉ BENITO DE ANDREÍS (INVEMAR) and GOVERNMENT OF ANTIOQUIA. Atlas of the Gulf of Urabá: a look at the Caribbean of Antioquia and Chocó. Series of special publications No. 12. Santa Marta: 2007. 180 pages. ISBN 978-958-98104-3-9.

7.2 Underground waters

For the construction of the port project of Bahía Colombia de Urabá, the use of groundwater is not required, since the area where the project is located, presents a sufficient water supply, therefore the demand for water will be requested from a surface source.

7.3 Spillways

7.3.1 Spillway flow

Currently the project has authorized a spillway flow of 3 L / s over the Nueva Colonia canal, which was granted through Resolution No. 0032 of 2012[27] for domestic wastewater and water from washing facilities, which they will pour into the canal after being treated in the wastewater treatment plant – PTAR.

7.3.2 Identification of the receiving source

The spillway authorized by means of Resolution No. 0032 of 2012[28], for wastewater, will have as a source the Nueva Colonia canal, before the confluence with the León River; the location is presented in Table No. 7.18.

Table No. 7.18 Coordinates of location of the spillway granted by Resolution No. 0032 of 2012

Description	Name of the source	Gauss - Kruger flat coordinates	
		North	East
Dumping of wastewater	Nueva Colonia Canal	1.368.469,05	706.833,96

Source: Resolution No. 0032 of 2012[29]

In the current Modification of the Environmental License, the relocation of the aforementioned waste is requested, which will be located in the flat coordinates

[27] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.
[28] Ibíd.
[29] Ibíd. .

(Magna Sirgas, origin Bogotá) presented in Table No. 7.19, within the site where the project´s onshore construction is planned.

This location point is requested as a minor change in relation to that granted by Resolution No. 0032 of 2012, which is located approximately 238 meters from the granted, without this causing additional impacts and / or affecting neighboring communities. See Figure No. 7.1.

The adjustment in the coordinate is mainly due to an error in the origin of the coordinates initially granted, as well as the location of this pouring point in the middle of the channel, which will be actually made on the right margin of the same.

Table No. 7.19 Adjustment of the location coordinates of the spillway requested in the current Modification of Environmental License

Description	Name of the source	Flat coordinates Magna Sirgas Origin Bogotá	
		North	East
Dumping of wastewater	Nueva Colonia Canal	1.368.533,07	706.604,83

Source: Aqua & Terra Consultores Asociados., S.A.S, 2015

7.3.3 Domestic wastewater

- Onshore facilities

A sewage network is projected, coded in Figure No. 7.6 with red color, which must be connected by link-ups to the buildings that generate wastewater thanks to its processes, such as sanitary points, washing, cleaning and basic sanitation.

For this reason, the sewage network for wastewater was not projected towards facilities such as storage compartments, as detailed in Figure No. 7.6.

The proposed location of the sewerage chambers in this conceptual engineering phase may be subject to minor modifications due to the lengths of the established networks.

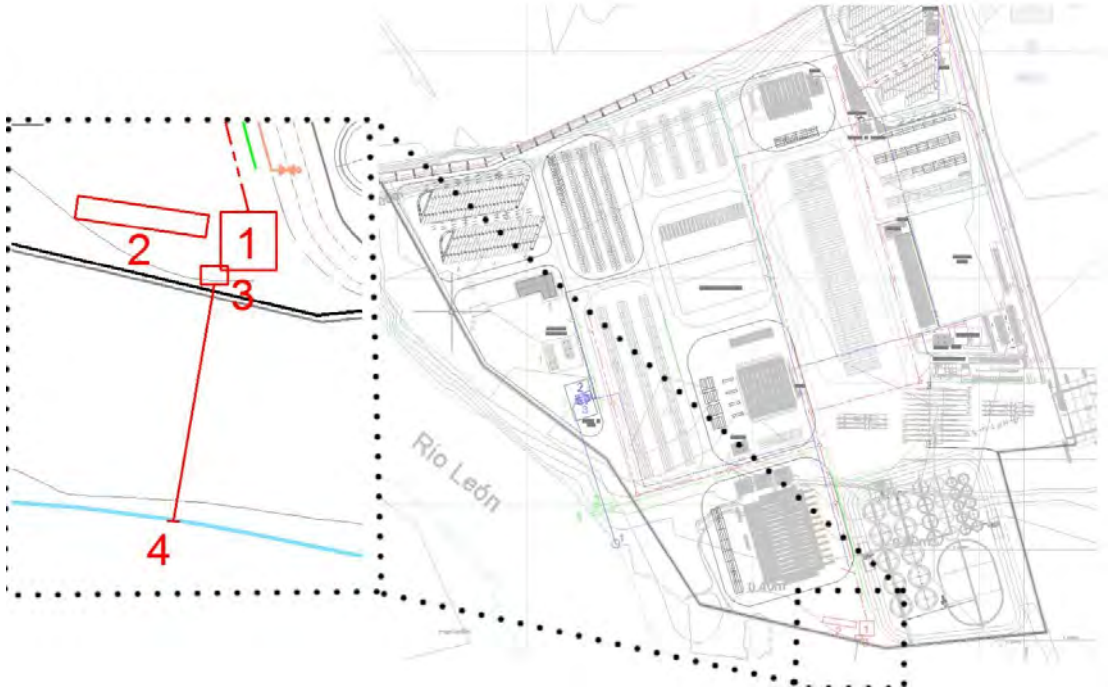

Figure No. 7.6 Location of infrastructure for wastewater in onshore facilities

Source: PIO S.A.S.

Table No. 7.20 Identification of the location points of the infrastructure for wastewater of Figure No. 7.6

Identification, ID in red	Infrastructure
1	PTAR
2	Drying Beds
3	Effluent pumping
4	Effluent discharge

Source: PIO S.A.S.

The sewage network must be exclusively for liquid waste of domestic origin.

A Wastewater Treatment Plant (WWTP) is projected, coded with the number 1 in red color in Figure No. 7.6, with a capacity to treat 2.56 L / s,

It is important that a grease trap be implemented to prevent the soaps of some maintenance washings for the operations of the port system, affect the other units of biological treatment, a treatment of primary level (sedimentation or physical) and secondary (aeration) to achieve the established goals of effluent quality.

It is necessary to have drying beds, coded with number 2, red color, in Figure No. 7.6, in order to properly dispose the waste generated by the treatment processes of the PTAR. It is worth mentioning that the final designs of the wastewater treatment plant will be submitted to the competent authority 90 days before the start of the construction phase of the port project.

Likewise, due to the flood protection required for the onshore Terminal in the area located on the margin of the Canal, it is necessary to design a pumping station for the effluent of the PTAR, coded with the number 3 in red color in Figure No. 7.6, so that said flow reaches the discharge head coded with number 4, and thus be able to perform the respective dumping at the authorized coordinates.

Figure 7.7 shows the behavior of the domestic wastewater networks projected on land, with green arrows for the flow direction to the PTAR.

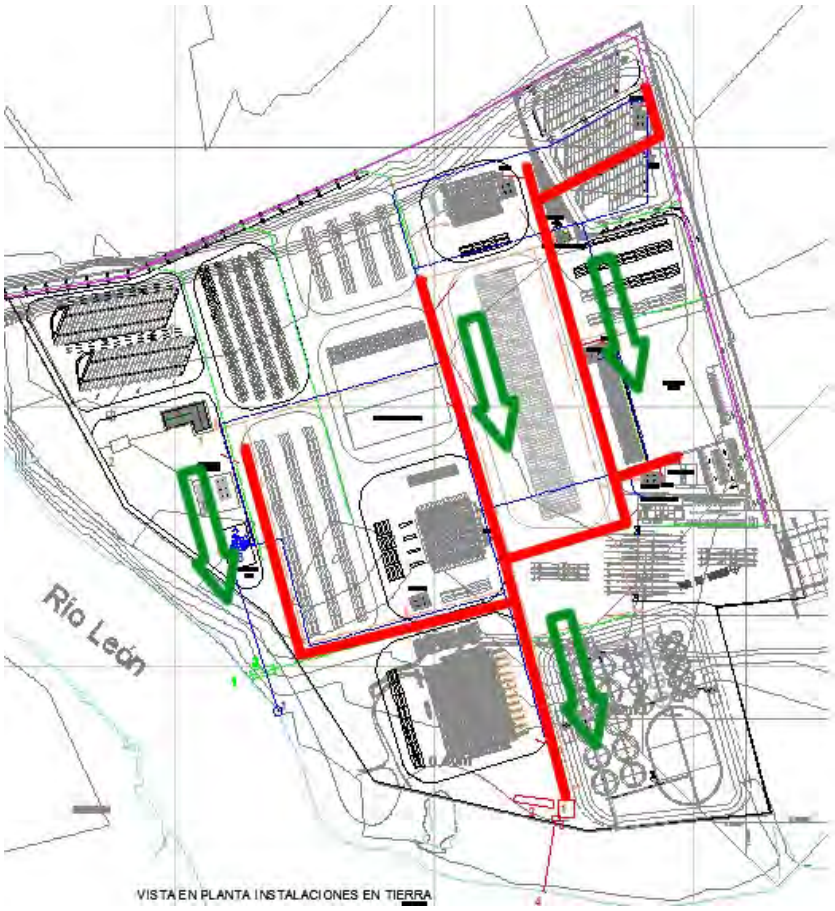

Figure No. 7.7 Behavior of domestic wastewater networks projected on land, with green arrows for the direction of flow

Source: PIO S.A.S., 2015

- Dock

It is planned to have sanitary batteries for basic sanitation needs at the dock. Said units will be mobile containers as sanitary rooms that operate independently of service networks, that is, said domestic wastewater will be stored in the portable sanitary units and a third party service will be responsible for carrying out the maintenance corresponding to their sanitation, removing the excreta in them confined.

This volume of wastewater is not considered for transport or treatment in the projected PTAR. This infrastructure is coded with the number 5 in red color in the following figure.

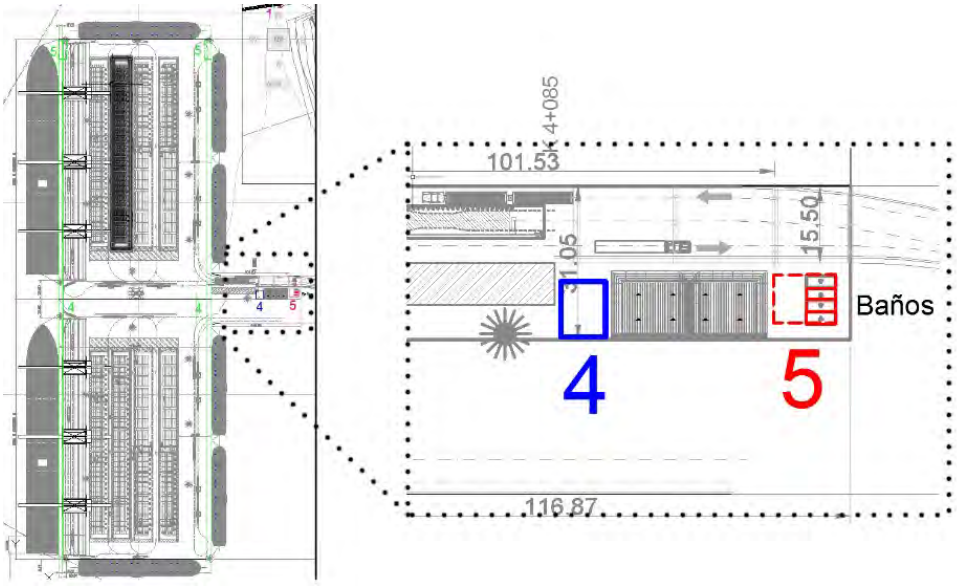

Figure No. 7.8 Location of infrastructure for use and residual water in the dock
Source: PIO S.A.S., 2015

Table No. 7.21 Identification of the location points of the infrastructure for wastewater of Figure No. 7.8

Identification, ID in red color - waste water, blue color - drinking water	Infrastructure
4	Potable water storage tank
5	Container in metallic structure with enclosure of panels for sanitary uses

Source: PIO S.A.S., 2015

For waste originating from oils (oleaginous) and other waste, a perimeter grid is projected for the projected building of a mechanical workshop, coded with the number 1 in brown color as shown in Figure No. 7.9, to ensure that oil residues be captured by it and avoid mixing with generated runoff.

This network of oily water surrounds the facilities where this feature is projected, such as the maintenance workshops.

The implementation of a Skimmer and / or Hydrocyclone is projected, with the purpose of executing an effective separation of grease and oils from the liquid waste,

codified in Figure No. 7.9 with the number 2 in brown color, in order to transport said effluent to a storage tank, which allows its extraction by a third party certified in the treatment of this type of waste, thus avoiding dumping to the ground or into bodies of water.

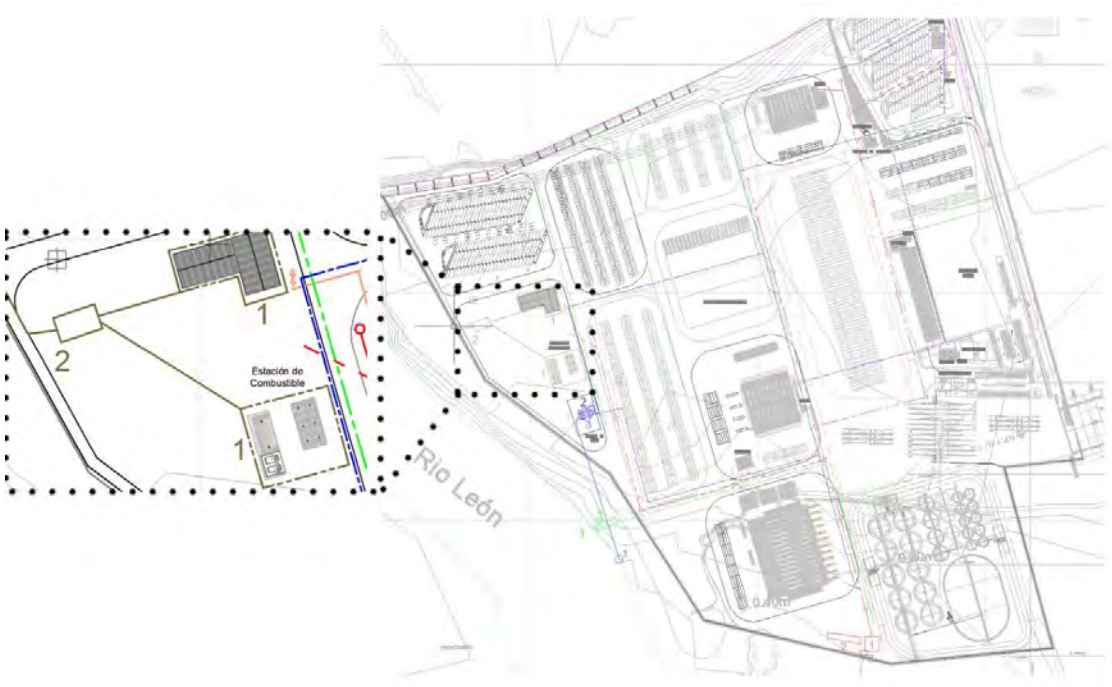

Figure No. 7.9 Location of infrastructure for oleaginous liquid waste

Source: PIO S.A.S.

7.4 Occupations of riverbeds

No permit is required for riverbed occupation for the current Environmental License Modification of the project, since the works contemplated for the operation and construction of the same, such as the suspension bridge that crosses the León River for the support of the viaduct or the jetty (fluvial dock) in the onshore terminal located at the north end of the right margin of the Nueva Colonia Canal, were already

authorized by Resolution No. 0032 of 2012[30]; On the other hand, said works were designed so that during its construction and operation, interventions are not carried out in the León River´s riverbed.

7.5 Forest exploitation

The construction of the necessary works for the development of the Puerto Bahía Colombia Project of Urabá, requires the forest exploitation of the arboreal individuals located in the area of direct affectation of the project; which is formed by a corridor of 2474.7 m long and 60 m wide, for an area of 148,484 m^2 that runs from the district of Nueva Colonia, to the site where the port's onshore terminal will be built.

The property (350,079 m^2) plus the withdrawal strip of the León rivers and the Nueva Colonia canal (63,358.58 m^2) have an area of 413,437.68 m^2; and a strip of 437.6 m long and 20 m wide (9,832.7 m^2), which is within the Protective Forest Reserve of the León and Suriquí River wetlands declared by agreement No 100-02- 02-01-0010-2011 by CORPOURABÁ[31] and which comprises the mangrove vegetation of this area, as shown in Table No. 7.22 and Figure No. 7.10.

This last strip was taken from the Protective Forest Reserve through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ[32], with the purpose of constructing the viaduct that will lead from the onshore terminal to the dock.

Table No. 7.22 Forest exploitation areas

Area to be used	Ecosystem	Name	Volume of wood (m^3)	Area (m^2)	Area (ha)
Continental	Wet tropical Zonobioma of the Magdalena-Caribe	Property	391.53	413437.68	41,34
Continental	Wet tropical Zonobioma of the Magdalena-Caribe	Terrestrial vegetation	378.97	148484.77	14,85

[30] COLOMBIA. AUTO, RIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.
[31] CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0010-2011 (June 16, 2011). By means of which the category of protected area of the Protective Forest Reserve of the Wetlands is certified between the rivers León and Suriquí in the municipality of Turbo, created in the agreement of the directive council No 100-02-02-01-011-2009 with the category of protected area Regional Natural Park (Decree 2372 of 2010).Apartadó, 7 p.
[32] CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011 (March 17, 2011). By means of which an area of the Protective Forest Reserve of the wetlands between the León and Suriquí rivers is partially and temporarily subtracted and a season is partially lifted. Apartadó, 6 p.

Coastal	Caribbean Halobioma	Mangrove vegetation within the Forest Reserve of the León and Suriquí river wetlands	36.46	5384.42	0,54
Coastal	Caribbean Halobioma	Secondary vegetation within the Forest Reserve of the León and Suriquí river wetlands	18.14	4448,32	0,44
Total area of forest exploitation				571755,18	57,17

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

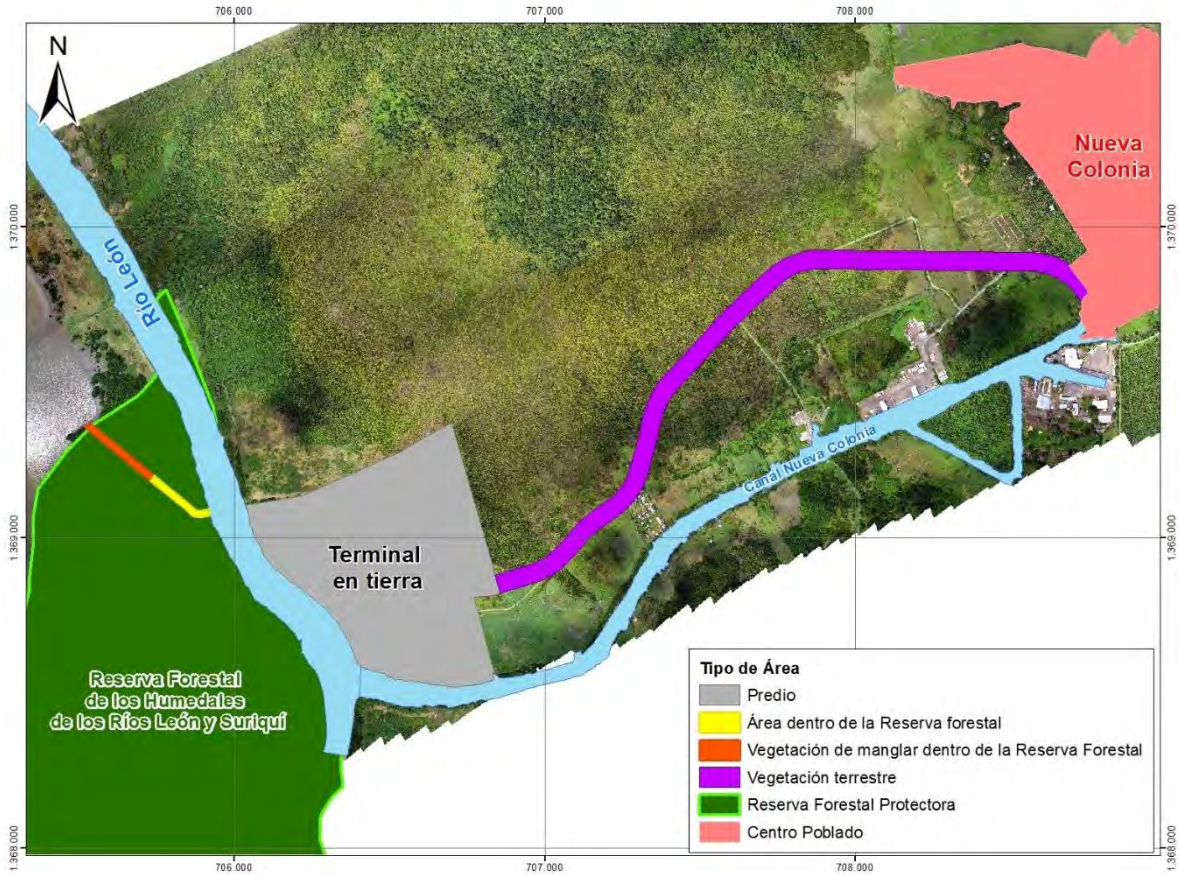

Figure No. 7.10 Area of direct impact of the project where the forest exploitation will be made

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

7.5.1 Structural analysis for the project´s area of direct impact

The floristic characterization of the species identified in the field within the project´s intervention area was carried out (Photograph No. 7.1), where the spatial distribution of the species was determined, allowing to know the degree to which they are grouped or dispersed and the amount of existing individuals per unit of land cover interpreted for the project´s area of influence, scale 1: 10,000 (Annex 7.5 Forest inventory at 100%).

Photograph No. 7.1 Overview of the project´s area of influence

Source: Taken by Puerto Bahía Colombia de Urabá S.A, 2009

The volume under which forest exploitation was estimated for the construction of Puerto Bahía Colombia in Urabá was made taking into account the entire area of influence of the project; however, considering that the land where the land terminal will be built borders the riverbank of the León River and the artificial canal of Nueva

Colonia, a retirement area defined by Decree 1076 of 2015[33] must be respected, which corresponds to a strip of 30 meters, conserving the riparian forest of this area. However, the only area that will be intervened and that has been included in the forest habitat, is the one associated to the fluvial pier, which will be located on the right margin of the north end of the artificial canal of Nueva Colonia, this was approved in resolution number 0032 of 2012[34], by which the environmental license of the Project was obtained.

Within the areas to be used is a strip of 437.6 m long and 20 m wide (9,832.7 m^2), composed of dense high floodplain mangrove cover and high secondary vegetation of the mangrove, which are within the Protective Forest Reserve of the León and Suriquí river wetlands declared by means of the agreement No 100-02-02-01-0010-2011 by CORPOURABÁ[35], this strip was subtracted through the agreement No 100-02-02-01- 0004-2011 by CORPOURABÁ[36]. The forest species that characterize these mangrove coverings are Avicennia germinans (Black mangrove), Rhizophora mangle (Red mangrove) and Laguncularia racemosa (White mangrove); these species are protected by a closure resolution number 076395 B of August 4, 1995 issued by CORPOURABÁ[37] and which was lifted by means of agreement No 100-02-02-01-0004-2011 by CORPOURABÁ[38].

Table No. 7.23 shows the commercial volume of wood to be harvested for each type of coverage, during each activity to be carried out in the construction and operation of the project. There it is observed that the coverage with the highest volume of wood

[33] COLOMBIA. MINISTERIO DE AMBIENTE Y DESARROLLO SOSTENIBLE. Decree 1076 (May 26, 2015). By means of which the single regulatory decree of the environmental sector and sustainable development is issued. Bogotá D.C.: El Ministerio, 2015. 654 p.

[34] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). By means of which an environmental license is granted. Bogotá D.C .: 135 p.

[35] CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No. 100-02-02-01-0010-2011., Op cit. 7 p.

[36] CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011., Op cit. 6 p.

[37] COLOMBIA. CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ - CORPOURABA. Resolution 076395B (August 4, 2014). By means of which the amounts of the rates for the use of public and private forests are fixed. Section, 2014. 5 p.

[38] CORPORATION FOR THE SUSTAINABLE DEVELOPMENT OF URABÁ - CORPOURABA. Agreement No 100-02-02-01-0004-2011 (March 17, 2011). By means of which an area of the Protective Forest Reserve of the wetlands between the rivers León and Suriquí is partially and temporarily subtracted and closure is partially lifted. Apartadó, 6 p.

to be extracted, is the gallery and / or riparian forest with 301.86 m^3, because this coverage is within the premises where the onshore terminal will be built.

Table No. 7.23 Commercial volume of wood that will be exploited in each of the land coverages by activity developed in the project

COVERAGE	Symbol	ACTIVITIES			Total Commercial volume (m³)
		Viaduct and Dock	Onshore terminal	Via	
		Transport, manufacture and driving of the piles	Dismantling, cleaning, stripping and filling of the land	Dismantling, cleaning, stripping of the land	
Discontinuous urban fabric	112			7,83	7,83
Banana and plantain	2213			6,3	6,3
Clean pastures	231	0,77	92,17	75,82	168,76
Woodland pastures	232			21,2	21,2
Dense high mangrove	311122	31,47			31,47
Palmares	311123		1,86	45,67	47,53
Gallery and / or riparian forest	314	26,3	275,56		301,86
Broadleaf planting	3152			2,01	2,01
Dense flooded herbage- not wooded	321121		12,21	227,23	239,44
Arracachal	321123		0,18		0,18
High secondary vegetation	3231	4,99			4,99
Total Commercial volume (m³)					831,57

Source Aqua & Terra Consultores Asociados S.A.S., 2015

Table No. 7.24 shows the number of trees that were found by type of coverage within the project´s area of direct impact. There it is observed that the coverage with the greatest number of individuals corresponds to the gallery and / or riparian forest, where the most abundant species are sweet Pithecellobium (Chiminango) with 210 individuals and Apuleia leiocarpa (Combita) with 43 individuals, followed by coverage of clean pastures, where 287 trees were identified, being the species

sweet Pithecellobium (Chiminango) with 135 individuals and Apuleia leiocarpa (Combita) with 29 individuals, the most abundant species in this coverage.

Table No. 7.24 Affected area and number of trees exploited by type of coverage within the area of direct impact of the project

Land coverages							Area (m^2)	No of trees
Corine Land Cover Methodology								
Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Symbol		
Artificialized Territories	Urbanized areas	Discontinuous urban fabric				112	5.281,6	31
Agricultural Territories	Permanent crops	Herbaceous permanent crops	Banana and plantain			2213	2.778,9	16
	Pastures	Clean Pastures				231	374.753,7	287
		Woodland pastures				232	5.319,0	24
Forests and Semi natural Areas	Forests	Dense forest	High dense forest	Dense high flood forest	Dense high mangrove	311122	1819,1157	167
					Palmares	311123	7.583,0	19
		Gallery and / or riparian forest				314	56.778,4	365
		Forest plantation	Broadleaf planting			3152	212,3	3
	Areas with herbaceous and / or shrubby vegetation	Pastures	Dense grassland	Dense flooded pastures	Dense flooded herbage - not wooded	321121	108.020,9	209
			Dense grassland	Dense flooded pastures	Arracachal	321123	5.710,7	1
		Secondary or transition vegetation	High secondary vegetation			3231	3.497,6	32

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Figure No. 7.11 shows the flora sampling points map by type of coverage within the project´s area of direct impact.

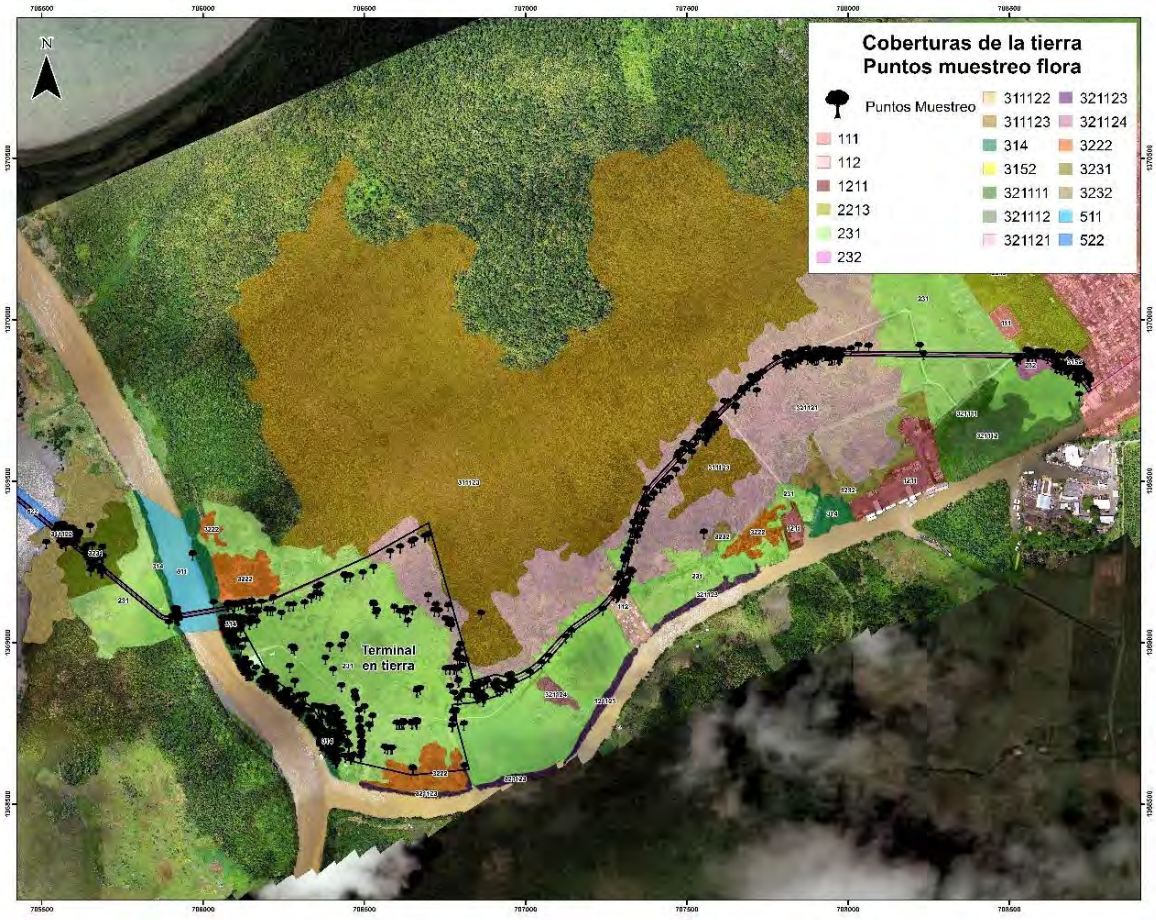

Figure No. 7.11 Flora sampling points in the project´s area of influence
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The registered floristic wealth for the area of direct affectation of the project is of 12 orders, 23 families, 38 species in 1154 individuals; of the total families one (6%) belongs to the monocotyledonous class and 25 families (94%) to the Magnoliopsid class.

Table No. 7.25 shows the floristic composition within the project´s area of influence.

Table No. 7.25 Floristic composition in the project´s area of influence

Division	Class	Order	Family	Species	Common name
Angiospermae	Monocotyledonous	Arecales	Arecaceae	*Elaeis Oleifera*	Coroza
				Raphia taedigera	Pangana
				Cocos nucifera	Coconut palm
Magnoliophyte	Magnoliopsida	Sapindales	Anacardiaceous	*Anacardium excelsum*	Caracoli
				Spondias purpurea	Plum
				Spondias mombin	Hobo
				Mangifera indica	Mango
			Sapindaceae	*Melicocca bijuga*	Mamoncillo
			Rutaceae	*Citrus sp*	Orange tree
		Lamiales	Avicenniaceae	*Avicennia germinans*	Smoke mangle
			Lamiaceas	*Gmelina arborea*	Melina
				Tectona grandis	Teak
			Bignoniaceae	*Tabebuia rosea*	Oak
				Crescentia Cujete L	Totumillo
		Malvales	Bombacaceae	*Ceiba pentandra*	Green Bonga
				Bombacopsis quinata	Ceiba Tolua
				Pachira aquatica	Salt shaker
			Malvaceae	*Ochroma pyramidale*	Balso
				Sterculia apetala	Camajon
			Sterculiaceae	*Guazuma ulmifolia*	Guacimo
		Rosales	Cecropiaceae	*Cecropia telenitida*	Yarumo
			Moraceae	*Ficus sp*	Lechudo
				Ficus glabrata	Higueron
		Myrtales	Combretaceae	*Laguncularia racemosa*	White mangrove
				Terminalia Catappa L	Almond
			Myrtaceae	*Psidium guajava*	Guava
			Melastomataceae	*Miconia sp*	Niguito
		Fabales	Fabaceae	*Brownea ariza*	Ariza
				Erythrina indica picta	Sing rooster

Division	Class	Order	Family	Species	Common name
				Pithecellobium dulce	Chiminango
				Apuleia leiocarpa	Combita
			Caesalpiniaceae	*Prioria copaifera*	Cativo
			Mimosaceae	*Inga codonantha*	Guamo
		Laurales	Lauraceae	*Beilschmiedi sp*	Laurel
		Rhizophorales	Rhizophoraceae	*Rhizophora mangle*	Red mangrove
		Gentianales	Rubiaceae	*Genipa americana*	Majagua
		Magnoliales	Annonaceae	*Annona muricata*	Soursop
		Malpighiales	Dichapetalaceae	*Tapura colombiana*	Nasedero

Fuente: Aqua & Terra Consultores Asociados S.A.S., 2015

The most representative families within the project´s area of direct involvement are the Fabaceae, Avecenniaceae, Bombacaceae, Arecaceae, Rhizophoraceae, Moraceae, Bignoniaceous, Cecropiaceae and Mimosaceous, as can be seen in:

Figure No. 7.12. The rest of the families have an abundance lower than 2%.

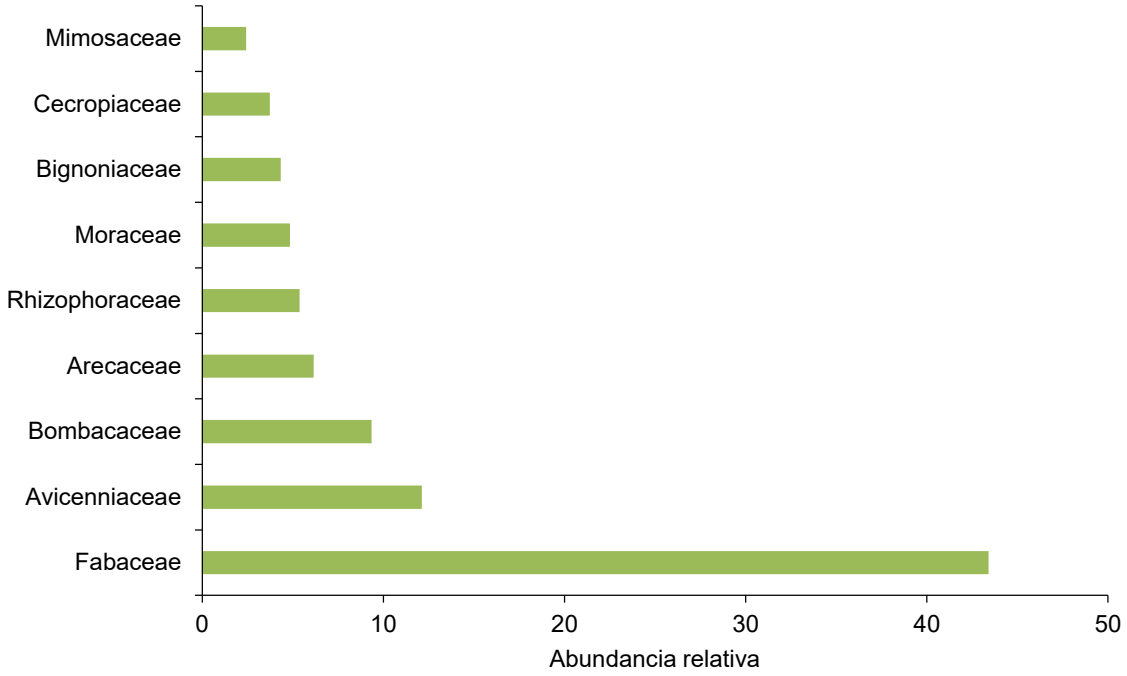

Figure No. 7.12 Relative abundance of the most representative families in the study area
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Next, the structural analysis of the vegetation by unit of coverage present in the area of direct impact of the project is carried out.

- Distribution by diametric and altimetric classes of the different species found

The total structure is the extension of tree species. In tropical forests this phenomenon is reflected in the distribution of individuals by diametric classes. The distribution of the diametric classes for most of the species in tropical forests is that of 'J inverted', that is, the number of trees decreases as the DBH increases (Diameter at Breast Height)[39].

[39] MELO CRUZ, O. A. Y R. VARGAS RIOS. Ecological and silvicultural assesment of forest ecosystems. University of Tolima, CRQ, Corpocaldas and Cortolima, Ibague. 2002. 207 p.

Table No. 7.26 shows the frequency distribution for the normal diameter variable, which has a decreasing trend, in which approximately the number of individuals of the next class has half of the individuals of the current class

Table No. 7.26 Frequency distribution for the normal diameter variable, for trees in the area directly affected by the project

Diametric class	class interval	Class mark	Frequency	
			Absolute	Accumulated
1	9 - 19 cm	14	606	606
2	19,1 - 29 cm	24	317	923
3	29,1 - 39 cm	34	106	1029
4	39,1 - 49 cm	44	60	1089
5	49,1 - 59 cm	54	18	1107
6	59,1 - 69 cm	64	38	1145
7	69,1 - 79 cm	74	4	1149
8	79,1 - 89 cm	84	1	1150
9	89,1 - 99 cm	94	1	1151
10	99,1 - 109 cm	104	2	1153
11	109,1 - 120 cm	114	1	1154
Total	1154			

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Figure No. 7.13 shows the diameter distribution tendency, for the trees that are within the project´s area of direct impact.

The inverted L or J shape of the histogram is observed, which characterizes forest ecosystems that are heterogeneous or have a tendency to heterogeneity[40]; This is due to the fact that the project´s area of direct impact crosses different forest coverings which are characterized by having a floristic composition that identifies each area, such as mangroves, gallery forest and arboreal vegetation associated with floodplains.

[40] Ibíd.

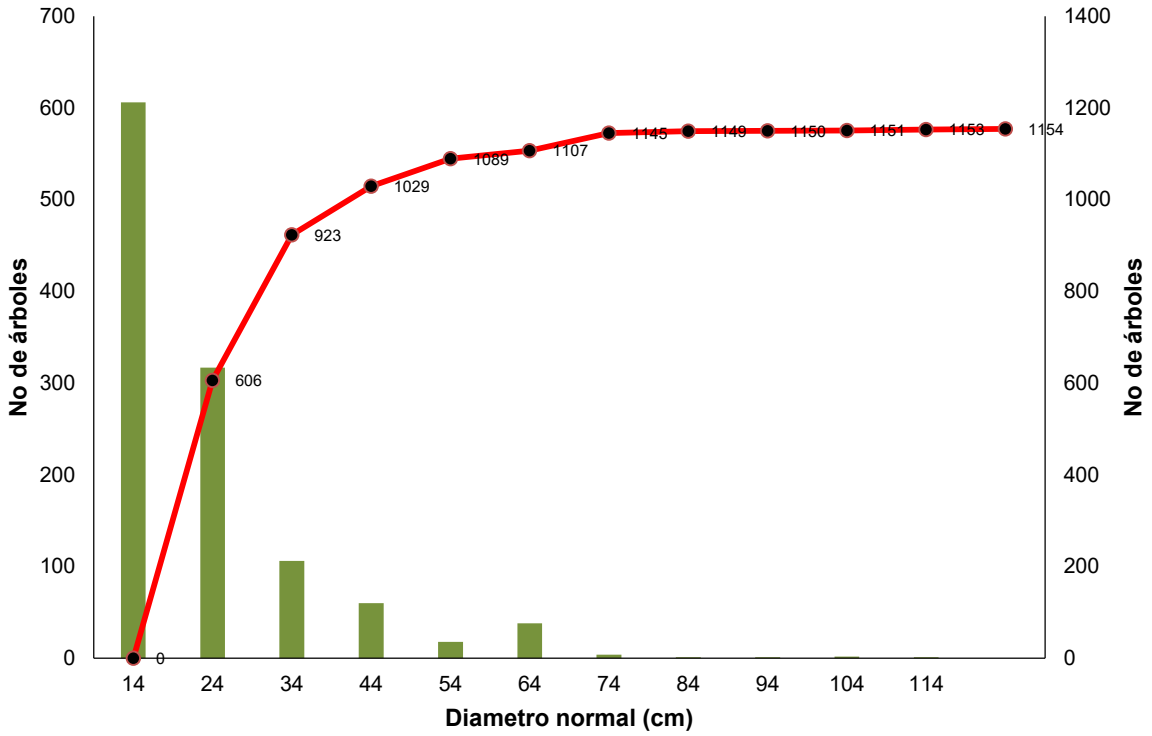

Figure No. 7.13 Diameter distribution in absolute and accumulated form, for trees in the area directly affected by the project
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The distribution of all the individuals reported in the project´s area of direct by diameter classes, have greater representation in the following classes: class 1 (Normal diameters between 9 cm to 19 cm) with a total of 606 (52.5%) individuals belonging to 34 species and 22 families; followed by class 2 (Normal diameters between 19.1 cm and 29 cm) with 317 (27.5%) individuals belonging to 27 species and 19 families; class 3 (Normal diameters between 29.1 cm to 39 cm) with 106 (9.2%) individuals of 16 species and 11 families and class 4 (Normal diameters between 39.1 cm to 49 cm) with 60 (5, 2%) individuals of 14 species and 11 families. The other 7 remaining classes represent 6% of the total inventory, corresponding to 65 individuals of 21 species and 8 families.

- Stratification of the forest profile

Figure No. 7.14 shows the tree dispersion diagram for the arboreal individuals identified within the project´s area of direct impact, where the stratifications trend can

be evidenced from well-defined conglomerates of points. The number of strata in the forest is equivalent to the number of conglomerates.

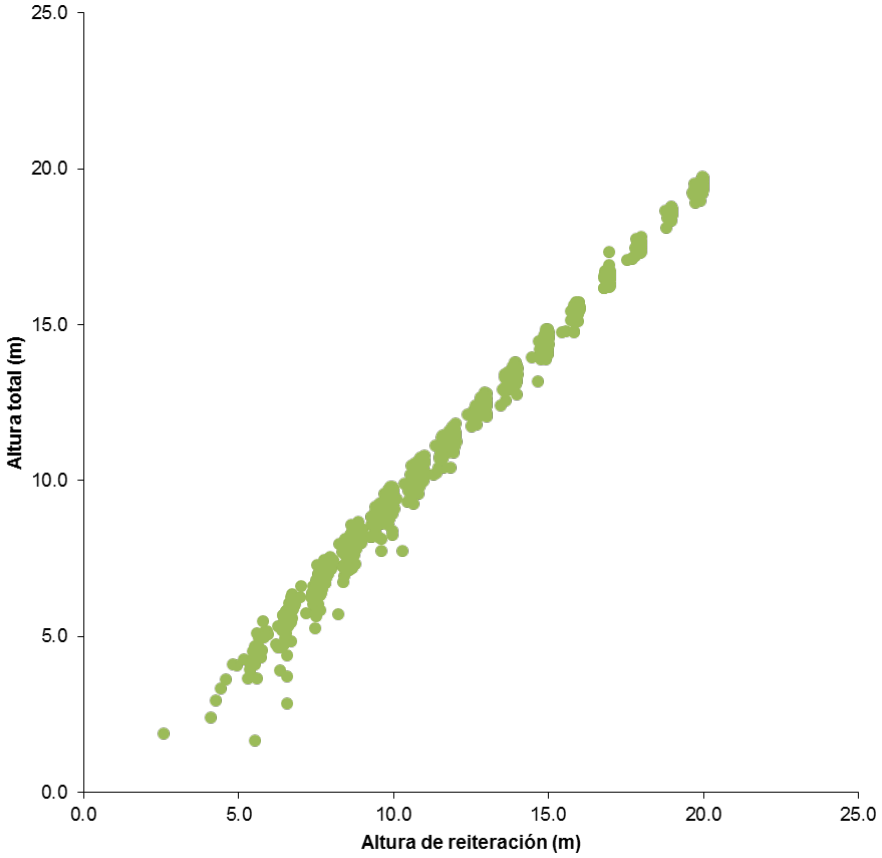

Figure No. 7.14 Stratification trends for the cup dispersion diagram within the project´s area of direct impact
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Table No. 7.27 shows the sociological position for each species identified within the project´s area of direct impact. There is observed the grouping of these species by forest stratum, from their respective intervals of total height.

Table No. 7.27 Distribution of the number of species and their abundances (Number of trees) in each stratum (Sociological position), for the trees inventoried in the project´s area of direct impact

Stratum	Interval	No of trees	No of species	Species
Stratum I	1,5 m - 5 m	44	9	*Apuleia leiocarpa*
				Avicennia germinans

				Ceiba pentandra
				Ficus sp
				Laguncularia racemosa
				Pachira aquatica
				Pithecellobium dulce
				Rhizophora mangle
				Spondias mombin
Stratum II	5,1 m - 10 m	464	33	*Anacardium excelsum*
				Annona muricata
				Apuleia leiocarpa
				Avicennia germinans
				Beilschmiedi sp
				Bombacopsis quinata
				Brownea ariza
				Cecropia telenitida
				Ceiba pentandra
				Citrus sp
				Cocos nucifera
				Crescentia Cujete L.
				Elaeis Oleifera
				Erythrina indica picta
				Euterpe oleracea
				Ficus glabrata
				Ficus sp
				Genipa americana
				Gmelina arborea
				Guazuma ulmifolia
				Inga codonantha
				Mangifera indica
				Melicocca bijuga
				Miconia sp
				Pachira aquatica
				Pithecellobium dulce
				Prioria copaifera
				Psidium guajava

				Rhizophora mangle
				Tabebuia rosea
				Tapura colombiana
				Tectona grandis
				Terminalia Catappa L
Stratum III	10,1 m - 15 m	433	28	*Apuleia leiocarpa*
				Avicennia germinans
				Bombacopsis quinata
				Cecropia telenitida
				Ceiba pentandra
				Cocos nucifera
				Erythrina indica picta
				Euterpe oleracea
				Ficus glabrata
				Ficus sp
				Genipa americana
				Gmelina arborea
				Inga codonantha
				Mangifera indica
				Miconia sp
				Ochroma pyramidale
				Pachira aquatica
				Pithecellobium dulce
				Prioria copaifera
				Psidium guajava
				Rhizophora mangle
				Spondias mombin
				Spondias purpurea
				Sterculia apetala
				Tabebuia rosea
				Tapura colombiana
				Tectona grandis
				Terminalia Catappa L
Stratum IV	15,1 m - 20 m	213	17	*Apuleia leiocarpa*
				Bombacopsis quinata

				Cecropia telenitida
				Ceiba pentandra
				Erythrina indica picta
				Euterpe oleracea
				Ficus glabrata
				Ficus sp
				Guazuma ulmifolia
				Inga codonantha
				Miconia sp
				Ochroma pyramidale
				Pachira aquatica
				Pithecellobium dulce
				Rhizophora mangle
				Spondias mombin
				Tabebuia rosea
Total		1154	87	

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

7.5.2 Ecological indices

Diversity is composed of two elements, variety or wealth and relative abundance of species. Its expression is achieved by recording the number of species, describing relative abundance or by using a measure that combines the two components.

Table No. 7.28 shows the values for the indices of species wealth and diversity found in the project´s area of direct impact.

Table No. 7.28 Wealth and Diversity indices for the project´s area of influence

SPECIES DIVERSITY MEASURES		
		Index
Wealth	Margalef	5,24
	Menhinick	1,11
Diversity	Shannon	2,55
	Simpson	0,86
	Berger-Parker	0,31

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The Margalef index corresponds to 5.24; the Menhinick index corresponds to 1.11, indicating that there is a high species wealth for the entire study area.

For diversity measures, the Shannon index is 2.55, reciprocal of Simpson (1 / D = 0.86) and reciprocal of Berger-parker (1 / d = 0.31). These results, in general terms, characterize a moderately diverse biotic community, with a tendency towards heterogeneity, typical of the tropical humid forest (bh-T).

7.5.3 Volume to take advantage of

The individuals that require a permit to carry out forest harvesting are presented in Table No. 7.29, which shows the total volume per species (Annex 7.5 Forest harvesting), including the closed species and / or to some degree of threat (numeral 7.5.5 of this chapter), and that through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ[41] the closure was lifted.

Table No. 7.29 Volume of wood to be harvested within the project´s area of direct impact.

Family	Species	Common name	Commercial volume (m³)
Arecaceae	*Elaeis Oleifera*	Coroza	11,25
	Raphia taedigera	Pangana	189,93
	Cocos nucifera	Coconut palm	5,12
Anacardiaceae	*Anacardium excelsum*	Caracoli	3,02
	Spondias purpurea	Plum	0,48
	Spondias mombin	Hobo	1,65
	Mangifera indica	Mango	3,28
Annonaceae	*Annona muricata*	Soursop	0,26
Avicenniaceae	*Avicennia germinans**	Smoke mangle	21,66
Bignoniaceae	*Tabebuia rosea*	Oak	15,08
	Crescentia Cujete L	Totumillo	0,69
Bombacaceae	*Ceiba pentandra*	Green Bonga	33,55
	Bombacopsis quinata	Ceiba Tolua	10,04
	Pachira aquatica	Salt shaker	26,53
Caesalpiniaceae	*Prioria copaifera**	Cativo	6,87
Cecropiaceae	*Cecropia telenitida*	Yarumo	9,01

[41] CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011 (March 17, 2011). By means of which an area of the Protective Forest Reserve of the wetlands between the León and Suriquí rivers is partially and temporarily subtracted and a closure is partially lifted. Apartadó, 6 p.

Combretaceae	*Terminalia Catappa L*	Almond	3,12
	*Laguncularia racemosa**	White mangrove	0,06
Dichapetalaceae	*Tapura colombiana*	Nacedero	1,43
Fabaceae	*Brownea ariza*	Ariza	0,17
	Erythrina indica picta	Sing rooster	12,49
	Pithecellobium dulce	Chiminango	258,14
	Apuleia leiocarpa	Combita	106,32
Lamiaceas	*Gmelina arborea*	Melina	10,5
	Tectona grandis	Teak	3,5
Lauraceae	*Beilschmiedi sp*	Laurel	4,9
Malvaceae	*Ochroma pyramidale*	Balso	36,78
	Sterculia apetala	Camagón	0,2
Melastomataceae	*Miconia sp*	Niguito	1,74
Mimosaceae	*Inga codonantha*	Guamo	9,07
Moraceae	*Ficus glabrata*	Higuerón	13,47
	Ficus sp	Lechudo	13,49
Myrtaceae	*Psidium guajava*	Guava	0,8
Rhizophoraceae	*Rhizophora mangle**	Red mangrove	15,18
Rubiaceae	*Genipa americana*	Majagua	0,44
Rutaceae	*Citrus sp*	Orange tree	0,18
Sapindaceae	*Melicocca bijuga*	Mamoncillo	0,44
Sterculiaceae	*Guazuma ulmifolia*	Guácimo	0,73
Overall total			**831,57**

* Species in closed season[42] and to which the closure was carried out [43]

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The commercial volume of wood for the entire project´s area of direct impact is 831.57 m³, which is divided into two areas requested for forest exploitation:

[42] COLOMBIA. CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ - CORPOURABA. Resolution 076395B., Op cit. 5 p.
[43] CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011., Op cit. 6 p.

- The first one belongs to the humid tropical zonobioma of the Magdalena-Caribe, with a volume of harvested wood of 794.58 m³ in 59.40 hectares, corresponding to an estimate of 13.37 m³ / ha.

- The second belongs to the halobioma of the Caribbean, formed by the species Avicennia germinans, Laguncularia racemosa and Rhizophora mangle, with a volume of wood to be harvested of 36.99 m³ in 1.59 hectares, corresponding to an estimate of 23.26 m³ / ha.

7.5.4 Handling of logging products

The harvested wood will be used in the area, according to the forest uses reported by the community, among which stand out, stakes for fences, domestic constructions, firewood, coal, rods, among others.

In the same way, it will be used in the realization of some of the project´s activities, such as forms, signaling enclosure, among other uses.

7.5.5 Species in threatened, closed season and / or endemism category

According to Resolution No. 0192 of 2014 "Threatened species is understood to be one that has been declared as such by international treaties or agreements approved and ratified by Colombia or declared in a threat category by the Ministry of Environment, housing and territorial development"[44].

After reviewing the CITES[45] database, the IUCN[46] red list, the red books of the Alexander von Humboldt Institute[47] for Biological Resources Research, identifies that for the forest inventory carried out in the study area, the Prioria copaifera species (Cativo) was categorized as EN Hazard (EN), due to the fact that two thirds of the

[44] COLOMBIA. MINISTERIO DE AMBIENTE, VIVIENDA Y DESARROLLO TERRITORIAL. Resolution 0192 (February 22, 2014). By which declared wild species that are threatened in the national territory and other determinations are made. Bogotá: The Ministry, 2014. 2p.
[45] CITES. [online] <http://www.cites.org/eng/resources/species.htm> [Retrieved on August 28, 2015]
[46] RED LIST Guiding Conservation for 50 years. [online] <http://www.iucnredlist.org/search/search-basic> [Retrieved on August 26, 2015]
[47] ALEXANDER VON HUMBOLDT INSTITUTE FOR BIOLOGICAL RESOURCES RESEARCH – HUMBOLT. [online] <http://www.humboldt.org.co/humboldt/mostrarpagina.php?codpage=300001102> [Retrieved on August 13, 2015]

natural population have disappeared, as a result of intense logging, according to the red book of Colombian plants[48]. Likewise, two levels of vulnerable (VU) and endangered (EN) threats are identified, in accordance with Resolution 0192 of 2014, for the Colombian Tapura (Nasedero) (VU) and Prioria copaifera (Cativo) species (EN).

Closed season Resolution number 076395 B of August 4, 1995[49] was also found in the database of CORPOURABÁ for the species Prioria copaifera (Cativo), Avicennia germinans (Black mangrove), Rhizophora mangle (Red mangrove) and Laguncularia racemosa (White Mangrove), which were found in the forest inventory carried out in the area of direct affectation, but that through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ was lifted[50].

In turn, the Panganales are identified as endemic vegetation of the area, these are found covering the basin of the Atrato River and part of the Litoral Caribbean, where almost pure formations of the species Raphia taedigera (Pangana), locally called "Panganales", are located. They are also found in the low areas of the main rivers, in the areas periodically flooded by freshwater or freshwater and saltwater mix, and in the areas that were exploited for timber extraction[51].

It is also important to note that the species that comprise the mangrove are important for the stability and fixation of the soil, as well as for the incursion of other species and for the flow of energy and nutrients[52].

[48] CÁRDENAS, Dairon & SALINAS, Nelson. Red book of plants of Colombia. Volume 4. Threatened timber species: First part. Red books series of threatened species of Colombia. Amazon Scientific Research Institute SINCHI - Ministerio de Ambiente, Vivienda y Desarrollo Territorial. 2007. 232 p. ISBN: 978-958-8317-19-9

[49] COLOMBIA. CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ - CORPOURABA. Resolution 076395B (August 4, 2014). By means of which the amounts of the rates for the utilization of the public and private forests are fixed. Apartado, 2014. 5p.

[50] C CORPORATION FOR THE SUSTAINABLE DEVELOPMENT OF URABÁ - CORPOURABA. Agreement No 100-02-02-01-0004-2011., Op cit. 6 p

[51] NATURAL NATIONAL PARKS. Nature and Science of Los Katíos Natural National Park. [online] https://www.parquesnacionales.gov.co/PNN/portel/libreria/php/decide.php.patron=01.014003 [Retrieved on October 15, 2015]

[52] OIMT. OIMT Work Plan on Mangroves. 2002 – 2006.

7.6 Atmospheric emissions

7.6.1 Emission sources without project

The project´s study area presents little industrial intervention, since it is an area with vocation of export-type plantain and banana crops, where land, fluvial and maritime traffic flows are related, for transportation to the boats in Bahía Colombia.

The industries, that are located in the project´s area of influence, are located in the district of Nueva Colonia (Uniban and Banacol), which have a pier, storage area and offices.

It is there where the aforementioned crops are harvested, to proceed with the transfer by means of the banana convoys to the anchorage area, where the export ships are located.

- Fixed Sources

The presence of emissions of gases and particulate material by fixed sources in the project´s study area, Nueva Colonia district and project land, located within the jurisdiction of the municipality of Turbo, was not evident.

- Mobile sources

Due to the presence of the banana companies in the district of Nueva Colonia and the transit of the same population to the district, the circulation of light vehicles such as automobiles and motorcycles, buses and heavy goods vehicles was evidenced. For the fluvial and marine transport boats, tugboats and ships are presented (Of the current study of environmental impact, see Chapter 5 Characterization of the area of influence, number 5.3 Socioeconomic environment).

According to the Transit Study of Puerto Antioquia 2015[53], the traffic flow between the section of the path of the Rio Grande district and the Nueva Colonia district, presented a total of 1912 vehicles / day, transiting through this section, of which 268

53 PIO SAS & GRUPO VIAL. Basic and detailed engineering, procurement and supply of materials, construction, assembly and commissioning of the works required for phase 1 of the Puerto Antioquia Port Terminal located at the mouth of the León River, in the Gulf of Urabá - Transit Study, Department of Antioquia. Cali, 2015. 203 p

are vehicles light and 1644 correspond to heavy vehicles (buses and trucks); this is equivalent to 86% of heavy vehicles and 14% of light vehicles.

Additionally, for the dredging of the León River and the Nueva Colonia Canal, a dredge is constantly presented for the maintenance of the channel, in order to guarantee its navigability and for the artisanal fishing activity, the fishermen transit through boats is presented as well.

- Area Sources

The presence of gas emissions and particulate material in a source area within the project´s study area was not evident, as is the district of Nueva Colonia and the area of the property where the port project is located, both are located in the jurisdiction of the municipality of Turbo of the department of Antioquia.

7.6.2 Project´s construction phase

In accordance with the stipulations of the applicable regulatory framework for industries that require permits for atmospheric emissions according to Resolution 909 of 2008[54], Decree 948 of 1995[55] and Resolution 619 of 1997[56], the Project does not require applying for a permit for atmospheric emissions in the Construction phase of the Port Terminal.

The activities to be carried out during the construction of the project do not require such permit, since no areas of exploitation of material are requested, nor material crushing plants will be installed, since it is considered that the contractor for the execution of the works, performs the purchase of material with external companies, which must comply with environmental legal regulations and have a valid mining title.

54 COLOMBIA. MINISTERIO DE AMBIENTE, VIVIENDA Y DESARROLLO TERRITORIAL Resolution 909 (June, 5, 2008). By which the regulations and standards of admissible emission of contamination to the atmosphere by fixed sources are established and dispositions are made. Bogotá D.C., 2008

55 COLOMBIA. PRESIDENTE DE LA REPUBLICA. Decree 948 (June 5, 1995). By which are regulated, partially Law 23 of 1973, articles 33, 73, 74, 75 and 75 of Decree-Law 2811 of 1974; articles 41, 42, 43, 44, 45, 48 and 49 of Law 9 of 1979; and Law 99 of 1993, in relation to the prevention and control of atmospheric pollution and the protection of air quality. Bogotá D.C., 1995

56 COLOMBIA. MINISTERIO DEL MEDIO AMBIENTE. Resolution 619 (July 7, 1997). By which the factors are partially established from which permission of atmospheric emission for fixed sources is required. Bogotá D.C., 1997

7.6.3 Operation phase

In accordance with the considerations made by the National Authority of Environmental Licenses - ANLA in Resolution No. 0032 of 2012[57], in the seventh Article, fourth paragraph () "No permit of atmospheric emissions is granted for the operation stage to the Sociedad Puerto Bahia de Colombia Urabá SA. The company will not be able to start operations without having the permit of atmospheric emissions for the handling and management of solid bulk cargoes".

Therefore, in the present modification for the operation phase of the port terminal the Permission of Atmospheric Emissions is requested, for the activities storage, loading, unloading and transport of the solid bulk cargoes, in accordance with the stipulated in the Article 73 of the Decree 948 of 1995[58], which establishes in section e) that the activity "Storage, transport, loading and unloading operations in ports susceptible to generating emissions to the air", requires such permit.

It is worth mentioning that the transfer between the ship's side and the onshore facilities will be carried out with specialized vehicles to transport solid bulk cargoes (see Chapter 3 Project description of the current environmental impact study). Likewise, specialized onshore facilities will have the technology to avoid air pollution with particles, since they will also be made up of a battery of silos and specialized warehouses interconnected by systems of conveyor belts that will have delivery systems for vehicle loads, avoiding contamination by dust, particulate material, gases and volatile substances.

The details are presented in Chapter 3 "Description of the project of the current study for the Modification of Environmental License".

- Location of facilities

The storage, loading and unloading of solid bulk area will be built in the onshore terminal, to the south-east of the project site, as shown in Figure No. 7.15.

In the marine dock the loading and unloading of the solid bulk from the ships will be carried out. The unloading configuration of the ships with solid bulk in the 1B, 2B and

[57] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.
58 COLOMBIA. REPUBLIC PRESIDENT. Decree 948 (June 5, 1995). Op Cit.

1D docks, will be made with the ship´s own cranes and each service will have a clam (spoon) and a hopper.

In the MOD_LA_PTO_ANT_01_LG map the general location of the project is presented and in Chapter 3 "Description of the project", the infrastructure of the same is detailed.

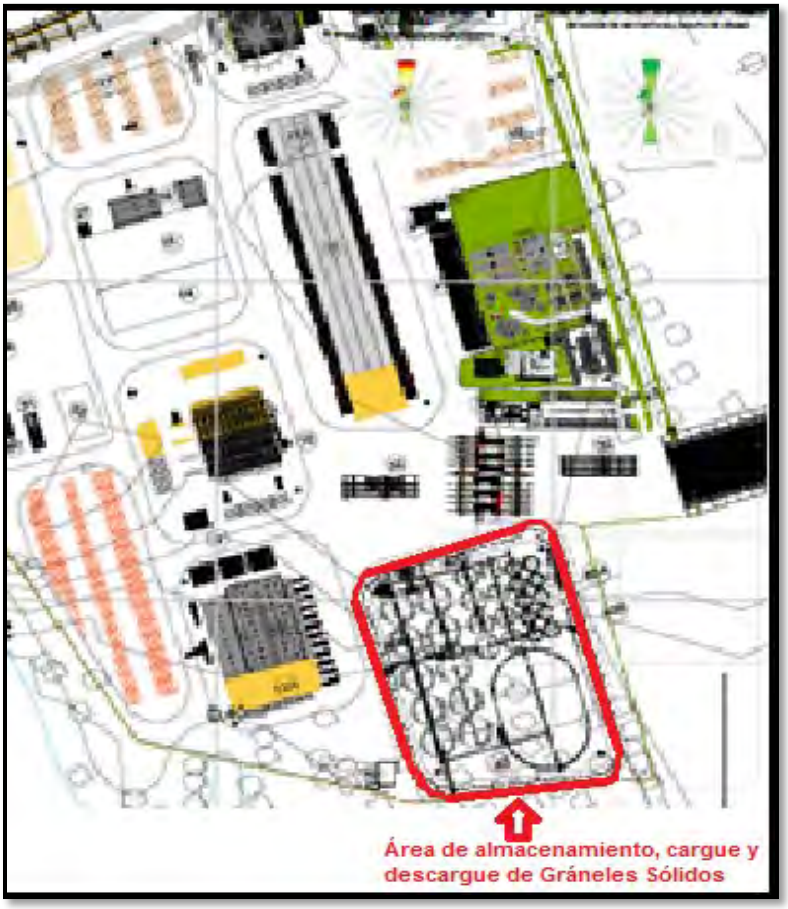

Figure No. 7.15. Location of storage, load and unload areas of solid bulk
Source: PIO S.A.S., 2015

Table No. 7.30 shows the location coordinates of the areas that require a permit for atmospheric emissions and are presented graphically in Figure No. 7.16.

Table No. 7.30 Location coordinates of the atmospheric emission permit

ZONE	VERTEX	FLAT COORDINATES MAGNA SIRGAS Origin BOGOTÁ	
		EAST	NORTH
Solid bulk cargoes - onshore terminal	1	706.752,49	1.368.817,64
	2	706.812,29	1.368.610,37
	3	706.645,07	1.368.591,57
	4	706.592,95	1.368.771,64
Dock 1B - Solid bulk	5	702.875,89	1.371.214,46
	6	702.875,89	1.370.908,23
	7	702.805,89	1.370.908,23
	8	702.805,89	1.371.214,46
Dock 2B - Solid bulk	9	702.875,89	1.370.874,46
	10	702.875,89	1.370.574,93
	11	702.805,89	1.370.574,93
	12	702.805,89	1.370.874,46
Dock 1D - Solid bulk	13	702.845,89	1.371.244,46
	14	702.845,89	1.371.194,46
	15	702.645,89	1.371.194,46
	16	702.645,89	1.371.244,46

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

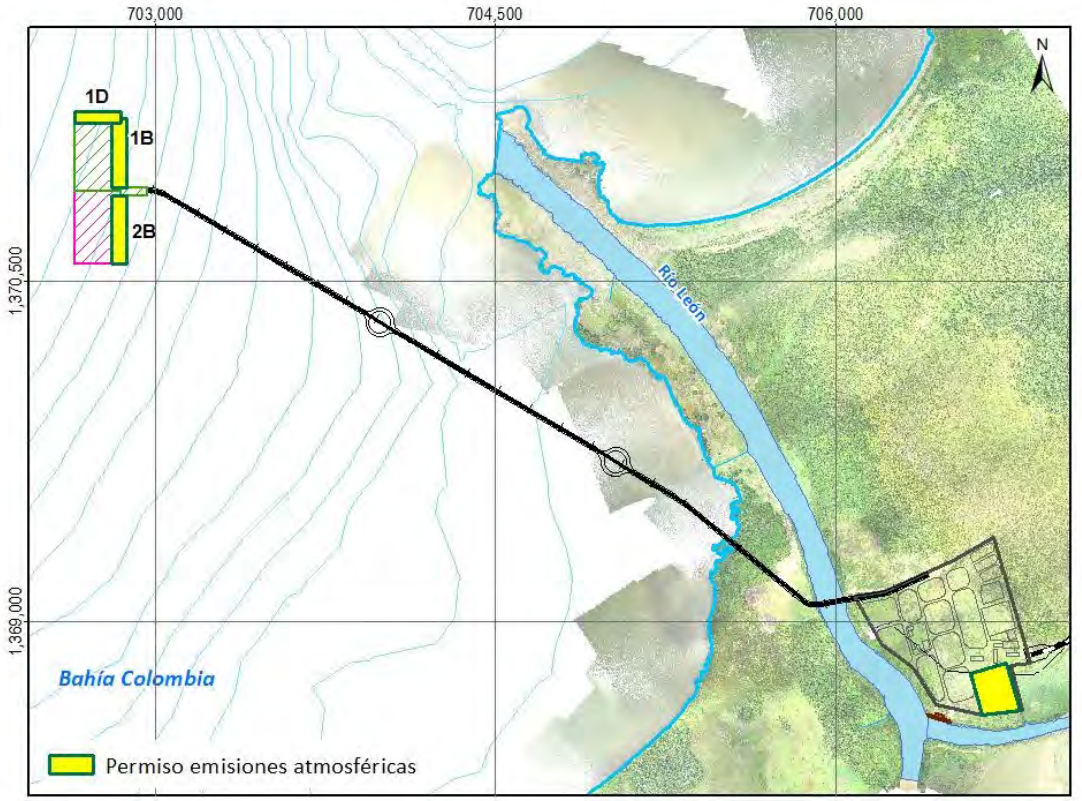

Figure No. 7.16. Location of the area that requires a permit of atmospheric emissions
Source: Aqua & Terra Consultores Asociados S.A.S., 2015 with information of PIO S.A.S., 2015

- Load projection

The project in Puerto Antioquia consists of a multipurpose port for cargo handling, export / import of containers, solid bulks and liquids, as well as an export / import terminal for vehicles.

The main design features of the multipurpose port are based on the projection of cargo from the commercial services of the port and therefore the vessel or design vessel. The projected short and long-term loads (2018 and 2030 respectively), according to the load analysis of CK Americas (2010), are listed in Table No. 7.31.

From the above, it is highlighted that the loads susceptible to the generation of atmospheric emissions of particulate material, are the loose loads and the bulk

cargo, for which it was estimated that in 2018 there would be a cargo projection of 400,000 t for loose cargo and 1,000,000 tons of bulk cargo; the other projections are presented in Table No. 7.31.

Table No. 7.31. Load Projection in the short and medium term.

CARGA MOVILIZADA	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030
TON Movilizada tipo de carga													
Contenedores 40 Ft. Llenos Refrig.	825,000	1,650,000	1,707,000	1,765,973	1,826,986	1,890,111	1,950,356	2,003,802	2,003,802	2,003,802	2,003,802	2,003,802	2,003,802
Contenedores Secos Llenos	633,540	1,267,081	1,355,776	1,450,681	1,523,215	1,599,376	1,679,344	1,729,725	1,729,725	1,729,725	1,729,725	1,729,725	1,729,725
Vehiculos Movilizados	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000
Carga Suelta (TON)	400,000	800,000	1,000,000	1,015,000	1,030,225	1,045,678	1,061,364	1,077,284	1,093,443	1,109,845	1,126,493	1,143,390	1,160,541
Carga Granel (TON)	1,000,000	1,500,000	1,522,500	1,545,338	1,568,518	1,592,045	1,615,926	1,640,165	1,664,767	1,689,739	1,715,085	1,740,811	1,766,923
Total TON	**2,894,540**	**5,253,081**	**5,621,276**	**5,812,991**	**5,984,943**	**6,163,210**	**6,342,990**	**6,486,975**	**6,527,737**	**6,569,110**	**6,611,104**	**6,653,728**	**6,696,991**
Movilización Carga (TEUs)													
TEUs Vacios Refrigerados	67,500	135,000	139,800	144,770	149,917	155,246	161,270	166,615	166,615	166,615	166,615	166,615	166,615
TEUs Llenos Refrigerados	82,500	165,000	170,700	176,597	182,699	189,011	195,036	200,380	200,380	200,380	200,380	200,380	200,380
Refrigerados Banano Expo	*75,000*	*150,000*	*155,250*	*160,684*	*166,308*	*172,128*	*178,153*	*183,498*	*183,498*	*183,498*	*183,498*	*183,498*	*183,498*
Refrigerados Otros Impo	*7,500*	*15,000*	*15,450*	*15,914*	*16,391*	*16,883*	*16,883*	*16,883*	*16,883*	*16,883*	*16,883*	*16,883*	*16,883*
TEUs Secos Vacios	10,000	20,000	21,400	22,898	24,043	25,245	26,507	27,303	27,303	27,303	27,303	27,303	27,303
TEUs Secos Llenos	60,000	120,000	128,400	137,388	144,257	151,470	159,044	163,815	163,815	163,815	163,815	163,815	163,815
Total TEUs	**220,000**	**440,000**	**460,300**	**481,654**	**500,916**	**520,972**	**541,857**	**558,113**	**558,113**	**558,113**	**558,113**	**558,113**	**558,113**

Source: PRC Análisis

- Bulk silos

For storage of solid bulk there will be a vertical silos battery configuration area. On average it is estimated to receive 30,000 t / boat, with an average of 28 boats per year, that is, 2 boats per month.

Next in Table No. 7.32 and Table No. 7.34, the storage capacity and its respective phases are presented:

Table No. 7.32. Bulk storage silos capacity

CAPACITY TO STORE GRAINS AND CAKES PUERTO ANTIOQUIA August-29/2014			
GRAIN WAREHOUSE	**PHASE-1**	**PHASE -2**	**PHASE -3**
Capacity in flat silos Ø75 '	5500	5500	
Number of silos Ø75 '	8	4	
Capacity in flat silos Ø42 '	1400	1400	
Number of silos Ø42 '	8	2	
Temporary storage			25500
TOTAL CORN STORE TONS (750 kg / m^3) AT EACH PHASE	**55200**	**24800**	**25500**
CAKES WAREHOUSE	**PHASE -1**	**PHASE -2**	**PHASE -3**
Capacity in flat silos Ø54 '	2540		
Number of silos Ø54 '	4		
Capacity in flat silos Ø48 '	1990	1990	
Number of silos Ø48 '	2	2	
Capacity in conical silos Ø36 '	1000	1000	
Quantity of conical silos Ø36	4	6	
Tilt-up type cellar, for cakes or fertilizers, of 26.60 m. width x 51.40 m. of Length. between centers			8150
Quantity of warehouses			1
TOTAL TONS OF STORAGE OF CAKES IN EVERY PHASE (600 kg / m^3)	**18.140**	**9.980**	**8.150**

CAPACITY TO STORE GRAINS AND CAKES PUERTO ANTIOQUIA August-29/2014			
GRAIN WAREHOUSE	**PHASE-1**	**PHASE -2**	**PHASE -3**
TOTAL ACCUMULATED AT THE END OF EACH PHASE	**18.450**	**28.430**	**36.580**

Source: Study of markets for the unloading of solid bulk cargoes in Puerto Antioquia, Turbo, Uraba. Ediagro, September 2014.

The total capacity in the first storage phase will be 73,650 t, that is, it has the capacity to store two (2) 30,000 t vessels.

In addition, it provides 24% for more storage. Likewise, the second phase covers the demand established by a ship. And finally, for future phases, it is expected to unload a ship in the shortest time possible by storing it in the receipt hopper that will have the capacity of 25,500 t.

The main loads of solid bulk cargoes are:

- Feed for animals: 615,000 tons / year
- Wheat: 100,000 tons / year
- Corn: 45,000 tons / year
- Fertilizers: 31,000 tons / year

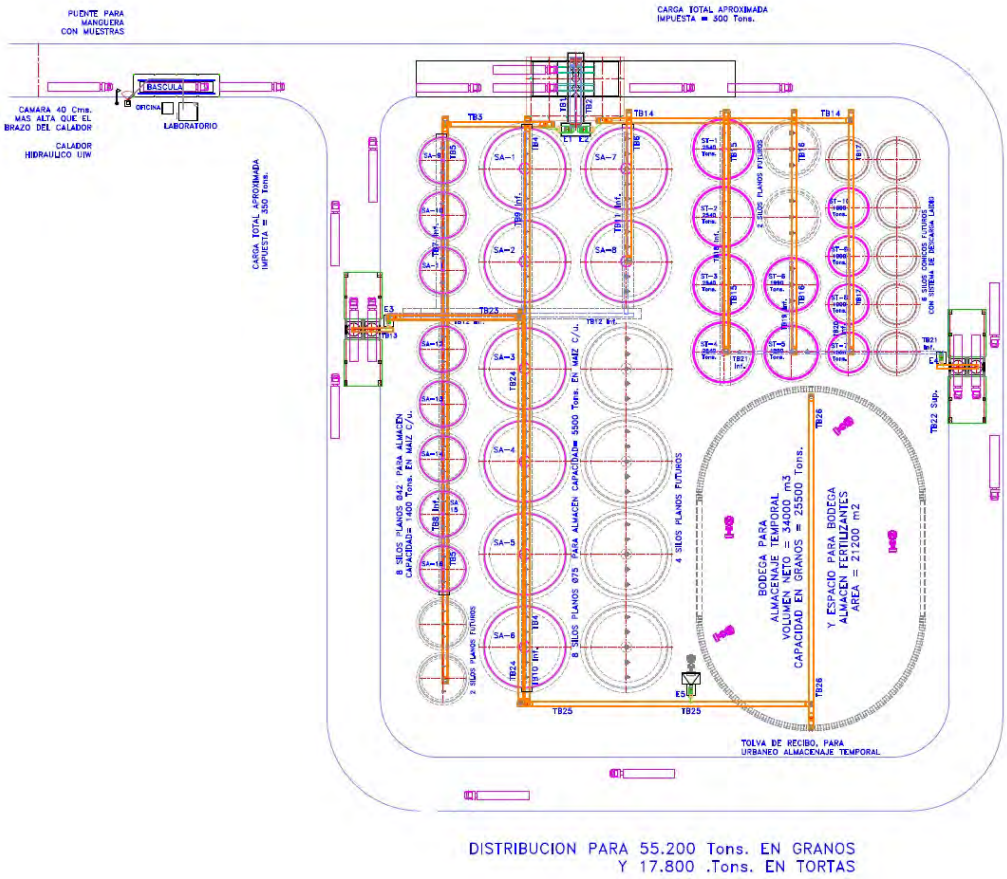

Figure No. 7.17. Silos and storage warehouses of grains Pto Antioquia.
Source: EDIAGRO, 2014

- Bulks operation

Solid Bulk Cargoes Ship

The unloading configuration of ships with solid bulk cargoes in docks 1B, 2B and 1D, will be made with the ship's own cranes and will be worked, on average, with three (3) cranes of the ship (3 services).

Each service will have a clam (spoon) with a gross capacity of approximately 25 t and a hopper with a capacity of approximately 20 t. The merchandise will be

delivered to the importers at the side of the ship, while the storage will be made in the onshore terminal.

The main types of solid bulk cargoes that will be operated are animal feed products, corn, wheat and fertilizers.

To unload solid bulk cargoes, it is also planned to have a mobile crane super post panamax, which will be equipped with a clam (spoon) and a double hopper to load two (2) vehicles simultaneously.

Once the specialized bulk onshore facilities are built, the merchandise will be delivered to the side of the ship and in the bulk onshore facilities, the transfer between the ship's side and the ground facilities will be carried out with specialized vehicles to transport solid bulk cargoes (see Figure No. 7.18).

Specialized onshore facilities will have the technology to avoid air pollution with particles, in addition they will be made up of a battery of silos and specialized warehouses interconnected by systems of conveyor belts, which will have loads delivery systems for vehicles.

Figure No. 7.18. Specialized vehicles for bulk transport, high speed unloading hopper and coupled tandem.

Source: Study of markets for the unloading of solid bulk cargoes in Puerto Antioquia, EDIAGRO, 09/2014.

The daily unloading cycle is presented in the following Table No. 7.33.

Table No. 7.33. Grain loading operation.

VEHICLES NEEDED			
Maximum download rate sought	8.000	tons per day	
Direct Load	30%	2.400	t day
Load to silos	70%	5.600	t day
Nominal capacity transport equipment	750	tons per hour, ideal conditions	
Real average capacity	500	Tons per hour	
Hours of work in real conditions	16		
Capacity "trailers and trucks"	30	tons	
Mobile hoppers capacity	40	tons	
Spoon capacity	12	tons	
Spoons Average cycle	2,9	Minutes	
Spoons Tons per hour, average	248,3		
Loading time of mobile hopper with spoons	9,7	Minutes	
Truck filling time from mobile hopper	6	Minutes	

VEHICLES NEEDED		
Platform dock to hopper receipt distance	5	km
Average truck speed	20	km/hour
Round trip time	15	minutes
Truck weighing time on the two scales	10	minutes
Unloading time of each truck in hopper receipt	5	minutes
Loading silos speed, tons per hour	360	for each hopper
Alignment time under mobile hopper	2	minutes
Hopper truck delivery time	2	minutes
Full cycle time trailer-truck	40	minutes
Capacity to transport each trailer-truck	45	tons per hour
Total trucks per hour	17	To transport the nominal capacity
Trailers quantity needed to load silos	12	
Trucks quantity load directly	5	

Source: EDIAGRO, 2014.[59]

Finally, for the unloading of cakes (feeding of materials), it has been planned for a Laiding type unloading system for storage silos in concrete or conical bottom steel, with approximately 8 m diameter and 1,100 m^3 capacity.

This system allows the loading and unloading of silos under a closed system of emissions, either with access design of load truck to the silo or by automated control of closed transport.

[59] EDIAGRO. Study of markets for the unloading of solid bulk cargoes in Puerto Antioquia. 2014

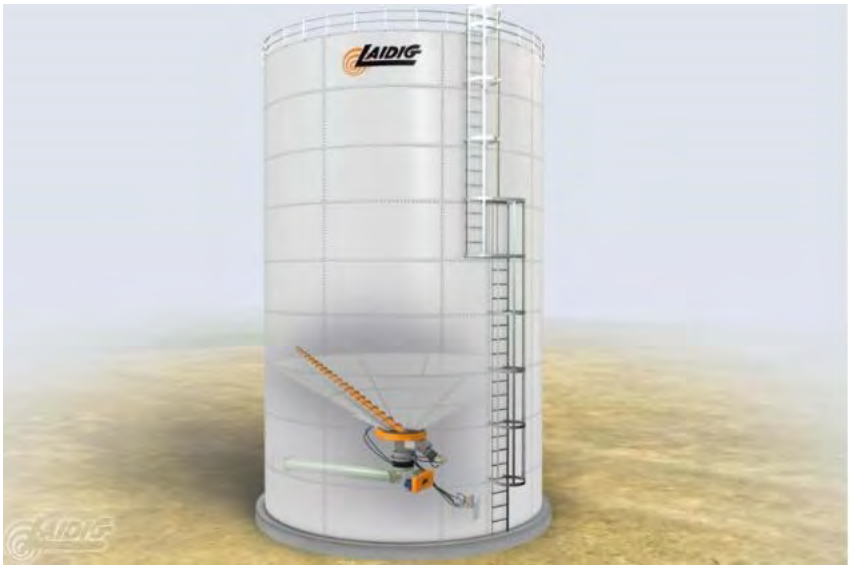

Figure No. 7.18. Laiding type unloading system.
Source: EDIAGRO, 2014.[60]

7.6.4 Estimation of emission factors of the possible emissions of particulate material by handling solid bulk cargoes

In accordance with what was presented in the Environmental Impact Study[61] with which the environmental license was obtained through Resolution No. 0032 of 2012[62], the emission factors estimated by the US EPA for grain elevators and their processing systems[63] were reviewed. Finding an assessment of the possible atmospheric emissions of total particulate material, PM_{10} and $PM_{2.5}$, without any environmental control, although the US EPA classifies these emission factors in the "poor" category, which corresponds to tests carried out in a number of facilities that

[60] Ibíd.
[61] PUERTO BAHÍA COLOMBIA DE URABA S.A. y ARAÚJO IBARRA & ASOCIADOS S.A. Environmental impact study for the construction and operation of a port terminal of solid bulk. Turbo. 2010. 428 p.
[62] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit
[63] UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US EPA). Compilation of air pollutant emission factors. Volume I: stationary point and area source. Chapter 9: Food and agricultural industry – 9.9: Grain processing – 9.9.1: Grain elevators & processes. [online]. AP42. 5a Edición. US EPA, 2003 <http://www.epa.gov/ttn/chief/ap42/ch09/index.html> [Retrieved on February 10, 2010].

can be reasonable, but with the suspicion that the sample is not representative of the sector, which can show much variability[64].

For the project, the generation of possible emissions with the emission factors was calculated, without the implementation of control systems, as presented in Table No. 7.34:

Table No. 7.34 Emission factors established by the US EPA for grain management, without emission control (category E: poor)

Operation	TSP	PM_{10}	$PM_{2,5}$
Receipt of grains by ships with port unloader (marine leg)	0,150 lb/t	0,038 lb/t	0,0050 lb/t
Grain handling (as unloaders and conveyor belts)	0,061 lb/t	0,034 lb/t	0,0058 lb/t
Storage (venting)	0,025 lb/t	0,063 lb/t	0,0011 lb/t
Unloading in trucks	0,086 lb/t	0,029 lb/t	0,0049 lb/t
ALL OF THE ABOVE	0,322 lb/t	0,164 lb/t	0,0168 lb/t

Source: US EPA. Grain elevators & processes, 2003[65].

According to the project´s license granted by Resolution No. 0032 of 2012[66], it was intended to handle a total of 2.2 million tons at the Terminal and 347 days of availability of the facilities, thus envisaging a potential emission of particulate material, which it was calculated with the aforementioned emission factors, with a total of emissions as shown in Table No. 7.35.

For the current Modification of Environmental License, according to the projection of general and loose cargo for the year 2018, it is estimated a total of 400,000 tons of loose cargo and 1,000,000 tons of bulk cargo and for the maximum of the projection the year 2030, a loose load of 1,160,541 tons and bulk cargo 1,766,923 tons for a total of 2,927,464 tons was estimated.

In Table No. 7.35 it can be seen that the particulate material emission concentration (TSP, PM10 and PM2.5) decreased according to the estimate for the load granted

[64] ESTADOS UNIDOS. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US EPA). Compilation of air pollutant emission factors. Volume I: stationary point and area source. Introduction to AP 42, Volume I, Fifth Edition [online]. AP42. 5th edition. US EPA, 1995. <http://www.epa.gov/ttn/chief/ap42/c00s00.pdf> [Quoted on February 10, 2010].
[65] US EPA. Grain elevators & processes, 2003. Op Cit
[66] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution No. 0032 (January 25, 2012). Op Cit.

for the project through the aforementioned resolution, comparing it with the total of the loading projection of the year 2018.

Therefore, variations in air quality are not very representative for the loads requested in the current license modification.

Table No. 7.35 Potential emission of particulate material, without the implementation of control systems

Total Load	TSP g / s emission	PM10 g / s Emission	Emission PM2.5 g / s
2.200.000 t Load Granted in Resolution No. 0032 of 2012	10.7	5.5	0.6
1.400.000 t. Loose Load and Bulk requested. Year 2018 projection	6.8	3.5	0.4
2.927.464 t. Loose Load and Bulk requested. Year 2030 projection	14.3	7.3	0.7

Source: Araujo & Barra, 2009 modified by Aqua & Terra Consultores Asociados S.A.S., 2015

The US EPA has not established emission factors with control systems.

7.6.5 Emission control systems and measures to prevent the emission of particulate material into the atmosphere

To reduce or avoid atmospheric emissions such as particulate material and dust in the storage silos loading processes, hose filters and vents will be installed as dust extractors, in order to prevent the formation of an explosive atmosphere in the silos and in the confined conveyor belt system, which is the biggest risk of handling dry cargoes.

The operation of the cranes to be used in the unloading will be completely covered and will be equipped with vacuum suction systems, supported by a pneumatic system associated to them.

It is worth mentioning that the solid bulk storage will be carried out in a closed system, which will have a vertical silos battery configuration area, in order to avoid the generation of particulate material emissions to the environment.

Below are some filters that may be used by the project, which are used as control techniques for particles emitted by a pollutant source [67].

Hose collectors

Hose collectors provide a complete line of solutions to handle, from annoying fine particles, to extremely heavy loads of these.

A variety of materials have been developed for the filter hose, so that the collectors are suitable for almost any fine particle collection application, including wet, chemical and high temperature applications[68] (see Figure No. 7.20).

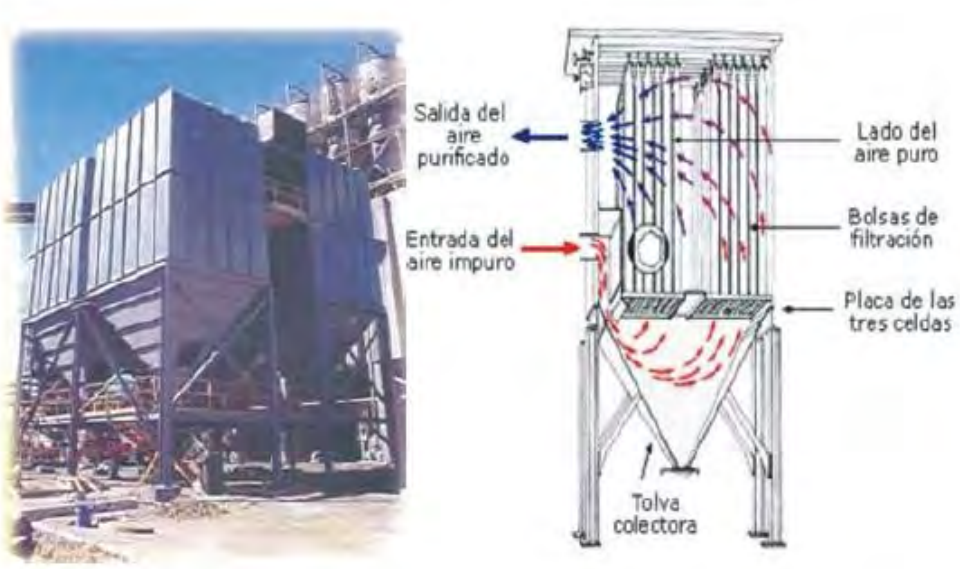

Figure No. 7.19 Hose collectors
Source: Directorate of Sustainable Sector Development, et al., 2004[69]

Electrostatic Precipitators

[67] DIRECTORATE OF SUSTAINABLE SECTORIAL DEVELOPMENT; MINISTRY OF ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENT, MINISTRY OF TRANSPORTATION. Port Terminal Environmental Guide. Bogotá D.C., 2004. 441 p. ISBN:958973-93-3-4
[68] Ibíd
[69] Ibíd.

Electrostatic precipitators (PES) capture the solid particles in a gas flow by means of electricity. The PES charges the particles with electricity, attracting them to metal plates with opposite charges located in the precipitator. The particles are removed from the plates by "dry blows" and collected in a hopper located in the lower part of the unit[70] (see Figure No. 7.21).

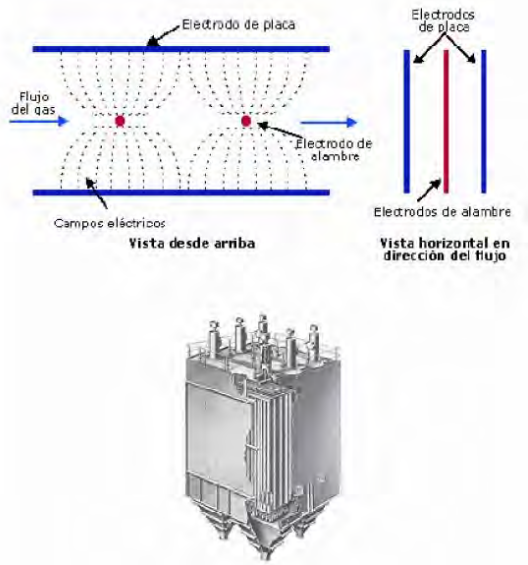

Figure No. 7.20 Electrostatic Precipitators
Source: Directorate of Sustainable Sector Development, et al., 2004[71]

Recognizing the possible impact dimensioned, it is planned to implement the following measures to prevent the emission of particulate material into the atmosphere:

- The cranes used for the unloading will be completely covered and will be equipped with vacuum suction systems, supported by a pneumatic system associated to them.

[70] Ibíd
[71] Ibíd.

- The conveyor belt will be continuously confined with a cover. For the number of fines (high to medium) susceptible to be generated, it is worth implementing closures for the belt in all transfers of the conveyor belt and obviously integrated hose filters as a single piece, for the control of particulate material.

- The conveyor belts to the silos and to the truck loading station will also be completely covered.

- The bucket elevators will be completely covered.

- The silos of the grains will be equipped with aeration, cooling, sweeping, brushing and vacuum systems, which must be provided when necessary. They will also be equipped with an inert gas system inside, in order to avoid the auto ignition of the grains and necessarily the increase of humidity inside the same.

- The transfer will be made between the side of the ship, which will arrive at dock 1B, 2B and 1D and the onshore facilities with specialized vehicles to transport solid bulk cargoes.

- The objects and products that are inside the port facilities must be maintained in perfect conditions of cleanliness and logical order, to prevent the introduction of pests.

In Resolution 909 of 2008 of the Ministry of Environment, Housing and Territorial Development, it is established in Art. 6, for "*any plant or facility in which the grain is unloaded, processed, cleaned, dried, stored or loaded*" of the milling industry, as well as for "*loading or unloading stations of trucks, barges and ships, railway wagons, grain dryers and grain handling operations* ..." of the same industry, the obligation to monitor its emissions of particulate material, complying with the permissible limit of 150 mg / m³ for flows ≤ 0.5 kg / h and 50 mg / m³ otherwise> 0.5, at 25 ° C and 101.325 kPa (limits established for new installations).

Due to the above, a monitoring program for particulate material emissions will be implemented, as presented in the corresponding sheet of the Project Monitoring and Monitoring Plan, in Chapter 11 Plans and Programs, of this environmental impact study.

7.6.6 Treatment and final disposal of the material collected by the control equipment

The solid waste generated by the control equipment during the operation of the solid bulk cargoes, such as particulate materials and dust, periodically, must be removed from the filters, as well as other waste resulting from the operation, in addition to the change of decks in poor condition.

The waste generated and coming from organic materials, according to the type of cargo that will be handled in the port, were classified as ordinary waste, which will be temporarily stored in the onshore terminal, where they must be covered and closed for later delivery to an external environmental manager, who must have a valid environmental license to manage and dispose of said waste.

7.6.7 Air quality in the area of interest

The compilation of the air quality information recorded in the Environmental Impact Study[72] was carried out with which the Environmental License for the project was obtained, through Resolution No. 0032 of 2012[73] and presented in Chapter 5 in the Characterization of the area of influence, of the current environmental impact study.

It is worth mentioning that air quality monitoring was not carried out, since the conditions of the intervention area did not vary according to the characteristics of the study area.

Comparing the monitoring carried out in 2009 for the activities of the port, with the atmospheric conditions and the generation sources in the 2015 designs, there are no significant variations in terms of infrastructure, industries, vehicular flow and other emission sources that may cause variations in pollution to the environment; therefore, it was considered that it was not representative to perform additional air quality monitoring for the modification of environmental license.

[72] PUERTO BAHÍA COLOMBIA DE URABA S.A. & ARAÚJO IBARRA & ASOCIADOS S.A, 2010. Op Cit.
[73] COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution No. 0032 (January 25, 2012) Op Cit.

The company Air Clean Systems S.A. (ACS SA) was in charge of carrying out air quality monitoring in the period between September 24 and October 4, 2009 (10 continuous days), in 3 stations of the Project site[74], whose methodology and results are presented in Chapters 2 in Generality and Chapter 5 in Characterization of the area of influence of the present environmental study.

The main conclusions indicated low levels of suspended particles (TSP and PM10), as well as very low levels of SO2 and NO2 (more than 75% of the values below the level of analytical detection) and low levels of CO, although indicators of anthropic activities in the sector.

7.7 Construction materials

7.7.1 Acquisition of material in existing sources

For the construction of the infrastructure associated with the project, the acquisition of materials from existing sources close to the project is planned.

The sands and gravels will be acquired from the Diseños, Agregados y Construcciones de Urabá S.A.S. (D.A. & C. DE URABA S.A.S.) quarry, located on Calle 80, km 1.5 Via Piedras Blancas-Carepa (Antioquia), which meets the legal and environmental requirements for the exploitation of the required materials.

Below is the detailed information of the mining areas concessioned to the aforementioned quarry:

- Mining title and Environmental License of the D.A. & C. DE URABA S.A.S quarry

[74] AIR CLEAN SYSTEMS S.A. (ACS). Air quality evaluation report for Puerto Bahía Colombia de Urabá S.A. ACS ICA 126. October 2009.

- National Mining Registry HJBL-07 of December 29, 2009, through which the mining title No. 7693 of December 09, 2008 is registered, under which it is authorized in an extension of 1,410.94 hectares, located in the Municipality of Carepa (Antioquia), the technical exploration and economic exploitation of trawls and other concessions. Below are some photographs of the area (see Photo No. 7.2)

Photograph No. 7.2. Area 7693 - Carepa (Antioquia)

Source: D.A & C DE URABA S.A.S (2015)

The contract was initially signed by OLGA LUCIA MARTINEZ RESTREPO, who ceded all the mining rights, in 2009, to Mrs. LUISA FERNANDA ZAPATA RUIZ, legal representative of D.A. & C. DE URABA S.A.S. This assignment was authorized by the mining title director of the Ministry of Mines of the department of Antioquia, through Resolution 3985 of February 03, 2010. In said act it is clarified

that at all times, the new owner will comply with the provisions of the Environmental License granted by Resolution 200-03-20-02-0787-2012, issued by CORPOURABÁ and modified in 2013 by Resolution 200-03-20-01-0146-2013 of the same entity (see Annex 7.6. existing material sources).

- The National Mining Registry HHVN-02 of December 18, 2007, corresponds to the mining title No. 7697 of November 13, 2007, granted by the Government of Antioquia, in 2007, to Mrs. OLGA LUCÍA MARTINEZ RESTREPO, under the which is granted the use of 1,324,600 hectares, in the Municipality of Turbo (Antioquia), for the technical exploration and economic exploitation of a natural sand and gravel mine. Below are some photographs of the area (see Photo No. 7.3).

Photograph No. 7.3. Area 7697 - Turbo (Antioquia)

Source: D.A & C DE URABA S.A.S (2015)

Likewise, the title was assigned to Mrs. LUISA FERNANDA ZAPATA RUIZ, legal representative of D.A. & C. DE URABA S.A.S., in 2010. This assignment was authorized by the mining title director of the Ministry of Mines of the Department of Antioquia, through Resolution 3983 of February 03, 2010 (see Annex 7.6 Sources of existing material)

- Relation of types of material required in the work

It is estimated that the total volume of concrete used for the works will be 123,018 m^3, for which 90,665 m^3 of sand and 90,665 m^3 of gravel are required, considering a 10% excess material as a factor of safety against possible losses during handling.

- Availability of the materials required in the material sources

The D.A. & C. DE URABA S.A.S quarry is a producer of sand for concrete, sand for glue, sand for plaster, stones for gabion, gravel, grit, pedraplen, raw material, and different granulometries crushed. For which they have a mining title on two areas.

In the first: Mining Title No. 7693, used for the extraction of trawl materials, the proved reserves are of eighteen million cubic meters (18,000,000 m^3). In the second area: Mining Title No. 7697, used for the extraction of natural sands and gravel, there are four million cubic meters (4,000,000 m^3). (See Annex 7.6.) Sources of existing material)

- Location and access route between the project and the material source

Finally, Figure No. 7.22 shows the communication routes for the transportation of the material between the quarry and the construction site of the "Puerto Antioquia" Port Terminal in the municipality of Turbo, in the district of Nueva Colonia.

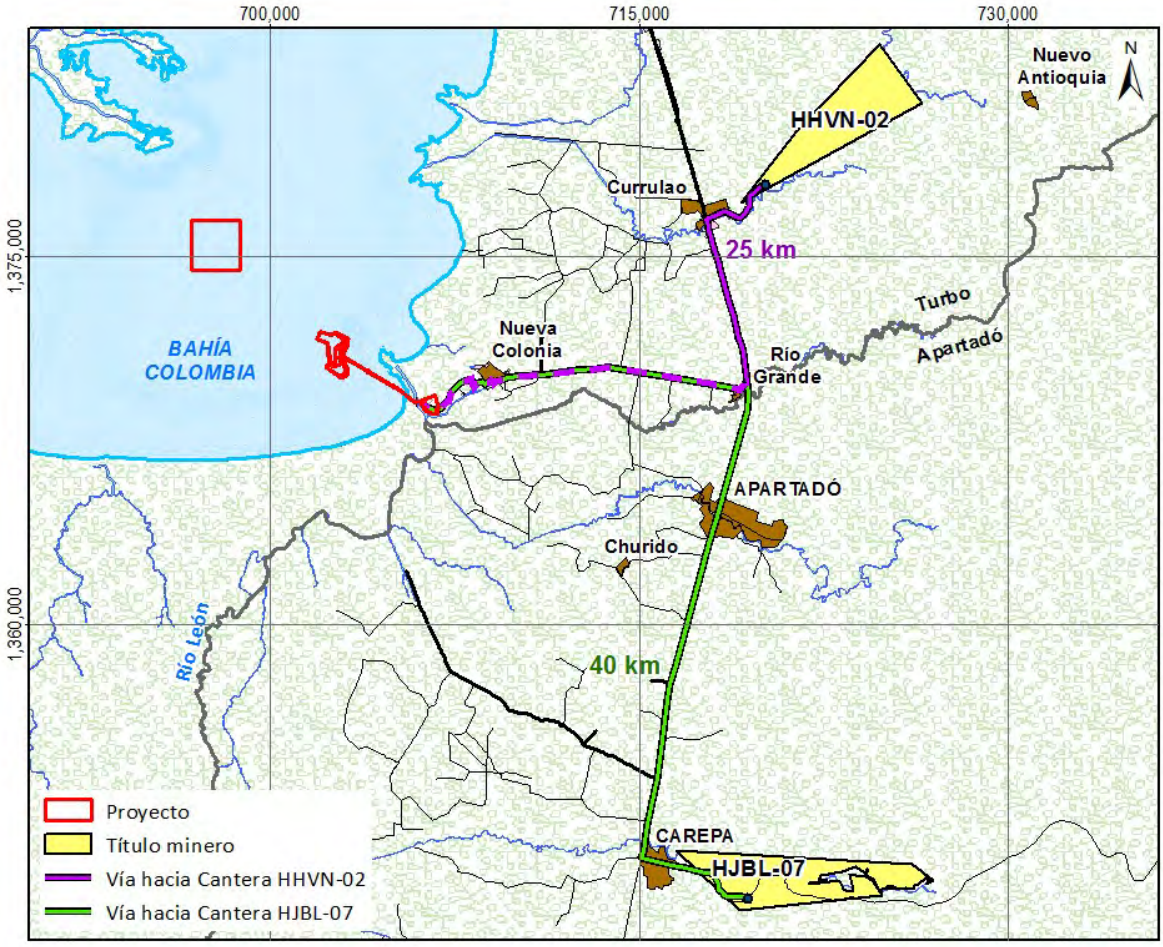

Figure No. 7.21 Communication routes between sources of material and project
Source: Aqua & Terra Consultores Asociados S.A.S., 2015